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Supplementary Information

Written submission from CNSC Staff

In the Matter of the

Ontario Power Generation Inc.

Applicability of the Darlington New Nuclear Project environmental assessment and plant parameter envelope to selected reactor technology

Commission Public Hearing

January 2024

Renseignements supplémentaires

Mémoire du personnel de la CCSN

À l'égard d'

Ontario Power Generation Inc.

Applicabilité de l'évaluation environnementale et de l'enveloppe des paramètres de la centrale à la technologie de réacteur sélectionnée pour le projet de nouvelle centrale nucléaire de Darlington

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Darlington New Nuclear Project

DNNP Workshop Summary Report

DNNP Workshop Summary Report

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Summary

As a modern and agile nuclear regulator, the Canadian Nuclear Safety Commission (CNSC) aims to be recognized as a trusted regulator and a source of objective scientific, technical, and regulatory information. The CNSC strives to build trust with the public and be transparent in its engagement and outreach efforts, by providing opportunities to engage directly with staff and subject matter experts in several formats.

In April 2023, the CNSC hosted a workshop with members of the public, Indigenous Nations and communities, as well as members of the public to hear comments and concerns on two documents submitted to support Ontario Power Generation (OPG's) review of the applicability of the Darlington New Nuclear Project (DNNP) Environmental Assessment to the BWRX-300 reactor. CNSC staff presented general information about the regulatory process and the DNNP and provided a summary of OPG's assessment of the applicability of the EA. Due to the volume of comments received, CNSC staff scheduled the workshop as a structured discussion, with participants organized into groups based on the themes of their submissions. However, participants commented that the format did not allow for full participation on all relevant topics. CNSC staff accepted and acted upon the feedback and adjusted the workshop by eliminating the breakout focus groups and having a full group discussion.

Participants also commented on the difficulty in locating information relevant to the DNNP, as it is often spread across multiple government websites and is sometimes presented in an inaccessible manner. The CNSC is committed to improving information availability and access. As such, CNSC staff have placed all DNNP-specific information or links to OPG's website, CEAA registry or other sources of DNNP information in a single location on the Open Government Portal website.

This report is a summary of the feedback and comments received from participants in the DNNP workshop, and staff will take all comments received into consideration for future Commission Member Documents (CMD) and for ongoing engagement and outreach activities.

Introduction

The Canadian Nuclear Safety Commission (CNSC) regulates nuclear energy and materials to protect the health, safety, security, and the environment in Canada. In doing so, the CNSC aims to be recognized as a trusted regulator, and a credible source of scientific, technical, and regulatory information. To achieve this, the CNSC undertakes a variety of activities, including, hosting Meet the Nuclear Regulator sessions, engaging municipalities and local organizations, developing Terms of Reference for long-term engagement with interested Indigenous Nations and communities, as well as workshops to inform and discuss concerns about potential nuclear projects.

On April 4th, 2023 the CNSC hosted a workshop with members of the public, Indigenous Nations and communities, civil society and environmental non-governmental organizations to discuss two key documents submitted as part of Ontario Power Generation's (OPG) Darlington New Nuclear Project (DNNP) Licence to Construct application: 1) the Updated Plant Parameter Envelope Report, and; 2) the Environmental Impact Statement Review Report. These documents were submitted by OPG to the CNSC to demonstrate that the selected technology, the GE-Hitachi BWRX-300, remains within the bounds of the previously approved 2012 environmental assessment.

The workshop was an opportunity to discuss comments received on these documents. These comments were received via e-mail or the *Let's Talk Nuclear Safety* consultation platform and informed the content of the workshop. Comments received during the workshop will help the CNSC to better understand concerns about the project and may inform CNSC recommendations to the Commission at future hearings, including the January 2024 Commission proceeding.

Background

In 2006, OPG proposed the DNNP to construct and operate up to four new nuclear reactors at the existing Darlington site in the Municipality of Clarington, on the north shore of Lake Ontario in the Region of Durham.

In 2009, OPG submitted an environmental impact statement and an application for a licence to prepare site to the CNSC. The CNSC issued a Licence to Prepare a Site in 2012, which was renewed in 2021 and is set to expire in 2031. The Joint Review Panel (JRP), that was considering the project as per the *Canadian Environmental Assessment Act 2009*, released its report on August 25, 2011, and presented 67 recommendations in its report, including recommendation 1:

> *The Panel understands that prior to construction, the Canadian Nuclear Safety Commission will determine whether this environmental assessment*

> *is applicable to the reactor technology selected by the Government of Ontario for the Project. Nevertheless, if the selected reactor technology is fundamentally different from the specific reactor technologies bounded by the plant parameter envelope, the Panel recommends that a new environmental assessment be conducted.*

The Government of Canada response to the JRP report concluded that no significant adverse environmental effects were likely if all mitigation measures were implemented. OPG is required to demonstrate that its chosen technology fits within the bounds of the approved environmental assessment and to assess the potential effects on any parameters that are outside the previously approved bounding approach.

In October 2022, OPG submitted an application to the CNSC for a licence to construct one small modular reactor (SMR). In response to JRP recommendation 1, OPG submitted the following 2 documents to provide updated details on the selected BWRX-300 technology, and to compare this selected technology to the specific reactor technologies bounded in the original 2009 submission:

- **Environmental Impact Statement Review Report (EIS Review Report)**, documents OPG's review of the 2009 environmental impact statement to demonstrate that the results remain valid with the BWRX-300.
- **Updated Plant Parameter Envelope Report (PPE Report)**. A PPE is a listing of values used in the environmental assessment and licence application to assist in predicting the potential safety and environmental effects of a nuclear power plant at a particular site. OPG submitted the updated report to assess the effects of BWRX-300 parameters and how that compares to the bounding 2009 PPE accepted by the Government of Canada.

OPG concluded that the BWRX-300 remains within the bounds of the approved environmental assessment, addressing JRP recommendation 1. Both documents were made available on *Let's Talk Nuclear Safety* for public review and comment between December 2022 and March 2023. Participant funding was also made available by the CNSC under its Participant Funding Program between January 2023 and March 2023 to assist members of the public, Indigenous Nations and communities, and stakeholders in reviewing the two documents.

The CNSC received a total of 188 comments through email and *Let's Talk Nuclear Safety* that focused on the following thematic areas, some of which over-lap:

THEME	**Number of Comments**
Design & Analysis	26
Effluents & Releases	7
Emergency Management	16
Environmental Effects & Risk Assessments	49
Radiological Dose	8
Wastes	28
Safeguards	1
Hazards Assessment	8
Licensing	13
General	28
TOTAL	**188**

All the comments received through the CNSC's Participant Funding Program can be found in Annex B.

The Workshop

The purpose of the workshop was threefold: 1) to engage participants on OPG's PPE Report and EIS Review Report; 2) to provide participants a transparent view of the activities undertaken as part of CNSC's licensing review process in advance of the Commission proceedings and; 3) to gather feedback early in the licensing process to help CNSC staff better understand participant concerns. Feedback received during the public consultation will be taken into consideration during CNSC staff's technical review for the upcoming Commission proceedings.

The full-day, virtual workshop welcomed over 17 participants representing the Canadian Environmental Law Association, the Nuclear Transparency Project, Canadian Coalition for Nuclear Responsibility, Northwatch, Durham Nuclear Health Committee, Mississaugas of Scugog Island First Nation, Six Nations of Grand River, Curve Lake First Nation, Hiawatha First Nation, the Radiation Safety Institute of Canada, and the Mayor of the Municipality of Clarington. Staff from Environmental and Climate Change Canada and the Fisheries and Oceans Canada, OPG, and technical specialists from the CNSC also attended.

In the morning of the workshop, OPG introduced the DNNP and a summary of results from the updated PPE and EIS Review Reports. CNSC staff provided an update on the technical review of OPG's documents as well as the licensing timeline for review of OPG's licence to construct application. CNSC staff also gave an overview of the comments received on the 2 reports leading up to the workshop, and the technical comments CNSC staff provided to OPG. In the afternoon of the workshop, CNSC staff facilitated an open discussion based on the themes that received the most comments, namely:

- Environmental Effects and Risks Assessments
- Waste Management and Decommissioning
- Design & Analysis and Hazard Assessment
- Releases, Doses and Emergency Management

These themes were initially to be discussed in thematic break-out rooms, however, after listening to the preferences and feedback of the participants for how they wanted to be engaged, these topics were discussed in an open forum with all in attendance.

What We Heard

The following section summarizes the key themes of issues, concerns, and recommendations that we heard from participants. The timing of the workshop provides participants an opportunity to elaborate on comments and share additional insights that CNSC staff will consider as we continue our regulatory review of OPG's licence to construct application.

Environmental Effects and Risks Assessment

Environmental Assessment

- OPG should augment the 2009 environmental impact statement with additional information which would provide the data required for the independent verification of numerical values that are assigned to various parameters.
- OPG should provide greater transparency on how it justified the project remaining within the original approved environmental assessment.
- OPG should provide access to the specific information it is relying on to make the claim that the selected technology remains within the bounds of the plant parameter envelope.

Environmental Effects

- OPG should conduct an assessment that adequately evaluates the potential environmental effects of the BWRX-300 to improve confidence in maintaining the original environmental assessment.

- OPG should perform a more robust analysis on the BWRX-300's potential effects on groundwater wells, terrestrial and aquatic ecosystems, and storm water infrastructure.
- OPG reports should be strengthened with a consideration of the environmental effects and dose impacts of the BWRX-300's noble gas releases.

Species at Risk

- CNSC and OPG should understand that within Indigenous Knowledge systems, birds and animals are living beings and not just valued ecosystem components. Documentation should consider this world view when determining the project's potential effects on species.
- CNSC and OPG should consider species at risk and cultural keystone species when environmental monitoring and ecological surveys are performed. Protective measures should be outlined in a long-term ecological management plan.
- OPG should provide more information regarding measures that will be taken to protect natural environmental features and habitats during, and post construction.

The Environmental Effects and Risk Assessment theme also attracted cross-cutting comments regarding barriers to accessing documents. Participants identified that greater transparency can be achieved by the CNSC by enhancing its proactive disclosure practices and allowing documents to be easily downloaded directly from nuclearsafety.gc.ca and keeping all documents in one location. Participants raised similar concerns to OPG and noted OPG should prepare reports in a manner that the public can comprehend.

Waste Management and Decommissioning

Waste Management, Inventory and Storage

- Consulting with Indigenous Nations and communities and engaging with local governments should be paramount to all discussions relating to spent fuel management, and the siting of a deep geological repository.
- OPG should provide a strengthened rationale for why the EIS is still appropriate, despite an acknowledgment by OPG that the BWRX-300's production of solid waste will be higher.
- OPG should provide greater information regarding the location of waste storage facilities in the conceptual plant layout.
- The Nuclear Waste Management Organization should clarify its mandate and authority to weigh-in on the future location of a deep geological repository, and how it will accommodate the BWRX-300's fuel assembly.

Decommissioning

- OPG should document a non-theoretical decommissioning strategic plan designed specifically for the BWRX-300, and its impact on the environment, to demonstrate that the technology remains within the bounds of the Government of Canada's accepted PPE.
- OPG should demonstrate that both reports comply with the International Joint Commission's Great Lakes Water Quality Board recommendations and the International Atomic Energy Agency's conclusion that immediate dismantling is the preferred decommissioning strategy for nuclear reactors.
- OPG should describe how lands will be restored after the site is decommissioned, including whether the area will become Crown Land after decommissioning.

Overall, participants were keen to gain access to enhanced information on waste generation, characteristics, storage, and financial guarantees, would provide the public with a better understanding of OPG's Radioactive Waste Management Plan and decommissioning strategy.

Design & Analysis and Hazard Assessment

Design and Analysis

- OPG should provide a documented rationale that supports its claim that the BWRX-300 is not fundamentally different from reactor designs previously considered to strengthen both reports.
- The EIS Review Report should identify where the BWRX-300 design has not progressed, or where it might yet change significantly enough to impact the EIS Review Report's conclusions.
- OPG should provide more detailed documentation describing how it intends to ensure the BWRX-300 will meet the requirement for two separate, independent, and diverse means of reactor shutdown.

Hazard Assessment

- OPG should provide improved clarity regarding why the BWRX-300 is assumed to have a smaller exclusion zone.
- OPG should provide a comparison of the risks associated with various designs to place the hazard assessment in better context.
- OPG should include an assessment of the potential hazards that may come with the co-location of nuclear reactors at the same facility to enhance the hazard assessment provided.
- OPG should resubmit its hazard assessment to include the scenario of a large military aircraft accident which includes an assessment of malevolent drone use, and large commercial aircraft collisions.

Overall, participants were interested in understanding whether the BWRX-300 design has evolved enough for the CNSC to sufficiently draw conclusions at this time. It was suggested that the aspects of the BWRX-300 design that are still in development be clearly documented and made publicly available.

Releases, Doses and Emergency Management

Releases & Doses

- OPG should provide publicly available documents on releases of radioactive iodine and a description of how these releases remain within the bounds of the previously approved environmental assessment.
- OPG should clarify how the proportions of radionuclides in gaseous effluents, liquid effluents, and solid waste have changed from the original EIS.
- CNSC should improve its communication regarding how the limits to effluent release levels are determined and regulated.

Emergency Management

- OPG should provide more information on its emergency management plan and how emergency planning for BWRX-300 deployment will encompass a larger range of the population in the event of a severe nuclear incident.
- OPG should consider effects of a severe core damage accident at an operating unit on safety of personnel engaged in construction of the new reactor(s) and this information should be reflected in OPG's emergency planning assessment.
- CNSC should publish the 2019 Technical Study Report of the Provincial Nuclear Emergency Response Plan (PNERP) on the Open Government Portal.

Conclusion

Participants expressed interest in future workshops as OPG's licence to construct application moves through the regulatory review process. CNSC staff will continue to work with Indigenous Nations and communities, civil societies, NGOs and the public to assess the effectiveness of the workshop and the format of any potential future workshops. These workshops will continue to enhance the CNSC's understanding of the concerns and interests of participants with respect to CNSC staff's technical review of OPG's request to construct one BWRX-300. CNSC staff wish to thank all participants for their meaningful contributions prior to and during the workshop and look forward to future engagement opportunities.

Next Steps

The CNSC is exploring how to further improve transparency of information and how it can be accessed. CNSC is enhancing document accessibility by linking the original environmental assessment archive to the Open Government portal and directing readers to the Open Government Portal webpage. CNSC is continuing to evaluate options to make information readily available on intuitive platforms. This includes encouraging OPG to post their EIS Review supporting documentation. CNSC staff will continue to provide updates on the project through the DNNP website and will follow-up with workshop participants, Indigenous Nations and communities, the public and stakeholders to discuss their concerns.

Since the workshop, the PENRP has been made available online.

The list below describes an evergreen multi-year schedule of planned CNSC engagement events on this project, as requested by workshop participants.

ACTIVITY	DATE
CNSC Open House in the Municipality of Clarington which will showcase all nuclear projects in the area	September 26th, 2023
Public webinars which will provide an overview of OPG's hearing submission and CNSC staff's recommendations to be considered at the hearing in January 2024	November, 2023
Requests to intervene in Hearing # 1 are due and filed with the Commission Registry	November 20th, 2023

OPG's DNNP Hearing #1	Week of January 22nd, 2024
Public webinar or workshop: Update on DNNP and Hearing #2	May/June 2024. This event is tentative and will be dependent on the Commission's decision on Hearing #1.
Public webinar which will provide an update on DNNP Hearing #2	September 2024. This event is tentative and will be dependent on the Commission's decision on Hearing #1.

Dates and events are subject to change to align with any changes in the DNNP schedule. More information on the public hearings and participant funding for this project can be found in the Notice of Hearing, published on April 3, 2023.

ANNEX A: Commitments

Table 1 – Status of Joint Review Panel Recommendations

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
1	The Panel understands that prior to construction, the Canadian Nuclear Safety Commission will determine whether this environmental assessment is applicable to the reactor technology selected by the Government of Ontario for the Project. Nevertheless, if the selected reactor technology is fundamentally different from the specific reactor technologies bounded by the Plant Parameter Envelope, the Panel recommends that a new environmental	The Government of Canada accepts the intent of this recommendation but acknowledges that any RA under the CEAA will need to determine whether the future proposal by the proponent is fundamentally different from the specific reactor technologies assessed by the JRP and if a new EA is required under the CEAA.	N/A	Initiated

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	assessment be conducted.			
2	The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to conduct a comprehensive soils characterization program. In particular, the potentially impacted soils in the areas OPG identifies as the spoils disposal area, cement plant area and asphalt storage area must be sampled to identify the nature and extent of potential contamination.	The Government of Canada accepts the recommendation to require OPG to conduct a comprehensive soils characterization program. The Government of Canada also notes that the recommended soils characterization program could also support future ecological risk assessment activities by OPG. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.	D-P-3.6	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
3	The Panel recommends that the Canadian Nuclear Safety Commission require that as part of the Application for a Licence to Construct a reactor, OPG must undertake a formal quantitative cost-benefit analysis for cooling tower and once-through condenser cooling water systems, applying the principle of best available technology economically achievable. This analysis must take into account the fact that lake infill should not go beyond the two-metre depth contour and should include cooling tower plume abatement technology.	The Government of Canada accepts the intent of this recommendation to require OPG to conduct a formal quantitative cost-benefit analysis for cooling tower and once-through condenser cooling water systems, as recommended, but acknowledges that this analysis may be required earlier than indicated in the recommendation given the relationship between site layout and the choice of condenser cooling technology. Fisheries and Oceans Canada and Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this	D-C-1.1	Complete

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		recommendation. The Government of Canada further acknowledges the connection of this Recommendation with Panel Recommendation #31 and as such notes that Fisheries and Oceans Canada will work with OPG to ensure through its regulatory process and conditions of authorization under the Fisheries Act that any Harmful Alteration, Disruption and Destruction (HADD) is limited to the 2 metre depth contour of Lake Ontario.		
4	The Panel recommends that the Canadian Nuclear Safety Commission exercise regulatory oversight to ensure that OPG complies with all municipal and provincial	The Government of Canada accepts this recommendation, however, recognizes that it is the responsibility of provincial and municipal officials to ensure compliance with their own requirements and	N/A	Complete

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	requirements and standards over the life of the Project. This is of particular importance because the conclusions of the Panel are based on the assumption that OPG will follow applicable laws and regulations at all jurisdictional levels.	standards over the life of the Project.		
5	To avoid any unnecessary environmental damage to the bluff at Raby Head and fish habitat, the Panel recommends that no bluff removal or lake infill occur during the site preparation stage, unless a reactor technology has been selected and there is certainty that the Project will proceed.	The Government of Canada accepts this recommendation to avoid any unnecessary environmental damage to the bluff at Raby Head and fish habitat as recommended. Fisheries and Oceans Canada and Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of	D-P-14.1	Open
			D-P-16.1	Open
			D-P-3.8	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		this recommendation. The Government of Canada further notes that authorization under the Fisheries Act will be required prior to any lake infill taking place, and confirms that Fisheries and Oceans Canada will work with OPG to ensure that as a condition of that authorization, that no lake infill occurs unless there is certainty that the Project will proceed and appropriate mitigation measures and habitat compensation have been implemented.		
6	The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to update its preliminary decommissioning plan for site	The Government of Canada accepts the intent of the recommendation to require OPG to maintain a preliminary decommissioning plan for site preparation in accordance with the requirements of CSA	D-P-13.1	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	preparation in accordance with the requirements of Canadian Standards Association (CSA) Standard N294-09. The OPG preliminary decommissioning plan for site preparation must incorporate the rehabilitation of the site to reflect the existing biodiversity in the event that the Project does not proceed beyond the site preparation phase. OPG shall prepare a detailed preliminary decommissioning plan once a reactor technology is chosen, to be updated as required by the Canadian Nuclear Safety Commission.	Standard N294-09, which provides direction on the decommissioning of licensed facilities and activities consistent with Canadian and international recommendations. The Government of Canada accepts the recommendation to require OPG to revise the preliminary decommissioning plan once a reactor technology is selected.		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
7	The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require that OPG establish a decommissioning financial guarantee to be reviewed as required by the Canadian Nuclear Safety Commission. Regarding the decommissioning financial guarantee for the site preparation stage, the Panel recommends that this financial guarantee contain sufficient funds for the rehabilitation of the site in the event the Project does not proceed beyond the site preparation stage.	The Government of Canada accepts the intent of this recommendation to require OPG to establish a financial guarantee for the site preparation stage, however, notes that the financial guarantee must be sufficient to cover the cost of decommissioning work outlined in the preliminary decommissioning plan referenced in Recommendation #6.	D-P-13.2	Closed
8	The Panel recommends that prior to site	The Government of Canada accepts this recommendation to	D-P-12.2	Closed
			D-P-3.10	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	preparation, the Canadian Nuclear Safety Commission require OPG to develop a follow-up and adaptive management program for air contaminants such as Acrolein, NO2, SO2, SPM, PM2.5 and PM10, to the satisfaction of the Canadian Nuclear Safety Commission, Health Canada and Environment Canada. Additionally, the Canadian Nuclear Safety Commission must require OPG to develop an action plan acceptable to Health Canada for days when there are air quality or smog alerts.	require OPG to develop a follow-up and adaptive management program for air contaminants and a smog alert action plan. Health Canada and Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, to assist in the implementation of this recommendation.		
9	The Panel recommends that the Canadian Nuclear Safety Commission, in collaboration with	The Government of Canada accepts this recommendation to require OPG to develop and implement a	D-P-3.2	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	Health Canada, require OPG to develop and implement a detailed acoustic assessment for all scenarios evaluated. The predictions must be shared with potentially affected members of the public. The OPG Nuisance Effects Management Plan must include noise monitoring, a noise complaint response mechanism and best practices for activities that may occur outside of municipal noise curfew hours to reduce annoyance that the public may experience.	detailed acoustic assessment. Health Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, to assist in the implementation of this recommendation.		
10	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to undertake a detailed site	The Government of Canada accepts the intent of this recommendation to require OPG to undertake a detailed site geotechnical investigation,	D-P-9.1	Closed
			D-P-9.2	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	geotechnical investigation prior to commencing site preparation activities. The geologic elements of this investigation should include, but not be limited to: collection of site-wide information on soil physical properties; determining the mechanical and dynamic properties of overburden material across the site; mapping of geological structures to improve the understanding of the site geological structure model; confirming the lack of karstic features in the local bedrock at the site; and	however, notes that this investigation may be performed concurrently with site preparation activities. Natural Resources Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	confirming the conclusions reached concerning the liquefaction potential in underlying granular materials.			
11	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop and implement a follow-up program for soil quality during all stages of the Project.	The Government of Canada accepts this recommendation to require OPG to develop and implement a follow-up program for soil quality. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.	D-P-12.6	Closed
12	The Panel recommends that before in-water works are initiated, the Canadian Nuclear Safety Commission require OPG to collect water and	The Government of Canada accepts this recommendation to require OPG to collect water and sediment quality data for any future embayment area. Environment	D-P-12.3	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	sediment quality data for any future embayment area that may be formed as a consequence of shoreline modifications in the vicinity of the outlet of Darlington Creek. This data should serve as the reference information for the proponent's post-construction commitment to conduct water and sediment quality monitoring of the embayment area.	Canada and Fisheries and Oceans Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation. The Government of Canada notes that authorization under the Fisheries Act will be required prior to in-water works. Prior to the issuance of an authorization, Fisheries and Oceans Canada will require a water and sediment quality monitoring program. This program is required to assess whether OPG continues to meet the intent of section 36 of the Fisheries Act.		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
13	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to collect and assess water quality data for a comprehensive number of shoreline and offshore locations in the site study area prior to commencing in-water works. This data should be used to establish a reference for follow-up monitoring.	The Government of Canada accepts the intent of this recommendation to require OPG to collect and assess water quality data for a comprehensive number of shoreline and offshore locations in the site study area prior to commencing in-water works and would further support the collection of sediment quality data as part of a comprehensive program. Environment Canada and Fisheries and Oceans Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation. The Government of Canada notes that	D-P-12.3	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		authorization under the Fisheries Act will be required prior to in-water works. Prior to the issuance of an authorization, Fisheries and Oceans Canada will require a water and sediment quality monitoring program. This program is required to assess whether OPG continues to meet the intent of section 36 of the Fisheries Act.		
14	The Panel recommends that following the selection of a reactor technology for the Project, the Canadian Nuclear Safety Commission require OPG to conduct a detailed assessment of predicted effluent releases from the Project. The assessment should include but not be limited to effluent	The Government of Canada accepts this recommendation to require OPG to conduct a detailed assessment of predicted effluent releases from the Project, as recommended. Environment Canada and Fisheries and Oceans Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety	D-C-2.1	Open
			D-C-4.1	Open
			D-P-12.9	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	quantity, concentration, points of release and a description of effluent treatment, including demonstration that the chosen option has been designed to achieve best available treatment technology and techniques economically achievable. The Canadian Nuclear Safety Commission shall also require OPG to conduct a risk assessment on the proposed residual releases to determine whether additional mitigation measures may be necessary.	Commission, upon request, to assist in the implementation of this recommendation.		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
15	The Panel recommends that following the start of operation of the reactors, the Canadian Nuclear Safety Commission require OPG to conduct monitoring of ambient water and sediment quality in the receiving waters to ensure that effects from effluent discharges are consistent with predictions made in the environmental impact statement and with those made during the detailed design phase.	The Government of Canada accepts this recommendation to require OPG to conduct monitoring of ambient water and sediment quality in the receiving waters as recommended. Environment Canada and Fisheries and Oceans Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation. The Government of Canada notes that authorization under the Fisheries Act will be required prior to in-water works. Prior to the issuance of an authorization, Fisheries and Oceans Canada will require a water and sediment quality monitoring	D-P-12.3	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		program. This program is required to assess whether OPG continues to meet the intent of section 36 of the Fisheries Act.		
16	The Panel recommends that prior to the start of construction, the Canadian Nuclear Safety Commission require the proponent to establish toxicity testing criteria and provide the test methodology and test frequency that will be used to confirm that stormwater discharges from the new nuclear site comply with requirements in the Fisheries Act.	The Government of Canada accepts the intent of this recommendation to require the proponent to establish toxicity testing criteria and provide the test methodology and test frequency for stormwater. The Government of Canada would additionally support the application of this recommended testing for process effluents. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the	D-C-2.1	Open
			D-P-3.4	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		implementation of this recommendation.		
17	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to provide an assessment of the ingress and transport of contaminants in groundwater on site during successive phases of the Project as part of the Application for a Licence to Construct. This assessment shall include consideration of the impact of wet and dry deposition of all contaminants of potential concern and gaseous emissions on groundwater quality. OPG shall conduct enhanced groundwater and contaminant	The Government of Canada accepts this recommendation to require OPG to provide an assessment of the ingress and transport of contaminants in groundwater on site during successive phases of the Project as recommended. For clarity, the Government of Canada would support enhanced groundwater and contaminant transport modelling extending to appropriate model boundaries, which may not necessarily be site boundaries. Natural Resources Canada and Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear	D-C-2.1	Open
			D-C-4.1	Open
			D-C-5.1	Open
			D-C-6.1	Open
			D-P-12.6	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	transport modelling for the assessment and expand the modelling to cover the effects of future dewatering and expansion activities at the St. Marys Cement quarry on the Project.	Safety Commission, upon request, to assist in the implementation of this recommendation.		
18	The Panel recommends that based on the groundwater and contaminant transport modelling results, the Canadian Nuclear Safety Commission require OPG to expand the Radiological Environmental Monitoring Program. This program shall include relevant residential and private groundwater well quality data in the local study area that are not captured by the	The Government of Canada accepts this recommendation to require OPG to update the Radiological Environmental Monitoring Program, based on the groundwater and contaminant transport modelling results. Natural Resources Canada and Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of	**D-C-6.1**	**Open**

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	current program, especially where the modelling results identify potential critical groups based on current or future potential use of groundwater.	this recommendation.		
19	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to expand the scope of the groundwater monitoring program to monitor transitions in groundwater flows that may arise as a consequence of grade changes during the site preparation and construction phases of the Project. The design of the grade changes should guide the determination of the required monitoring	The Government of Canada accepts this recommendation to require OPG to expand the scope of the groundwater monitoring program to monitor transitions in groundwater flows that may arise as a consequence of grade changes during the site preparation and construction phases of the Project. Natural Resources Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of	D-P-12.6	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	locations, frequency of monitoring and the required duration of the program for the period of transition to stable conditions following the completion of construction and the initial period of operation.	this recommendation.		
20	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to perform a thorough evaluation of site layout opportunities before site preparation activities begin, in order to minimize the overall effects on the terrestrial and aquatic environments and maximize the opportunity for quality terrestrial	The Government of Canada accepts this recommendation to require OPG to perform a thorough evaluation of site layout opportunities before site preparation activities begin, as recommended. Environment Canada and Fisheries and Oceans Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation	D-P-14.1	Open
			D-P-3.7	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	habitat rehabilitation.	of this recommendation. As part of the conditions of authorization under the Fisheries Act, Fisheries and Oceans Canada also commits to working with OPG to ensure overall impacts to aquatic habitat are minimized with appropriate mitigation and habitat compensation.		
21	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to compensate for the loss of ponds, like-for-like, preferably in the site study area. The Panel also recommends that the Canadian Nuclear Safety Commission require OPG to use best management practices to	The Government of Canada accepts the recommendation to require OPG to use best management practices to prevent or minimize the potential runoff of sediment and other contaminants. The Government of Canada accepts the intent of compensating for the loss of ponds but would also support the Canadian Nuclear Safety Commission requiring OPG to	D-P-3.7	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	prevent or minimize the potential runoff of sediment and other contaminants into wildlife habitat associated with Coot's Pond during site preparation and construction phases.	design compensation ponds that maximize ecological function, and not necessarily limited to "like-for-like". Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.		
22	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop a follow-up program for insects, amphibians and reptiles, and mammal species and communities to ensure that proposed mitigation measures are effective.	The Government of Canada accepts the intent of this recommendation to require OPG to develop a follow-up program for insects, amphibians and reptiles, and mammal species and communities as appropriate, and would support a focus for this follow-up program on species at risk and the use of this follow-up program	D-P-12.5	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		to verify the conclusions of the Ecological Risk Assessment. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.		
23	The Panel recommends that Environment Canada collaborate with OPG to develop and implement a follow-up program to confirm the effectiveness of OPG's proposed mitigation measures for bird communities should natural draft cooling towers be chosen for the condenser cooling system.	The Government of Canada accepts the intent of this recommendation to collaborate with OPG to develop such a follow-up program for bird communities and would further support the consideration of potential impacts from habitat disturbance, as well as from bird collision impacts, in the scope of that program. The Government of Canada	D-P-12.5	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		acknowledges that the Canadian Nuclear Safety Commission has the statutory authority and powers to ensure such a follow-up program is implemented through future licensing under the Nuclear Safety and Control Act. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.		
24	The Panel recommends that during the site preparation stage, Environment Canada shall ensure that OPG not undertake habitat destruction or disruption between the	The Government of Canada accepts the intent of this recommendation to avoid habitat destruction or disruption between the period of May 1 and July 31 of any year to protect most bird species' nesting activities. However,	D-P-3.7	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	period of May 1 and July 31 of any year to minimize effects to breeding migratory birds.	Environment Canada does not have the ability to ensure that OPG conducts all of its land clearing activities when migratory bird nests are not active since the department does not have a regulatory permitting ability to bind the proponent. The Government of Canada acknowledges that the Canadian Nuclear Safety Commission has the statutory authority and powers to address this recommendation through future licensing under the Nuclear Safety and Control Act. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		this recommendation.		
25	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to conduct more sampling to confirm the presence of Least Bittern before site preparation activities begin. The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop and implement a management plan for the species at risk that are known to occur on site. The plan should consider	The Government of Canada accepts this recommendation to require OPG to conduct more sampling to confirm the presence of Least Bittern and to develop and implement a management plan for species at risk, as may be appropriate. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.	D-P-12.5	Closed
			D-P-3.7	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	the resilience of some of the species and the possibility of off-site compensation.			
26	The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop a comprehensive assessment of hazardous substance releases and the required management practices for hazardous chemicals on site, in accordance with the Canadian Environmental Protection Act, once a reactor technology has been chosen.	The Government of Canada accepts this recommendation to require OPG to develop a comprehensive assessment of hazardous substance releases and the required management practices for hazardous chemicals on site once a reactor technology has been chosen. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.	D-C-2.1	Open
			D-C-5.1	Open
			D-P-12.9	Open
			D-P-3.6	Closed
27	The Panel recommends that prior to any destruction of the Bank Swallow habitat, the Canadian Nuclear Safety Commission	The Government of Canada accepts the intent of this recommendation to require OPG to implement the identified Bank Swallow mitigation measures using an	D-P-3.8	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	require OPG to implement all of its proposed Bank Swallow mitigation options, including: the acquisition of off-site nesting habitat; the construction of artificial Bank Swallow nest habitat with the capacity to maintain a population which is at least equal to the number of breeding pairs currently supported by the bluff and as close to the original bluff site as possible; and the implementation of an adaptive management approach in the Bank Swallow mitigation plan, with the inclusion of a threshold of loss to be established in	adaptive management approach and would support determining required mitigation based on reasonable estimates of actual burrow loss. The Government of Canada expects that the acquisition of offsite nesting habitat should only be necessary if follow-up monitoring shows that onsite mitigation is unsuccessful, and notes that onsite mitigation may also include the enhancement of potential natural nesting sites within the Site Study Area. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	consultation with all stakeholders before any habitat destruction takes place.	this recommendation.		
28	The Panel recommends that Fisheries and Oceans Canada require OPG to continue conducting adult fish community surveys in the site study area and reference locations on an ongoing basis. These surveys shall be used to confirm that the results of 2009 gillnetting and 1998 shoreline electrofishing reported by OPG, and the additional data collected in 2010 and 2011, are representative of existing conditions, taking into account	The Government of Canada accepts this recommendation. Fisheries and Oceans Canada will work with Environment Canada, the Canadian Nuclear Safety Commission, the Ontario Ministry of Natural Resources and OPG to develop the details of an ongoing fisheries monitoring program which will be included as a condition of a Fisheries Act authorization.	D-P-12.4	Open
			D-P-15.1	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	natural year-to-year variability. Specific attention should be paid to baseline gillnetting monitoring in spring to verify the findings on fish spatial distribution and relatively high native fish species abundance in the embayment area, such as white sucker and round whitefish. The shoreline electrofishing habitat use study is needed to establish the contemporary baseline for later use to test for effects of lake infill armouring, if employed, and the effectiveness of mitigation.			
29	The Panel recommends that Fisheries and Oceans Canada require OPG to continue the	The Government of Canada accepts this recommendation. Fisheries and Oceans Canada will work with	D-P-12.4	Open
			D-P-15.1	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	research element of the proposed Round Whitefish Action Plan for the specific purpose of better defining the baseline condition, including the population structure, genome and geographic distribution of the round whitefish population as a basis from which to develop testable predictions of effects, including cumulative effects.	Environment Canada, Canadian Nuclear Safety Commission, Ontario Ministry of Natural Resources and OPG to develop and finalize the Round Whitefish Action Plan. This plan, as a condition of a Fisheries Act authorization, will form part of the ongoing monitoring program and feed into an adaptive management plan to protect the round whitefish population into the future.		
30	In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to the construction of in-water structures, Fisheries and Oceans Canada require OPG to conduct:	The Government of Canada accepts this recommendation. Fisheries and Oceans Canada will work with the Canadian Nuclear Safety Commission, and the Ontario Ministry of Natural Resources to develop an impingement and entrainment sampling program. The Government of	D-C-1.2 D-P-12.4 D-P-15.1	Closed Open Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	additional impingement sampling at the existing Darlington Nuclear Generating Station to verify the 2007 results and deal with inter-year fish abundance variability and sample design inadequacies; and additional entrainment sampling at the existing Darlington Nuclear Generating Station to better establish the current conditions. The program should be designed to guard against a detection limit bias by including in the analysis of entrainment losses those fish species whose larvae and eggs are captured in larval tow surveys for the seasonal period of	Canada would also like to note that authorization under the Fisheries Act will be required prior to any lake infill taking place and commits that Fisheries and Oceans Canada will work with OPG to ensure that the impingement and entrainment sampling program is developed and implemented as a condition of that authorization.		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	the year in which they occur. A statistical optimization analysis will be needed to determine if there is a cost-effective entrainment survey design for round whitefish larvae.			
31	Irrespective of the condenser cooling system chosen for the Project, the Panel recommends that Fisheries and Oceans Canada not permit OPG to infill beyond the two-metre depth contour in Lake Ontario.	The Government of Canada accepts the intent of this recommendation. Fisheries and Oceans Canada will work with OPG to ensure that the HADD of fish habitat associated with the proposed lake infill is limited to the area within the two-metre depth contour of Lake Ontario. The extent of the HADD as well as appropriate mitigation and habitat compensation will be included in the conditions of	D-C-1.1	Closed
			D-P-14.1	Open
			D-P-16.1	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		authorization under the Fisheries Act.		
32	In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that Fisheries and Oceans Canada require OPG to mitigate the risk of adverse effects from operation, including impingement, entrainment and thermal excursions and plumes, by locating the system intake and diffuser structures in water beyond the nearshore habitat zone. Furthermore, OPG must evaluate other mitigative technologies for the system intake, such as live fish return systems and acoustic deterrents.	The Government of Canada accepts this recommendation. Fisheries and Oceans Canada will work with Environment Canada and the Canadian Nuclear Safety Commission to determine the appropriate location for the intake and diffuser structures, and to evaluate other mitigation options for both the intake and the diffuser structures, in order to mitigate adverse effects. Fisheries and Oceans Canada will work with OPG to ensure implementation through its regulatory process and conditions of authorization under the Fisheries Act.	D-C-1.2	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
33	The Panel recommends that Fisheries and Oceans Canada require OPG to conduct an impingement and entrainment follow-up program at the existing Darlington Nuclear Generating Station and the Project site to confirm the prediction of adverse effects, including cumulative effects, and the effectiveness of mitigation. For future entrainment sampling for round whitefish, a statistical probability analysis will be needed to determine if unbiased and precise sample results can be produced.	The Government of Canada accepts this recommendation. Fisheries and Oceans Canada will work with the Canadian Nuclear Safety Commission and Ontario Power Generation to develop an impingement and entrainment study on the existing Darlington Nuclear Generating Station and at the proposed Project site to confirm predicted adverse effects and will further ensure implementation through its regulatory process and conditions of authorization under the Fisheries Act.	D-P-12.4	Open
34			D-C-1.2	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, Environment Canada ensure that enhanced resolution thermal plume modeling is conducted by OPG, taking into account possible future climate change effects. Fisheries and Oceans Canada shall ensure that the results of the modeling are incorporated into the design of the outfall diffuser and the evaluation of alternative locations for the placement of the intake and the diffuser of the proposed condenser cooling water system.	The Government of Canada accepts the intent of this recommendation. Environment Canada is committed to reviewing the information provided by OPG, and will rely on Fisheries and Oceans Canada authorization for a HADD associated with the intake or outfall to ensure that OPG undertakes this modelling. Fisheries and Oceans Canada will work with Environment Canada, and the Canadian Nuclear Safety Commission to incorporate the results from the thermal plume modeling into the determination of the appropriate location for the intake and diffuser structures to mitigate adverse	D-P-12.4	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		effects. Fisheries and Oceans Canada will ensure implementation through conditions of a Fisheries Act authorization.		
35	In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to operation, the Canadian Nuclear Safety Commission require OPG to include the following in the surface water risk assessment: the surface combined thermal and contaminant plume; and the physical displacement effect of altered lake currents as a hazardous pulse exposure to fish species whose larvae passively drift through the	The Government of Canada accepts this recommendation to require OPG to update a comprehensive surface water risk assessment as recommended, however would clarify that an assessment of the combined thermal and contaminant plume should consider not only the surface area of the plume, but its vertical extent as well. Environment Canada and Fisheries and Oceans Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in	D-C-1.2	Closed
			D-P-12.3	Open
			D-P-12.4	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	area, such as lake herring, lake whitefish, emerald shiner and yellow perch. If the risk assessment result predicts a potential hazard, then the Canadian Nuclear Safety Commission shall convene a follow-up monitoring scoping workshop with Environment Canada, Fisheries and Oceans Canada and any other relevant authorities to develop an action plan.	the design of the surface water risk assessment and any subsequent action plan development.		
36	In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to undertake adult	The Government of Canada accepts this recommendation to require OPG to undertake adult fish monitoring to confirm the effectiveness of mitigation measures and effect predictions. Environment Canada and	D-C-1.2	Closed
			D-P-12.4	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	fish monitoring of large-bodied and small-bodied fish to confirm the effectiveness of mitigation measures and verify the predictions of no adverse thermal and physical diffuser jet effects.	Fisheries and Oceans Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation. Fisheries and Oceans Canada is committed to working with OPG to develop their fish and fish habitat monitoring and follow-up program and ensuring implementation through conditions of authorization under the Fisheries Act.		
37	In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, the Canadian Nuclear Safety	The Government of Canada accepts the intent of this recommendation to require OPG to determine the total area of permanent aquatic effects from identified impacts. The Government of Canada would	D-C-1.2	Closed
			D-P-12.4	Open

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	Commission require OPG to determine the total area of permanent aquatic effects from the following, to properly scale mitigation and scope follow-up monitoring: § the thermal plume + 2°C above ambient temperature; § the mixing zone and surface plume contaminants; physical displacements from altered lake currents; and infill and construction losses and modifications.	further support inclusion of cumulative effects assessment in this assessment, including the effects of impingement and entrainment and climate change. Environment Canada and Fisheries and Oceans Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation. Further, Fisheries and Oceans Canada is committed to working with the Canadian Nuclear Safety Commission and OPG to ensure that any permanent aquatic habitat effects are mitigated, and appropriate habitat compensation is developed and implemented as a		

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		condition of any Fisheries Act authorization.		
38	The Panel recommends that the Canadian Nuclear Safety Commission require that the geotechnical and seismic hazard elements of the detailed site geotechnical investigation to be performed by OPG include, but not be limited to: Prior to site preparation: demonstration that there are no undesirable subsurface conditions at the Project site. The overall site liquefaction potential shall be assessed with the site investigation data; and confirmation of the absence of paleoseismologic	The Government of Canada accepts the intent of this recommendation to require OPG's detailed site investigation to include the noted geotechnical and seismic hazard elements, however, notes that this investigation may be performed concurrently with site preparation activities. Natural Resources Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.	D-O-3.1	Open
			D-P-9.1	Closed
			D-P-9.3	Open
			D-P-9.4	Open
			D-P-9.5	Open

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	features at the site and, if present, further assessment to reduce the overall uncertainty in the seismic hazard assessment during the design of the Project must be conducted. During site preparation and/or prior to construction: verification and confirmation of the absence of surface faulting in the overburden and bedrock at the site. Prior to construction: verification of the stability of the cut slopes and dyke slopes under both static and dynamic loads with site/Project-specific data during the design of the cut slopes and dykes or			

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	before their construction; assessment of potential liquefaction of the northeast waste stockpile by using the data obtained from the pile itself upon completion of site preparation; measurement of the shear strength of the overburden materials and the dynamic properties of both overburden and sedimentary rocks to confirm the site conditions and to perform soil-structure interaction analysis if necessary; assessment of the potential settlement in the quaternary deposits due to the groundwater drawdown caused by future St. Marys			

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	Cement quarry activities; and assessment of the effect of the potential settlement on buried infrastructures in the deposits during the design of these infrastructures. Prior to operation: development and implementation of a monitoring program for the Phase 4 St. Marys Cement blasting operations to confirm that the maximum peak ground velocity at the boundary between the Darlington and St. Marys Cement properties is below the proposed limit of three millimetres per second (mm/s).			
39	The Panel recommends that	The Government of Canada accepts this	D-C-7.1	Open

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	prior to construction, the Canadian Nuclear Safety Commission require OPG to prepare a contingency plan for the construction, operation and decommissioning Project stages to account for uncertainties associated with flooding and other extreme weather hazards. OPG shall conduct localized climate change modelling to confirm its conclusion of a low impact of climate change. A margin/bound of changes to key parameters, such as intensity of extreme weather events, needs to be established to the satisfaction of the Canadian Nuclear Safety Commission. These parameters	recommendation to require OPG to prepare a contingency plan to account for uncertainties associated with flooding, drought and other extreme weather hazards, as recommended. The Government of Canada accepts the intent of the recommendation to conduct localized climate change modelling; however, if OPG uses reputable published studies to evaluate the anticipated impact of climate change for the Project area, localized climate change modelling may not be necessary. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	can be incorporated into hydrological designs leading up to an application to construct a reactor, as well as measures for flood protection. OPG must also conduct a drought analysis and incorporate any additional required mitigation/design modifications, to the satisfaction of the Canadian Nuclear Safety Commission, as part of a Licence to Construct a reactor.	implementation of this recommendation.		
40	The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to: establish an adaptive management program for algal	The Government of Canada accepts this recommendation to require OPG to establish an adaptive management program for algal hazards to the cooling water system intake and factor that assessment into	D-C-1.2	Closed
			D-P-12.4	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	hazard to the Project cooling water system intake that includes the setup of thresholds for further actions; and factor the algal hazard assessment into a more detailed biological evaluation of moving the intake and diffuser deeper offshore as part of the detailed siting studies and the cost-benefit analysis of the cooling system.	planned siting studies and cost-benefit analyses. Fisheries and Oceans Canada and Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.		
41	The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission coordinate discussions with OPG and key stakeholders on the effects of the Project on housing supply and	The Government of Canada accepts the intent of this recommendation for the CNSC to initiate discussions with OPG and key stakeholders, however, notes that these discussions may occur concurrently with site preparation activities.	D-P-17.1	Closed

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	demand, community recreational facilities and programs, services and infrastructure as well as additional measures to help deal with the pressures on these community assets.			
42	The Panel recommends that on an ongoing basis, OPG pursue its strategy to ensure that Aboriginal students can benefit from the permanent job opportunities that will be available during the lifetime of the Project. In this regard, OPG should collaborate with various secondary and post-secondary education institutions as well as Aboriginal groups to ensure that such	The Government of Canada supports this proposal and notes that such programs are consistent with OPG's presentation to the Panel on Aboriginal Interests on March 28, 2011, and with OPG's Aboriginal Relations Policy.	D-P-17.1	Closed

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	programs would be successful.			
43	The Panel recommends that the Canadian Nuclear Safety Commission engage appropriate stakeholders, including OPG, Emergency Management Ontario, municipal governments and the Government of Ontario to develop a policy for land use around nuclear generating stations.	The Government of Canada accepts this recommendation for the Canadian Nuclear Safety Commission to engage appropriate stakeholders in developing policy for land use around nuclear generating stations.	D-P-17.1	Closed
44	The Panel recommends that the Government of Ontario take appropriate measures to prevent sensitive and residential development within three kilometres of the site boundary.	This recommendation was directed to the Government of Ontario.	N/A	Complete

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
45	The Panel recommends that the Municipality of Clarington prevent, for the lifetime of the nuclear facility, the establishment of sensitive public facilities such as school, hospitals and residences for vulnerable clienteles within the three-kilometre zone around the site boundary.	This recommendation was directed to the Municipality of Clarington.	N/A	Complete
46	Given that a severe accident may have consequences beyond the three and 10-kilometre zones evaluated by OPG, the Panel recommends that the Government of Ontario, on an ongoing basis, review the emergency planning zones and the emergency preparedness and	This recommendation was directed to the Government of Ontario.	N/A	Complete

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	response measures, as defined in the Provincial Nuclear Emergency Response Plan (PNERP), to protect human health and safety.			
47	The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission ensure the OPG Traffic Management Plan addresses the following: contingency plans to address the possibility that the assumed road improvements do not occur; consideration of the effect of truck traffic associated with excavated material disposal on traffic operations and safety;	The Government of Canada accepts this recommendation to require that OPG's Traffic Management Plan consider elements related to contingency plans, truck traffic, queuing potential on Highway 401 and additional mitigation measures.	D-P-10.1	Closed

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	further analysis of queuing potential onto Highway 401; and consideration of a wider range of mitigation measures, such as transportation-demand management, transit service provisions and geometric improvements at the Highway 401/Waverley Road interchange.			
48	In consideration of public safety, the Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission coordinate a committee of federal, provincial and municipal transport authorities to review the need for road	The Government of Canada accepts the intent of this recommendation to support a federal, provincial and municipal review of the need for road development and modifications, however, notes that this review may be performed concurrently with site preparation activities.	N/A	Not Initiated

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	development and modifications.			
49	The Panel recommends that prior to construction, Transport Canada ensure that OPG undertake additional quantitative analysis, including collision frequencies and rail crossing exposure indices, and monitor the potential effects and need for mitigation associated with the Project.	The Government of Canada accepts the intent of this recommendation to require OPG to undertake additional rail safety studies, monitor the potential effects and determine the need for mitigation. The Railway Safety Act (RSA) places crossing safety responsibilities on the Railways and the Road Authorities. This policy reflects the objectives of Section 3 of the RSA. Ultimately, the Railway and the Road Authority must take the responsibility of performing the crossing assessment. Transport Canada is committed to provide assistance and expertise to the	D-C-3.1	Open

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		interested parties if required during the risk assessment and in the evaluation of any proposed mitigation measures.		
50	The Panel recommends that prior to construction, Transport Canada require OPG to conduct a risk assessment, jointly with Canadian National Railway, that includes: an assessment of the risks associated with a derailment or other rail incident that could affect the Project; an analysis of the risks associated with a security threat, such as a bomb being placed on a train running on the tracks that bisect the Project;	The Government of Canada recognizes that the CNSC has the statutory authority and powers to address this recommendation through future regulatory activities under the Nuclear Safety and Control Act. Transport Canada is committed to provide assistance and expertise to the Canadian Nuclear Safety Commission and other parties if required during the risk assessment and in the evaluation of any proposed mitigation measures.	D-C-3.1	Open

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	a comparative evaluation of the effectiveness of various mitigation measures or combination of measures (e.g., blast wall, retaining wall, recessed tracks, berm and railway speed restrictions within the vicinity of the site); a determination of the design criteria necessary to ensure the effectiveness of these measures (e.g., the appropriate height, strength, material and design of a blast wall); and a critical analysis to confirm that these measures, when properly designed and implemented, would be sufficient to provide protection to the Project site			

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	in the event of a derailment at full speed or other adverse event.			
51	In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, Transport Canada work with OPG to develop a follow-up program to verify the accuracy of the prediction of no significant adverse effects to boating safety from the establishment of an increased prohibitive zone. OPG must also develop an adaptive management program, if required, to mitigate potential effects to small watercraft.	The Government of Canada accepts the intent of this recommendation. Transport Canada will provide guidance and support to OPG to assist in their development of a follow-up program to confirm that boating safety will not be significantly adversely affected. If an adaptive management program is required, Transport Canada can provide support and expertise to OPG in its development.	D-P-12.8	Closed

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52	The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to make provisions for on-site storage of all used fuel for the duration of the Project, in the event that a suitable off-site solution for the long-term management for used fuel waste is not found.	The Government of Canada accepts the intent of this recommendation to the extent that it is the responsibility of waste owners for managing and funding the safe and secure operation of their own wastes. Canada's 1996 Radioactive Waste Policy Framework states that the owners of radioactive waste are responsible for developing and implementing solutions, including all costs associated with safely and securely managing their wastes.	D-C-9.1	Open
53	The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to make provisions for on-site storage	The Government of Canada accepts the intent of this recommendation to the extent that it is the responsibility of waste owners for managing and funding the safe and secure	D-C-9.1	Open

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	of all of low and intermediate-level radioactive waste for the duration of the Project, in the event that a suitable off-site solution for the long-term management for this waste is not approved.	operation of their own wastes, in accordance with CNSC's regulatory requirements. Canada's 1996 Radioactive Waste Policy Framework states that the owners of radioactive waste are responsible for developing and implementing solutions, including all costs associated with safely and securely managing their wastes.		
54	The Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to implement measures to manage releases from the Project to avoid tritium in drinking water levels exceeding a running annual average of 20 Becquerels per litre at drinking	The Government of Canada accepts the intent of this recommendation to safeguard drinking water; however, it notes that any proposed limits should be consistent with the tritium standards put in place by the relevant regulatory authorities. Health Canada's Guidelines for Canadian Drinking Water Quality, based on	D-C-4.1	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	water supply plants in the regional study area.	the recommendations of the International Commission on Radiological Protection and the World Health Organization, establish a safe consumption guideline limit of 7,000 Bq/L for tritium in drinking water. This limit has been accepted as a standard by the Province of Ontario. Since water quality is primarily a provincial responsibility in Canada, the provinces may adopt federal guidelines, or may establish their own criteria. The Government of Canada further notes that the Canadian Nuclear Safety Commission regulates potential releases of tritium to the environment from nuclear facilities by imposing regulatory		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		limits as well as precautionary action levels for tritium releases into air or water on a licence-specific basis. These limits are set with a goal to protect human health. The Canadian Nuclear Safety Commission's Radiation Protection Regulations require that releases are kept "As Low As Reasonably Achievable" (ALARA), social and economic factors taken into account.		
55	The Panel recommends that Health Canada and the Canadian Nuclear Safety Commission continue to participate in international studies seeking to identify long-term health effects of low-level radiation exposures, and to identify if there is a need for revision of limits specified	The Government of Canada accepts the recommendation to continue its participation in international studies seeking to identify long-term health effects of low-level radiation exposures. The Government of Canada accepts the intent of the recommendation to identify if there is a need for revision of limits specified in	N/A	Initiated

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	in the Radiation Protection Regulations.	the Radiation Protection Regulations based on the results of international studies. Health Canada and the Canadian Nuclear Safety Commission will continue to participate in international studies dealing with long-term health effects of low-level radiation exposures; participate in committees/working groups with relevant international organizations; and regularly review the reports published by these international groups for developments in radiation protection. Health Canada can provide expertise to the Canadian Nuclear Safety Commission, upon request, in support of the review of limits specified in the Radiation Protection Regulations.		

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
56	The Panel recommends that over the life of the Project, the Canadian Nuclear Safety Commission require OPG to conduct ambient air monitoring in the local study area on an ongoing basis to ensure that air quality remains at levels that are not likely to cause adverse effects to human health.	The Government of Canada accepts this recommendation to require OPG to conduct ambient air monitoring to ensure that air quality is not likely to cause adverse effects to human health. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation.	D-P-12.2	Closed
57	The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to undertake an assessment of the off-site effects of a severe accident. The assessment should determine	The Government of Canada accepts this recommendation to require OPG to undertake an assessment of the off-site effects of a severe accident. Environment Canada can provide available scientific and technical expertise to the Canadian Nuclear	D-C-3.1	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	if the off-site health and environmental effects considered in this environmental assessment bound the effects that could arise in the case of the selected reactor technology.	Safety Commission, upon request, to assist in the implementation of this recommendation.		
58	The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission confirm that dose acceptance criteria specified in RD-337 at the reactor site boundary—in the cases of design basis accidents for the Project's selected reactor technology—will be met.	The Government of Canada accepts this recommendation to ask the Canadian Nuclear Safety Commission to confirm that dose acceptance criteria specified in RD-337 will be met.	D-C-3.1	Open
59	The Panel recommends that the Municipality of Clarington manage	This recommendation was directed to the Municipality of Clarington.	N/A	Complete

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	development in the vicinity of the Project site to ensure that there is no deterioration in the capacity to evacuate members of the public for the protection of human health and safety.			
60	The Panel recommends that prior to construction, the Government of Canada review the adequacy of the provisions for nuclear liability insurance. This review must include information from OPG and the Region of Durham regarding the likely economic effects of a severe accident at the Darlington Nuclear site where there is a requirement for relocation, restriction of use and remediation	The Government of Canada accepts the intent of this recommendation, that the Government of Canada review the adequacy of the provisions for nuclear liability insurance. In bringing forward modernized nuclear civil liability legislation to replace the current Nuclear Liability Act, the Government of Canada will continue to review the adequacy of the provisions for nuclear liability insurance, taking into consideration the risk of Canadian	N/A	Complete

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	of a sector of the regional study area.	nuclear installations and other relevant factors.		
61	The Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to monitor aquatic habitat and biota for potential cumulative effects from the thermal loading and contaminant plume of the discharge structures of the existing Darlington Nuclear Generating Station and the Project.	The Government of Canada accepts this recommendation to require OPG to monitor aquatic habitat and biota for potential cumulative effects from the thermal loading and contaminant plume. Environment Canada and Fisheries and Oceans Canada can provide available scientific and technical expertise to the Canadian Nuclear Safety Commission, upon request, to assist in the implementation of this recommendation. The proponent will also be required to undertake an aquatic monitoring program as a condition of any	D-P-12.4	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		Fisheries Act authorization.		
62	The Panel recommends that prior to site preparation, Environment Canada evaluate the need for additional air quality monitoring stations in the local study area to monitor cumulative effects on air quality.	The Government of Canada accepts this recommendation to evaluate the need for additional air quality monitoring stations in the local study area to monitor cumulative effects on air quality. If this evaluation finds that additional air quality monitoring stations in the local study area are required, the Government of Canada acknowledges that the Canadian Nuclear Safety Commission has the statutory authority and powers to address the findings of this recommendation through future licensing under the	N/A	Complete

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		Nuclear Safety and Control Act.		
63	The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to evaluate the cumulative effect of a common-cause severe accident involving all of the nuclear reactors in the site study area to determine if further emergency planning measures are required.	The Government of Canada accepts the intent of this recommendation to require OPG to evaluate the cumulative effect of a common-cause severe accident in the site study area. The Government of Canada notes that the CNSC has established a task force to examine the lessons learned from the Japan Earthquake and will evaluate the operational, technical and regulatory implications of the nuclear event in Japan in relation to Canadian nuclear power plants.	D-C-3.1	Open

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
64	The Panel recommends that the Canadian Environmental Assessment Agency revise the Canadian Environmental Assessment Agency Cumulative Effects Practitioner's Guide to specifically include consideration of accident and malfunction scenarios.	The Government of Canada accepts this recommendation. The Canadian Environmental Assessment Agency is in the process of updating its suite of instruments in support of cumulative effects assessment under the CEAA. An operational policy statement, scheduled for completion by December 2012, will provide core guidance to practitioners and include the consideration of accidents and malfunctions.	N/A	(blank)
65	The Panel recommends that the Government of Canada make it a priority to invest in developing solutions for long-term management of used nuclear fuel, including storage, disposal,	The Government of Canada accepts the intent of this recommendation that priority be given to invest in solutions for the long-term management of used nuclear fuel. It is the responsibility	N/A	(blank)

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	reprocessing and re-use.	of waste owners to fund and manage the safe and secure operation of their wastes. The Nuclear Waste Management Organization, established by the nuclear energy corporations, is responsible for implementing the government-selected plan for managing nuclear fuel waste over the long-term. The Government of Canada is committed to ensuring that an appropriate and properly funded long-term safe and secure solution is in place for the managing nuclear fuel waste over long term.		
66	The Panel recommends that the Government of Canada update the Nuclear Liability and Compensation Act	The Government of Canada accepts the intent of this recommendation, that the Government of Canada update the	N/A	(blank)

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
	or its equivalent to reflect the consequences of a nuclear accident. The revisions must address damage from any ionizing radiation and from any initiating event and should be aligned with the polluter pays principle. The revised Nuclear Liability and Compensation Act, or its equivalent, must be in force before the Project can proceed to the construction phase.	Nuclear Liability and Compensation Act or its equivalent to reflect the consequences of a nuclear accident. The Government of Canada recognizes the importance of bringing forward modernized nuclear civil liability legislation to bring compensation in line with internationally accepted levels and will decide on the timing of the next introduction of the Nuclear Liability and Compensation Act bill in Parliament.		
67	The Panel recommends that the Government of Canada provide clear and practical direction to the application of sustainability assessment in environmental assessments for future nuclear projects.	The Government of Canada accepts the intent of this recommendation. However, the scope of the assessment and the factors to be considered in future EAs for nuclear projects are decisions that should be taken on a project-by-project basis by future	N/A	(blank)

#	JRP Recommendation	Government of Canada Response	OPG Commitment Reference	Status
		Responsible Authorities. Recognizing that sustainable development is a principle of the Canadian Environmental Assessment Act, should a separate sustainability assessment be required by Responsible Authorities for future nuclear projects, the Government of Canada agrees that it would be desirable for those Responsible Authorities to provide clear and practical direction to proponents and the public on how a sustainability assessment should be conducted.		

ANNEX B: Participant Funding Program Comments (6992421)

Design and Analysis	
General	• The report has not fully considered the industry guidelines for such a report that were issued by NEI almost one and a half years earlier. It does not address

Parameters Analysis	all data suggested by NEI-10-Rev-2. It does not reflect any industry experience; NRC queries or advances in reactor safety expectations that NEI says were reflected in this revision. Some of these questions are quite central to a safe design, many numbered subject headings that were not broached. [LIST TRUNCATED] • NRC expects a clear statement on margin of error on the bounding values chosen. CNSC should too. Certain critical data where margins of error are critically important. • The effect of a limiting severe core damage accident on the plant parameter envelope was not considered. • When the new entry into the list of potential reactor designs had a parameter that was outside the enveloping limits defined in the earlier incarnation of the PPE, the envelope was extended without any explanation. For example, when the BWRX-300 required to be built onto a depth of 38 meters feet underground and above ground, equivalent to a total structure height of a 25-story building – the PPE was merely re-written to make these parameters acceptable.
Climate Change Means of Shutdown	• Additional studies should be conducted on the impacts of an increase in algal blooms due to climate change impacts on Lake Ontario. The modelling for managing aquatic species' interactions with water intake equipment needs to be adapted for the worst-case scenario due to climate change. • OPG should provide updated information on ambient water temperature trends for Lake Ontario and compare that with the allowed range of inlet temperatures for the BWRX-300 reactor design. • OPG must address how it intends to ensure the proposed reactors will meet the requirement for 2 separate, independent and diverse means of reactor shutdown.
Civil Structures	• We would like more information about the construction of the intake and discharge structures offshore, including their size and location in Lake Ontario as well as anticipated environmental effects/mitigations.

General	• What made these parameters no longer important or of interest to OPG? • Did OPG not receive verification that BWRX-300 design is bounded by the PPE? • Does it incorporate all values from the BWRX-300? If not, what values are outstanding? • If GE-Hitachi chose not to participate in the RFP process and the bounding limits for the PPE were designed for the ACR-1000, EPR, and AP-1000, how can the PPE properly capture the values for the BWRX-300 (made by GE-Hitachi) if they were not part of the RFP process? • It is important for the distinctions to be made between the Vendor Design Specific (VDS) parameters and the Reactor Class Specific parameters because the vendor that was chosen did not participate in the design of the PPE and therefore, those parameters that are VDS would not apply? • While it is understood that the values of the composite PPE are presumed to capture the values of the BWRX-300 design, it would be prudent to demonstrate a comparison between the designs that were used to create the PPE and the design technology that was chosen. Where does the BWRX-300 differ? • The BWRX-300 wasn't incorporated into the design of the PPE until the revisions at the very end of the process. This seems contradictory to the purpose of designing a PPE specific for the technology that is selected to be used. • What PPE values were adjusted? Adjusting the parameters is contradictory to the intent of designing the PPE based on reactor designs considered. The BWRX-300 design did not fit within the values used in the PPE or it would not have to be adjusted. • Why is the BWRX-300 not included in this list? How many of the BWRX reactors can be built at the Darlington site? • Why was the decision made to create a new switchyard instead of the original plans to expand the previously existing DNGS switchyard? Does this increase the project footprint?

Parameters Analysis Releases	• P.62 speaks to the site water level, measuring the maximum flood and maximum ground water. If the BWRX is below grade 38 metres, how will these parameters change? • P. 61 speaks to earthquakes and the ground acceleration for which the plant is designed. The BWRX was not included in the list of limiting reactors. How will the BWRX design be compromised given that it is deeper below grade than the other reactors? • What is a boiling water reactor and whether the water becomes radioactive. • What happens with the spent water and where it is stored. • Are the impact of the water considered in the environmental report.
Climate Change	• Item 2.1.4 "Maximum ambient temperature (0% exceedance) is presently cited at 39.0 C. Given the variability of weather patterns and the potential for extreme heat events, has the impact of temperatures above 39.0°C on the system been considered?"
Effluents and Releases	
Monitoring	• Need for radiation monitoring equipment that would detect and save data on normal operation effluents as well as radiation fields from accidents.
Source Term Inventory	• Iodine emissions from the BWRX-300 will be higher than anticipated in the EIS. Please explain the impacts of higher levels of radioactive iodine emissions in the atmosphere to humans and the environment.
Releases Source Term Inventory	• Table 5 includes a note that “the radionuclides in gaseous effluents, liquid effluents, and solid waste are the same as in the EIS, but their proportions have changed” but there is no reference for a supporting document; it would be useful to have the data on how their proportions have changed. • Section 5.3.6 “Radiation and Radioactivity Environment” also states that “A comparison of emissions from the BWRX-300 reactor and the reactors assessed in the EIS, found that tritium, carbon-14, particulates, and noble gases emissions from the BWRX-300 are less than these

	emissions for the reactors assessed in the EIS. In contrast, the emissions of iodine are higher for the BWRX-300 than the values assumed in the EIS"; again, no supporting information is provided, and equally troubling is the absence of any discussion of the consequences of higher levels of iodine emissions
Source Term Inventory	• In Table 4.1: Airborne Source Term Single Reactor, it appears that the BWRX-300 is projected to release higher quantities of certain individual isotopes when compared to other reactors that were previously considered. Notably, a greater amount of radioiodine appears to be released from this reactor compared to others.
Releases	• Who decides how much effluent release is fine, and what guidelines are available for OPG to follow? How was it decided that the parameters have no differences?
Emergency Management	
Exclusion and Emergency Protection Zones Severe Accident Management	• That no new reactor be allowed by CNSC to be built within the exclusion zone of any other existing reactor. • That OPG be required by CNSC to derive science-based exclusion zones for both Darlington NGS and for the proposed BWRX-300 reactor according to the criteria laid out in U.S. NRC document 100.11. • Concept of PPE, the plant and site data that it collects was developed before the Fukushima disaster struck in 2012. That was also long before we all took a good look at the vulnerabilities to severe accidents that our reactors inherited and developed a semblance of accident management guidelines, engineered measures, new systems and coordination mechanisms for emergency planning. Given that the OPG PPE is so wanting in detail and the new reactor design make unsubstantiated claims about their infallibility, there is a need to reflect these topics in that in the PPE data. Both common sense and NEI-10-Rev. 2 guidelines require that severe accident mitigation related information be included and with clarity and detail. It feels like the parties never heard of Fukushima or the conclusions of its investigations into the root causes.

	• Effect of a severe core damage accident at an operating unit on safety of personnel engaged in construction of the new reactor(s) was not considered. The source term data given to the Emergency Management Organizations by utility running the operating reactors is irresponsibly fraudulent and cannot be used to prepare emergency evacuation or sheltering processes for our fellow citizens working on site. • Effect of an accident at one of the operating units on construction, operation or decommissioning of the new reactor was not given.
Emergency Planning Emergency Response	• OPG must ensure that it controls the use and occupation of land within 20 km of the site to maintain safety margins for the fifth level of defence in depth by preventing the intensification and development of residential dwellings to comply with the establishment of a 20 km Contingency Zone in accordance with PNERP. • OPG must provide more information on how emergency planning for BWRX-300 deployment will encompass a larger range of the population in the event of a severe nuclear incident. • The CNSC and OPG must ensure that emergency planning authorities are sufficiently prepared for a severe nuclear accident. • As the PNERP Technical Study has been released by the province of Ontario to the CNSC, we request licensing documents be revised to directly respond to its findings. • Because the CNSC has been given permission by the OFMEM to share the PNERP Technical Study with anyone who requests it, the CNSC should make this report publicly available on the CNSC website. • Before a determination can be made as to whether the BWRX-300 reactor fits within the parameters of the EIS and PPE, the updated Darlington Site Evacuation Time Estimate and emergency planning models based on the 2021 Census data must be made available.

Public Information	• Emergency preparedness instructions must be assessed in light of the types of accidents and releases that the BWRX-300 reactor technology may have. • The CNSC should review the PNERP Technical Study and as part of the review of the EIS and the PPE within the context of the proposed BWRX-300 reactor technology, demonstrate the sufficiency of contingency planning for the protection of drinking water, such as Lake Ontario, in the event of an emergency. • As a condition of siting new nuclear, the CNSC should require ongoing public education and clear communication about emergency preparedness and protective actions.
Environmental Effects and Risk Assessments	
Environmental Assessment	• The EIS for the BWRX-300 must provide a sufficiently detailed description of the plant's design to allow for independent verification of numerical values that are assigned to various parameters such as source terms. It should not be accepted as a foregone conclusion that the Darlington site is necessarily suitable as compared with other sites.
Site Characterization	• Site parameter characteristic data on effect of operations of the existing reactors on operation of the proposed new reactor (and vice versa) was not clearly given. • The data set does not contain any information that would be necessary and be specific to the Darlington site where other operating reactors already exist. This includes data on Derived Emission Limits and actual emission history that would be added to that from new units.
Climate Change	• Another relevant effect of DNNP would be the increase in water temperature via outflow into Lake Ontario. Thermal effects of the DNNP project should be considered alongside climate change already increasing surface water temperatures as a cumulative effect on the lake ecosystem.
Environmental Assessment	• It is understood that the DNNP Project is subject to the Ontario Environmental Assessment Act, which typically has an expiry date for most projects. Please explain why

Environmental Effects In-Water Works Mitigation Measures	there is no expiry date on the EA decision for DNNP, as well as how OPG justifies the project remaining within the original scope from 2011. The natural environment on the DNNP site as well as the surrounding land use has changed significantly over the last decade and must be taken into consideration. • Concern that even if OPG concludes that the effect will be reduced compared to the original EA finding, there will still be an effect. • What is the effect / impact will be and if the impacts are different with the new technology? • Limited shoreline work would be required under the new PPE/EIS due to the smaller footprint of the project. Please elaborate on details of the dredging so that we can better assess impacts to the environment. • It is unreasonable to conclude that because the east-west wildlife corridor has survived past fragmentation that wildlife will still be present during/after DNNP project construction. Cumulative effects of multiple activities on site over a long period of time could permanently impact the corridor disrupting connectivity and the surrounding ecosystem. • OPG should look into retaining part of the site for the wildlife corridor and keeping some of it fenced off to allow migration throughout the site preparation and construction period. • What are the environmental risks and mitigation measures of blasting and excavation vs. boring via tunnel machine. Which is less impactful to the environment? Request to be kept updated on the construction of the intake and discharge pipes offshore. • Please share the Fish Habitat Compensation Plan for review. • Does OPG have an approximate number for expected fish losses through impingement and entrainment? This would allow us to understand the comparison between expected losses and Lake Ontario fish populations. • Please update on the status of the wetlands on site and whether they will remain throughout the project. If they will remain, please inform us of the results of the effects

	assessment. If not, what will OPG do to compensate for the loss?
	• As stated in the EIS report, commencement of the project is occurring approximately 12 years later than the original date. What was the cause of such a significant delay? • In terms of environmental conditions on site, it should be noted that the project delay also allowed significant ecological lands and SAR habitat to thrive and grow, which now must be destroyed.
Mitigation Measures – Fish Impingement	
	• Comments were submitted to OPG and the ERO regarding OPG's Endangered Species Act (ESA) Permit for the DNNP project site preparation. Concern raised regarding the lack of guarantee for long-term protection of the SAR habitat on site. A request for a conservation easement or restrictive covenant be placed on the created SAR habitat to ensure it is not destroyed during further site prep for reactors 2-4. It was suggested that an off-site ecological restoration fund as an alternative, but OPG was unwilling to accommodate either request.
Mitigation Measures – Terrestrial Environment	• Requests are considered feasible; therefore, it is not fair to say that "OPG endeavors to achieve feasible mitigation measures and/or accommodation".
Species at Risk	• Is OPG not planning to impact the bank where the remaining swallows live as part of site prep? Given that bank swallow burrow counts have already been decreasing on site, is OPG able to relocate the SAR habitat or create habitat elsewhere for the species? • Later site preparation activities are likely to destroy the newly created SAR habitat on site as the remaining reactors are constructed and the Project footprint grows. Please explain how OPG plans to maintain protection of the natural features created to satisfy their ESA permit as the project proceeds. • Please explain how there is no further concern for the fish species if entrainment of Deepwater Sculpin has been identified recently on site? What does OPG mean by "fish protection measures will be taken if needed at the intake structures"? Requests that fish protection

	measures be taken at the intake structures regardless of prevalence of SAR or other factors. • See previous comment re. Bank Swallow. The plan is for 4 reactors to be constructed on site, and various site preparations are being undertaken that fit this scope (i.e., water intake structures are being built to handle 4 reactors). Why does the EIS suggest that this may not happen, and that the SAR habitat may be retained? It seems highly unlikely that the bank swallow habitat will remain if the project proceeds as planned. • Will OPG be creating any beneficial actions or offsetting as they are likely to impact these two SAR species? Will DFO Authorizations be required?
Thermal Plume	• Question about potential impacts from DNNP caused from warm water entering Lake Ontario. Were the impacts resulting from a thermal plume was included in the EIS and what considerations were included (i.e., algal growth, climate change).
Environmental Effects	• Table 1 identifies a very significant difference between the BWRX-300 and any other reactor designs considered in the 2009 EIS, that being that the reactor structure will penetrate 38 metres below ground level; this very important difference is given minimal treatment, and there is not enough information provided to fully evaluate, or to have confidence that OPG or their consultants have adequately evaluated the potential environmental consequences, including but limited to migration of radio-contaminants from the sub-surface structure to surrounding groundwater and potentially reporting to surface water; for example, there is no description of how monitoring will be undertaken or what mitigation measures might be employed; noted that there is a very brief (but inadequate) description in Section 4.1.2 and again in 5.2.2 where the potential for an effect on groundwater flow was identified as not having been considered in the 2009 EIS but this statement is not followed by any substantive discussion.

Further Studies	• Has the CNSC has done any studies on the lake water, water quality and fish consumption?
Environmental Risk Assessment Mitigation Measures	• It was noted that the panel stated that a new environmental assessment would not be required if the selected reactor technology is not fundamentally different from those used for the plant parameter envelope. • It was commented that it appears that the selected reactor technology is fundamentally different. Even if the choses technology is smaller than the options studied in the original EA. • Have the studies conducted during the EA in 2009 have been updated? • Regardless of whether or not the reactor technologies are different, the environment has likely changed since 2009. • Comment that mitigation measures are not always effective, and populations are declining. Proponents should go above and beyond in their mitigation or offsetting to try to reduce the negative environmental impacts and work towards improving the environment. An example was replanting trees at a 10 to 1 ratio. • Comment that other species should be considered, not just species at risk. Recommendation including species that are culturally important to Indigenous Nations and communities or used for subsistence.
Environmental Effects	• Further, arguments relating to the "smaller footprint" for the BWRX-300 ignore the deeper foundations required for the BWRX-300 (38m compared to all other reactors in the initial EIS that had a foundation depth of around 13.5m deep). The excavation work required for the BWRX-300 will alter the water table at the site, though the ways in which it may do so, and for exactly how long, are not discussed sufficiently in the 2022 EIS report; • OPG asserts terrestrial effects of the BWRX-300 reactors will similarly be less than those identified for other reactors in the initial EIS since the surface area taken up by the reactors will be less for the BWRX-300 (19 hectares per reactor compared with the average 35

Fundamental Differences Threshold	hectares for other reactors examined in the original EIS). The relative differences in disruption during construction of the BWRX-300 reactors versus other EIS reactors is under examined, and there is no evaluation of the likelihood that any saved surface area from smaller reactors would constitute significant gains in species habitat; • OPG asserts the aquatic environment will be more protected by BWRX-300 than the other reactors in the initial EIS because its flow rate is relatively smaller. However, no assessment is provided to characterize the BWRX-300 flow rate and its impact on aquatic biota in more detail. • After reviewing the EIS and PPE, it became apparent that there was not enough information in either document to get a comprehensive sense of the potential adverse environmental impacts of the BWRX-300 modular reactor. There was also insufficient information to develop a clear understanding of how the BWRX-300 modular reactors would interact more generally with the local environment. For example, neither the EIS nor the PPE contain detailed information or data relating to: • The source, volumes, or discharge points for all identified contaminants to air, surface water, groundwater, and stormwater; • Exact treatment or mitigative efforts to address potential contaminants in liquid effluent, contaminant releases to air, groundwater or in stormwater; or • Additional environmental monitoring that will be required, should the BWRX-300 modular reactor be approved, to ensure against any significant adverse environmental effects. • Since the original EIS was prepared, it was considered in an Environmental Assessment that resulted in a series of additional information requests of OPG, and a final EA report in 2011 that specified the project could only

Further Studies	proceed if the following studies were undertaken and resulted in findings that any identified environmental impacts could be mitigated to ensure against them becoming 'significant'. These studies included: [TRUNCATED] • Neither the 2022 EIS nor PPE systematically address any of these studies or their progress. As such, it remains unclear to what extent this ongoing work has been conducted. It remains unclear whether the studies themselves have been included in the supporting documents referred to in the EIS.
Environmental Effects Mitigation Measures	• The species listed in this quote include Cultural Keystone Species. While the EIS does not identify a risk to these species, they should be prioritized in any monitoring of the aquatic community to ensure that there is no adverse effect on any Culturally Significant species in this community. • Wetlands are incredibly important to Indigenous culture and way of life and are protected by Treaty Rights. Any impacts to a wetland as part of this project are an infringement on these constitutionally protected rights. Furthermore, under the 2008 Water Declaration: "First Nations in Ontario have our own territories that includes the waters, which include the rain waters, waterfalls, rivers, streams, creeks, lakes, mountain springs, swamp springs, bedrock water veins, snow, oceans, icebergs, and the seas". Indigenous Nations have rights and responsibilities to these wetlands and ponds on their territory. • Proponents should provide more clarity on the negligible changes expected to occur in wetlands and ponds and demonstrate how they will continue to monitor wetlands and ponds to ensure they are protected during and after the project. • Many amphibians and reptiles are Culturally Significant species and are protected under treaty rights. Indigenous Nations also have rights and responsibilities to the wetland and ponds on their territory.

	• The proponents need to clarify how they will be monitoring amphibian and reptile communities and habitat to ensure this project does not infringe on Inherent and Treaty rights. Wetland community surveys should be done prior to, and after construction to ensure the protection of wetland habitat and any Cultural Keystone Species making use of this habitat. • Many Culturally significant species could be using this corridor and disruptions to their movement patterns can be disruptive to their overall health. This work may also affect harvesting and hunting in the area, particularly if it disrupts wildlife movement. • Have the proponents considered how this disruption may infringe on inherent and treaty rights? Has there been considerations for how workers will interact with any Indigenous People they may encounter practicing these rights during the project? • The proponents should clarify the process they are taking to reduce disruption and other associated harm to wildlife (e.g., vehicle mortality). Proponents should clarify how this work will not infringe on Inherent and Treaty Rights. • Many birds, especially raptors, are Culturally Significant species. The full effects of this habitat loss should be known, specifically which birds might be affected and how, and a plan to restore habitat should be in place. • The proponents should clarify how they will monitor the bird communities, including the identification of any Cultural Keystone Species, that may be affected by project activities. Proponents should also specify how they will restore this habitat after the project and work with Indigenous Nations to develop these restoration plans. • As indicated in the EIS, four bat species identified on the DNNP site are listed as endangered (Little Brown Myotis, Northern Myotis, Eastern Small-footed Myotis, and Tri-colored Bat). It is important that these species and their habitat are protected from any adverse effects related to this project.

	• Response has been provided to OPG that speaks to the need for monitoring the effect of dust and noise on the bat populations and the invertebrate community, specifically aerial insectivore prey for bats. The suggestions given in that document related to monitoring should be incorporated into this project. • There is no mention of Monarch butterflies (Danaus plexippus) in this area, do they use this habitat? Monarch butterflies are listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC. 2021). There is also no mention of milkweed (Asclepias spp.), a species critical in the monarch lifecycle. Have surveys for milkweed been carried out? Does OPG have a plan in place to restore lost habitat or lost milkweed plants which are essential components in the monarch life cycle? • Proponents should clarify how they will monitor the area, including an assessment of milkweed plants, especially in areas that will be affected by project activities. Proponents should also specify how they will restore this habitat and work with Indigenous Nations to develop this restoration protocol. • Why were Cultural Keystone Species not included or mentioned within the document?
Species at Risk	
General	
Availability of Documents	• Even simple, typically publicly available information on reactor designs was not made available for the design ultimately chosen under the inexplicable guise of being 'proprietary'. Such blatant cover of 'proprietary' information is inconsistent with the vendor's obligations to people of Canada where the vendor hopes to benefit from a proof of concept with public funds. Reactor data on new Chinese reactor designs is more abundantly available than was made available for BWRX-300. This is not a time machine design, or a shoulder carried hypersonic missile design. • Public relations propaganda about the chosen reactor design's safety was freely dispensed without giving any numerical information on the reactor design that could

Land-Use Planning Parameters Analysis	be verified by nuclear safety experts working in public interest. • We propose that the current PPE be not accepted as surrogate to anything, and a renewed set of documents be prepared that details the actual data for BWRX-300 and issued for comments to me. It should include enough information on each of the reactor designs that were considered (as a summary design description with pictures and tables and references) and a much broader discussion of the chosen BWRX-300 design. • An important omission in the PPE and site description is in discussion of why the new build HAS TO BE within an existing station's exclusion boundary, despite all the risks such a decision entails. • A composite spreadsheet for all vendor data was not created (one column for each design). While bounding values (numerically maximum or minimum of data sent in by the vendors without any accompanying description) were identified, no rationale for comparing the supplied data with diverse origins, meaning or credibility was discussed. There was no discussion of any missing data, consistency check within vendor data set or any discussion of any reasonableness of data or error margins. These are actually explicit requirements and expectations in repeated NRC and NEI documents on the subject. A mere dump of bounding values makes no meaningful contribution to the stated intent. • The PPE provided bounding values for 3 reactors tabulated in 2009 for them by Condesco with ZERO additions made through the next 13 years or any feedback from any person or organization. • The process of arriving at the bounding value is not transparent as the data provided by each of the three vendors that dominate the information scape is not individually tabulated or referred to in a separate summary document for the design. That should have been an easy thing to do and with sufficient volume of information on the actual design, a proper way of verifying if the bounding data values were in context of ANY new design that may

Procurement Timelines and Process	show up on the horizon layer, just as the BWRX-300 did, many years after the PPE was issued first. Observations on the specific features of a reactor design from which the bounding value was derived were not made. • Information on fuel procurement • Main contention is that the present procedure lacks validity given the realities of the post-Fukushima world and the paucity of information provided about the BWRX-300 boiling water reactor – a type of reactor that was never considered in the original EIS
Availability of Documents	• To increase transparency, the Intervenors submit that OPG should be required to make all non-confidential documents readily available for public viewing, either via hyperlinks within documents, or through an archived database on their website. Information must be shared with the public in a timely manner.
General Indigenous Nations Relationships Timelines and Processes	• Why did the due diligence process result in the selection of the BWRX-300 if that specific technology wasn't studied in the design of the PPE? • As per above comments, concerns regarding the lack of guarantee for long-term protection of the SAR habitat on site in previous consultations. OPG was unwilling to accommodate either of our requests. • Although OPG may be unaware of the exact contents of the WTFN settlement agreement (2018), they do have relationships with many of the seven Treaty Nations. Through these relationships, OPG is aware that protection of the environment and living relatives is of high priority. When identifying rights impacted by the project and working toward accommodations, OPG should consider what they are hearing directly from impacted First Nations. • When did GE Hitachi decide to participate in the process? How long did they participate in the PPE development prior to being selected as the technology to be deployed at the DNNP site?
General	• It is recommended that consistency be maintained in the units of measurement to prevent potential errors in

	the future. Section 17.1.2 provides the value in "tonnes," while section 18.1.2 provides the value in "metric tons." • Sections 9.3.1, 10.1.1, and 10.1.2 make reference to CNSC G-129, which has been superseded by REGDOC 2.7.1 as of July 2021. While it is understood that G-129 requirements are a part of REGDOC 2.7.1, it is recommended that current regulatory documents be referenced throughout. This ensures consistency and communicates an understanding of and adherence to current safety regulatory requirements. • There is inconsistency in the units used for land area measurement in the document. Specifically, hectares are used in section 2.7.1, while both m2 and acres are used in section 3.3.1. Additionally, the values provided in the actual "acreage" section (17.2) are in hectares, which further adds to the confusion. It is recommended that uniformity in the units be used for land area throughout the document to avoid any ambiguity.
Timelines and Processes	• What are the expected timelines for the DNNP?
Timelines and Processes	• As discussed above, both the EIS and PPE are highly context-dependant documents, part of a process initiated in 2009 that was subject to two court rulings (though ultimately affirmed). This full context and the supporting documents referenced in OPG's EIS and PPE should have been made available alongside the 2022 EIS and PPE documents themselves – both on the CNSC consultation website as well as OPG's own website. The follow-up studies required by the EA report of the JRP should also have been explicitly discussed by OPG in their application and shared online with the public along with the current EIS and PPE documents. This is still something that can be done now, as intervenors like ourselves continue to study this proposal and prepare for any further environmental review or application by OPG for a licence to construct new reactors at the Darlington site. • Projects like these underscore the importance of proactive routine environmental performance disclosures, so that members of the public can ground their reviews of the proposed project in larger

	understandings of the Darlington site and how existing nuclear facilities engage with the local ecosystem in which they are embedded.
Indigenous Nations Relationships	• Why is there no mention of the Gunshot Treaty within the land acknowledgment and in the report? How are Inherent and Treaty Rights upheld throughout the provided report?
Hazards Assessment	
Severe Accident Management Severe Accident Assessment	• Some very important lessons were learnt from Fukushima. There is no mention of any comparison of risk between various designs; especially from BWRX-300 except that claims of eternal and near absolute safety are made. • Drawing on the lessons of Fukushima regarding the special vulnerabilities of co-located reactors, respondent urges that construction of any new reactors within the exclusion zone of the existing DNGS four-reactor complex must be ruled out as against the public interest.
Fire Protection Severe Accident Management	• OPG should conduct a thorough assessment of the hazards associated with spent fuel fires at the Darlington nuclear power plant. • OPG needs to revisit the hazard assessment of a large military aircraft accident in proximity to the BWRX-300 reactors. • OPG should conduct a hazard assessment of malevolent drone use on SMRs like the BWRX-300 reactor design, even if the likelihood of such an event occurring is low. • The Intervenors submit that the low frequency of commercial aircraft accidents should not be a reason to screen out the risk. OPG must analyze the hazards associated with and impacts due to a commercial aircraft hitting the reactor building, or the waste management facilities, or any of other facilities and buildings located on the Darlington site. • The potential for and effects of a multi-unit accident must take into consideration the relationship between the existing reactors of the Darlington Nuclear Generating Station and the proposed BWRX-300 reactors.

Severe Accident Assessment	• OPG should carry out a full-fledged severe accident analysis considering the challenges of estimating the reliability of the Passive Isolation Condenser System in order to show how the BWRX-300 design will adhere to CNSC requirements.
Licensing	
Environmental Assessment Licensing	• In keeping with the CNSC regulatory practice as outlined in PPE-2, OPG should be required to prepare a new environmental impact statement with high level design information about the BWRX-300. • CNSC shall ensure that all the conditions laid down by the JRP are fully implemented before a construction licence is considered. • CNSC shall require OPG to publish, in tabular form, all measures taken to implement each applicable JRP condition and sub-condition, with links to appropriate documents detailing how the implementation was carried out. CNSC staff shall certify that the implementations have been satisfactorily realized or that they must be redone
Land-use Planning	• The CNSC should direct CNSC staff to review the current and planned provincial land use directions under the Places to Grow Act and other indications of provincial intent to continue increasing density in this area; to ensure land use compatibility in the vicinity of major facilities, which includes energy generation facilities. Specific regard should be given to population density and growth around nuclear generating stations and impacts of new and additional nuclear on the implementation of emergency measures. • With recent legislative changes in Ontario opening sections of the Greenbelt to development, the CNSC should require OPG to address how unplanned density growth within Durham Region is considered for emergency planning for the DNNP site. • The CNSC must exercise its jurisdiction and fulfill the federal constitutional jurisdiction over nuclear site approval. Any siting decision must ensure the protection of the public and environment for the intended lifespan of the new nuclear development. This

Licensing	decision must also account for changes in land use, population density, climate, and environmental factors. No amount of subsequent regulatory action short of license termination can adequately protect the public if an unsuitable site is selected.
Environmental Assessment Licensing	• As mentioned, the selected BWRXT reactor was not one of the reactors considered in the original EIS or PPE. Although OPG states that the BWRXT reactor is not fundamentally different than those previously considered, this will be North America's first SMR. Does this not justify a new EA to ensure the technology fully conforms with the current environmental conditions and parameters? • To clarify, the Government of Canada delegated this determination to the CNSC? What dictates what is "fundamentally different" between SMR technologies, and how did the CNSC come to this decision? • Please explain the reasoning behind creating the PPE before selecting a specific reactor technology. This does not seem like the best method to ensuring the chosen reactor is environmentally and physically compatible with the DNNP site. Why did OPG take this selection approach?
Regulatory Codes and Standards	• The PPE approach utilized in the document is based on a U.S. methodology. It is noted that at least five "NUREG" documents were referred to within the document (i.e., publications prepared by US Nuclear Regulatory Commission Staff). It would have been preferable to refer to documents that apply directly to the Canadian regulatory environment, but as this is the first preliminary assessment for an SMR there is no Canadian example to point to. It is important that the adoption of any methodology be based on a sound rationale that is applicable to the Canadian context. This approach should help ensure that the regulatory framework in Canada is well-defined and effective in overseeing the implementation of Small Modular Reactors (SMRs). If SMRs are to become an important part of Canada's solution to producing low carbon electricity, and if Canada is to take a leadership role in

	all things SMR, especially where safety is concerned, it does make sense for the Canadian SMR proponents and for the Canadian regulatory agency to continue moving towards developing assessment methods devised for the Canadian regulatory environment.
Environmental Assessment	• In addition to the question of the BWRX-300's "fundamental difference" to other reactor technologies, or not, there are other public interest arguments for a new EA. Since the completion of the EA for the DNNP, federal environmental assessment legislation has changed twice. New species at risk have been listed and are present in the vicinity of the Darlington site. Further, the underlying need for these projects, and changes in energy demand forecasts and energy mixes since 2006 have been significant – as have public decision-making processes in the province relating to these types of determinations. EIS revisions (between 2010 and 2022) were dormant for 12 years, and the initial EIS is now 14-17 years old.
Operations	
Reactor Operations	• How much water is used in this process, and is it lake water? What happens to the water once it has been used as a coolant/moderator? • In past discussions with OPG/CNSC staff regarding the BWRXT technology, we were told there is no "spent water" and that the process occurs in a continuous loop. Can this concept be further elaborated on? Does the process not generate wastewater?
Reactor Operations	• While section 3.1 provided a reasonable summary of the of the general characteristics of the reactor, this section of the report – or other sections – did not provide an indication of burnup; it is important to know the expected burn-up to anticipate composition and properties of the spent fuel and this information is not provided
Radiological Dose	
Source Term Inventory	• No comparison of source terms between 4 reactors without giving any information about the reactors, their

	vulnerabilities, accident scenarios, release locations, release frequencies is meaningless. • Source term from normal operation from a number of release points was provided (also recommended by NRC in its review of NEI-10) with certain entries missing. Source term from regular emissions was provided without providing any information on its nature (continuous or frequency of puffs if any) and what sources it includes, of basis of its derivation, analytical assumptions and tools.
Effects on Humans	• It is our understanding that water interacts with the radioactive bundles in the BWRX-300 design. Has the PPE considered the effects on humans and the environment if the radioactive water interacts with the environment? It is our understanding that the interaction of water with the nuclear bundles is unique to this design.
Effects on Humans	• Section 4.13 discussed three parameters associated with airborne and waterborne releases of radioactive contaminants that result in doses to the public were outside of the parameters assessed in the EIS, and notes that "The three parameters associated with airborne and waterborne radioactive releases required a separate study to assess their effect and compare it with what was assessed in the EIS…."; This reference [14] was requested "Amendola and R. Parker, "DN Dose Calculations for Gap Analysis," on February 23 and received it on March 10th, but this arrival date – regrettably – left insufficient time for our experts' review; the referenced documents are not available online and there can be a significant time lag between making the request and receiving the document, in those instances where the document is provided and this is problematic in all reviews, including in this instance. • Section 5.3.6 "Radiation and Radioactivity Environment" makes an important statement about Radiation and Radioactivity Environment being considered a pathway to effects in other environmental components, but provides no supporting documentation

Source Term Inventory	• [Table 5 in the EIS] presented in both the PPE and EIS documents indicates that the BWRX-300 has higher levels of releases for certain isotopes compared to the other reactors evaluated, even though the overall dose from the four proposed SMRs is stated to be less than that already included in the EIS. It would be helpful to obtain details on how the dose was calculated or provide a summary of dose of the radionuclide groups. • For example, the Institute invites further elaboration on why the BWRX-300, despite generating less electricity than the other reactors assessed, is expected to have higher annual airborne releases of radioiodine and a higher solid waste component of radioiodine release, as indicated in the PPE and EIS documentation. This is particularly relevant to public concern, given the need to distribute iodine pills in the event of an accidental release. A more in-depth discussion of all the airborne and liquid effluent source terms would have been beneficial.
Safeguards	
Non-Proliferation	• What are the global security considerations for this technology are and who is responsible for that? Where would the fuel come from?
Wastes	
Decommissioning	• Decommissioning costs • Decommissioning responsibility
Decommissioning	• Without a decommissioning plan designed specifically for a BWRX-300 reactor, it is not possible to determine whether the technology selected by OPG complies with the EIS. We request that the CNSC require OPG to outline a detailed and non-theoretical decommissioning plan for the BWRX-300 reactors before any further assessments occur for the DNNP site.
Decommissioning	• It is disappointing that OPG has not created a decommissioning plan or even a preliminary strategy for the BWRXT reactors/DNNP site. OPG’s own website states “It is imperative that Preliminary Decommissioning Plans (PDP) are put into place for OPG's generating facilities.”

Waste Inventory and Storage	• It is irresponsible to begin a project of this size without a decommissioning strategy, this is a requirement for most major projects on Crown land. Please provide the decommissioning strategy for the BWRXT-300 as soon as it becomes available. It is recommended that a strategy be implemented before any further site-prep is conducted. • It is concerning that the solid waste anticipated to be generated by the BWRXT technology is even higher than initially reported in the EIS. There is still no long-term plan for the safe management and storage of nuclear waste in Ontario, and Indigenous Nations must live with the risk of temporarily storing this excess waste in their Treaty Territory, at the DWMF, without ever providing their consent. This should be considered before construction of the remaining reactors.
Practices	• The statement in Table 3 in Section 3.6 that "There is no change in the description of waste management practices" is misleading at best; while little information is provided in these documents about the fuel or the waste or their characteristics it is known that the wastes will have different characteristics (for example, a different burnup rate) and different dimensions than CANDU waste, which is the subject of all waste management practices in Ontario at present; so the document may parse the situation to say there is "no change to the description" of waste management practices, but that could only be the case if the 'description' was of management practices other than for the current and past wastes generated by OPG reactors; this parsing characterizes the problem with the approach CNSC as adopted, wherein the comparison is being made to an inadequate report about theoretical reactors from over a decade ago, rather than describing the currently proposed reactor in sufficient detail, including the associated and ancillary activities, including and particularly waste generation and management. • Section 4.1.4 "Solid Waste and Spent Fuel" states that a) solid waste volumetric activity (Bq/m3) generated by

Volume of Wastes Produced	the operation of the BWRX-300 is higher than what was assessed in the EIS but that there will be equipment changes in response and b) the weight of the cask used to transport the BWRX-300 spent fuel on site (113 tonnes) is heavier than the cask assessed in the EIS, but the roads will be upgraded in response , and then indicates that “there is no impact on the EIS conclusions as a result of these mitigation measures”; insufficient details is included about the waste and the waste containers, but this is far to simplistic a response to be credible; this is another example of why a full examination of the project through a full environmental assessment is required. • Section 5.2.8 makes assertions with respect to the volumes of L&ILW and used fuel to be generated from the BWRX-300 being lower and the land area required for used fuel dry storage being smaller than what was assessed in the 2009 EIS but provides no actual information about the fuel, the various wastes, or the dry storage systems; the document should include supporting data, or at least live links to documents which include the supporting data • Section 5.2.13 “Operation and Maintenance Phase” includes statements that the BWRX-300 used fuel pool is smaller than what was assessed in the EIS but that the change in capacity is accounted for through the availability to move used fuel earlier and that it is planned that used fuel storage facilities will be available once the BWRX-300 starts operation and that dose consequence due to higher activity will be managed through appropriate cask and shielding design; these statements are not referenced, and no supporting information is provided; several questions arise, include: why will used fuel be moved earlier and how much earlier and to where? Which casks are being referred to in the statement that the higher activity will be managed through cask and shielding design? i.e., interim dry storage, transportation or perpetual care casks?

Waste Inventory and Storage	• Figure 5 in Section 3.2 on Conceptual Plant Layout does not identify the location of the various radioactive waste storage facilities; these are listed on page 17, but their locations are not identified and there are no, or inadequate descriptions provided. • Section 3.4 indicates that irradiated fuel and low and intermediate level waste will be stored on the site, but the report does not include a detailed description of liquid, radioactive waste management systems, although a generic description is found in later sections of the report. • Section 3.6 states that "There is no change to the description of waste management practices in Ontario. The process in this section applies to the BWRX-300 deployment; L&ILW will also be produced, and will be processed on-site, and shipped to an off- site OPG licensed facility"; while that may very well be the case, the very general statements offer little basis for review and are not a substitute for a detailed description and discussion of radioactive wastes. • Section 3.7 states that "Management of spent fuel for BWRX-300 will also use an on-site dry storage facility", but no additional information is provided, such as: how long will the dry cask storage be in operation? What will be the state of the fuel after this period? Are there provisions for repackaging defect fuel assemblies? • Table 4 similarly makes the assertion that "the description of the on-site dry storage facility in the EIS is applicable to the BWRX-300 deployment; this statement is unsupported by an actual detailed description of the on-site dry storage facility, and would require comparison to a detailed description of dry storage facilities for the 2009 fleet of conceptual reactors; at minimum, a comparison of the BWRX-300 "Radioactive Waste Management Plan"(scheduled for release in Q1 2023) to the 2009 Nuclear Waste TSD would be required, although at this point we cannot be confident that the BWRX-300 "Radioactive Waste Management Plan"(scheduled for release in Q1 2023)

	will contain sufficient detail and information about dry storage facilities. • The BWRX-300 deployment will transport the L&ILW off-site to an OPG licensed facility. The description of the on-site dry storage facility in the EIS is applicable to the BWRX-300 deployment. Again, not much can be said about such statements without more documentation. • The report states in Section 3.7 that "The volume of L&ILW and used fuel generated from the BWRX-300 deployment over the 60 years of operation is estimated to be less than for the larger reactors assessed in the EIS"; this statement is not consistent with the findings set out in the expert paper Nuclear waste from small modular reactors13 (Krall et al.,2022); this is a key point – do the report authors have actual information to support this questionable statement. • Section 5.7.2 "Radiological and Transportation Malfunctions and Accidents" describes the BWRX-300 radiological waste as containing different proportions of radionuclides than the waste that was assessed in 2009 EIS, and notes that the mass of fuel placed in the spent fuel transfer cask is different than what had been assessed in the EIS; this section states that the assessment of radiological malfunctions and accidents involving radioactive waste and used nuclear fuel was reanalyzed for the BWRX-300 "using the same scenario as was examined in the EIS" and then goes on to say that the reassessment lead to the same conclusion, but it does not provide any of the supporting data, discussion of documentation; for this and for the other re-evaluations of accidents (e.g. transportation accidents, damage to spent fuel) further information is required; also, in evaluating the probability and consequences of accidents all four of the proposed BWRX-300 reactors should be considered as a system, and this cannot be determined based on the very limited information provided; one of the lessons at Fukushima was that there can be disadvantages to having reactors connected by the same supporting

	systems and it is not clear from these documents if the systems for each reactor unit are independent or combined; more detail is required in order to assess or review critical assertions on exposure to the public.
Decommissioning	• Noted there is a long-term impact of the project on the land and asked who gets the land after it is 'abandoned', and whether it becomes crown land.
Volume of Wastes Produced	• OPG asserts BWRX-300 will generate smaller volumes of waste than the reactor models examined in the initial EIS, and argues this factor indicates a smaller environmental impact.8 However, these wastes have higher radioactivity levels, than other CANDU wastes at the Darlington site. It is unclear from the 2022 EIS and PPE how this higher activity is taken into consideration when evaluating impacts and management requirements for spent fuel from the BWRX-300 reactors.

Projet de nouvelle centrale nucléaire de Darlington

Rapport sommaire de l’atelier sur le Projet de nouvelle centrale nucléaire de Darlington (PNCND)

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Résumé

En tant qu'organisme de réglementation nucléaire moderne et agile, la Commission canadienne de sûreté nucléaire (CCSN) vise à être reconnue comme un organisme de réglementation de confiance et comme une source de renseignements scientifiques, techniques et réglementaires objectifs. La CCSN s'efforce d'établir un climat de confiance avec le public et d'être transparente dans ses efforts de mobilisation et de relations externes, en offrant des possibilités de dialoguer directement, dans différents formats, avec le personnel et avec les experts en la matière.

En avril 2023, la CCSN a organisé un atelier avec des membres du public et des Nations et communautés autochtones pour entendre leurs commentaires et leurs préoccupations sur deux documents soumis à l'appui de l'examen par Ontario Power Generation (OPG) de l'applicabilité de l'évaluation environnementale (EE) du PNCND au réacteur BWRX-300. Le personnel de la CCSN a présenté des renseignements généraux sur le processus d'examen réglementaire et sur le PNCND et a fourni un résumé de l'évaluation d'OPG sur l'applicabilité de l'EE. En raison du nombre de commentaires reçus, le personnel de la CCSN a organisé l'atelier sous forme de discussion structurée, et les participants ont été séparés en groupes, en fonction des thèmes des commentaires qu'ils avaient soumis. Toutefois, les participants ont fait remarquer que le format ne permettait pas une pleine participation sur tous les sujets pertinents. Le personnel de la CCSN a tenu compte de cette rétroaction, a agi en conséquence et a ajusté le format de l'atelier, éliminant les petits groupes de discussion et organisant plutôt une discussion de groupe pour l'ensemble des participants.

Les participants ont également signalé la difficulté à trouver des renseignements pertinents concernant le PNCND, sachant qu'ils sont souvent répartis sur plusieurs sites Web gouvernementaux et sont parfois présentés de manière inaccessible. La CCSN est déterminée à améliorer la disponibilité et l'accès à l'information. À ce titre, le personnel de la CCSN a placé tous les renseignements propres au PNCND, ainsi que les liens vers le site Web d'OPG, le registre de l'Agence d'évaluation d'impact du Canada (AEIC) ou d'autres sources de renseignements sur le PNCND en un seul endroit sur le site Web du portail Gouvernement ouvert.

Ce rapport est un résumé des rétroactions et des commentaires reçus des participants à l'atelier du PNCND. Le personnel prendra tous les commentaires reçus en considération pour les futurs documents à l'intention des commissaires (CMD) et pour les prochaines activités de mobilisation et de relations externes.

Introduction

La CCSN réglemente l'énergie et les matières nucléaires, afin de préserver la santé, la sûreté et la sécurité et de protéger l'environnement au Canada. Ce faisant, elle vise à être reconnue comme un organisme de réglementation fiable et une source crédible de renseignements scientifiques, techniques et réglementaires. Pour y parvenir, elle entreprend diverses activités, notamment l'organisation de séances *Rencontrez l'organisme de réglementation nucléaire*, la mobilisation des municipalités et des organisations locales, l'élaboration de cadres de référence pour une mobilisation à long terme des Nations et communautés autochtones intéressées, ainsi que des ateliers d'information et de discussion au sujet de préoccupations concernant d'éventuels projets nucléaires.

Le 4 avril 2023, la CCSN a organisé un atelier avec des membres du public, les Nations et communautés autochtones, des organisations de la société civile et des organisations non gouvernementales de l'environnement pour discuter de deux documents clés soumis dans le cadre de la demande de permis de construction pour le Projet de nouvelle centrale nucléaire de Darlington (PNCND) d'Ontario Power Generation (OPG), à savoir le rapport mis à jour sur l'enveloppe des paramètres de la centrale (EPC) et le rapport d'examen de l'énoncé des incidences environnementales (EIE). Ces documents ont été soumis par OPG à la CCSN pour démontrer que la technologie sélectionnée, le réacteur BWRX-300 de GE-Hitachi, restait dans les limites de l'évaluation environnementale de 2012 précédemment approuvée.

L'atelier a été l'occasion de discuter des commentaires reçus sur ces documents. Ces commentaires, reçus par courriel ou sur la plateforme de consultation *Parlons sûreté nucléaire*, ont servi de base pour déterminer le contenu de l'atelier. Les commentaires reçus ultérieurement au cours de l'atelier aideront la CCSN à mieux comprendre les préoccupations concernant le projet et pourraient éclairer ses recommandations à la Commission lors d'audiences futures, notamment celle de janvier 2024.

Contexte

En 2006, OPG a proposé le PNCND qui comprenait la construction et l'exploitation d'un maximum de quatre nouveaux réacteurs nucléaires sur le site existant de Darlington, qui se trouve dans la municipalité de Clarington, sur la rive nord du lac Ontario, dans la région de Durham.

En 2009, OPG a soumis un EIE et une demande de permis de préparation de l'emplacement à la CCSN. La CCSN a délivré un permis de préparation de l'emplacement en 2012, qui a été renouvelé en 2021 et qui viendra à échéance en 2031. La Commission d'examen conjoint (CEC), qui a étudié le projet conformément à la *Loi canadienne sur l'évaluation environnementale (2009)* (LCEE 2009) a publié son rapport le 25 août 2011 et y a présenté 67 recommandations, la recommandation 1 étant ainsi formulée :

> *La CEC comprend qu'avant la construction, la CCSN déterminera si la présente évaluation environnementale s'appliquera à la technologie de réacteur choisie par le gouvernement de l'Ontario pour le projet. Néanmoins, si la technologie de réacteur choisie est fondamentalement différente des technologies de réacteur spécifiques délimitant l'enveloppe des paramètres présentement à l'étude, la CEC recommande d'effectuer une nouvelle évaluation environnementale.*

Dans sa réponse au rapport de la CEC, le gouvernement du Canada a conclu qu'aucun effet négatif important sur l'environnement n'était à prévoir si toutes les mesures d'atténuation étaient mises en œuvre. OPG est tenue de démontrer que la technologie qu'elle a choisie s'inscrit dans les limites de l'évaluation environnementale approuvée et d'évaluer les effets potentiels sur tous les paramètres qui sont en dehors de l'approche limitative approuvée précédemment.

En octobre 2022, OPG a soumis à la CCSN une demande de permis de construction d'un petit réacteur modulaire (PRM). En réponse à la recommandation 1 de la CEC, OPG a soumis les deux documents suivants pour fournir des détails à jour sur la technologie du réacteur BWRX-300 sélectionnée et pour la comparer aux technologies de réacteur spécifiques incluses dans la soumission originale de 2009 :

- le **rapport d'examen de l'énoncé des incidences environnementales (rapport d'examen de l'EIE)** qui documente l'examen, par OPG, de l'EIE de 2009, en vue de démontrer que les résultats restent valables pour le réacteur BWRX-300

- le **rapport mis à jour sur l'enveloppe des paramètres de la centrale** (**rapport EPC)** qu'OPG a soumis pour évaluer les effets des paramètres du réacteur BWRX-300 et les comparer à l'EPC limitative de 2009 acceptée par le gouvernement du Canada. Une « enveloppe des paramètres de la centrale » ou « EPC » est une liste de valeurs utilisées dans l'évaluation environnementale et la demande de permis pour aider à prédire les effets potentiels sur la sûreté et l'environnement d'une centrale nucléaire sur un site particulier.

OPG a conclu que le réacteur BWRX-300 restait dans les limites de l'évaluation environnementale approuvée, satisfaisant ainsi à la recommandation 1 de la CEC. Les deux documents ont été affichés, entre décembre 2022 et mars 2023, sur *Parlons sûreté nucléaire*, aux fins d'examen et de commentaires du public. Une aide financière aux participants a également été mise à disposition par la CCSN, dans le cadre de son Programme de financement des participants, entre janvier 2023 et mars 2023, pour aider les membres du public, les Nations et communautés autochtones, ainsi que les parties intéressées, à examiner les deux documents.

La CCSN a reçu un total de 188 commentaires par courriel et sur *Parlons sûreté nucléaire* qui portaient sur les domaines thématiques suivants, dont certains se chevauchent :

THÈME	**Nombre de commentaires**
Conception et analyse	26
Effluents et rejets	7
Gestion des urgences	16
Effets environnementaux et évaluations des risques	49
Doses radiologiques	8
Déchets	28
Garanties	1
Évaluation des dangers	8
Délivrance de permis	13
Généralités	28
TOTAL	**188**

Tous les commentaires reçus dans le cadre du Programme de financement des participants de la CCSN se trouvent à l'annexe B.

L'atelier

L'objectif de l'atelier était triple : 1) mobiliser les participants sur le rapport EPC et sur le rapport d'examen de l'EIE d'OPG; 2) fournir aux participants une vue transparente des activités entreprises dans le cadre du processus d'examen de la demande de permis par la CCSN en amont des séances de la Commission; 3) recueillir des commentaires, tôt dans le processus d'autorisation, pour aider le personnel de la CCSN à mieux comprendre les préoccupations des participants. Les commentaires reçus à l'occasion de la consultation publique seront pris en considération lors de l'examen technique du personnel de la CCSN en vue des prochaines séances de la Commission.

L'atelier virtuel d'une journée complète a accueilli plus de 17 participants représentant l'Association canadienne du droit de l'environnement, le Projet pour la transparence nucléaire, le Regroupement pour la surveillance du nucléaire (Canada), Northwatch, le Comité sur la sûreté nucléaire de Durham, la Première Nation des Mississaugas de Scugog Island, les Six Nations de Grand River, la Première Nation de Curve Lake, la Première Nation de Hiawatha, l'Institut de radioprotection du Canada et le maire de la municipalité de Clarington. Des membres du personnel d'Environnement et Changement climatique Canada (ECCC), du ministère des Pêches et des Océans (MPO) et d'OPG, ainsi que des spécialistes techniques de la CCSN étaient également présents.

Dans la matinée de l'atelier, OPG a présenté le PNCND et un résumé des résultats du rapport EPC mis à jour et du rapport d'examen de l'EIE. Le personnel de la CCSN a fait le point sur l'examen technique des documents d'OPG, ainsi que sur le calendrier d'examen de la demande de permis de construction d'OPG. Le personnel de la CCSN a également donné un aperçu des commentaires reçus sur les deux rapports examinés avant l'atelier, ainsi que des commentaires techniques qu'il a fournis à OPG. Dans l'après-midi de l'atelier, le personnel de la CCSN a animé une discussion ouverte basée sur les thèmes qui ont reçu le plus de commentaires, à savoir :

- Effets environnementaux et évaluations des risques
- Gestion des déchets et déclassement
- Conception et analyse, et évaluation des dangers
- Rejets, doses et gestion des urgences

Ces thèmes devaient initialement être discutés dans des groupes thématiques. Cependant, après avoir écouté les préférences et les commentaires des participants sur la manière dont ils souhaitaient s'impliquer, ces sujets ont été discutés dans un forum ouvert en présence de tous.

Ce que nous avons entendu

La section suivante résume les principaux thèmes des enjeux, des préoccupations et des recommandations que nous avons entendus de la part des participants. Le déroulement de l’atelier a offert à ces derniers l’occasion d’approfondir leurs commentaires et de faire part d’éclairages supplémentaires que le personnel de la CCSN prendra en compte, alors que son examen réglementaire de la demande de permis de construction d’OPG se poursuit.

Effets environnementaux et évaluations des risques

Évaluation environnementale

- OPG devrait ajouter à l’EIE de 2009 des renseignements supplémentaires qui fourniraient les données requises pour la vérification indépendante des valeurs numériques attribuées à divers paramètres.
- OPG devrait faire preuve d’une plus grande transparence quant à la manière dont elle a justifié le maintien du projet dans le cadre de l’EE initialement approuvée.
- OPG devrait donner accès aux renseignements précis sur lesquels elle s’appuie pour affirmer que la technologie sélectionnée reste dans les limites de l’EPC.

Effets environnementaux

- OPG devrait mener une évaluation qui évalue adéquatement les effets environnementaux potentiels du réacteur BWRX-300, afin d’améliorer la confiance dans le maintien de l’EE initiale.
- OPG devrait effectuer une analyse plus solide des effets potentiels du réacteur BWRX-300 sur les puits d’eau souterraine, les écosystèmes terrestres et aquatiques et les infrastructures de traitement des eaux pluviales.
- Les rapports d’OPG devraient être améliorés, en tenant compte des effets environnementaux et de l’incidence sur les doses des rejets de gaz rares provenant du réacteur BWRX-300.

Espèces en péril

- La CCSN et OPG devraient comprendre que, dans les systèmes de connaissances traditionnelles autochtones, les oiseaux et les animaux sont des êtres proches et non de simples composantes valorisées de l’environnement. La documentation devrait tenir compte de cette vision du monde lors de la détermination des effets potentiels du projet sur les espèces.
- La CCSN et OPG devraient tenir compte des espèces en péril et des espèces revêtant une grande importance culturelle dans le cadre de la surveillance environnementale et des enquêtes écologiques. Les mesures de protection devraient être décrites dans un plan de gestion écosystémique à long terme.

- OPG devrait fournir plus de renseignements sur les mesures qui seront prises pour protéger les caractéristiques environnementales naturelles et les habitats pendant et après la construction.

Le thème « Effets environnementaux et évaluation des risques » a également suscité des commentaires s'appliquant aux autres thèmes et concernant la difficulté d'accès aux documents. Les participants ont indiqué que la CCSN pourrait atteindre une plus grande transparence en améliorant ses pratiques de divulgation proactive, en permettant le téléchargement facile des documents directement à partir du site suretenucleaire.gc.ca et en conservant tous les documents au même endroit. Les participants ont soulevé des préoccupations similaires concernant OPG et ont souligné que cette dernière devrait préparer des rapports compréhensibles pour le public.

Gestion des déchets et déclassement

Gestion des déchets, inventaire et entreposage

- La consultation des Nations et communautés autochtones et la mobilisation des administrations locales devraient être primordiales dans toutes les discussions relatives à la gestion du combustible usé et à l'emplacement d'un dépôt géologique en profondeur.
- OPG devrait fournir une justification solide expliquant pourquoi l'EIE est toujours appropriée, même si OPG reconnaît que la production de déchets solides du réacteur BWRX-300 sera plus élevée.
- OPG devrait fournir davantage de renseignements sur l'emplacement des installations d'entreposage des déchets dans le plan conceptuel de la centrale.
- La Société de gestion des déchets nucléaires devrait clarifier son mandat et son autorité pour se prononcer sur l'emplacement futur d'un dépôt géologique en profondeur et sur la manière dont il accueillera les assemblages de combustible du réacteur BWRX-300.

Déclassement

- OPG devrait documenter un plan stratégique de déclassement non théorique conçu spécifiquement pour le réacteur BWRX-300 et son incidence sur l'environnement, afin de démontrer que la technologie reste dans les limites de l'EPC acceptée par le gouvernement du Canada.
- OPG devrait démontrer que les deux rapports sont conformes aux recommandations du Conseil de la qualité de l'eau des Grands Lacs de la Commission mixte internationale et à la conclusion de l'Agence internationale de

l'énergie atomique selon laquelle le déclassement immédiat est la stratégie de déclassement privilégiée pour les réacteurs nucléaires.
- OPG devrait décrire comment les terres seront remises en état après le déclassement du site, en précisant notamment si la zone deviendra alors une terre de la Couronne.

Dans l'ensemble, les participants étaient désireux d'avoir accès à des renseignements améliorés sur la production, les caractéristiques et l'entreposage des déchets ainsi que sur les garanties financières, qui permettraient au public de mieux comprendre le plan de gestion des déchets radioactifs et la stratégie de déclassement d'OPG.

Conception et analyse, et évaluation des dangers

Conception et analyse

- Pour renforcer les deux rapports, OPG devrait fournir une justification documentée à l'appui de son affirmation selon laquelle le réacteur BWRX-300 n'est pas fondamentalement différent des conceptions de réacteur précédemment envisagées.
- Le rapport d'examen de l'EIE devrait indiquer les domaines pour lesquels la conception du réacteur BWRX-300 n'a pas progressé ou ceux pour lesquels elle pourrait encore changer de manière suffisamment importante pour avoir une incidence sur les conclusions du rapport.
- OPG devrait fournir une documentation plus détaillée décrivant comment elle compte garantir que le réacteur BWRX-300 répondra à l'exigence relative à deux moyens d'arrêt du réacteur qui sont distincts et autonomes.

Évaluation des dangers

- OPG devrait expliquer plus clairement pourquoi on suppose que le réacteur BWRX-300 aura une zone d'exclusion plus petite.
- OPG devrait fournir une comparaison des risques associés aux différentes conceptions, afin de mieux mettre en contexte l'évaluation des dangers.
- OPG devrait inclure une évaluation des dangers potentiels pouvant découler de la cohabitation de réacteurs nucléaires au sein de la même installation, afin d'améliorer l'évaluation des dangers fournie.
- OPG devrait soumettre à nouveau son évaluation des dangers en y incluant le scénario d'un accident impliquant un avion militaire de grande taille, ainsi qu'une évaluation de l'utilisation malveillante de drones et de collisions d'avions commerciaux de grande taille.

Dans l'ensemble, les participants souhaitaient savoir si la conception du réacteur BWRX-300 avait suffisamment évolué pour que la CCSN puisse tirer des conclusions suffisantes à ce stade. Il a été suggéré que les aspects de la conception du réacteur BWRX-300 qui sont encore en développement soient clairement documentés et rendus publics.

Rejets, doses et gestion des urgences

Rejets et doses

- OPG devrait fournir des documents accessibles au public sur les rejets d'iode radioactif et une description de la manière dont ces rejets resteront dans les limites de l'EE précédemment approuvée.
- OPG devrait clarifier la manière dont les proportions de radionucléides dans les effluents gazeux, les effluents liquides et les déchets solides ont changé par rapport à l'EIE original.
- La CCSN devrait améliorer ses communications sur la manière dont les limites pour les rejets dans les effluents sont déterminées et réglementées.

Gestion des urgences

- OPG devrait fournir plus de renseignements sur son plan de gestion des urgences et sur la manière dont la planification d'urgence pour le déploiement du réacteur BWRX-300 englobera une plus grande partie de la population en cas d'accident nucléaire grave.
- OPG devrait prendre en compte les effets d'un accident ayant provoqué des dommages graves au cœur, à une tranche en exploitation, sur la sécurité du personnel travaillant à la construction d'un ou de plusieurs nouveaux réacteurs et intégrer lesdits effets à l'évaluation de sa planification d'urgence.
- La CCSN devrait publier le rapport d'étude technique 2019 du Plan provincial d'intervention en cas d'urgence nucléaire (PPIUN) sur le portail Gouvernement ouvert.

Conclusion

Les participants ont indiqué qu'ils souhaitaient que de futurs ateliers soient organisés, à mesure de l'avancement du processus d'examen réglementaire de la demande de permis de construction d'OPG. Le personnel de la CCSN continuera de travailler avec les Nations et communautés autochtones, les organisations de la société civile, les ONG et le public pour évaluer l'efficacité de cet atelier et le format de tout futur atelier potentiel. Ces ateliers continueront d'améliorer la compréhension qu'a la CCSN au sujet des préoccupations et des intérêts des participants en ce qui concerne l'examen technique, par le personnel de la CCSN, de la demande d'OPG visant la construction d'un réacteur BWRX-300. Le personnel de la CCSN souhaite remercier tous les participants pour leurs contributions pertinentes, avant et pendant l'atelier, et attend avec impatience de futures occasions de mobilisation.

Prochaines étapes

La CCSN étudie les moyens d'améliorer davantage la transparence de l'information et les moyens d'y accéder. La CCSN améliore l'accessibilité des documents en reliant les archives originales de l'EE au portail Gouvernement ouvert et en dirigeant les lecteurs vers la page Web pertinente de ce portail. La CCSN continue d'évaluer les options permettant de rendre l'information facilement accessible sur des plateformes intuitives. Il s'agit notamment d'encourager OPG à publier les documents à l'appui de son examen de l'EIE. Le personnel de la CCSN continuera de faire régulièrement le point sur le projet par l'entremise du site Web du PNCND et effectuera un suivi auprès des participants à l'atelier, des Nations et communautés autochtones, du public et des parties intéressées pour discuter de leurs préoccupations.

Depuis l'atelier, le PPIUN a été mis à disposition en ligne.

À la demande des participants à l'atelier, la liste ci-dessous présente un calendrier pluriannuel évolutif des activités de mobilisation prévues par la CCSN pour ce projet.

ACTIVITÉ	DATE
Journée portes ouvertes de la CCSN dans la municipalité de Clarington qui présentera tous les projets nucléaires de la région	26 septembre 2023
Webinaires publics qui donneront un aperçu du mémoire d'OPG et des recommandations du personnel de la CCSN qui seront examinés lors de l'audience de janvier 2024	Novembre 2023
Date limite pour le dépôt des demandes d'intervention auprès du Greffe de la Commission pour l'audience n° 1	20 novembre 2023
Audience n° 1 sur le PNCND d'OPG	Semaine du 22 janvier 2024
Webinaire ou atelier public qui fera le point sur le PNCND et l'audience n° 2	Mai – juin 2024, cette activité est provisoire et dépendra de la décision de la Commission lors de l'audience n° 1.
Webinaire public qui fera le point sur l'audience n° 2 au sujet du PNCND	Septembre 2024, cette activité est provisoire et dépendra de la décision de la Commission lors de l'audience n° 1.

Les dates et les activités pourront être modifiées pour tenir compte d'éventuels changements dans le calendrier du PNCND. L'avis d'audience publié le 3 avril 2023 offre de plus amples renseignements sur les audiences publiques et l'aide financière aux participants pour ce projet.

Annexe A : Engagements

Tableau 1 – État des recommandations de la Commission d'examen conjoint (CEC)

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
1	La CEC comprend qu'avant la construction, la Commission canadienne de sûreté nucléaire déterminera si la présente évaluation environnementale s'appliquera à la technologie de réacteur choisie par le gouvernement de l'Ontario pour le projet. Néanmoins, si la technologie de réacteur choisie est fondamentalement différente des technologies de réacteur spécifiques délimitant l'enveloppe des paramètres présentement à l'étude, la CEC recommande d'effectuer une nouvelle évaluation environnementale.	Le gouvernement du Canada accepte l'intention de cette recommandation, mais précise que les autorités responsables en vertu de la LCEE seront tenues d'établir si la proposition qui sera faite par le promoteur est fondamentalement différente des technologies de réacteur évaluées par la CEC et s'il est nécessaire d'effectuer une nouvelle évaluation environnementale aux termes de la LCEE.	S. O.	Lancée
2	La CEC recommande qu'avant la préparation de l'emplacement, la CCSN exige qu'OPG mène un programme exhaustif de caractérisation des sols. Plus précisément, les sols qui pourraient être touchés dans	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG mène un programme exhaustif de caractérisation des sols. Il remarque également que le programme recommandé	D-P-3.6	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	les emplacements désignés par OPG pour le rejet de matériaux, l'usine de ciment et l'entreposage d'asphalte doivent être échantillonnés pour que l'on puisse déterminer la nature et la portée de toute contamination potentielle.	pourrait aussi soutenir les activités d'évaluation des risques écologiques qui seront menées par OPG. Environnement Canada (EC) peut fournir, sur demande, l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.		
3	La CEC recommande que la CCSN exige que, dans le cadre de la demande de permis de construction de réacteur, OPG entreprenne une analyse coût-bénéfice quantitative des systèmes de tours de refroidissement ou des systèmes à eau avec refroidissement à passage unique, en appliquant le principe de la meilleure technologie disponible économiquement réalisable. Cette analyse doit tenir compte du fait que le remblayage dans le lac ne doit pas dépasser la courbe isobathe de 2 m et la nécessité d'intégrer une technologie d'atténuation du panache de la tour de refroidissement.	Le gouvernement du Canada accepte l'intention de cette recommandation d'exiger qu'OPG entreprenne une analyse coût-bénéfice quantitative des systèmes de tours de refroidissement et des systèmes à eau avec refroidissement à passage unique, tel que recommandé, mais précise que cette analyse pourrait être exigée plus tôt que ce qui est indiqué dans la recommandation étant donné la relation qu'il y a entre l'aménagement du site et le choix de la technologie de refroidissement. Sur demande, Pêches et Océans Canada (MPO) et EC	DC-1.1	Terminée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
		peuvent fournir l’expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation. Le gouvernement du Canada reconnaît par ailleurs le lien qui existe entre cette recommandation et la recommandation 31. Par conséquent, il prend note du fait que le MPO travaillera avec OPG pour s’assurer, par l’entremise de son processus réglementaire et des conditions d’autorisation prévues aux termes de la *Loi sur les pêches*, que toute détérioration, destruction ou perturbation de l’habitat (DDPH) se limitera à une courbe bathymétrique de 2 m du lac Ontario.		
4	La CEC recommande que la CCSN exerce un contrôle réglementaire afin de s’assurer qu’OPG respecte toutes les normes et les exigences municipales et provinciales durant la réalisation du projet. Cela revêt une importance	Le gouvernement du Canada accepte cette recommandation, mais précise que, pendant toute la durée du projet, ce sont les fonctionnaires provinciaux et municipaux qui ont la responsabilité de s’assurer que le tout est	S. O.	Terminée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	particulière, puisque les conclusions de la CEC sont fondées sur l'hypothèse qu'OPG respecte les lois et règlements applicables à tous les paliers de gouvernement.	conforme à leurs normes et exigences.		
5	Pour éviter tout dommage environnemental inutile au promontoire de Raby Head et à l'habitat du poisson, la CEC recommande de ne pas éroder le promontoire, ni de faire de remblayage dans le lac pendant l'étape de préparation de l'emplacement, sauf si une technologie de réacteur a été sélectionnée et qu'il y a certitude que le projet va aller de l'avant.	Le gouvernement du Canada accepte cette recommandation d'éviter tout dommage environnemental inutile au promontoire de Raby Head et à l'habitat du poisson, tel qu'indiqué. Sur demande, le MPO et EC peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation. Par ailleurs, le gouvernement du Canada signale qu'en vertu de la *Loi sur les pêches*, il faudra obtenir une autorisation avant de procéder à toute opération de remblayage dans le lac, et confirme que le MPO travaillera avec OPG pour qu'il soit entendu qu'à titre de condition à cette autorisation, aucun remblayage ne devra avoir	D-P-14.1 D-P-16.1 D-P-3.8	Ouverte Ouverte Ouverte

N°	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		lieu dans le lac, à moins qu'il ne soit certain que le projet ira de l'avant, que les mesures d'atténuation pertinentes auront été prises et qu'il y aura eu compensation de l'habitat.		
6	La CEC recommande qu'avant la préparation de l'emplacement, la CCSN exige qu'OPG mette à jour son plan préliminaire de déclassement en vue de la préparation de l'emplacement, conformément aux exigences de la norme CSA N294-09. Ce plan préliminaire de déclassement en vue de la préparation de l'emplacement d'OPG doit incorporer une réhabilitation du site reflétant la biodiversité existante, au cas où le projet ne dépasserait pas cette étape. Une fois qu'une technologie de réacteur aura été choisie, OPG doit préparer un plan de préliminaire de déclassement détaillé, plan	Le gouvernement du Canada accepte l'intention de cette recommandation d'exiger qu'OPG maintienne un plan préliminaire de déclassement en vue de la préparation de l'emplacement, conformément aux exigences de la norme CSA N294-09. La norme CSA N294-09 fournit les lignes directrices conformes aux recommandations canadiennes et internationales en matière de déclassement d'installations et d'activités autorisées. Le gouvernement du Canada accepte la recommandation d'exiger d'OPG qu'elle révise le plan préliminaire de déclassement une fois la technologie de réacteur choisie.	D-P-13.1	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	qui doit être mis à jour selon les exigences de la CCSN.			
7	La CEC recommande qu'avant la préparation de l'emplacement, la CCSN exige qu'OPG fournisse une garantie financière de déclassement qui sera examinée selon les exigences de la CCSN. Compte tenu de la garantie financière de déclassement fournie à l'étape de préparation de l'emplacement, la CEC recommande que cette garantie financière comporte des fonds suffisants pour la réhabilitation du site au cas où le projet ne dépasserait pas cette étape.	Le gouvernement du Canada accepte l'intention de cette recommandation d'exiger qu'OPG fournisse une garantie financière à l'étape de la préparation de l'emplacement; cependant, le gouvernement précise que la garantie financière doit être suffisante pour couvrir le coût des travaux de déclassement présentés dans le plan préliminaire de déclassement dont il est question dans la recommandation 6.	D-P-13.2	Fermée
8	La CEC recommande qu'avant la préparation de l'emplacement, la CCSN exige qu'OPG mette au point un programme de	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG mette au point un programme de suivi et de	D-P-12.2	Fermée
			D-P-3.10	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	suivi et de gestion adaptative des contaminants dans l'air comme l'acroléine, le NO_2, le SO_2, les matières particulaires, les $PM_{2,5}$ et les PM_{10}, à la satisfaction de la CCSN, de Santé Canada et d'EC. De plus, la CCSN doit exiger qu'OPG mette au point un plan d'action, acceptable pour Santé Canada, durant les jours d'alertes de mauvaise qualité de l'air ou de smog.	gestion adaptative des contaminants dans l'air et un plan d'action pour les jours d'alertes de smog. Santé Canada et EC peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.		
9	La CEC recommande que la CCSN, en collaboration avec Santé Canada, exige qu'OPG mette au point et mette en œuvre une évaluation acoustique détaillée pour tous les scénarios évalués. Les prévisions doivent être partagées avec les membres du public qui pourraient être affectés. Le plan de gestion des effets des nuisances d'OPG doit comprendre une surveillance du bruit, un mécanisme de réponse aux plaintes liées au bruit ainsi que des pratiques exemplaires pour les activités qui peuvent se dérouler après les heures du	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG mette au point et mette en œuvre une évaluation acoustique détaillée. Santé Canada peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-P-3.2	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	couvre-feu municipal exigées à cet égard, afin de réduire les inconvénients pour le public.			
10	La CEC recommande que la CCSN exige qu'OPG effectue un examen géotechnique détaillé avant d'entreprendre les travaux de préparation de l'emplacement. Les éléments géologiques visés par cet examen doivent comprendre, sans s'y limiter : la collecte de données sur les propriétés physiques du sol à l'échelle de l'emplacement; l'identification des propriétés mécaniques et dynamiques des morts-terrains à l'échelle de l'emplacement; la cartographie des structures géologiques pour améliorer la compréhension du modèle de structure géologique de l'emplacement;	Le gouvernement du Canada accepte l'intention de la recommandation d'exiger qu'OPG effectue un examen géologique détaillé; cependant, il précise que l'examen pourrait être fait parallèlement aux activités de préparation de l'emplacement. Sur demande, Ressources naturelles Canada peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-P-9.1	Fermée
			D-P-9.2	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	la confirmation de l'absence de modèle karstique dans le substrat rocheux local de l'emplacement; la confirmation des conclusions obtenues concernant le potentiel de liquéfaction des matériaux granulaires sous-jacents.			
11	La CEC recommande à la CCSN d'exiger qu'OPG élabore et applique un programme de suivi visant la qualité des sols durant toutes les étapes du projet.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG élabore et applique un programme de suivi visant la qualité des sols. Sur demande, EC peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-P-12.6	Fermée
12	La CEC recommande qu'avant le début des travaux dans l'eau, la CCSN exige qu'OPG recueille des données sur la qualité de l'eau et des sédiments de la future configuration de la baie qui pourrait se former à la suite de modifications le long de la rive autour de la décharge de Darlington. Ces données doivent servir de	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG recueille des données sur la qualité de l'eau et des sédiments de la future configuration de la baie. Sur demande, EC et le MPO peuvent fournir l'expertise scientifique et technique à la CCSN pour	D-P-12.3	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	référence dans le cadre de l'engagement du promoteur d'effectuer, après les travaux de construction, la surveillance de la qualité de l'eau et des sédiments de la nouvelle baie.	appuyer la mise en œuvre de cette recommandation. Le gouvernement du Canada note qu'en vertu de la *Loi sur les pêches*, il faudra obtenir une autorisation avant le début des travaux dans l'eau. Avant de donner une autorisation, le MPO exigera la mise en place d'un programme de surveillance de la qualité des sédiments et de l'eau. Ce programme est nécessaire pour savoir si OPG continue à répondre à l'intention de l'article 36 de la *Loi sur les pêches*.		
13	La CEC recommande que la CCSN exige qu'OPG recueille et évalue des données sur la qualité de l'eau, pour un nombre important de lieux le long de la rive du lac et au large dans la zone d'étude du site, avant le début des travaux dans l'eau. Ces données doivent servir à établir une référence d'échantillonnage aux fins de suivi.	Le gouvernement du Canada accepte l'intention de la recommandation d'exiger qu'OPG recueille et évalue des données sur la qualité de l'eau, pour un nombre important de lieux le long de la rive du lac et au large dans la zone d'étude du site, avant le début des travaux dans l'eau, et soutiendrait aussi la cueillette de données sur la qualité des sédiments dans le cadre d'un programme	D-P-12.3	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
		global. Sur demande, EC et le MPO peuvent fournir l’expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation. Le gouvernement du Canada note qu’en vertu de la *Loi sur les pêches*, il faudra obtenir une autorisation avant le début des travaux dans l’eau. Avant de donner une autorisation, le MPO exigera la mise en place d’un programme de surveillance de la qualité des sédiments et de l’eau. Ce programme est nécessaire pour savoir si OPG continue à répondre à l’intention de l’article 36 de la *Loi sur les pêches*.		
14	La CEC recommande qu’à la suite du choix d’une technologie de réacteur pour le projet, la CCSN exige qu’OPG effectue une évaluation détaillée des rejets d’effluents prévus pour ce projet. L’évaluation doit comprendre, sans s’y limiter, la quantité, la concentration, les points de	Le gouvernement du Canada accepte cette recommandation d’exiger qu’OPG effectue une évaluation détaillée des rejets d’effluents prévus pour ce projet, tel qu’indiqué dans la recommandation. Sur demande, EC et le MPO peuvent fournir l’expertise	D-C-2.1	Ouverte
			D-C-4.1	Ouverte
			D-P-12.9	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	rejets et une description de leur traitement; elle doit aussi démontrer que l'option choisie constitue la meilleure technologie de traitement disponible et économiquement réalisable. La CCSN doit aussi exiger qu'OPG effectue une évaluation des risques liés aux rejets résiduels anticipés du projet, afin de déterminer si d'autres mesures d'atténuation peuvent être nécessaires.	scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.		
15	La CEC recommande qu'à la suite du début de l'exploitation des réacteurs, la CCSN exige qu'OPG effectue une surveillance de l'eau ambiante et de la qualité des sédiments du milieu récepteur, afin de s'assurer que les conséquences des rejets d'effluents sont conformes aux prédictions faites dans l'énoncé des incidences environnementales et à celles définies pendant la phase de conception détaillée.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG effectue une surveillance de l'eau ambiante et de la qualité des sédiments du milieu récepteur, tel qu'indiqué dans la recommandation. Sur demande, EC et le MPO peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation. Le gouvernement du Canada note qu'en vertu de la *Loi sur les pêches*, il faudra	D-P-12.3	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		obtenir une autorisation avant le début des travaux dans l'eau. Avant de donner une autorisation, le MPO exigera la mise en place d'un programme de surveillance de la qualité des sédiments et de l'eau. Ce programme est nécessaire pour savoir si OPG continue à répondre à l'intention de l'article 36 de la *Loi sur les pêches*.		
16	La CEC recommande qu'avant le début des travaux de construction, la CCSN exige du promoteur qu'il établisse les critères des tests de toxicité et fournisse la méthodologie et la fréquence des tests qui serviront à confirmer que les eaux pluviales déversées par la nouvelle centrale nucléaire respectent les exigences de la *Loi sur les pêches*.	Le gouvernement du Canada accepte l'intention de cette recommandation d'exiger que le promoteur établisse les critères des tests de toxicité et fournisse la méthodologie et la fréquence des tests des eaux pluviales. Le gouvernement du Canada souhaiterait aussi que cette recommandation de tests s'applique aux effluents de transformation. Sur demande, EC peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-C-2.1	Ouverte
			D-P-3.4	Fermée
17			D-C-2.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	La CEC recommande que la CCSN exige qu'OPG fournisse une évaluation de l'infiltration et du transport de contaminants dans les eaux souterraines du site durant les phases successives du projet, dans le cadre de la demande de permis de construction. Cette évaluation doit tenir compte de l'impact des dépôts secs et humides de tous les contaminants potentiellement préoccupants et des effluents gazeux sur la qualité des eaux souterraines. OPG doit effectuer une meilleure modélisation des eaux souterraines et du transport des contaminants aux fins de l'évaluation, et étendre cette modélisation aux effets des futures activités d'assèchement et d'expansion de la carrière St. Marys Cement dans le cadre du projet.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG fournisse une évaluation de l'infiltration et du transport de contaminants dans les eaux souterraines du site durant les phases du projet, selon ce qui est indiqué dans la recommandation. Par souci de clarté, le gouvernement du Canada souhaiterait étendre la modélisation des eaux souterraines et du transport des contaminants aux limites appropriées du modèle, qui ne correspondent pas forcément aux limites du site. Sur demande, Ressources naturelles et EC peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-C-4.1	Ouverte
			D-C-5.1	Ouverte
			D-C-6.1	Ouverte
			D-P-12.6	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
18	La CEC recommande, à la lumière des résultats de modélisation des eaux souterraines et du transport des contaminants, que la CCSN exige d'OPG de modifier le Programme de surveillance environnementale et de contrôle radiologique. Ce programme doit comprendre les données pertinentes sur la qualité de l'eau des puits souterrains résidentiels et privés, situés dans la zone d'étude locale qui n'est pas touchée par le programme actuel, surtout aux endroits où les résultats de modélisation démontrent des groupes potentiellement à risque, basés sur l'utilisation potentielle actuelle ou future de l'eau souterraine.	Le gouvernement du Canada accepte cette recommandation d'exiger qu'OPG modifie le Programme de surveillance environnementale et de contrôle radiologique à la lumière des résultats de modélisation des eaux souterraines et du transport des contaminants. Sur demande, Ressources Canada et EC peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	**D-C-6.1**	**Ouverte**
19	La CEC recommande que la CCSN exige qu'OPG accroisse la portée du programme de surveillance des eaux souterraines, afin d'en surveiller les transitions de débits que peuvent causer les changements	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG accroisse la portée du programme de surveillance des eaux souterraines, afin d'en surveiller les transitions de	D-P-12.6	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
	apportés à l’inclinaison de la surface du sol pendant les étapes de préparation de l’emplacement et de construction. La conception des changements d’inclinaison du sol doit guider le choix des endroits où une surveillance est requise, la fréquence de la surveillance, et la durée requise du programme couvrant la période de transition vers des conditions stables qui suivra la fin de la construction et la période initiale d’exploitation.	débits que peuvent causer les changements apportés à l’inclinaison de la surface du sol pendant les étapes de préparation de l’emplacement et de construction. Sur demande, Ressources naturelles Canada peut fournir l’expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.		
20	La CEC recommande que la CCSN exige qu’OPG effectue une évaluation en profondeur des possibilités d’aménagement de l’emplacement avant le début des travaux de préparation. Ainsi, les conséquences globales sur les environnements terrestre et aquatique seront réduites au minimum, et les possibilités pour une réhabilitation subséquente d’un habitat terrestre de qualité seront maximisées.	Le gouvernement du Canada accepte la recommandation d’exiger qu’OPG effectue une évaluation en profondeur des possibilités d’aménagement de l’emplacement avant le début des travaux de préparation, tel qu’indiqué dans la recommandation. Sur demande, EC et le MPO peuvent fournir l’expertise scientifique et technique à la CCSN pour appuyer la	D-P-14.1	Ouverte
			D-P-3.7	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		mise en œuvre de cette recommandation. En vertu de la *Loi sur les pêches*, avant d'obtenir une autorisation, le MPO doit également s'engager à travailler avec OPG pour s'assurer que les mesures d'atténuation et la compensation de l'habitat minimisent les répercussions globales sur l'habitat aquatique.		
21	La CEC recommande que la CCSN exige qu'OPG remplace la perte des étangs par des équivalents, de préférence dans la zone d'étude de l'emplacement. La CEC recommande également que la CCSN exige qu'OPG recoure aux pratiques exemplaires de gestion, afin de prévenir ou de réduire au minimum l'infiltration potentielle de sédiments et d'autres contaminants dans l'habitat naturel de l'étang Coot's au cours des étapes de préparation de l'emplacement et de construction.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG recoure aux pratiques exemplaires de gestion, afin de prévenir ou de réduire au minimum l'infiltration potentielle de sédiments et d'autres contaminants. Le gouvernement du Canada accepte l'intention de remplacer la perte des étangs par des équivalents, mais souhaiterait aussi que la CCSN exige qu'OPG conçoive des étangs de remplacement qui maximisent la fonction écologique, et ne se limite	D-P-3.7	Fermée

N°	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		pas nécessairement à un « remplacement similaire ». Sur demande, EC peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.		
22	La CEC recommande que la CCSN exige qu'OPG mette au point un programme de suivi pour les insectes, les amphibiens, les reptiles, les mammifères et leurs collectivités; ce programme servira à s'assurer que les mesures d'atténuation proposées sont efficaces.	Le gouvernement du Canada accepte l'intention de la recommandation d'exiger qu'OPG mette au point un programme adapté de suivi pour les insectes, les amphibiens, les reptiles, les mammifères et leurs collectivités, et souhaiterait aussi que ce programme de suivi mette l'accent sur les espèces en péril et serve à vérifier les conclusions de l'évaluation des risques écologiques. Sur demande, EC peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-P-12.5	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
23	La CEC recommande à EC de collaborer avec OPG afin d'élaborer et de mettre en œuvre un programme de suivi pour confirmer l'efficacité des mesures d'atténuation proposées par OPG visant les collectivités d'oiseaux advenant que des tours de refroidissement à tirage naturel pour le système de refroidissement du condenseur y soient aménagées.	Le gouvernement du Canada accepte l'intention de cette recommandation de collaborer avec OPG pour élaborer ledit programme de suivi pour les collectivités d'oiseaux, et souhaiterait aussi que ce programme tienne compte des répercussions potentielles de la perturbation de l'habitat et de la collision d'oiseaux. Le gouvernement du Canada reconnaît que, grâce aux permis qui seront délivrés plus tard en vertu de la *Loi sur la sûreté et la réglementation nucléaires*, la CCSN a le fondement législatif et les pouvoirs nécessaires pour s'assurer qu'un tel programme de suivi est mis en œuvre. Sur demande, EC peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-P-12.5	Fermée
24	La CEC recommande que, au cours de la phase de préparation de l'emplacement, EC s'assure	Le gouvernement du Canada accepte l'intention de la recommandation d'éviter de détruire ou de	D-P-3.7	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
	qu’OPG n’effectue aucune destruction ni perturbation de l’habitat entre le 1er mai et le 31 juillet de chaque année, afin de minimiser les incidences sur la reproduction des oiseaux migrateurs.	perturber l’habitat entre le 1er mai et le 31 juillet de chaque année, afin de protéger les activités de reproduction de la plupart des espèces d’oiseaux. Cependant, EC n’est pas en mesure de s’assurer qu’OPG mène toutes ses activités de défrichage lorsque ce n’est pas la période de reproduction des oiseaux migrateurs, car le ministère n’a pas la capacité réglementaire de délivrer un permis liant le promoteur. Le gouvernement du Canada reconnaît que, grâce aux permis qui seront délivrés plus tard en vertu de la *Loi sur la sûreté et la réglementation nucléaires*, la CCSN a le fondement législatif et les pouvoirs nécessaires pour s’assurer qu’un tel programme de suivi est mis en œuvre. Sur demande, EC peut fournir l’expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.		
25			D-P-12.5	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	La CEC recommande que la CCSN exige qu'OPG effectue un échantillonnage supplémentaire, afin de confirmer la présence de blongios avant le début des travaux de préparation de l'emplacement. La CEC recommande également que la CCSN exige qu'OPG mette au point et mette en œuvre un plan de gestion des espèces menacées dont on connaît la présence sur le site. Ce plan doit prendre en compte la résilience de certaines des espèces et la possibilité de compensation hors site.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG effectue un échantillonnage supplémentaire afin de confirmer la présence de blongios et qu'elle élabore et mette en œuvre un plan de gestion des espèces menacées, s'il y a lieu. Sur demande, EC peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	DP-3.7	Fermée
26	La CEC recommande que la CCSN exige qu'OPG mette au point une évaluation complète des rejets de substances dangereuses, ainsi que les mesures nécessaires à la gestion des produits chimiques dangereux qui se trouvent sur le site du projet, conformément à la *Loi canadienne sur la protection de l'environnement*, une fois qu'une technologie de réacteur aura été choisie.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG mette au point une évaluation complète des rejets de substances dangereuses, ainsi que les mesures nécessaires à la gestion des produits chimiques dangereux qui se trouvent sur le site du projet une fois qu'une technologie de réacteur aura été choisie. Sur demande, EC peut fournir l'expertise scientifique et technique à la CCSN pour	D-C-2.1	Ouverte
			D-C-5.1	Ouverte
			D-P-12.9	Ouverte
			D-P-3.6	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
		appuyer la mise en œuvre de cette recommandation.		
27	La CEC recommande qu’avant toute destruction de l’habitat de l’hirondelle de rivage, la CCSN exige qu’OPG adopte toutes ses mesures d’atténuation proposées : l’aménagement d’un habitat de nidification hors site; la construction d’habitats de nidification artificiels ayant la capacité d’accueillir une population égale ou supérieure au nombre de couples reproducteurs vivant, à l’heure actuelle, sur la falaise. Cet habitat doit être situé le plus près possible de la falaise d’origine; l’adoption d’une approche de gestion adaptative du plan d’atténuation de l’habitat de l’hirondelle de rivage, incluant un seuil de perte établi en consultation avec toutes les parties intéressées avant la destruction de l’habitat.	Le gouvernement du Canada accepte l’intention de la recommandation d’exiger qu’OPG mette en œuvre les mesures d’atténuation proposées pour l’hirondelle de rivage au moyen d’une méthode de gestion adaptative, et souhaiterait aussi que ces mesures d’atténuation soient déterminées en fonction d’une estimation raisonnable de la perte réelle d’hirondelles. Le gouvernement du Canada croit que l’aménagement d’un habitat de nidification hors site ne sera nécessaire que si les activités de suivi montrent que les mesures d’atténuation sur place ne sont pas suffisantes. Le gouvernement précise que ces mesures pourraient aussi comprendre l’amélioration des sites naturels de nidification potentiels sur la zone même de l’étude. Sur demande, EC peut fournir l’expertise scientifique et technique à	DP-3.8	Ouverte

N°	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		la CCSN pour appuyer la mise en œuvre de cette recommandation.		
28	La CEC recommande que le MPO exige qu'OPG poursuive, sur une base continue, la réalisation d'études sur les communautés de poissons adultes dans la zone d'étude et sur les sites de référence. Ces études doivent permettre de confirmer si les résultats des échantillonnages par filet maillant de 2009 et par pêche électrique du littoral de 1998, ainsi que les données additionnelles de 2010 et 2011, soumis par OPG sont représentatifs des conditions existantes tout en tenant compte de la variabilité naturelle d'une année à l'autre. Il faut accorder une attention particulière aux conditions de base de la surveillance par filet maillant au printemps, afin de vérifier les résultats de la répartition spatiale des poissons et l'abondance relativement	Le gouvernement du Canada accepte cette recommandation. Le MPO travaillera avec EC, la CCSN, le ministère des Ressources naturelles de l'Ontario et OPG pour mettre au point les détails d'un programme permanent de surveillance des poissons, qui fera partie des conditions auxquelles il faudra répondre avant d'obtenir une autorisation en vertu de la *Loi sur les pêches*.	D-P-12.4 D-P-15.1	Ouverte Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
	importante des espèces de poissons autochtones, comme le meunier noir et le ménomini rond. L’étude d’utilisation de l’habitat touché par la pêche électrique du littoral est nécessaire, afin d’établir des conditions de référence contemporaines auxquelles pourront être comparées les données d’utilisation futures pour mesurer les effets de l’enrochement, s’il y a lieu, et l’efficacité des mesures d’atténuation.			
29	La CEC recommande que le MPO exige qu’OPG continue ses recherches sur le plan d’action visant le ménomini rond afin de pouvoir mieux définir les conditions existantes, y compris la répartition de la population, le génome et la répartition géographique de la population du ménomini rond, qui serviront de référence pour élaborer des hypothèses vérifiables des effets, y compris les effets cumulatifs.	Le gouvernement du Canada accepte cette recommandation. Le MPO travaillera avec EC, la CCSN, le ministère des Ressources naturelles de l’Ontario et OPG pour mettre au point le plan d’action visant le ménomini rond. Ce plan fera partie des conditions auxquelles il faudra répondre avant d’obtenir une autorisation en vertu de la *Loi sur les pêches*. Il sera également intégré au programme de surveillance et servira au programme de gestion adaptative visant à	DP-12.4	Ouverte
			DP-15.1	Fermée

N°	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		protéger la population de ménominis ronds à l'avenir.		
30	Advenant qu'un système à eau avec refroidissement à passage unique soit choisi pour le projet, la CEC recommande qu'avant la construction des ouvrages dans l'eau, le MPO exige qu'OPG effectue les travaux suivants : un échantillonnage supplémentaire d'impaction, à la centrale nucléaire existante de Darlington, afin de vérifier les résultats de 2007 et d'approfondir la connaissance de la variation interannuelle de la population de poissons, ainsi que de vérifier les déficiences du plan d'échantillonnage; un échantillonnage d'entraînement supplémentaire, à la centrale nucléaire existante de Darlington, afin de mieux établir la situation présente. Le programme doit être conçu afin d'éviter un faux alignement dans la limite de détection, en tenant compte,	Le gouvernement du Canada accepte cette recommandation. Le MPO travaillera avec la CCSN et le ministère des Ressources naturelles de l'Ontario pour élaborer un programme d'échantillonnage des effets d'entraînement et d'impaction. Le gouvernement du Canada aimerait également signaler qu'il faudra obtenir une autorisation en vertu de la *Loi sur les pêches* avant de procéder au remblayage dans le lac et s'engage à ce que le MPO travaille avec OPG pour s'assurer que le programme d'échantillonnage des effets d'entraînement et d'impaction est mis au point et mis en œuvre à titre de condition de cette autorisation.	D-C-1.2	Fermée
			D-P-12.4	Ouverte
			D-P-15.1	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	dans l'analyse, des pertes d'entraînement, des espèces de poissons dont les larves et les œufs sont capturés lors des échantillonnages de larves par traits de filet durant la période saisonnière de l'année où ils sont présents; une analyse d'optimisation statistique sera requise, afin de déterminer s'il existe un concept avantageux d'échantillonnage d'entraînement visant les larves du ménomini rond.			
31	Indépendamment du système de refroidissement du condenseur choisi, la CEC recommande que le MPO interdise à OPG de remblayer au-delà de la ligne de fond de 2 m du lac Ontario.	Le gouvernement du Canada accepte cette recommandation. Le MPO travaillera avec OPG pour s'assurer que toute détérioration, destruction ou perturbation de l'habitat (DDPH) associée à la proposition de remblayage du lac se limite à la ligne de fond de 2 m du lac Ontario. Les autorisations en vertu de la *Loi sur les pêches* seront également conditionnelles à l'ampleur de la DDPH, aux mesures d'atténuation et à la compensation de l'habitat.	D_C-1.1	Fermée
			D-P-14.1	Ouverte
			D-P-16.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
32	Advenant qu'un système à eau de refroidissement à passage unique soit choisi pour le projet, la CEC recommande au MPO d'exiger qu'OPG atténue les effets néfastes de l'exploitation, y compris ceux causés par l'impaction, l'entraînement et les mélanges et panaches thermiques, en situant les canaux d'amenée et de rejet en aval de la zone d'habitat sublittorale. De plus, OPG doit évaluer d'autres technologies d'atténuation pour le canal d'amenée, comme des systèmes de retour du poisson vivant et des éléments dissuasifs sonores.	Le gouvernement du Canada accepte cette recommandation. Le MPO va travailler avec EC et avec la CCSN pour déterminer où seront situés les canaux d'amenée et de rejet, et pour évaluer la possibilité de prendre d'autres mesures d'atténuation pour les canaux d'amenée et de rejet, de manière à atténuer les effets néfastes de l'exploitation. LE MPO travaillera avec OPG pour s'assurer de la mise en œuvre de cette recommandation, par l'entremise de son processus de réglementation et des conditions d'autorisation prévues aux termes de la *Loi sur les pêches*.	D-C-1.2	Fermée
33	La CEC recommande que le MPO exige qu'OPG adopte un programme de suivi des effets d'entraînement et d'impaction à la centrale nucléaire existante de Darlington et sur le site du projet, afin de confirmer la prédiction des effets	Le gouvernement du Canada accepte cette recommandation. Le MPO travaillera avec la CCSN et avec OPG pour mettre au point une étude des effets d'entraînement et d'impaction à la centrale nucléaire existante de	D-P-12.4	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
	néfastes, y compris les effets cumulatifs, et l’efficacité des mesures d’atténuation. Pour les échantillonnages d’entraînement futurs visant le ménomini rond, une analyse de probabilité statistique sera requise, afin de déterminer si des résultats d’échantillon non biaisés et précis peuvent être produits.	Darlington et sur l’emplacement proposé du projet, afin de confirmer les prévisions des effets néfastes, et s’assurera ensuite de la mise en œuvre par l’entremise de son processus de réglementation et des conditions d’autorisation prévues aux termes de la *Loi sur les pêches*.		
35	Advenant qu’un système à eau avec refroidissement à passage unique soit choisi pour le projet, la CEC recommande qu’avant la construction, EC s’assure qu’OPG effectue une modélisation de panache thermique à résolution accrue qui tiendrait compte de possibles incidences de changements climatiques. Le MPO doit s’assurer que les résultats de la modélisation soient incorporés dans la conception du diffuseur de décharge et dans l’évaluation des emplacements différents pour la mise en place des canaux d’amenée et de rejet du système d’eau de	Le gouvernement du Canada accepte l’intention de cette recommandation. EC est résolu à passer en revue l’information donnée par OPG et se fondera sur l’autorisation du MPO à l’égard de la DDPH associée à l’amenée ou au rejet pour s’assurer qu’OPG effectue cette modélisation. Le MPO va travailler avec EC et avec la CCSN pour que les résultats de la modélisation de panache thermique fassent partie des éléments pris en considération dans le choix de l’emplacement des canaux d’amenée et de rejet, de manière à atténuer	D-C-1.2	Fermée
			D-P-12.4	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	refroidissement du condenseur.	les effets néfastes de l'exploitation. Le MPO veillera à la mise en œuvre de ces mesures, qui feront partie des conditions pour obtenir une autorisation en vertu de la *Loi sur les pêches*.		
35	Si un système à eau avec refroidissement à passage unique est choisi pour le projet, la CEC recommande qu'avant l'exploitation, la CCSN exige qu'OPG inclue ce qui suit dans l'évaluation des risques liés aux eaux de surface : les panaches thermiques de contaminants combinés en surface; l'effet de déplacement physique des courants modifiés du lac constituant une dangereuse exposition d'impulsions pour les espèces de poissons tels le cisco, le grand corégone, le méné émeraude, la perchaude, dont les larves dérivent passivement à travers le secteur. Si les résultats de l'évaluation des risques	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG mette à jour l'évaluation exhaustive des risques liés aux eaux de surface selon ce qui est recommandé, mais tient à préciser qu'une évaluation des panaches thermiques et de contaminants ne devrait pas seulement prendre en considération la surface des panaches, mais également sa dimension verticale. Sur demande, EC et le MPO peuvent fournir l'expertise scientifique et technique disponible à la CCSN pour l'aider à mettre au point l'évaluation des risques liés aux eaux de surface et le plan d'action qui en découlera.	D-C-1.2 D-P-12.3 D-P-12.4	Fermée Ouverte Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	prévoient un risque potentiel, la CCSN doit convoquer un atelier portant sur la portée de la surveillance nécessaire aux fins de suivi avec EC, le MPO et toute autre autorité pertinente, afin de mettre au point un plan d'action.			
36	Dans le cas où un système à eau avec refroidissement à passage unique est choisi pour le projet, la CEC recommande qu'au cours des activités d'exploitation, la CCSN exige qu'OPG fasse la surveillance du poisson adulte chez les grands et petits poissons, afin de confirmer l'efficacité des mesures d'atténuation et de vérifier les prédictions concernant l'absence d'incidence thermique ou physique néfaste causée par le jet du diffuseur.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG fasse la surveillance du poisson adulte pour confirmer l'efficacité des mesures d'atténuation et vérifier les prévisions. Sur demande, EC et le MPO peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation. Le MPO est résolu à travailler avec OPG pour mettre au point son programme de surveillance et de suivi du poisson et de l'habitat du poisson, et pour s'assurer de sa mise en œuvre par l'entremise des conditions d'autorisation	D-C-1.2 D-P-12.4	Fermée Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		aux termes de la *Loi sur les pêches*.		
37	Si un système à eau avec refroidissement à passage unique est choisi pour le projet, la CEC recommande qu'avant les travaux de construction, la CCSN exige qu'OPG détermine la superficie totale des impacts permanents sur le milieu aquatique pour les éléments suivants, afin de déterminer adéquatement l'ampleur des mesures d'atténuation et de définir la portée de la surveillance aux fins de suivi : • panache thermique de 2 °C plus chaud que la température ambiante; • contaminants de la zone de mélange et du panache de surface; • déplacements physiques dus aux changements de courants du lac; • pertes et modifications dues aux travaux de remblayage et de construction.	Le gouvernement du Canada accepte l'intention de cette recommandation d'exiger qu'OPG détermine la superficie totale des effets permanents sur le milieu aquatique à partir des effets qui auront été mis en évidence. Le gouvernement du Canada souhaiterait aussi inclure à cette évaluation une évaluation des effets cumulatifs, y compris les effets d'entraînement et d'impaction et les effets des changements climatiques. Sur demande, EC et le MPO peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation. De plus, le MPO est résolu à travailler avec la CCSN et avec OPG pour s'assurer que les effets permanents sur le milieu aquatique soient atténués et qu'un programme approprié de compensation de l'habitat soit mis au point et mis en	D-C-1.2 D-P-12.4	Fermée Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		œuvre à titre de condition aux autorisations en vertu de la *Loi sur les pêches*.		
38	La CEC recommande que la CCSN exige que les éléments géotechniques et ceux liés à l'aléa sismique abordés dans l'étude géotechnique détaillée qu'OPG doit réaliser comprennent, sans s'y limiter, les éléments suivants. Avant la préparation de l'emplacement : démontrer qu'il n'y a pas de conditions de sous-sol indésirables à l'emplacement du projet; le potentiel de liquéfaction global à l'emplacement doit être évalué d'après les données d'étude du terrain; confirmer l'absence de caractéristiques paléosismologiques à l'emplacement. Le cas échéant, effectuer une évaluation approfondie pour réduire l'incertitude générale liée à l'évaluation de l'aléa	Le gouvernement du Canada accepte l'intention de la recommandation d'exiger qu'OPG effectue un examen détaillé de l'emplacement comprenant les éléments géotechniques et ceux liés à l'aléa sismique; cependant, il précise que cet examen pourrait être fait parallèlement aux activités de préparation de l'emplacement. Sur demande, Ressources naturelles Canada peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-O-3.1 D-P-9.1 D-P-9.3 D-P-9.4 D-P-9.5	Ouverte Fermée Ouverte Ouverte Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	sismique au moment de la conception du projet. Au cours de la préparation de l'emplacement et avant la construction : vérifier et confirmer l'absence de défauts de surface dans les morts-terrains et dans le substrat rocheux à l'emplacement. Avant la construction : vérifier la stabilité des pentes des talus et des digues sous des charges statiques et dynamiques, selon les données propres à l'emplacement et au projet, et ce, pendant la conception des pentes des talus et des digues ou avant leur construction; évaluer le potentiel de liquéfaction de l'amas de déchets situé au nord-est du site, en utilisant les données obtenues de cet amas à la fin de la préparation de l'emplacement; mesurer la résistance au cisaillement des morts-terrains et les			

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	propriétés dynamiques des morts-terrains et des roches sédimentaires, afin de confirmer les conditions de l'emplacement et d'effectuer l'analyse de l'interaction sol-structure au besoin; évaluer le tassement potentiel des dépôts quaternaires dû au rabattement des eaux souterraines causé par les activités futures de la carrière St. Marys Cement; évaluer l'effet du tassement potentiel sur les infrastructures à enfouir dans les dépôts lors de la conception de ces infrastructures. Avant l'exploitation : élaborer et mettre en œuvre un programme de surveillance pour la phase 4 des opérations de décapage de la carrière St. Marys Cement, afin de confirmer que la vitesse maximale de pointe du sol à la limite qui sépare la centrale de Darlington et St. Marys Cement est inférieure à la			

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	limite proposée de 3 mm par seconde (mm/s).			
39	La CEC recommande qu'avant la construction, la CCSN exige qu'OPG prépare un plan de rechange pour les étapes de construction, d'exploitation et de déclassement du projet, prenant en compte les incertitudes liées aux inondations et aux autres épisodes météorologiques extrêmes. OPG doit modéliser les conditions locales de changements climatiques pour confirmer sa conclusion d'un faible effet résultant de ces changements. Une marge/limite de changements de paramètres clés, comme l'intensité des événements météorologiques extrêmes, doit être définie à la satisfaction de la CCSN. Ces paramètres peuvent être incorporés dans la conception hydrologique d'une demande de construction de réacteur, ainsi que dans les mesures de protection contre les	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG prépare un plan de rechange prenant en compte les incertitudes liées aux inondations, à la sécheresse, et aux autres épisodes météorologiques extrêmes, tel que recommandé. Le gouvernement du Canada accepte l'intention de la recommandation de modéliser les conditions locales de changements climatiques; cependant, si OPG s'appuie sur des études réputées pour évaluer l'effet anticipé des changements climatiques sur la zone du projet, il pourrait ne pas être nécessaire de procéder à la modélisation des conditions locales de changements climatiques. Sur demande, le MPO et EC peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-C-7.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	inondations. OPG doit aussi effectuer une analyse de sécheresse et intégrer toute autre mesure d'atténuation/modification de conception requise, à la satisfaction de la CCSN, dans le cadre de la demande de permis de construction de réacteur.			
40	La CEC recommande qu'avant la construction, la CCSN exige d'OPG ce qui suit : • établir un programme de gestion adaptative des risques liés aux algues pour le système d'apport d'eau des tours de refroidissement, comprenant l'établissement de seuils en vue d'actions supplémentaires; • tenir compte de l'évaluation des risques liés aux algues, aux fins d'une évaluation biologique plus détaillée de la relocalisation du système d'apport d'eau et du diffuseur, plus au large et plus en profondeur, et	Le gouvernement du Canada accepte cette recommandation d'exiger qu'OPG établisse un programme de gestion adaptative des risques liés aux algues pour le système d'apport d'eau des tours de refroidissement, et tienne compte de cette évaluation dans le cadre d'études d'emplacement détaillées et d'analyses coût-bénéfice. Sur demande, EC et le MPO peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-C-1.2	Fermée
			D-P-12.4	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	ce, dans le cadre d'études d'emplacement détaillées et de l'analyse coût-bénéfice du système de refroidissement.			
41	La CEC recommande qu'avant la préparation de l'emplacement, la CCSN coordonne des discussions avec OPG avec et les principales parties intéressées sur les conséquences du projet sur l'offre et la demande de logement, les équipements et les programmes de loisirs communautaires, les services et les infrastructures, de même que sur les autres mesures à prendre pour faire face aux pressions exercées sur ces biens et services collectifs.	Le gouvernement du Canada accepte l'intention de cette recommandation invitant la CCSN à entamer des discussions avec OPG et les principales parties intéressées; cependant, il précise que ces discussions pourraient avoir lieu parallèlement aux activités de préparation de l'emplacement.	D-P-17.1	Fermée
42	La CEC recommande qu'OPG poursuive, sur une base continue, sa stratégie visant l'embauche d'étudiants autochtones selon les perspectives d'emplois permanents disponibles pendant la durée de vie du projet. À cet égard, OPG doit collaborer	Le gouvernement du Canada appuie cette proposition et note que de tels programmes sont conformes à la présentation qu'OPG a faite à la CEC sur les intérêts autochtones le 28 mars 2011 et avec la politique des relations avec les autochtones d'OPG.	D-P-17.1	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
	avec les établissements d’enseignement secondaire et postsecondaire ainsi qu’avec les groupes autochtones, afin de s’assurer que de tels programmes sont couronnés de succès.			
43	La CEC recommande à la CCSN de mettre à contribution les parties intéressées compétentes, y compris OPG, le service de gestion des mesures d’urgence de l’Ontario, les administrations municipales et le gouvernement de l’Ontario, afin d’élaborer une politique concernant l’utilisation du territoire autour des centrales nucléaires.	Le gouvernement du Canada accepte la recommandation invitant la CCSN à mettre à contribution les intervenants compétents pour élaborer une politique concernant l’utilisation du territoire autour des centrales nucléaires.	D-P-17.1	Fermée
44	La CEC recommande que le gouvernement de l’Ontario adopte des mesures adéquates, afin de prévenir la construction d’ensembles résidentiels et d’édifices destinés à des personnes vulnérables dans un rayon de 3 km du site.	Cette recommandation était adressée au gouvernement de l’Ontario.	S. O.	Terminée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
45	La CEC recommande que la municipalité de Clarington évite, pour la durée de vie du projet, de construire des édifices destinés à des personnes vulnérables, comme des écoles, des hôpitaux et des résidences pour clientèles à statut précaire, dans un rayon de 3 km autour du site.	Cette recommandation était adressée à la municipalité de Clarington.	S. O.	Terminée
46	Étant donné qu’un accident grave peut avoir des conséquences au-delà des zones de 3 et de 10 km évaluées par OPG, la CEC recommande que le gouvernement de l’Ontario, sur une base continue, revoie les zones de planification d’urgence, la planification d’urgence et les mesures d’intervention prescrites dans le PPIUN, afin de protéger la sûreté et la santé des personnes.	Cette recommandation était adressée au gouvernement de l’Ontario.	S. O.	Terminée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
47	La CEC recommande qu'avant la préparation de l'emplacement, la CCSN s'assure que le plan de gestion de la circulation d'OPG se charge des éléments suivants : • les plans de rechange au cas où les travaux routiers prévus n'auraient pas lieu; • la prise en compte des effets de la circulation des camions relevant de l'élimination des matériaux excavés sur la circulation et sa sûreté; • une analyse plus approfondie du potentiel de refoulement sur l'autoroute 401; • la considération d'un éventail plus large de mesures d'atténuation, telles que la gestion du transport selon la demande, du transport en commun accru et des améliorations géométriques de l'échangeur de l'autoroute 401 et du chemin Waverley.	Le gouvernement du Canada accepte cette recommandation d'exiger que le plan de gestion de la circulation d'OPG tienne compte des éléments liés aux plans de rechange, à la circulation des camions, au refoulement possible sur l'autoroute 401 et prenne en considération un éventail plus large de mesures d'atténuation.	D-P-10.1	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
48	En considération de la sécurité publique, la CEC recommande qu'avant la préparation de l'emplacement, la CCSN coordonne un comité des sociétés de transport fédéral, provincial et municipal qui examinera le besoin de construction et de modifications de routes.	Le gouvernement du Canada accepte l'intention de la recommandation selon laquelle le gouvernement fédéral, le gouvernement provincial et les autorités municipales examinent la nécessité de construire et de modifier les routes; cependant, il précise que cet examen peut être fait parallèlement aux activités de préparation de l'emplacement.	S. O.	Pas lancée
49	La CEC recommande qu'avant la construction, Transports Canada (TC) s'assure qu'OPG effectue des analyses quantitatives supplémentaires, y compris sur les fréquences de collisions et les indices d'exposition aux passages à niveau, et surveille les effets potentiels et le besoin d'adopter des mesures d'atténuation liées au projet.	Le gouvernement du Canada accepte l'intention de la recommandation d'exiger qu'OPG effectue des études supplémentaires sur la sécurité ferroviaire, surveille les effets potentiels et détermine s'il est nécessaire d'adopter des mesures d'atténuation. En vertu de la *Loi sur la sécurité ferroviaire*, la sécurité des passages à niveau revient aux autorités responsables du service de voirie et à l'administration ferroviaire. Cette politique reflète les objectifs de l'article 3 de la *Loi sur la sécurité ferroviaire*.	D-C-3.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		En dernier ressort, il revient aux autorités responsables du service de voirie et à l'administration ferroviaire de procéder à l'évaluation des passages à niveau. TC s'engage à offrir son aide et son expertise aux parties intéressées dans le cadre de l'évaluation des risques et de l'évaluation des mesures d'atténuation qui seront proposées.		
50	La CEC recommande qu'avant la construction, TC exige qu'OPG effectue une évaluation des risques, en collaboration avec le Canadien National, qui comprendra : • une évaluation des risques liés à un déraillement ou à tout autre incident ferroviaire pouvant toucher le projet; • une analyse des risques liés à une menace pour la sécurité, comme un train transportant une bombe sur le chemin de fer qui traverse le projet; • une évaluation comparative de l'efficacité	Le gouvernement du Canada reconnaît que la *Loi sur la sûreté et la réglementation nucléaires* confère à la CCSN l'autorité et les pouvoirs de suivre cette recommandation au moyen des activités de réglementation qui sont les siennes. TC s'engage à offrir son aide et son expertise à la CCSN et aux autres parties intéressées dans le cadre de l'évaluation des risques et de l'évaluation des mesures d'atténuation qui seront proposées.	D-C-3.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	des diverses mesures d'atténuation ou de la combinaison des mesures (par exemple, mur pare-souffle, mur de soutènement, rails en retrait, berme et limitation de vitesse des trains dans les environs du site); • la détermination des critères de conception nécessaires, afin d'assurer l'efficacité de ces mesures (par exemple, la hauteur appropriée, la résistance, la conception et le matériel adéquat d'un mur pare-souffle); • une analyse critique, afin de confirmer que ces mesures, lorsqu'elles sont adéquatement conçues et mises en œuvre, seront suffisantes pour offrir une protection du site du projet advenant un déraillement d'un train voyageant à pleine vitesse ou d'autres événements indésirables.			
51	Advenant qu'un système à eau avec refroidissement à passage unique soit choisi pour le projet, la CEC	Le gouvernement du Canada accepte l'intention de cette recommandation. TC guidera et appuiera OPG	D-P-12.8	Fermée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	recommande qu'avant la construction, TC travaille en collaboration avec OPG, afin d'élaborer un programme de suivi visant à vérifier l'exactitude des prédictions indiquant qu'aucun effet néfaste important à la sécurité des bateaux n'a été engendré par la mise en place d'une plus grande zone de prohibition. OPG doit aussi élaborer un programme de gestion adaptative, au besoin, afin d'atténuer les incidences potentielles sur les petites embarcations.	pour l'aider à mettre au point un programme de suivi permettant de s'assurer qu'il n'y aura aucun effet néfaste important sur la sécurité des bateaux. S'il est nécessaire de mettre en place un programme de gestion adaptative, TC peut mettre son expertise à la disposition d'OPG pour élaborer un tel programme.		
52	La CEC recommande qu'avant la construction, la CCSN exige qu'OPG prévoie des dispositions pour l'entreposage sur place de tout combustible nucléaire utilisé pendant la durée du projet, au cas où une solution adéquate de gestion à long terme hors site du combustible nucléaire usé ne puisse être trouvée.	Le gouvernement du Canada accepte l'intention de la recommandation dans la mesure où c'est aux propriétaires de déchets que revient la responsabilité de gérer et de financer le traitement sécuritaire de leurs propres déchets. Le *Cadre d'action sur les déchets radioactifs* adopté par le Canada en 1996 stipule que les propriétaires de déchets radioactifs sont chargés de trouver et d'appliquer des solutions, et	D-C-9.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
		de débourser tous les frais associés à la gestion du traitement sécuritaire de leurs déchets.		
53	La CEC recommande qu’avant la construction, la CCSN exige qu’OPG prévoie des dispositions pour l’entreposage sur place de tous les déchets de faible et moyenne activité pour la durée du projet, au cas où une solution adéquate de gestion à long terme hors site de ces déchets ne serait pas approuvée.	Le gouvernement du Canada accepte l’intention de la recommandation dans la mesure où c’est aux propriétaires de déchets que revient la responsabilité de gérer et de financer le traitement sécuritaire de leurs propres déchets, conformément aux exigences réglementaires de la CCSN. Le *Cadre d’action sur les déchets radioactifs* adopté par le Canada en 1996 stipule que les propriétaires de déchets radioactifs sont chargés de trouver et d’appliquer des solutions, et de débourser tous les frais associés à la gestion du traitement sécuritaire de leurs déchets.	D-C-9.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
54	La CEC recommande qu'au cours des activités d'exploitation, la CCSN exige qu'OPG adopte des mesures de gestion des rejets du projet, afin d'éviter que les niveaux de tritium dans l'eau potable ne dépassent une moyenne annuelle courante de 20 Bq/l dans les usines d'approvisionnement en eau potable situées dans la zone d'étude régionale.	Le gouvernement du Canada accepte l'intention de la recommandation de protéger l'eau potable; cependant, il précise que toute limite imposée devrait être conforme aux normes en matière de tritium mises en place par les autorités réglementaires. Dans les Recommandations pour la qualité de l'eau potable de Santé Canada, formulées d'après les recommandations de la CEC internationale de protection radiologique et l'Organisation mondiale de la santé, la ligne directrice en matière de consommation sécuritaire d'eau potable fixe la limite de tritium à 7 000 Bq/l. La province de l'Ontario a fait de cette limite une norme. Étant donné que, au Canada, la qualité de l'eau relève essentiellement des provinces, ces dernières peuvent adopter les lignes directrices fédérales ou choisir de fixer leurs propres critères.	D-C-4.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
		De plus, le gouvernement du Canada précise que la CCSN réglemente les rejets potentiels de tritium dans l'environnement par les centrales nucléaires en imposant des limites réglementaires, et, lors de chaque demande de permis, en prenant des mesures de précaution pour contrôler les niveaux de rejets de tritium dans l'air ou dans l'eau. Ces limites visent à protéger la santé humaine. En vertu du *Règlement sur la radioprotection* de la CCSN, les rejets doivent rester « au niveau le plus bas qu'il soit raisonnablement possible d'atteindre » (ALARA), tout en tenant compte des facteurs socio-économiques.		
55	La CEC recommande que Santé Canada et la CCSN continuent à participer aux études internationales cherchant à identifier les incidences à long terme sur la santé d'une exposition à un rayonnement de faible niveau et à savoir si une révision des limites	Le gouvernement du Canada accepte cette recommandation l'incitant à continuer à participer aux études internationales cherchant à déterminer les incidences à long terme sur la santé d'une exposition à un rayonnement de faible niveau.	S. O.	Lancée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	prescrites dans le *Règlement sur la radioprotection* est nécessaire.	Le gouvernement du Canada accepte l'intention de la recommandation de savoir si, à partir des résultats d'études internationales, il s'avère nécessaire de réviser les limites prescrites dans le *Règlement sur la radioprotection*. Santé Canada et la CCSN continueront de participer aux études internationales traitant des effets à long terme sur la santé d'une exposition à un rayonnement de faible niveau; à siéger aux comités et groupes de travail des organisations internationales pertinentes et à examiner régulièrement les rapports publiés par ces groupes internationaux pour être au courant des derniers développements dans le domaine de la radioprotection. Sur demande, Santé Canada peut offrir son expertise à la CCSN pour appuyer l'examen des limites dont fait état le *Règlement sur la radioprotection*.		

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
56	La CEC recommande qu'au cours de la durée de vie du projet, la CCSN exige qu'OPG surveille l'air ambiant dans la zone d'étude locale de façon régulière afin de s'assurer que la qualité de l'air demeure à des niveaux qui ne risqueraient pas de causer des effets néfastes sur la santé.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG surveille l'air ambiant pour s'assurer que la qualité de l'air ne risque pas d'avoir des effets néfastes sur la santé. Sur demande, EC peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-P-12.2	Fermée
57	La CEC recommande qu'avant la construction, la CCSN exige qu'OPG entreprenne une évaluation des conséquences hors site d'un accident grave. L'évaluation doit déterminer si les conséquences sur la santé et l'environnement hors site, considérées dans la présente EE, engloberont celles pouvant être causées par la technologie de réacteur qui sera choisie.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG entreprenne une évaluation des conséquences hors site d'un accident grave. Sur demande, EC peut fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation.	D-C-3.1	Ouverte
58	La CEC recommande qu'avant la construction, la CCSN confirme que les critères d'acceptation des doses spécifiés dans le	Le gouvernement du Canada accepte la recommandation de demander à la CCSN de confirmer que les critères	D-C-3.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	document RD-337 à la limite du site du projet, dans le cas d'accidents de dimensionnement limite pour la technologie de réacteur choisie, seront respectés.	d'acceptation des doses spécifiés dans le document RD-337 seront respectés.		
59	La CEC recommande que la municipalité de Clarington gère le développement du territoire dans les environs du projet, afin de s'assurer que rien ne nuit à la capacité d'évacuation du public, de sorte à garantir la protection de la santé et de la sécurité des personnes.	Cette recommandation était adressée à la municipalité de Clarington.	S. O.	Terminée
60	La CEC recommande qu'avant la construction, le gouvernement du Canada révise la pertinence des clauses de l'assurance responsabilité nucléaire. Cette révision doit comprendre l'information provenant d'OPG et de la région de Durham concernant les effets économiques potentiels d'un accident grave sur le site de Darlington nécessitant le déménagement, la	Le gouvernement du Canada accepte l'intention de la recommandation voulant que le gouvernement du Canada révise la pertinence des clauses de l'assurance responsabilité nucléaire. Dans le cadre de son travail visant à moderniser la loi sur la responsabilité civile en matière nucléaire pour remplacer l'actuelle *Loi sur la responsabilité nucléaire*, le gouvernement du Canada	S. O.	Terminée

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	restriction d'utilisation et la restauration d'une portion de la zone d'étude régionale.	va continuer d'examiner la pertinence des clauses de l'assurance responsabilité nucléaire, en tenant compte, entre autres, des risques que posent les installations nucléaires canadiennes.		
61	La CEC recommande qu'au cours des activités d'exploitation, la CCSN exige qu'OPG surveille l'habitat et le biote aquatiques, afin de mesurer les effets cumulatifs potentiels de la charge thermique et du panache de contaminants des ouvrages de rejets de la centrale nucléaire de Darlington et du projet.	Le gouvernement du Canada accepte la recommandation d'exiger qu'OPG surveille l'habitat et le biote aquatiques, afin de mesurer les effets cumulatifs potentiels de la charge thermique et du panache de contaminants. Sur demande, EC et le MPO peuvent fournir l'expertise scientifique et technique à la CCSN pour appuyer la mise en œuvre de cette recommandation. Le promoteur devra aussi mettre en place un programme de surveillance aquatique avant de pouvoir obtenir une autorisation en vertu de la *Loi sur les pêches*.	D-P-12.4	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
62	La CEC recommande qu'avant la préparation de l'emplacement, EC évalue le besoin d'aménager des stations additionnelles de surveillance de la qualité de l'air dans la zone d'étude locale, afin de surveiller les effets cumulatifs sur la qualité de l'air.	Le gouvernement du Canada accepte la recommandation d'évaluer la nécessité d'aménager des stations additionnelles de surveillance de la qualité de l'air dans la zone d'étude locale, afin de surveiller les effets cumulatifs sur la qualité de l'air. Si les résultats de cette évaluation montrent que des stations additionnelles de surveillance de la qualité de l'air dans la zone d'étude locale sont nécessaires, le gouvernement du Canada signale que la CCSN est investie des pouvoirs qui lui sont conférés par la loi et de l'autorité d'agir pour donner suite aux résultats de cette recommandation, notamment au moyen des permis qu'elle accordera en vertu de la *Loi sur la sûreté et la réglementation nucléaires*.	S. O.	Terminée
63	La CEC recommande qu'avant la construction, la CCSN exige qu'OPG évalue les effets cumulatifs d'un accident grave de cause	Le gouvernement du Canada accepte l'intention de la recommandation d'exiger qu'OPG évalue les effets cumulatifs d'un	D-C-3.1	Ouverte

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
	commune qui impliquerait tous les réacteurs nucléaires de la zone d'étude du site, afin de déterminer si des mesures de planification d'urgence supplémentaires sont nécessaires.	accident grave de cause commune dans la zone d'étude. Le gouvernement du Canada signale que la CCSN a mis sur pied un groupe de travail chargé d'examiner les leçons tirées du tremblement de terre japonais et qu'elle évaluera les conséquences opérationnelles, techniques et réglementaires de l'accident nucléaire qui s'est produit au Japon dans le contexte des centrales nucléaires canadiennes.		
64	La CEC recommande que l'Agence canadienne d'évaluation environnementale révise l'Évaluation des effets cumulatifs – Guide du praticien de l'Agence canadienne d'évaluation environnementale, afin de tenir compte des scénarios d'accidents et de défaillances.	Le gouvernement du Canada accepte cette recommandation. L'Agence canadienne d'évaluation environnementale est en voie de mettre à jour sa gamme d'instruments appuyant l'évaluation des effets cumulatifs en vertu de la LCEE. Un énoncé de politique opérationnelle, qui devrait être prêt d'ici décembre 2012, fournira des lignes directrices de base aux praticiens et tiendra compte des accidents et défaillances.	S. O.	(vide)

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
65	La CEC recommande que le gouvernement du Canada investisse de manière prioritaire dans l’élaboration de solutions concernant la gestion à long terme du combustible usé, y compris l’entreposage, l’évacuation, le retraitement et la valorisation du combustible nucléaire usé.	Le gouvernement du Canada accepte l’intention de la recommandation voulant que la priorité soit donnée à l’élaboration de solutions concernant la gestion à long terme du combustible usé. La responsabilité de financer et de gérer le traitement sécuritaire des déchets revient aux propriétaires de ces mêmes déchets. La Société de gestion des déchets nucléaires, créée par les entreprises du secteur nucléaire, est chargée de mettre en œuvre le plan choisi par le gouvernement pour gérer à long terme les déchets de combustible usé. Le gouvernement du Canada est résolu à s’assurer que, à long terme, une solution pertinente, sécuritaire et correctement financée soit en place pour traiter les déchets de combustible usé.	S. O.	(vide)

N°	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l'engagement d'OPG	État
66	La CEC recommande que le gouvernement du Canada mette à jour la *Loi sur la responsabilité et l'indemnisation en matière nucléaire* ou son équivalent, afin de tenir compte des conséquences d'un accident nucléaire. Les révisions doivent toucher les dommages engendrés par le rayonnement ionisant et par tout événement déclencheur et doivent être harmonisées avec le principe du pollueur-payeur. La *Loi sur la responsabilité et l'indemnisation en matière nucléaire* révisée ou son équivalent devra être en vigueur avant que le projet puisse procéder à la phase de construction.	Le gouvernement du Canada accepte l'intention de la recommandation voulant que le gouvernement du Canada mette à jour la *Loi sur la responsabilité et l'indemnisation en matière nucléaire* ou son équivalent, afin de tenir compte des conséquences d'un accident nucléaire. Le gouvernement du Canada reconnaît l'importance de moderniser la loi sur la responsabilité civile en matière nucléaire pour que les indemnités correspondent aux niveaux estimés acceptables à l'échelle internationale et il décidera du moment auquel sera déposé au Parlement le projet de *Loi sur la responsabilité et l'indemnisation en matière nucléaire*.	S. O.	(vide)

Nº	Recommandation de la CEC	Réponse du gouvernement du Canada	Référence de l’engagement d’OPG	État
67	La CEC recommande que le gouvernement du Canada fournisse des directives claires et pratiques concernant l’utilisation de l’évaluation de la durabilité dans le cadre des évaluations environnementales des projets nucléaires futurs.	Le gouvernement du Canada accepte l’intention de cette recommandation. Toutefois, la portée des évaluations environnementales et les facteurs qui seront pris en compte dans le cadre de projets nucléaires ultérieurs seront déterminés sur la base de projets distincts par les autorités qui en seront responsables. Étant donné que le développement durable est un principe inscrit dans la *Loi canadienne sur l’évaluation environnementale*, si les autorités responsables exigeaient une évaluation de durabilité distincte dans le cadre de projets nucléaires ultérieurs, le gouvernement du Canada estime qu’il serait souhaitable que ces autorités responsables fournissent des lignes directrices claires et pratiques aux promoteurs et au public sur la manière de mener une telle évaluation de durabilité.	S. O.	(vide)

Annexe B : Commentaires des bénéficiaires du Programme de financement des participants (6992421)

Conception et analyse	
Généralités Analyse des paramètres	• Le rapport n'a pas pleinement pris en compte les lignes directrices de l'industrie pour un tel rapport, publiées par le NEI près d'un an et demi auparavant, et ne traite pas toutes les données suggérées dans le document NEI-10-Rev-2. Il ne tient pas compte de l'expérience de l'industrie, ni des questions de la NRC ou de l'évolution de ses attentes en matière de sûreté des réacteurs qui, selon le NEI, ont été intégrées dans cette révision. Certaines de ces questions sont essentielles à une conception sûre et de nombreuses rubriques thématiques numérotées n'ont pas été abordées. [LISTE TRONQUÉE] • La NRC s'attend à une déclaration claire sur la marge d'erreur des valeurs limites choisies et la CCSN devrait en faire de même. Pour certaines données critiques, les marges d'erreur sont d'une importance cruciale. • L'effet sur l'EPC de dommages graves au cœur, à la suite d'un accident limitatif, n'a pas été pris en compte. • Lorsque la nouvelle entrée dans la liste des conceptions de réacteurs potentielles présentait un paramètre en dehors des limites définies dans la version précédente de l'EPC, cette dernière a été étendue sans aucune explication. Par exemple, comme le réacteur BWRX-300 devrait être construit à une profondeur de 38 m sous terre et hors terre, équivalente à la hauteur totale de la structure d'un bâtiment de 25 étages, l'EPC a simplement été réécrite pour rendre ces paramètres acceptables.
Changements climatiques	• Des études supplémentaires doivent être menées sur les effets d'une prolifération accrue d'algues, due aux changements climatiques, sur le lac Ontario. La modélisation de la gestion des interactions des espèces aquatiques avec les équipements de prise d'eau doit

Systèmes d'arrêt	être adaptée au pire scénario dû aux changements climatiques. • OPG devrait fournir des renseignements à jour sur les tendances en matière de température ambiante de l'eau du lac Ontario et les comparer à la plage autorisée de températures d'entrée pour la conception du réacteur BWRX-300. • OPG doit expliquer comment elle entend garantir que les réacteurs proposés satisferont à l'exigence de deux systèmes d'arrêt des réacteurs distincts et indépendants.
Ouvrages de génie civil Généralités	• Nous aimerions plus de renseignements sur la construction des ouvrages de prise d'eau et de rejet au large des côtes, notamment leur taille et leur emplacement dans le lac Ontario, ainsi que les effets environnementaux prévus et les mesures d'atténuation correspondantes. • Qu'est-ce qui a fait que ces paramètres ne sont plus importants ou ne présentent plus d'intérêt pour OPG? • OPG n'a-t-elle pas reçu la confirmation que la conception du réacteur BWRX-300 est limitée par l'EPC? • Intègre-t-elle toutes les valeurs du réacteur BWRX-300? Si non, quelles sont les valeurs en suspens? • Si les limites de l'EPC ont été conçues pour l'ACR-1000, l'EPR et l'AP-1000, comment peut-elle rendre compte correctement des valeurs du réacteur BWRX-300 fabriqué par GE-Hitachi qui n'a, en outre, pas participé au processus de demande de propositions? • Il est important de distinguer entre les paramètres propres à la conception du fournisseur (PCF) et ceux propres à la catégorie de réacteur. Puisque le fournisseur choisi n'a pas participé à la conception de l'EPC, alors les paramètres PCF ne s'appliqueraient pas? • Même s'il est entendu que les valeurs de l'EPC composite sont présumées refléter les valeurs de la conception du réacteur BWRX-300, il serait prudent de mettre en évidence une comparaison entre les conceptions utilisées pour la création de l'EPC et la

Analyse des paramètres	technologie de réacteur choisie. En quoi le réacteur BWRX-300 diffère-t-il? • Le réacteur BWRX-300 n'a été intégré à la conception de l'EPC qu'avec les dernières révisions à la toute fin du processus. Cela semble contradictoire avec l'objectif de concevoir une EPC propre à la technologie choisie. • Quelles valeurs de l'EPC ont-elles été ajustées? L'ajustement des paramètres est contradictoire avec l'intention de concevoir l'EPC en fonction des conceptions de réacteurs prises en compte. La conception du réacteur BWRX-300 ne correspondait pas aux valeurs utilisées dans l'EPC, sinon elle n'aurait pas dû être ajustée. • Pourquoi le réacteur BWRX-300 n'est-il pas inclus dans cette liste? Combien de réacteurs BWRX peuvent être construits sur le site de Darlington? • Pourquoi la décision a-t-elle été prise de créer un nouveau poste de manœuvre au lieu des plans initiaux visant à agrandir le poste existant de la centrale nucléaire de Darlington? Est-ce que cela augmente l'empreinte du projet?
Rejets	• À la page 62, on parle du niveau d'eau du site, mesurant la crue maximale et la nappe phréatique maximale. Si le réacteur BWRX est situé 38 m sous terre, comment ces paramètres changeront-ils? • À la page 61, on parle des tremblements de terre et de l'accélération du sol pour laquelle la centrale est conçue. Le réacteur BWRX ne figurait pas dans la liste des réacteurs limitatifs. Quels compromis seront faits concernant la conception de ce réacteur puisque ce réacteur sera plus profond que les autres? • Qu'est-ce qu'un réacteur à eau bouillante? L'eau utilisée devient-elle radioactive? • Que se passe-t-il avec l'eau usée et l'endroit où elle est entreposée? • Le rapport environnemental prend-il en compte l'incidence de l'eau?
Changements climatiques	• Au point 2.1.4, il est indiqué que la température ambiante maximale (dépassement de 0 %) actuellement

	prise en compte est de 39,0 °C. Compte tenu de la variabilité des conditions météorologiques et du risque d'épisodes de chaleur extrême, l'incidence de températures supérieures à 39,0 °C sur le système a-t-elle été prise en considération?
Effluents et rejets	
Surveillance	• Nécessité d'un équipement de surveillance des rayonnements capable de détecter et de sauvegarder les données sur les effluents produits lors de l'exploitation normale ainsi que les champs de rayonnement produits en cas d'accidents.
Inventaire du terme source	• Les émissions d'iode du réacteur BWRX-300 seront plus élevées que prévu dans l'EIE. Veuillez expliquer les incidences de concentrations plus élevées d'iode radioactif dans l'atmosphère sur les humains et sur l'environnement.
Rejets Inventaire du terme source	• Le tableau 5 comprend une note selon laquelle « les radionucléides dans les émissions gazeuses, les effluents liquides et les déchets solides sont les mêmes que dans l'EIE, mais leur proportion a changé », mais il n'y a aucune référence à un document justificatif; il serait utile de disposer de données sur l'évolution de leurs proportions. • La section 5.3.6 « Rayonnement et radioactivité » indique : « Une comparaison entre les rejets du réacteur BWRX-300 et celles des réacteurs évalués dans l'EIE a révélé que les quantités de rejets de tritium, de carbone 14, de particules et de gaz nobles du réacteur BWRX-300 sont inférieures à celles des rejets des réacteurs évalués dans l'EIE. En revanche, la quantité des rejets d'iode du réacteur BWRX-300 est plus élevée que les valeurs supposées dans l'EIE. » Encore une fois, aucune donnée n'est fournie pour étayer ces affirmations, l'absence de toute analyse sur les conséquences de concentrations plus élevées d'iode s'avérant tout aussi troublante.

Inventaire du terme source	• Au tableau 4.1 « Terme source pour les rejets atmosphériques – une seule tranche », il semble que le réacteur BWRX-300 rejettera des quantités plus élevées de certains isotopes individuels par rapport aux autres réacteurs précédemment envisagés, notamment une plus grande quantité d’iode radioactif.
Rejets	• Qui décide de la quantité acceptable d’effluents rejetés et quelles lignes directrices OPG doit-elle suivre? Comment a-t-il été décidé que les paramètres ne présentaient aucune différence?
Gestion des urgences	
Zone d’exclusion et zone de planification d’urgence Gestion des accidents graves	• La CCSN ne devrait pas autoriser la construction d’un nouveau réacteur dans la zone d’exclusion de tout autre réacteur existant. • Il faudrait que la CCSN exige d’OPG qu’elle établisse des zones d’exclusion fondées sur des données scientifiques pour la centrale nucléaire de Darlington et pour le réacteur BWRX-300 proposé, selon les critères énoncés dans le document 100.11 de la NRC des États-Unis. • Le concept de l’EPC, ainsi que les données sur la centrale et sur le site qu’elle intègre, a été élaboré avant la catastrophe de Fukushima de 2012. C’était également bien avant que nous ayons tous examiné attentivement les vulnérabilités aux accidents graves dont nos réacteurs ont hérité et que nous ayons élaboré un semblant de lignes directrices pour la gestion des accidents, de mesures techniques, de nouveaux systèmes et de mécanismes de coordination pour la planification des urgences. Étant donné que l’EPC d’OPG manque cruellement de détails et que des affirmations non étayées sont intégrées à la conception du nouveau réacteur quant à son infaillibilité, il est nécessaire que ces sujets se reflètent dans les données de l’EPC. Le bon sens et les lignes directrices NEI-10-Rev2 exigent que les renseignements relatifs aux mesures d’atténuation en cas d’accidents graves soient inclus de manière claire et détaillée. Il semble

	que les parties n'aient jamais entendu parler de Fukushima ni des conclusions des enquêtes sur les causes profondes de l'accident. • L'effet de graves dommages au cœur à la suite d'un accident dans une tranche en exploitation sur la sécurité du personnel travaillant à la construction d'un ou de plusieurs nouveaux réacteurs n'a pas été pris en compte. Les données sur le terme source fournies aux organismes de gestion des urgences par les services publics exploitant actuellement des réacteurs sont frauduleuses de manière irresponsable et ne peuvent pas être utilisées pour préparer des processus d'évacuation d'urgence ou de mise à l'abri de nos concitoyens travaillant sur le site. • L'effet d'un accident à l'une des tranches en exploitation sur la construction, l'exploitation ou le déclassement du nouveau réacteur n'a pas été indiqué.
Planification d'urgence	• OPG doit s'assurer de contrôler l'utilisation et l'occupation des terrains dans un rayon de 20 km du site, afin de maintenir les marges de sûreté pour le cinquième niveau de défense en profondeur, en empêchant de nouveaux projets résidentiels ou l'expansion de projets existants, en vue de se conformer à l'établissement d'une zone de planification des mesures d'urgence de 20 km, en conformité avec le PPIUN. • OPG doit fournir de plus amples renseignements sur la manière dont la planification d'urgence pour le déploiement du réacteur BWRX-300 englobera une population plus nombreuse en cas d'accident nucléaire grave. • La CCSN et OPG doivent veiller à ce que les autorités chargées de la planification des mesures d'urgence soient suffisamment préparées en cas d'accident nucléaire grave. • Étant donné que l'étude technique du PPIUN a été transmise par le gouvernement provincial de l'Ontario à la CCSN, nous demandons que les documents de

Intervention en cas d’urgence	permis soient révisés pour répondre directement aux conclusions de ladite étude. • Étant donné que le BCIGSU de l’Ontario a autorisé la CCSN à communiquer l’étude technique du PPIUN à toute personne qui en fait la demande, la CCSN devrait rendre ce rapport accessible au public sur son site Web. • Avant de pouvoir déterminer si le réacteur BWRX-300 s’inscrit dans les limites des paramètres de l’EIE et de l’EPC, il convient de rendre disponibles l’Estimation actualisée du temps d’évacuation du site de Darlington et les modèles de planification d’urgence basés sur les données du recensement de 2021. • Les instructions de préparation aux situations d’urgence doivent être évaluées à la lumière des types d’accidents et de rejets que la technologie du réacteur BWRX-300 pourrait entraîner. • La CCSN devrait examiner l’étude technique du PPIUN et démontrer, dans le cadre de l’examen de l’EIE et de l’EPC dans le contexte de la technologie proposée du réacteur BWRX-300, le caractère suffisant des plans d’urgence pour la protection de l’eau potable, comme celle du lac Ontario, en situation d’urgence.
Information publique	• Comme condition préalable à l’implantation d’une nouvelle centrale nucléaire, la CCSN devrait exiger la mise en place d’activités permanentes d’éducation du public et une communication claire sur la préparation aux situations d’urgence et les mesures de protection.
Effets sur l’environnement et évaluations des risques	
Évaluation environnementale	• L’EIE du réacteur BWRX-300 doit fournir une description suffisamment détaillée de la conception de la centrale pour permettre une vérification indépendante des valeurs numériques attribuées à divers paramètres tels que les termes sources. Il ne faut pas considérer comme inéluctable que le site de Darlington soit nécessairement adéquat par rapport à d’autres sites. • Les données caractéristiques des paramètres du site en matière d’effets de l’exploitation des réacteurs existants sur l’exploitation du nouveau réacteur proposé (et

Caractérisation du site	réciproquement) n'ont pas été fournies de manière non ambiguë. • L'ensemble de données ne contient aucun renseignement qui serait nécessaire et propre au site de Darlington sur lequel d'autres réacteurs en exploitation existent déjà. Il s'agit notamment de données sur les limites de rejet dérivées et sur l'historique des émissions réelles qui seraient ajoutées à celles des nouvelles tranches.
Changements climatiques Évaluation environnementale Effets environnementaux Ouvrages en milieu aquatique	• Un autre effet pertinent du PNCND serait l'augmentation de la température de l'eau par le biais de son écoulement dans le lac Ontario. Les effets thermiques du PNCND devraient être pris en compte conjointement avec l'augmentation de la température des eaux de surface d'ores et déjà constatée dans le cadre des changements climatiques, en tant qu'effet cumulatif sur l'écosystème du lac. • Il est entendu que le projet PNCND est assujetti à la *Loi sur les évaluations environnementales* de l'Ontario, qui prévoit généralement une date d'expiration pour la plupart des projets. Veuillez expliquer pourquoi la décision sur l'EE du PNCND ne comporte aucune date d'expiration, et expliquer la façon dont OPG justifie que le projet continue de s'inscrire dans la portée initiale de 2011. L'environnement naturel du site du PNCND ainsi que l'utilisation des terres environnantes ont considérablement changé au cours de la dernière décennie, cette évolution devant être prise en considération. • On craint que même si OPG conclut que l'effet sera réduit par rapport aux conclusions initiales de l'EE, il ne sera pas nul pour autant. • Quelle sera l'incidence si les effets sont différents avec la nouvelle technologie? • Des travaux riverains limités seraient nécessaires dans le cadre de l'EPC et de l'EIE actualisées en raison de l'empreinte plus réduite du projet. Veuillez donner des détails sur le dragage, afin que nous puissions mieux évaluer les incidences sur l'environnement.

Mesures d’atténuation	• Il n’est pas raisonnable de conclure que, parce que le corridor faunique est-ouest a survécu à la fragmentation passée, la faune sera toujours présente pendant et après la construction du PNCND. Les effets cumulatifs de multiples activités sur le site sur une longue période pourraient avoir des répercussions permanentes sur le corridor, perturbant la connectivité et l’écosystème environnant. • OPG devrait envisager de conserver une partie du site pour le corridor faunique et d’en garder une partie clôturée pour permettre la migration tout au long de la période de préparation de l’emplacement et de construction. • Quelle comparaison peut-on établir en matière de risques environnementaux et de mesures d’atténuation correspondantes entre le dynamitage et l’excavation, d’une part, et le forage à l’aide d’un tunnelier, d’autre part? Quelle méthode a la plus faible incidence sur l’environnement? Demande pour être tenu au courant de la construction des conduites de prise d’eau et de rejet au large des côtes. • Veuillez communiquer le plan des mesures compensatoires visant l’habitat du poisson pour examen. • OPG dispose-t-elle d’un chiffre approximatif des pertes de poissons prévues par impaction et entraînement? Cela nous permettrait de comprendre la comparaison entre les pertes attendues et les populations de poissons du lac Ontario. • Veuillez faire le point sur l’état des terres humides sur le site et indiquer si elles seront maintenues tout au long du projet. Si c’est le cas, veuillez nous informer des résultats de l’évaluation des effets. Dans la négative, que fera OPG pour compenser la perte? • Comme indiqué dans le rapport d’EIE, le projet débutera environ 12 ans plus tard que la date initialement prévue. Comment explique-t-on un retard aussi important?

Mesures d’atténuation – Impaction des poissons Mesures d’atténuation – Milieu terrestre Espèces en péril	• En ce qui concerne les conditions environnementales sur le site, il convient de noter qu’il faudra détruire des terres écologiques et des habitats d’espèces en péril importants qui ont pu prospérer et s’étendre du fait du retard du projet. • Des commentaires ont été soumis à OPG et au Registre environnemental de l’Ontario concernant le permis d’OPG en vertu de la *Loi sur les espèces en voie de disparition* (LEVD) pour la préparation de l’emplacement du PNCND. Des préoccupations ont été soulevées concernant le manque de garantie quant à la protection à long terme de l’habitat des espèces en péril sur le site. On demande qu’une servitude de conservation ou une clause restrictive soit placée sur l’habitat des espèces en péril créé, afin de garantir qu’il ne sera pas détruit lors de la préparation ultérieure du site pour les réacteurs 2 à 4. Il a été suggéré de créer un fonds de restauration écologique hors site comme solution de rechange, mais OPG n’était pas disposée à répondre à l’une ou l’autre de ces demandes. • Les demandes sont considérées comme réalisables; par conséquent, il n’est pas juste de dire que : « OPG s’efforce de prendre des mesures d’atténuation et/ou d’adaptation réalisables ». • Dans le cadre de la préparation de l’emplacement, OPG ne prévoit-elle pas des répercussions sur la berge où vivent les hirondelles restantes? Étant donné que le nombre de terriers d’hirondelles de rivage a déjà diminué sur le site, OPG est-elle en mesure de déplacer l’habitat de l’espèce en péril ou de créer un habitat ailleurs pour cette espèce? • Les activités retardées de préparation de l’emplacement vont vraisemblablement détruire l’habitat d’espèces en péril nouvellement créé sur le site, à mesure que les réacteurs restants seront construits et que l’empreinte du projet augmentera. Veuillez expliquer comment OPG prévoit maintenir la protection des caractéristiques naturelles créées pour satisfaire à son permis en vertu de la LEVD à mesure que le projet avance.

Panache thermique	• Veuillez expliquer pourquoi cette espèce de poisson n'est plus préoccupante si l'entraînement du chabot de profondeur a été mis en évidence récemment sur le site. Que veut dire OPG par « des mesures de protection du poisson seront prises au besoin à la structure de la prise d'eau »? On demande que des mesures de protection du poisson soient prises à la structure de la prise d'eau, quelle que soit la prévalence des espèces en péril ou d'autres facteurs. • Voir commentaire précédent concernant l'hirondelle de rivage. Il est prévu de construire quatre réacteurs sur le site, ce qui donne lieu à divers travaux de préparation de l'emplacement correspondant à ce chiffre (c'est-à-dire que des ouvrages de prise d'eau sont en cours de construction pour accueillir quatre réacteurs). Pourquoi l'EIE suggère-t-elle que cela pourrait ne pas se produire et que l'habitat des espèces en péril pourrait être conservé? Il semble très peu probable que l'habitat de l'hirondelle de rivage soit préservé si le projet se déroule comme prévu. • OPG prendra-t-elle des mesures bénéfiques ou compensatoires susceptibles d'avoir un effet sur ces deux espèces en péril? Des autorisations du MPO seront-elles requises? • On a posé une question sur les incidences potentielles de l'eau chaude provenant du PNCNP et entrant dans le lac Ontario. Les incidences d'un panache thermique ont-elles été incluses dans l'EIE? Quels éléments ont été pris en considération (croissance des algues, changement climatique, etc.)?
Effets environnementaux	• Le tableau 1 montre une différence très importante entre le réacteur BWRX-300 et tout autre modèle de réacteur pris en compte dans l'EIE de 2009, à savoir que la structure du réacteur pénétrera à 38 m sous terre. Cette différence notable est traitée de manière minimale. Les renseignements disponibles sont donc insuffisants pour déterminer dans quelle mesure OPG ou ses consultants ont évalué adéquatement les conséquences environnementales potentielles, y

	compris, mais sans s'y limiter, la migration de radiocontaminants des ouvrages en sous-sol aux eaux souterraines environnantes et potentiellement aux eaux de surface, ou pour avoir des certitudes en la matière. Par exemple, il n'y a aucune description de la manière dont la surveillance sera entreprise ou des mesures d'atténuation qui pourraient être utilisées. On notera qu'il y a une description très brève (mais inadéquate) dans la section 4.1.2, et à nouveau dans la section 5.2.2, indiquant qu'il avait été déterminé qu'il n'était pas nécessaire de prendre en compte un effet possible sur l'écoulement des eaux souterraines dans l'EIE de 2009; toutefois, aucune analyse de fond ne fait suite à cet énoncé.
Études plus poussées	• La CCSN a-t-elle réalisé des études sur l'eau du lac, la qualité de l'eau et la consommation de poisson?
Évaluation des risques environnementaux Mesures d'atténuation	• Il a été noté que la CEC avait déclaré qu'une nouvelle EE ne serait pas nécessaire si la technologie du réacteur sélectionnée n'était pas fondamentalement différente de celle utilisée pour l'EPC. • On a fait remarquer qu'il semble que la technologie du réacteur choisi soit fondamentalement différente, même cette technologie est plus petite que les options étudiées dans l'EE d'origine. • Les études réalisées lors de l'EE de 2009 ont-elles été mises à jour? • Que les technologies des réacteurs soient différentes ou non, l'environnement a probablement changé depuis 2009. • On fait remarquer que les mesures d'atténuation ne sont pas toujours efficaces et que les populations sont en déclin. Les promoteurs devraient aller au-delà de leurs mesures d'atténuation ou de compensation pour tenter de réduire les effets environnementaux négatifs et travailler à l'amélioration de l'environnement. • Un exemple était la replantation d'arbres dans un rapport de 10 pour 1.

	• On fait remarquer que d'autres espèces devraient être prises en compte, pas seulement les espèces en péril. On recommande l'inclusion des espèces culturellement importantes pour les Nations et communautés autochtones ou utilisées à des fins de subsistance.
Effets environnementaux	• De plus, les arguments relatifs à l'« empreinte au sol plus petite » du réacteur BWRX-300 font fi des fondations plus profondes requises pour ce dernier (38 m par rapport à tous les autres réacteurs de l'EIE initiale qui avaient une profondeur de fondation d'environ 13,5 m). Les travaux d'excavation requis pour le réacteur BWRX-300 modifieront la nappe phréatique du site; toutefois, les manières dont la nappe sera modifiée et la durée exacte de ces effets ne sont pas suffisamment abordées dans le rapport d'examen de l'EIE de 2022. • OPG affirme que les effets terrestres du réacteur BWRX-300 seront également inférieurs à ceux mis en évidence pour les autres réacteurs dans l'EIE initiale, puisque la superficie occupée par ces réacteurs sera moindre que pour le réacteur BWRX-300 (19 hectares par réacteur par rapport à une moyenne de 35 hectares pour les autres réacteurs examinés dans l'EIE originale). Les différences relatives en matière de perturbations pendant la construction du réacteur BWRX-300 par rapport aux autres réacteurs de l'EIE sont en cours d'examen, et il n'y a aucune évaluation de la probabilité que toute superficie non touchée du fait de réacteurs plus petits entraîne des gains significatifs dans l'habitat des espèces. • OPG affirme que le milieu aquatique sera mieux protégé par le réacteur BWRX-300 que par les autres réacteurs de l'EIE initiale, car son débit est relativement plus faible. Cependant, aucune évaluation n'est fournie pour caractériser plus en détail le débit du réacteur BWRX-300 et son incidence sur le biote aquatique. • Après examen de l'EIE et de l'EPC, il apparaît clairement que ces documents ne contiennent pas suffisamment de renseignements pour avoir une idée complète des

Seuil en matière de différences fondamentales	effets environnementaux négatifs potentiels du réacteur modulaire BWRX-300. Les renseignements sont également insuffisants pour comprendre clairement comment les réacteurs modulaires BWRX-300 interagiront, d'une manière plus générale, avec l'environnement local. Par exemple, ni l'EIE ni l'EPC ne contiennent de renseignements ou de données détaillées concernant : • la source, les volumes ou les points de rejet de tous les contaminants identifiés dans l'air, dans les eaux de surface, dans les eaux souterraines et dans les eaux pluviales; • le traitement précis ou les efforts d'atténuation pour traiter les contaminants potentiels dans les effluents liquides, les rejets de contaminants dans l'air, les eaux souterraines ou les eaux pluviales; ou • la surveillance environnementale supplémentaire qui serait nécessaire, si le réacteur modulaire BWRX-300 était approuvé, pour se prémunir contre tout effet environnemental indésirable important.
Études plus poussées	• Depuis que l'EIE originale a été préparée, elle a été prise en compte dans une EE qui a donné lieu à une série de demandes d'information supplémentaire à OPG, ainsi que dans un rapport d'EE final, en 2011, précisant que le projet ne pourrait aller de l'avant que si les études suivantes étaient entreprises et aboutissaient à des conclusions indiquant que tout effet environnemental mis en évidence pourrait être atténué pour éviter qu'il ne devienne « important ». Ces études comprenaient : [TRONQUÉ] • Ni l'EIE ni l'EPC de 2022 ne traitent systématiquement de ces études ou de leurs progrès. On ne sait donc pas exactement dans quelle mesure ces travaux en cours sont menés. Il reste difficile de savoir si les études elles-mêmes ont été incluses dans les documents justificatifs mentionnés dans l'EIE.
Effets environnementaux	• Les espèces répertoriées dans cette citation comprennent des espèces revêtant une grande

Mesures d'atténuation	importance culturelle. Bien que l'EIE ne recense pas de risque pour ces espèces, elles devraient être prioritaires dans toute surveillance de la communauté aquatique, pour garantir qu'il n'y aura aucun effet négatif sur ces espèces dans ladite communauté. • Les terres humides sont extrêmement importantes pour la culture et le mode de vie autochtones et sont protégées par les droits issus de traités. Tout effet sur une terre humide dans le cadre de ce projet constitue une violation de ces droits protégés par la Constitution. Par ailleurs, en vertu de la Déclaration sur l'eau de 2008 : « Les Premières Nations de l'Ontario ont leurs propres territoires qui comprennent les eaux, notamment les eaux de pluie, les cascades, les rivières, les ruisseaux, les lacs, les sources de montagne, les sources de marais, les veines d'eau du substrat rocheux, la neige, les océans, les icebergs et les mers ». Les Nations autochtones ont des droits et des responsabilités envers les terres humides et les étangs sur leur territoire. • Les promoteurs devraient se montrer plus clairs quant aux changements négligeables attendus dans les terres humides et les étangs et démontrer comment ils continueront à les surveiller pour s'assurer de leur protection pendant et après le projet. • De nombreux amphibiens et reptiles sont des espèces revêtant une importance culturelle protégée en vertu de droits issus de traités. Les Nations autochtones ont également des droits et des responsabilités à l'égard des terres humides et des étangs situés sur leur territoire. • Les promoteurs doivent clarifier la manière dont ils surveilleront les communautés et l'habitat des amphibiens et des reptiles pour garantir que ce projet ne porte pas atteinte aux droits inhérents et issus de traités. Des relevés sur les communautés des zones humides doivent être effectués avant et après la construction pour assurer la protection de l'habitat des

	zones humides et de toute espèce culturelle revêtant une importance essentielle qui utilise cet habitat. • De nombreuses espèces revêtant une importance culturelle pourraient utiliser ce corridor et les perturbations de leurs habitudes de déplacement pourraient avoir une incidence sur leur santé globale. Ces travaux pourraient également avoir des conséquences sur la récolte et la chasse dans le secteur, notamment s'ils perturbent les déplacements de la faune. • Les promoteurs ont-ils réfléchi à la manière dont cette perturbation pourrait porter atteinte aux droits inhérents et issus de traités? Ont-ils pris en compte la manière dont les travailleurs interagiront avec les Autochtones qu'ils pourraient rencontrer en train d'exercer ces droits pendant la durée du projet? • Les promoteurs devraient clarifier le processus qu'ils suivent pour réduire les perturbations et les autres dommages associés à la faune (par exemple, la mortalité due aux véhicules). Les promoteurs devraient préciser comment ces travaux ne porteront pas atteinte aux droits inhérents et issus de traités. • De nombreux oiseaux, notamment les rapaces, sont des espèces revêtant une importance culturelle. L'intégralité des effets de cette perte d'habitat devrait être connue, en particulier quant aux oiseaux susceptibles d'être touchés et à la manière dont ils pourraient l'être, et un plan de restauration de l'habitat devrait être mis en place. • Les promoteurs devraient clarifier la manière dont ils surveilleront les communautés d'oiseaux, y compris le recensement de toute espèce revêtant une grande importance culturelle, susceptible d'être touchée par les activités du projet. Les promoteurs devraient également préciser comment ils restaureront cet habitat après le projet et travailleront avec les Nations autochtones pour élaborer ces plans de restauration.
Espèces en péril	• Comme indiqué dans l'EIE, quatre espèces de chauves-souris repérées sur le site du PNCND sont

	inscrites sur la liste des espèces en voie de disparition (le vespertilion brun, le vespertilion nordique, le vespertilion pygmée de l'Est et la chauve-souris tricolore). Il est important que ces espèces et leur habitat soient protégés de tout effet négatif lié à ce projet. • Une réponse a été fournie à OPG concernant la nécessité de surveiller les effets de la poussière et du bruit sur les populations de chauves-souris et la communauté d'invertébrés, en particulier les proies insectivores aériennes des chauves-souris. Les suggestions données dans ce document concernant la surveillance devraient être intégrées à ce projet. • Il n'y a aucune mention des monarques (*Danaus plexippus*) dans cette zone; utilisent-ils cet habitat? Le monarque est inscrit sur la liste des espèces en voie de disparition par le Comité sur la situation des espèces en péril au Canada (COSEPAC, 2021). Il n'y a également aucune mention de l'asclépiade (*Asclepias* spp.), une espèce essentielle au cycle de vie du monarque. Des relevés de l'asclépiade ont-ils été réalisés? OPG a-t-elle mis en place un plan pour restaurer l'habitat perdu ou les plants d'asclépiade perdues, qui sont des éléments essentiels du cycle de vie du monarque? • Les promoteurs devraient clarifier la manière dont ils surveilleront la zone, y compris une évaluation des plants d'asclépiades, en particulier dans les zones qui seront touchées par les activités du projet. Les promoteurs devraient également préciser comment ils restaureront cet habitat et travailleront avec les Nations autochtones pour élaborer ce protocole de restauration. • Pourquoi les espèces revêtant une grande importance culturelle ne sont-elles pas incluses ou mentionnées dans le document?
Généralités	
Disponibilité des documents	• Même des renseignements simples, généralement accessibles au public, sur la conception des réacteurs n'ont pas été mis à la disposition du public pour la

	conception finalement choisie, sous le prétexte peu plausible qu'il s'agissait de renseignements « exclusifs ». Une telle protection abusive au titre du caractère « exclusif » des renseignements est incompatible avec les obligations du fournisseur envers les citoyens du Canada, un pays où le fournisseur espère bénéficier d'une preuve de concept financée à partir de l'argent des contribuables. Il y a beaucoup plus de données disponibles sur les nouveaux modèles de réacteurs chinois que sur le réacteur BWRX-300. Il ne s'agit pas d'une conception de machine à voyager dans le temps ni d'une conception de missile hypersonique porté à l'épaule! • La propagande de relations publiques sur la sûreté du modèle de réacteur choisi a été largement diffusée, sans donner aucun renseignement chiffré sur ledit modèle qui pourrait être vérifié par des experts en sûreté nucléaire travaillant dans l'intérêt public. • Nous proposons que l'EPC actuelle ne soit pas acceptée comme substitut à n'importe quel autre document, et qu'un nouvel ensemble de documents qui détaille les données réelles du réacteur BWRX-300 soit préparé et publié aux fins de commentaires. Cet ensemble devrait inclure suffisamment de renseignements sur chacune des conceptions de réacteur examinées (sous forme d'une description sommaire de la conception avec des images, des tableaux et des références) et une analyse beaucoup plus large sur la conception choisie du réacteur BWRX-300. • Une analyse des raisons pour lesquelles la nouvelle construction DOIT ÊTRE située dans les limites d'exclusion d'une centrale existante, malgré tous les risques qu'une telle décision implique, constitue une omission importante dans l'EPC et dans la description du site. • Une feuille de calcul composite pour toutes les données du fournisseur n'a pas été créée (une colonne pour chaque conception). Bien que des valeurs limitatives (maximum ou minimum numérique des données
Aménagement du territoire	

Analyse des paramètres	envoyées par les fournisseurs sans aucune description d'accompagnement) aient été indiquées, aucune justification logique permettant de comparer les données fournies avec des origines, une signification ou une crédibilité diverses n'a été étudiée. Il n'y a eu aucune analyse des données manquantes, aucune vérification de l'exhaustivité de l'ensemble de données du fournisseur, ni aucune discussion du caractère raisonnable des données ou des marges d'erreur. Il s'agit en fait d'exigences et d'attentes explicites répétées dans les documents de la NRC et du NEI sur le sujet. Une simple mention brute de valeurs limitatives n'apporte aucune contribution réelle à l'intention déclarée. • L'EPC a fourni des valeurs limitatives pour trois réacteurs sous forme de tableau en 2009 par Condesco; au cours des 13 années suivantes, AUCUN ajout n'a été effectué à ce tableau et il n'a donné lieu à aucun retour d'information de la part du personnel ou de l'organisation. • Le processus permettant d'arriver à des valeurs limitatives n'est pas transparent dans la mesure où les données fournies par chacun des trois fournisseurs qui dominent le paysage informationnel ne sont pas mises individuellement sous forme de tableau ni mentionnées dans un document de synthèse distinct pour la conception. Cela aurait dû être une chose facile à faire et, avec un volume suffisant de renseignements sur la conception réelle, cela aurait représenté une manière appropriée de vérifier si les valeurs des données limitatives étaient dans le contexte de TOUTE nouvelle conception susceptible d'émerger à l'horizon, comme le réacteur BWRX-300, plusieurs années après la production initiale de l'EPC. Aucune observation n'a été effectuée sur les caractéristiques spécifiques d'une conception de réacteur à partir de laquelle la valeur limitative a été calculée.
Acquisitions	• Renseignements sur l'achat de combustible

Échéanciers et processus	• Le principal argument est que la procédure actuelle manque de bien-fondé, étant donné les réalités du monde post-Fukushima et le peu de renseignements fournis sur le réacteur à eau bouillante BWRX-300, un type de réacteur qui n'a jamais été pris en compte dans l'EIE original.
Disponibilité des documents	• Pour accroître la transparence, les intervenants ont soutenu qu'OPG devrait être tenue de rendre tous les documents non confidentiels facilement accessibles au public par le biais d'hyperliens dans les documents ou d'une base de données archivée sur le site Web de l'entreprise. Les renseignements doivent être rapidement communiqués au public.
Généralités Relations avec les Nations autochtones Échéances et processus	• Pourquoi le processus de diligence raisonnable a-t-il abouti à la sélection du réacteur BWRX-300 si cette technologie particulière n'avait pas été étudiée dans la conception de l'EPC? • Conformément aux commentaires ci-dessus, des préoccupations se sont manifestées concernant le manque de garantie pour la protection à long terme de l'habitat des espèces en péril sur le site, lors des consultations précédentes. OPG n'était disposée à répondre à aucune de nos demandes. • Bien qu'OPG ignore peut-être le contenu exact de l'accord de règlement des Premières Nations visées par les Traités William (WTFN) (2018), elle entretient des relations avec bon nombre des sept Nations signataires du traité. Grâce à ces relations, OPG est consciente que la protection de l'environnement et des êtres vivants est une priorité élevée. Lorsqu'elle recense les droits touchés par le projet et travaille à des accommodements, OPG devrait tenir compte de ce qu'elle entend directement de la part des Premières Nations concernées. • Quand GE Hitachi a-t-elle décidé de participer au processus? Combien de temps l'entreprise a-t-elle participé à l'élaboration de l'EPC avant que sa

	technologie ne soit retenue pour un déploiement sur le site du PNCND?
Généralités	• Il est recommandé de maintenir la cohérence des unités de mesure, afin d'éviter d'éventuelles erreurs à l'avenir. La section 17.1.2 fournit les valeurs en « tonnes », tandis que la section 18.1.2 utilise les « tonnes métriques ». • Les sections 9.3.1, 10.1.1 et 10.1.2 font référence au document G-129 de la CCSN qui a été remplacé par le REGDOC-2.7.1 à compter de juillet 2021. Bien qu'il soit entendu que les exigences G-129 font partie du REGDOC-2.7.1, il est recommandé de faire référence aux documents d'application de la réglementation actuels. Cela garantit la cohérence et communique une compréhension et un respect des exigences réglementaires en matière de sûreté en vigueur. • Il existe une incohérence dans les unités utilisées pour mesurer la superficie des terres dans le document. Plus précisément, les hectares sont utilisés dans la section 2.7.1, tandis que les mètres carrés et les acres sont utilisés dans la section 3.3.1. De plus, les valeurs fournies dans la section « superficie » (17.2) sont en hectares, ce qui ajoute encore à la confusion. Il est recommandé d'utiliser les mêmes unités de superficie tout au long du document, afin d'éviter toute ambiguïté.
Échéances et processus	• Quel est le calendrier prévu pour le PNCND?
Échéances et processus	• Comme indiqué ci-dessus, l'EIE et l'EPC sont des documents très dépendants du contexte qui font partie d'un processus lancé en 2009, lequel a fait l'objet de deux décisions judiciaires (bien que finalement confirmé). L'intégralité de ce contexte et les documents justificatifs cités en référence dans l'EIE et l'EPC d'OPG auraient dû être rendus disponibles, parallèlement aux documents de l'EIE et de l'EPC de 2022, sur le site Web de consultation de la CCSN ainsi que sur le site Web d'OPG. Les études de suivi requises dans le rapport d'EE de la CEC auraient également dû être explicitement

	abordées par OPG dans sa demande et rendues accessibles en ligne avec les documents actuels d'EIE et d'EPC. Il est encore temps de le faire, alors que des intervenants comme nous continuent d'étudier cette proposition et de se préparer à tout examen environnemental plus approfondi ou à toute demande de permis d'OPG pour construire de nouveaux réacteurs sur le complexe nucléaire de Darlington. • Des projets comme celui-ci soulignent l'importance d'une divulgation proactive et régulière en matière de rendement environnemental, afin que les membres du public puissent fonder leur examen du projet proposé sur une compréhension plus large du complexe de Darlington et de la manière dont les installations nucléaires existantes interagissent avec l'écosystème local dans lequel elles sont intégrées.
Relations avec les Nations autochtones	• Pourquoi n'y a-t-il aucune mention du Traité Gunshot dans la reconnaissance des territoires et dans le rapport? Comment les droits inhérents et issus de traités sont-ils respectés tout au long du rapport fourni?
Évaluation des dangers	
Gestion des accidents graves Évaluation des accidents graves	• Des leçons très importantes ont été tirées de Fukushima. Il n'y a aucune mention d'une comparaison des risques entre les différentes conceptions, en particulier celle du réacteur BWRX-300, sauf par le biais d'affirmations de sûreté éternelle et quasi absolue. • S'appuyant sur les leçons de Fukushima concernant les vulnérabilités particulières des réacteurs implantés sur un même site, le répondant insiste pour que la construction de tout nouveau réacteur dans la zone d'exclusion du complexe existant de quatre réacteurs de la centrale nucléaire de Darlington soit exclue pour motif que ce projet est contraire à l'intérêt public.
Protection contre le feu	• OPG devrait procéder à une évaluation approfondie des dangers associés aux incendies de combustible usé à la centrale nucléaire de Darlington.

Gestion des accidents graves Évaluation des accidents graves	• OPG doit revoir l'évaluation des risques liés à un accident d'avion militaire de grande taille à proximité des réacteurs BWRX-300. • OPG devrait procéder à une évaluation des risques liés à l'utilisation malveillante de drones sur des PRM comme le réacteur BWRX-300, même si la probabilité qu'un tel événement se produise est faible. • Les intervenants soutiennent que la faible fréquence des accidents d'avions commerciaux ne devrait pas être une raison pour éliminer ce risque. OPG doit analyser les dangers de l'entrée en collision d'un avion commercial avec le bâtiment du réacteur, avec les installations de gestion des déchets, ou avec une autre installation ou un autre bâtiment situés sur le complexe de Darlington, et les conséquences associées à un tel accident. • Le potentiel et les effets d'un accident impliquant plusieurs tranches doivent tenir compte de la relation entre les réacteurs existants de la centrale nucléaire de Darlington et les réacteurs BWRX-300 proposés. • OPG devrait effectuer une analyse complète des accidents graves en tenant compte des défis liés à l'estimation de la fiabilité du système de condenseur d'isolement passif, afin de montrer comment la conception du réacteur BWRX-300 respectera les exigences de la CCSN.
Processus d'autorisation	
Évaluation environnementale Autorisation	• Conformément aux pratiques réglementaires de la CCSN décrites dans l'EPC-2, OPG devrait être tenue de préparer un nouvel EIE contenant des renseignements de conception de haut niveau sur le réacteur BWRX-300. • La CCSN devra s'assurer que toutes les conditions fixées par la CEC sont pleinement mises en œuvre avant qu'un permis de construction ne soit envisagé. • La CCSN devra exiger qu'OPG publie, sous forme de tableau, toutes les mesures prises pour mettre en œuvre chaque condition et chaque sous-condition

	applicables de la CEC, avec des liens vers les documents appropriés détaillant comment la mise en œuvre a été réalisée. Le personnel de la CCSN devra certifier que les mises en œuvre ont été réalisées de manière satisfaisante ou imposer qu'elles soient refaites.
Aménagement du territoire Autorisation	• La CCSN devrait demander à son personnel d'examiner les lignes directrices provinciales actuelles et prévues en matière d'aménagement du territoire en vertu de la *Loi sur les zones de croissance* et d'autres indications de l'intention provinciale de continuer à augmenter la densité dans cette zone, afin de veiller à la compatibilité de l'utilisation des sols à proximité des principales installations, y compris les installations de production d'énergie. Il convient d'accorder une attention particulière à la densité et à la croissance de la population autour des centrales nucléaires, ainsi qu'aux effets de la production d'énergie nucléaire nouvelle et supplémentaire sur la mise en œuvre des mesures d'urgence. • Compte tenu des récents changements législatifs en Ontario ouvrant des sections de la ceinture de verdure à des projets d'aménagement, la CCSN devrait exiger qu'OPG examine la façon dont la croissance imprévue de la densité de la population dans la région de Durham est prise en compte dans la planification d'urgence pour le site du PNCND. • La CCSN doit exercer sa compétence et s'acquitter de la compétence constitutionnelle fédérale en matière d'approbation des sites nucléaires. Toute décision d'implantation doit garantir la protection du public et de l'environnement pendant la durée de vie prévue du nouveau projet nucléaire. Cette décision doit également tenir compte des changements dans l'utilisation des terres, la densité de population, le climat et les facteurs environnementaux. Aucune mesure réglementaire ultérieure, autre que l'annulation du permis, ne peut protéger adéquatement le public si un site inapproprié est sélectionné.

Évaluation environnementale Autorisation	• Comme mentionné, le réacteur BWRXT sélectionné ne faisait pas partie des réacteurs pris en compte dans l'EIE ou l'EPC d'origine. Bien qu'OPG affirme que le réacteur BWRXT n'est pas fondamentalement différent de ceux envisagés précédemment, il s'agira du premier PRM en Amérique du Nord. Cela ne justifie-t-il pas une nouvelle EE pour garantir que la technologie est pleinement conforme aux conditions et paramètres environnementaux actuels? • Pour clarifier, le gouvernement du Canada a délégué cette détermination à la CCSN. Qu'est-ce qui détermine ce qui est « fondamentalement différent » entre les technologies de PRM, et comment la CCSN en est-elle arrivée à cette décision? • Veuillez expliquer le raisonnement derrière l'élaboration de l'EPC avant de sélectionner une technologie de réacteur particulière. Cela ne semble pas être la meilleure méthode pour garantir que le réacteur choisi soit écologiquement et physiquement compatible avec le site du PNCND. Pourquoi OPG a-t-elle adopté cette approche de sélection?
Codes et normes réglementaires	• L'approche de l'EPC utilisée dans le document est basée sur une méthodologie américaine. Il est à noter qu'au moins cinq documents « NUREG », c'est-à-dire des publications préparées par le personnel de la US Nuclear Regulatory Commission, ont été mentionnés dans le document. Il aurait été préférable de faire référence à des documents qui s'appliquent directement à l'environnement réglementaire canadien, mais comme il s'agit de la première évaluation préliminaire d'un PRM, il n'y a aucun exemple canadien à citer. Il est important que l'adoption de toute méthodologie repose sur une justification solide applicable au contexte canadien. Cette approche devrait contribuer à garantir que le cadre de réglementation du Canada est bien défini et efficace pour superviser la mise en œuvre des petits réacteurs modulaires (PRM). Si les PRM doivent devenir un élément important de la solution du Canada pour produire de l'électricité à

	faible émission de carbone et si le Canada doit jouer un rôle de chef de file dans tout ce qui concerne les PRM, particulièrement en matière de sûreté, il semble logique que les promoteurs canadiens de PRM et l'organisme national de réglementation continuent d'avancer vers l'élaboration de méthodes d'évaluation conçues pour répondre à l'environnement réglementaire canadien.
Évaluation environnementale	• Outre la question de savoir si le réacteur BWRX-300 présente ou non une « différence fondamentale » avec d'autres technologies de réacteur, il existe d'autres arguments d'intérêt public en faveur d'une nouvelle EE. Depuis l'achèvement de l'EE du PNCND, la législation fédérale en matière d'EE a changé à deux reprises. De nouvelles espèces en péril ont été inscrites et sont présentes à proximité du site de Darlington. De plus, à l'instar des processus décisionnels publics provinciaux concernant ce type de détermination, le besoin sous-jacent de ces projets et les prévisions en matière de demande énergétique et de paniers énergétiques ont notablement évolué depuis 2006. Il s'est écoulé 12 ans avant la révision de l'EIE (de 2010 à 2022), et l'EIE initiale a maintenant 14 à 17 ans.
Opérations	
Fonctionnement du réacteur	• Quelle est la quantité d'eau utilisée dans ce processus et s'agit-il de l'eau du lac? • Qu'arrive-t-il à l'eau une fois qu'elle a été utilisée comme réfrigérant ou comme modérateur? • Lors de discussions antérieures avec le personnel d'OPG et de la CCSN concernant la technologie du réacteur BWRXT, on nous a dit qu'il n'y avait pas « d'eau usée » et que le processus se déroulait en boucle continue. Ce concept peut-il être approfondi davantage? Le processus ne génère-t-il pas d'eaux usées?
Fonctionnement du réacteur	• Alors que la section 3.1 fournissait un résumé raisonnable des caractéristiques générales du réacteur, ni cette section du rapport ni aucune autre section ne fournit d'indication sur la combustion. Or, il est

	important de connaître le taux de combustion attendu pour anticiper la composition et les propriétés du combustible usé, mais ces données ne sont pas fournies.
Doses radiologiques	
Inventaire du terme source	• Aucune comparaison des termes sources entre quatre réacteurs n'a de sens, en l'absence de renseignements sur les réacteurs, leurs vulnérabilités, les scénarios d'accidents, les lieux de rejet et les fréquences de rejet. • Le terme source découlant de l'exploitation normale à partir d'un certain nombre de points de rejet a été fourni (également recommandé par la NRC dans son examen du NEI-10), certaines entrées étant toutefois manquantes. Le terme source provenant des émissions régulières a été fourni, sans fournir aucun renseignement sur sa nature (continue ou par bouffées avec leur fréquence, le cas échéant), sur les sources qu'il inclut, sur le fondement de sa dérivation, sur les hypothèses analytiques ou sur les outils.
Effets sur les humains	• Nous comprenons que l'eau interagit avec les grappes radioactives dans la conception du réacteur BWRX-300. L'EPC a-t-elle pris en compte les effets sur les humains et l'environnement dans le cas où l'eau radioactive interagirait avec l'environnement? Nous comprenons que l'interaction de l'eau avec les grappes nucléaires est unique à cette conception.
Effets sur les humains	• La section 4.13 traite de trois paramètres associés aux rejets de contaminants radioactifs dans l'air et dans l'eau qui entraînent des doses au public se situant en dehors des paramètres évalués dans l'EIE, et note que « Les trois paramètres associés aux rejets radioactifs dans l'air et dans l'eau ont nécessité une étude distincte pour évaluer leurs effets et les comparer à ceux qui ont été évalués dans l'EIE… ». La référence [14] « DN Dose Calculations for Gap Analysis », par A. Amendola et R. Parker, a été demandée le 23 février et reçue le 10 mars, ce qui n'a malheureusement laissé que peu

	de temps pour l'examen par nos experts. Les documents cités en référence ne sont pas disponibles en ligne et il peut y avoir un délai important entre la demande et la réception du document, dans les cas où le document est fourni, ce qui pose problème dans tous les examens, y compris dans ce cas. • La section 5.3.6 « Rayonnement et radioactivité » formule un énoncé important selon lequel le rayonnement et la radioactivité sont considérés comme une voie d'enchaînements d'effets vers d'autres composantes environnementales, mais ne fournit aucune documentation à l'appui.
Inventaire du terme source	• [Le tableau 5 de l'EIE] présenté dans les documents d'EPC et d'EIE indique que le réacteur BWRX-300 présente des niveaux de rejets plus élevés pour certains isotopes par rapport aux autres réacteurs évalués, même s'il est indiqué que la dose globale des quatre PRM proposés est inférieure à celle figurant dans l'EIE. Il serait utile d'obtenir des détails sur la façon dont la dose a été calculée ou de fournir un sommaire des doses des groupes de radionucléides. • Le NEI invite, par exemple, à expliquer plus en détail pourquoi le réacteur BWRX-300, bien qu'il produise moins d'électricité que les autres réacteurs évalués, devrait avoir des rejets annuels d'iode radioactif dans l'air plus élevés et une composante de déchets solides plus importante dans les rejets d'iode radioactif, comme indiqué dans les documents d'EPC et d'EIE. Ce point s'applique particulièrement aux préoccupations du public, compte tenu de la nécessité de distribuer des pilules d'iode en cas de rejet accidentel. Une analyse plus approfondie de tous les termes sources des effluents rejetés dans l'air et dans l'eau aurait été bénéfique.
Garanties	

Non-prolifération	• Quelles sont les considérations en matière de sécurité mondiale liées à cette technologie et qui en est responsable? D'où proviendrait le combustible?
Déchets	
Déclassement	• Coûts de déclassement • Responsabilité du déclassement
Déclassement	• En l'absence d'un plan de déclassement conçu spécifiquement pour un réacteur BWRX-300, il n'est pas possible de déterminer si la technologie choisie par OPG est conforme à l'EIE. Nous demandons à la CCSN d'exiger qu'OPG présente un plan de déclassement détaillé et non théorique pour le réacteur BWRX-300 avant toute autre évaluation du site du PNCND.
Déclassement Inventaire et stockage des déchets	• Il est décevant qu'OPG n'ait pas créé de plan de déclassement, ni même de stratégie préliminaire pour le réacteur BWRXT ou le site du PNCND. OPG indique sur son propre site Web : « Il est impératif que des plans préliminaires de déclassement (PPD) soient mis en place pour les installations de production d'OPG. » • Il est irresponsable de démarrer un projet de cette envergure sans une stratégie de déclassement qui constitue une exigence pour la plupart des grands projets sur les terres de la Couronne. Veuillez fournir la stratégie de déclassement du réacteur BWRXT-300 dès qu'elle sera disponible. Il est recommandé qu'une stratégie soit mise en œuvre avant toute autre préparation d'un emplacement. • Il est préoccupant de constater que les déchets solides qui devraient être générés par la technologie du réacteur BWRXT soient encore plus élevés que ceux initialement mentionnés dans l'EIE. Il n'existe toujours pas de plan à long terme pour la gestion et l'entreposage sûrs des déchets nucléaires en Ontario, et les Nations autochtones doivent vivre avec le risque d'un entreposage temporaire de ces déchets excédentaires sur leur territoire visé par un traité, à l'IGDD, sans avoir jamais donné leur consentement. Cela

	devrait être pris en compte avant la construction des réacteurs restants.
Pratiques Volume de déchets produits	• L'affirmation du tableau 3, section 3.6, selon laquelle « aucun changement n'est apporté à la description des pratiques de gestion des déchets » est au mieux trompeuse. En dépit du faible nombre de renseignements fournis dans ces documents sur le combustible ou sur les déchets, ou encore sur leurs caractéristiques, on sait que les déchets auront des caractéristiques différentes (par exemple, un taux de combustion différent) et des dimensions différentes de celles des déchets CANDU, qui sont assujettis à toutes les pratiques de gestion des déchets en Ontario à ce jour. Le document peut donc analyser la situation pour dire qu'il n'y a « aucun changement à la description » des pratiques de gestion des déchets, mais cette affirmation ne serait pertinente que si ladite « description » concernait des pratiques de gestion autres que celles des déchets actuels et passés générés par les réacteurs d'OPG. Cette démarche d'analyse s'avère caractéristique de l'approche problématique adoptée par la CCSN, dans le cadre de laquelle des comparaisons sont effectuées avec un rapport inadéquat portant sur des réacteurs théoriques et datant d'il y a plus de dix ans, plutôt que de décrire le réacteur actuellement proposé de manière suffisamment détaillée, y compris en ce qui concerne les activités associées et auxiliaires, notamment et plus particulièrement la production et la gestion des déchets. • La section 4.1.4 « Déchets solides et combustible usé » indique a) que l'activité volumétrique des déchets solides (Bq/m^3) générée par l'exploitation du réacteur BWRX-300 est supérieure à ce qui a été évalué dans l'EIE, mais que cette augmentation sera prise en compte par le biais d'un changement d'équipement, b) que le poids du château de transport utilisé pour transporter le combustible usé du réacteur BWRX-300 sur le site (113 tonnes) est plus lourd que le château évalué dans

	l'EIE, mais que cette augmentation sera prise en compte par le biais d'une amélioration des itinéraires de transport, et ensuite qu'il n'y a aucune incidence sur les conclusions de l'EIE, compte tenu de ces mesures d'atténuation. Les détails mentionnés sur les déchets et les conteneurs de déchets sont insuffisants, et cette réponse est bien trop simpliste pour être crédible. Il s'agit là d'un autre exemple des raisons pour lesquelles un examen complet du projet au moyen d'une EE complète est nécessaire. • À la section 5.2.8, il est affirmé que le volume de DRFMA et de combustible usé produit par le déploiement des réacteurs BWRX-300 sont inférieurs à celui des réacteurs évalués dans l'EIE et que la superficie requise pour l'entreposage à sec du combustible usé est inférieure à celle évaluée dans l'EIE de 2009. Toutefois, on ne fournit aucun renseignement réel ni sur le combustible, ni sur les différents déchets, ni sur les systèmes d'entreposage à sec. Le document devrait inclure des données justificatives, ou au moins des liens directs vers des documents comprenant de telles données. • La section 5.2.13 « Phase d'exploitation et d'entretien » comprend des déclarations selon lesquelles la piscine de combustible usé du réacteur BWRX-300 est plus petite que celle évaluée dans l'EIE, mais que ce changement sur le plan de la capacité est pris en compte en raison de la possibilité de déplacer le combustible usé plus tôt. On y précise également qu'on prévoit la disponibilité d'installations d'entreposage du combustible usé une fois que le réacteur BWRX-300 sera mis en service et que les conséquences de la dose découlant d'une activité plus élevée seront gérées grâce à une conception adéquate du blindage et des fûts d'entreposage. Toutefois, ces déclarations ne sont liées à aucune référence et aucun renseignement justificatif n'est fourni. Plusieurs questions se posent, notamment : Pourquoi le combustible usé sera-t-il transporté plus tôt, combien de temps plus tôt et vers où? À quels fûts

Inventaire et entreposage des déchets	d'entreposage fait-on référence dans la déclaration selon laquelle l'activité plus élevée sera gérée grâce à une conception adéquate du blindage et des fûts d'entreposage? Parle-t-on d'un entreposage à sec provisoire, de transport ou de fûts en entretien perpétuel? • La figure 5 de la section 3.2 sur le plan d'implantation de la centrale ne montre pas l'emplacement des différentes installations d'entreposage des déchets radioactifs qui sont toutefois répertoriés à la page 17, sans que leurs emplacements ne soient indiqués et sans qu'aucune description adéquate ne soit fournie. • La section 3.4 indique que le combustible usé et les déchets de faible et moyenne activité seront entreposés sur le site, mais le rapport n'inclut pas de description détaillée des systèmes de gestion des déchets liquides et radioactifs, bien qu'une description générique se trouve dans les sections ultérieures du rapport. • La section 3.6 indique : « Aucun changement n'est apporté à la description des pratiques de gestion des déchets en Ontario; le processus décrit dans la présente section s'applique au déploiement des réacteurs BWRX-300; les DRFMA seront également produits, traités sur le site et expédiés vers une installation autorisée d'OPG hors site. » Bien que cela puisse s'avérer vrai, ces déclarations très générales n'offrent qu'une base limitée pour un examen et ne remplacent pas une description et une analyse détaillées des déchets radioactifs. • La section 3.7 indique : « Une installation d'entreposage à sec sur le site servira à gérer le combustible usé du réacteur BWRX-300 », sans qu'aucun renseignement supplémentaire ne soit fourni, concernant par exemple : la durée pendant laquelle le combustible sera entreposé dans des conteneurs de stockage à sec; l'état du combustible après cette période; l'existence de dispositions pour le reconditionnement des assemblages fissibles défectueux.

	• Le tableau 4 affirme également : « La description de l'installation d'entreposage à sec sur le site dans l'EIE est applicable au déploiement des réacteurs BWRX-300 ». Toutefois, cette affirmation n'est étayée par aucune description détaillée réelle de l'installation d'entreposage à sec sur le site et nécessiterait une comparaison avec une description détaillée des installations d'entreposage à sec pour le parc de réacteurs conceptuels de 2009. Il faudrait au minimum une comparaison du « Plan de gestion des déchets radioactifs » du réacteur BWRX-300 (dont la publication est prévue au premier trimestre 2023) avec le document d'assistance technique sur les déchets nucléaires de 2009, bien qu'à ce stade, nous ne puissions pas être sûrs que le premier contiendra suffisamment de détails et de renseignements sur les installations d'entreposage à sec. • Le déploiement des réacteurs BWRX-300 comportera le transport des DRFMA hors site vers une installation autorisée d'OPG. La description de l'installation d'entreposage à sec sur le site dans l'EIE s'applique au déploiement des réacteurs BWRX-300. Encore une fois, on ne peut pas dire grand-chose de ces déclarations en l'absence de documentation supplémentaire. • Le rapport indique à la section 3.7 : « Selon les estimations, le volume de DRFMA et de combustible usé produit par le déploiement des réacteurs BWRX-300 au cours des 60 années d'exploitation est inférieur à celui des réacteurs plus grands évalués dans l'EIE. » Cette affirmation n'est pas cohérente avec les conclusions présentées dans le document d'expert Nuclear waste from small modular reactors (Krall et coll., 2022)[13]. Il s'agit là d'un point essentiel : les auteurs du rapport disposent-ils de renseignements réels pour étayer cette déclaration discutable? • La section 5.7.2 « Défaillances et accidents liés à la radioactivité et au transport » décrit les déchets radioactifs du réacteur BWRX-300 comme contenant des proportions de radionucléides différentes de celles

	des déchets évalués dans l'EIE de 2009, notant que la masse de combustible placée dans le château de transfert de combustible usé est différente de celle qui avait été évaluée dans l'EIE. Cette section indique que l'évaluation des défaillances et des accidents radiologiques mettant en cause des déchets radioactifs et du combustible nucléaire usé a été analysée de nouveau pour le réacteur BWRX-300 « selon le même scénario que celui examiné dans l'EIE » et poursuit en disant que la réévaluation a donné lieu à la même conclusion, ne fournissant toutefois ni données, ni analyse, ni documentation pour étayer ladite conclusion. Des renseignements supplémentaires sont donc requis pour cette réévaluation ainsi que pour les autres réévaluations d'accidents (par exemple, les accidents de transport ou les dommages causés au combustible usé). En outre, lors de l'évaluation de la probabilité et des conséquences des accidents, les quatre réacteurs BWRX-300 proposés doivent être considérés comme un système, ce qui ne peut être déterminé sur la base des renseignements très limités fournis. L'une des leçons tirées de l'accident de Fukushima est qu'il peut y avoir des inconvénients à avoir des réacteurs reliés par les mêmes systèmes de soutien. Les documents d'OPG ne permettent pas clairement de savoir si les systèmes de chaque tranche de réacteur seront indépendants ou combinés. De plus amples détails sont nécessaires afin d'évaluer ou de réviser les affirmations essentielles sur l'exposition du public.
Déclassement	• On a fait remarquer les effets à long terme du projet sur les terres et on a demandé qui en serait propriétaire après leur « abandon » et si elles devenaient des terres de la Couronne.
Volume de déchets produits	• OPG affirme que le réacteur BWRX-300 générera de plus petits volumes de déchets que les modèles de réacteur examinés dans l'EIE initiale, et soutient que ce facteur indique un impact environnemental plus limité[8].

	• Cependant, ces déchets ont des niveaux de radioactivité plus élevés que les autres déchets CANDU du complexe de Darlington. Néanmoins, l'EIE et l'EPC de 2022 ne permettent pas de déterminer clairement comment cette activité plus élevée sera prise en compte lors de l'évaluation des effets et des exigences de gestion du combustible usé des réacteurs BWRX-300.

Submission to the CNSC by the
Canadian Coalition for Nuclear Responsibility

Regarding the Darlington New Nuclear Project (DNNP)
and the documents provided in support of
siting one of four BWRX-300 reactors
at the existing Darlington NGS site

EIS Environmental Impact Statement
PPE Plant Parameter Envelope

Submitted March 20 2023

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Part 1. Much Ado About Siting.

by Gordon Edwards, Ph.D.

Part 1. Much Ado About Siting, by Gordon Edwards

1.1 The original Darlington New Nuclear Project (DNNP-1)

Forty-six years ago, the Ontario government announced its decision to build four new CANDU nuclear reactors at the Darlington site. CANDU reactors are pressurized heavy water reactors. Heavy water is used both as coolant (to cool the fuel) and moderator (to slow down the neutrons).

That event marked the end of an era of rapid nuclear power growth in North America. After that date, from 1978 to 2008, the nuclear industry on this continent endured a three-decades-long drought in domestic reactor sales.

It seemed the drought might be ending fifteen years ago when, in March 2008, Infrastructure Ontario issued a competitive Request for Proposal (RFP) for a new nuclear power station in Ontario. Four vendors were invited to participate in the RFP process: AECL (the ACR-1000), Areva (the EPR), Westinghouse (the AP1000), and GE-Hitachi (ESBWR – Economic Simplified Boiling Water Reactor). These are all water-cooled reactors.

GE-Hitachi chose not to participate in the RFP process. Its reactor, the ESBWR, was the only Boiling Water Reactor design in the mix. The three vendors that remained in competition were all offering pressurized water reactors (PWRs using light water as coolant and moderator, or PHWRs using heavy water for those two functions).

In 2009, Ontario Power Generation (OPG) produced an Environmental Impact Statement (EIS) for the Darlington New Nuclear Project (DNNP). **The utility decided that the new reactors, if approved, would be co-located with four existing CANDU reactors that were already on the Darlington site.** Along with the EIS, the utility produced a Plant Parameter Envelope (PPE) document. **No choice of reactor model had yet been made**.

The Darlington New Build of 2008-2009 would have constituted the first order for new power reactors in North America since 1977, had it come to pass. But it didn't. The project underwent a full Environmental Assessment (EA) review in 2011, and Ontario Power Generation (OPG) even received a licence from the Canadian Nuclear Safety Commission (CNSC) to prepare the Darlington site for the new reactors.

Then, in 2014, the Ontario government abruptly cancelled the order for the first two of the four new reactors. Queen's Park balked at the exorbitant price tag, rumoured to be in the ballpark of $14 billion per unit. In the wake of that decision, none of the planned new reactors found their way into OPG's long-term energy plan.

However, OPG insisted that the DNNP New Build project was deferred, not cancelled. The utility ensured that the CNSC licence permitting it to prepare the Darlington site to accommodate new reactors would remain in force until 2022. Then, in 2020, OPG saw to it that the site preparation licence was extended even beyond 2022.

1.2 The current Darlington New Nuclear Project (DNNP-2)

Today OPG wants to use that 12-year old licence to prepare the Darlington site for a smaller reactor that was never under consideration in the first go-around. It is a previously unbuilt General-Electric-Hitachi (GEH) Boiling Water reactor design, the BWRX-300, touted as one member of a gang of "Small Modular Nuclear Reactors" (SMRs or SMNRs).

OPG must now persuade CNSC that the old site preparation licence is still valid, despite altered circumstances, and can be used for this new, unforeseen purpose. To do this, OPG has dusted off two documents that were written in support of the original Darlington New Build Project conceived 15 years ago, involving three completely different reactor designs.

Those documents are:

(1) OPG's 2009 Environmental Impact Statement (EIS-2) report for the original Darlington New Build Project; updated version October 2022.

(2) OPG's Plant Parameter Envelope (PPE-2) report; updated October 2022 (revision #5).

OPG has modified these two pre-Fukushima documents by adding some data relevant to the BWRX-300, without describing the reactor design in any meaningful detail. In the modified PPE, for example, the description of the BWRX-300 reactor design is limited to just three-quarters of a page and one diagram– the very last two pages of PPE-2.

The 2011 EA Report noted that, following a request for OPG to consider other reactor designs, "a revised version of the plant parameter envelope was submitted by OPG on November 30, 2010. OPG noted that a similar **assessment was not performed for a boiling water reactor as insufficient information was available** to allow OPG to do so."

CCNR also finds insufficient information available in the aforementioned documents for our reviewers to do a meaningful analysis bearing on the site preparation licence for the boiling water reactor BWRX-300. Indeed, it appears to us that this entire exercise may be merely a formality – a prelude before CNSC grants OPG a licence to construct, which seems to be taken by all players as a forgone conclusion.

Just one day after Canada's Infrastructure Bank gave OPG a $970-million "low-interest loan" to develop the BWRX-300 at Darlington, the Minister of Natural Resources Canada boasted to a Washington audience that it would soon be Canada's first commercial SMNR.

Coincidentally, the Minister of Natural Resources (NRCan) is designated as the "responsible minister" in the Canadian Nuclear Safety and Control Act. That's the law establishing CNSC as an agency of the crown, whose mandate is to protect the health and safety of Canadians and the environment from unreasonable radiation exposures, and to disseminate objective scientific information on nuclear matters.

Although the International Atomic Energy Agency (IAEA) has urged that nuclear regulators not be linked to government agencies that promote the nuclear industry, that sensible suggestion does not seem to have been implemented in Canada.

CNSC president Rumina Velshi has publicly lauded the speed at which the BWRX-300 licensing is proceeding, saying that Canada will be the first western country to approve an SMNR built for the grid. She has stated publicly that the CNSC is there to protect people against radiation, not against progress.

CNSC has not yet approved the reactor. However, OPG held a ground-breaking ceremony at Darlington in December 2022. So the licence to construct seems to be a foregone conclusion – to NRCan, to CNSC, and to OPG. In 2017, CNSC freely admitted that from the year of the agency's inception, in 2000, it has never refused to grant a licence for any major nuclear facility.

Government, regulator and industry are already on board. So what is the intended purpose of this review?

On page 5 of the PPE-2 we read: "The concept of a PPE was developed in the United States for use in the Early Site Permit (ESP) process to resolve siting and environmental issues at a particular site **before a reactor design has been chosen**."

However, we have now arrived at the point where a reactor design has been chosen. So the PPE-2 document is actually moot and irrelevant– filled as it is with extraneous information about the three original candidate reactors that have since gone by the wayside. Adding sparse numerical data about the BWRX-300 – data supplied by the vendor, without any detailed design information to allow others to verify or to challenge those data, hardly constitutes a meaningful review process.

Continuing from page 5 of PPE-2: “The PPE concept is also consistent with the Canadian Nuclear Safety Commission (CNSC) statement in Revision 1 of the CNSC Information Document INFO-0756 [R-12]; ‘An application for a Licence to Prepare Site does not require detailed information or determination of reactor design; however, **high level design information is required for the environmental assessment that precedes the licensing** decision for a Licence to Prepare Site.’”

It is crystal clear that “high level design information” about the BWRX-300 reactor has never been made available to the public, nor to the Joint Review Panel that reviewed the original EIS and produced the 2011 EA Report. OPG just wants the site approval.

That information vacuum and accompanying pressure to accept the sleight-of-hand of replacing one reactor for three others, inspired the title of this report – Much Ado about Siting.

According to CCNR, both documents – the PPE-2 and the EIS-2 – cannot be considered satisfactory surrogates for the real thing: an actual honest-to-goodness environmental impact assessment of the BWRX-300 reactor itself, sited at Darlington or elsewhere.

The present report, Much Ado About Siting, is based on the professional services of Dr. Gordon Edwards and Dr. Sunil Nijhawan. The report is a critical commentary by the Canadian Coalition for Nuclear Responsibility (CCNR) on the use of the afore-mentioned documents as the basis for a decision-making procedure regarding the siting of up to four new BWRX-300 reactors very close to the four existing co-located CANDU reactors.

Part 1, by Dr. Edwards, deals with the siting question directly, while Part 2, by Dr. Nijhawan, deals with the OPG surrogate documents, especially PPE-2.

In the next two sections it will be shown that the construction of the first of these new BWRX-300 reactors (1 of 4) is intended to take place well within the exclusion boundary of the existing Darlington reactors. CCNR believes that this should not be allowed.

Recommendations:

1. CCNR’s main contention is that the present procedure lacks validity given the realities of the post-Fukushima world and the paucity of information provided about the BWRX-300 boiling water reactor – a type of reactor that was never considered in the original EIS.

2. Drawing on the lessons of Fukushima regarding the special vulnerabilities of co-located reactors, CCNR urges that construction of any new reactors within the exclusion zone of the existing DNGS four-reactor complex must be ruled out as against the public interest.

3. In keeping with the CNSC regulatory practice as outlined in PPE-2, OPG should be required to prepare a new environmental impact statement with high level design information about the BWRX-300.

4. The EIS for the BWRX-300 must provide a sufficiently detailed description of the plant's design to allow for independent verification of numerical values that are assigned to various parameters such as source terms. It should not be accepted as a foregone conclusion that the Darlington site is necessarily suitable as compared with other sites.

1.3 Radioactive Emissions from Darlington New Build

Let's consider one of the numbers missing from PPE-2, the total atmospheric release of radioactive noble gases (last entries in tables 4.1 and 4.2). We know boiling water reactors tend to release more radioactive gases into the atmosphere than pressurized water reactors.

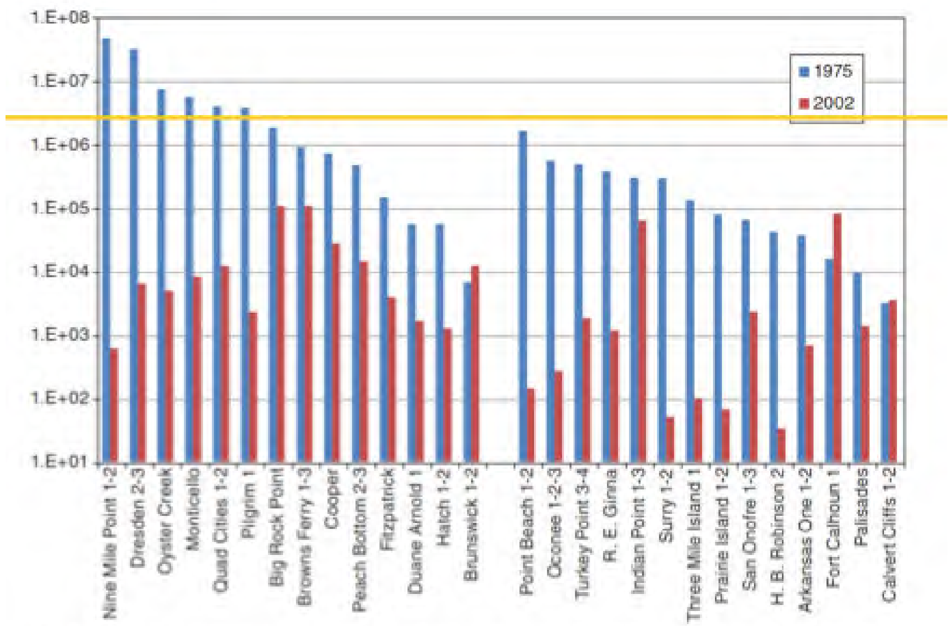


FIGURE 2.5 Comparison of atmospheric releases of noble gases for selected BWRs (left) and PWRs (right) in the United States. The units on the vertical scale are in gigabecquerels (GBq = 0.03 Ci). SOURCE: Data from the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

It is troubling that OPG would omit listing the total noble gas emissions in both tables of PPE-2. After all, the BWRX-300 is the only boiling water reactor ever considered in the context of this pre-licensing process.

But even if the appropriate numbers had been given, it would not be enough. You cannot judge the environmental impact of radioactive noble gas emissions just by the number of becquerels released each year. These gases are considerably heavier than air. They have to be released at a great altitude to minimize the gamma dose ("sky shine") to people and animals on the ground below.

But, the BWRX-300 reactor is underground and the building does not reach as high (35 m) as any of the other reactors previously considered in the PPE (typically around 48 m). So the possibility of a near-ground release cannot be excluded. That would be problematic.

There are a great many other considerations surrounding the important topic of radioactive releases. Dr. Frank Greening discussed many such aspects authoritatively in the original DNNP EA hearings of 2011. With his permission, Dr. Greening's original work on this subject is attached as Annex D: "Radioactive Emissions from Darlington New Build." His work should be considered as an integral part of this report.

Dr. Greening's work was originally submitted by le Mouvement Vert Mauricie, along with other reports by Dr. Gordon Edwards and Dr. Michel Duguay, in the original DNNP EA Hearings of 2011. The entire MVM submission is found at www.ccnr.org/MVM_final.pdf

1.4 Fulfilling the JRP conditions

The EIS-2 and PPE-2 documents have been modified by OPG in an effort to include some aspects of the newly chosen design, the GE-Hitachi Boiling Water reactor called BWRX-300. However, very little information about the actual reactor design is given.

Numbers are provided by the vendor without any clear evidence of how they were derived. These numbers are used by OPG to bolster its contention that the GEH BWRX-300 reactor, although never an object of scrutiny during the 2011 EA review, is nevertheless within the scope of that review and therefore acceptable.

As noted earlier, an EA review of the EIS was carried out in 2011. Public hearings were held before a three-person Joint Review Panel (JPR). Two of the Panel members were drawn from the Environmental Assessment Agency and the third from the Canadian Nuclear Safety Commission (CNSC).

The JPR recommended that the EIS be accepted and the project be approved, subject to a large number of important conditions. Approval is given "provided the mitigation measures proposed and commitments made by OPG during the review, and the JRP's recommendations, are implemented."

Those conditions are reproduced in Annex A as a ten-page document.

A great many of the JRP conditions are very specific to the Darlington site. Not only the licensee OPG, but also the regulator CNSC is required to act. Some of the conditions apply "Prior to Site Preparation", some apply "During Site Preparation", some apply "Prior to Construction", and so forth. Here are some examples:

• "CNSC [shall] require OPG to conduct a comprehensive soils characterization program." [Rec. 2];

• "CNSC [shall] require OPG to develop a follow-up and adaptive management program for air contaminants [and] must require OPG to develop an action plan acceptable to Health Canada for days when there are air quality or smog alerts." [Rec. 8]

• "CNSC [shall] require OPG to undertake a detailed site geotechnical investigation prior to commencing site preparation activities." [Rec. 10]

• "CNSC [shall] require OPG to perform a thorough evaluation of site layout opportunities before site preparation activities begin, in order to minimize the overall effects on the terrestrial and aquatic environments and maximize the opportunity for quality terrestrial habitat rehabilitation."

Recommendations:

5. CNSC shall ensure that all of the conditions laid down by the JRP are fully implemented before a construction licence is considered.

6. CNSC shall require OPG to publish, in tabular form, all measures taken to implement each applicable JRP condition and subcondition, with links to appropriate documents detailing how the implementation was carried out. CNSC staff shall certify that the implementations have been satisfactorily realized or that they must be redone.

A particularly important condition is the one dealing with geotechnical aspects of the site:

Recommendation # 38 (Section 5.9):
The Panel recommends that the Canadian Nuclear Safety Commission require that the geotechnical and seismic hazard elements of the detailed site geotechnical investigation to be performed by OPG include, but not be limited to:

Prior to site preparation:

- demonstration that there are no undesirable subsurface conditions at the Project site. The overall site liquefaction potential shall be assessed with the site investigation data; and

· confirmation of the absence of paleoseismologic features at the site and, if present, further assessment to reduce the overall uncertainty in the seismic hazard assessment during the design of the Project must be conducted.

During site preparation and/or prior to construction:

· verification and confirmation of the absence of surface faulting in the overburden and bedrock at the site.

Prior to construction:

· verification of the stability of the cut slopes and dyke slopes under both static and dynamic loads with site/Project-specific data during the design of the cut slopes and dykes or before their construction;
· assessment of potential liquefaction of the northeast waste stockpile by using the data obtained from the pile itself upon completion of site preparation;
· measurement of the shear strength of the overburden materials and the dynamic properties of both overburden and sedimentary rocks to confirm the site conditions and to perform soil-structure interaction analysis if necessary;
· assessment of the potential settlement in the quaternary deposits due to the groundwater drawdown caused by future St. Marys Cement quarry activities; and
· assessment of the effect of the potential settlement on buried infrastructures in the deposits during the design of these infrastructures.

OPG contends that BWRX-300 should be accepted as an acceptable surrogate for the three reactor designs that were indeed considered by the Joint Review Panel (JPR), and that PPE-2 and EIS-2 be accepted as acceptable surrogates for the original EIS-1 and EIS-2.

The Canadian Coalition for Nuclear Responsibility does not share this view, as already indicated. Reasons for the CCNR position will be laid out in the following sections.

1.4 Infiltrating the Exclusion Zone

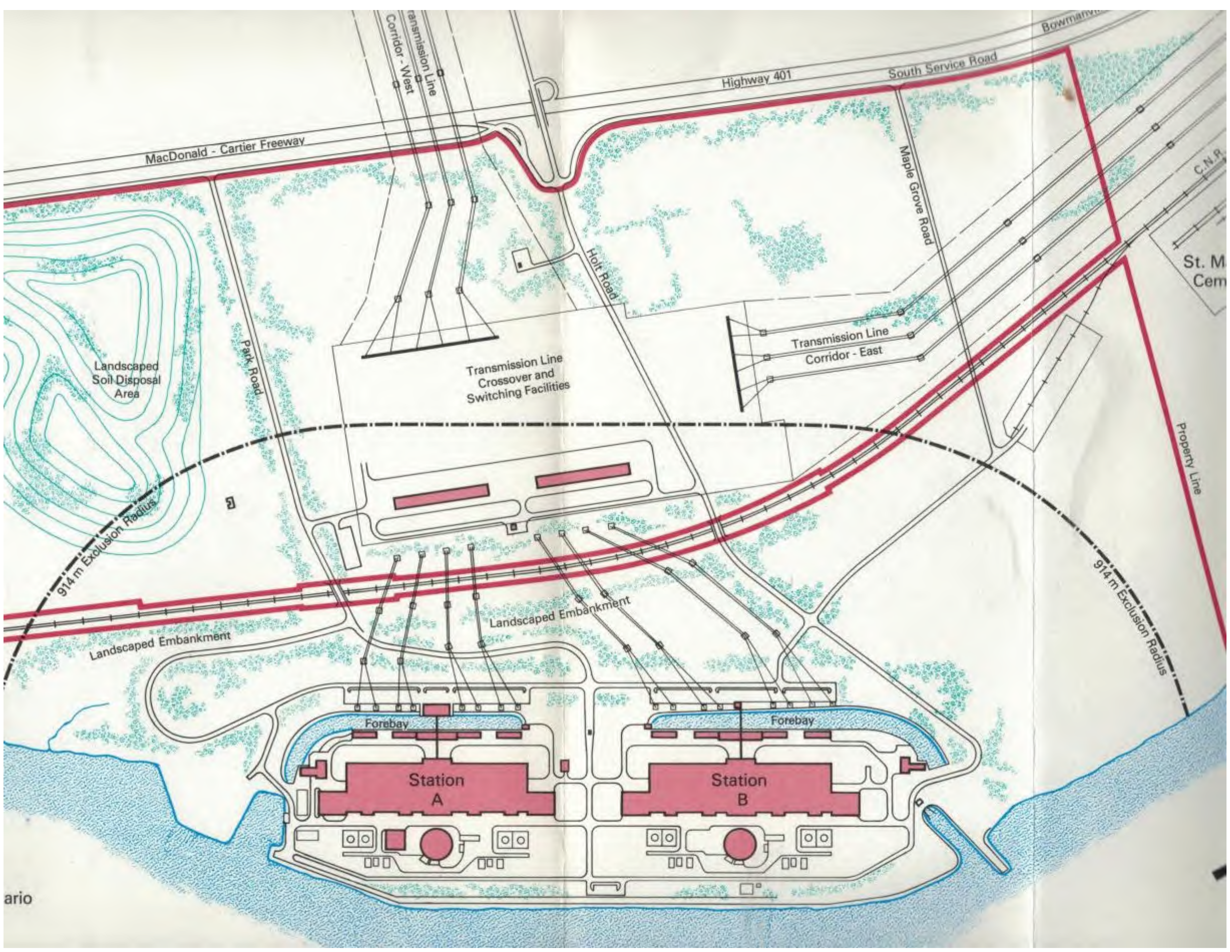
To maintain that the BWRX-300 has essentially been approved "in absentia" by the Joint Review Panel's Environmental Assessment Report of 2011, is unacceptable given
(1) the lack of detailed consideration of the idiosyncrasies of the new reactor choice
(2) the proximity of the Darlington site to Lake Ontario, and
(2) the lessons of Fukushima, which were not available to OPG, the CNSC, the JPR or the Canadian public at the time when the original EIS, PPE and EA report were drawn up.

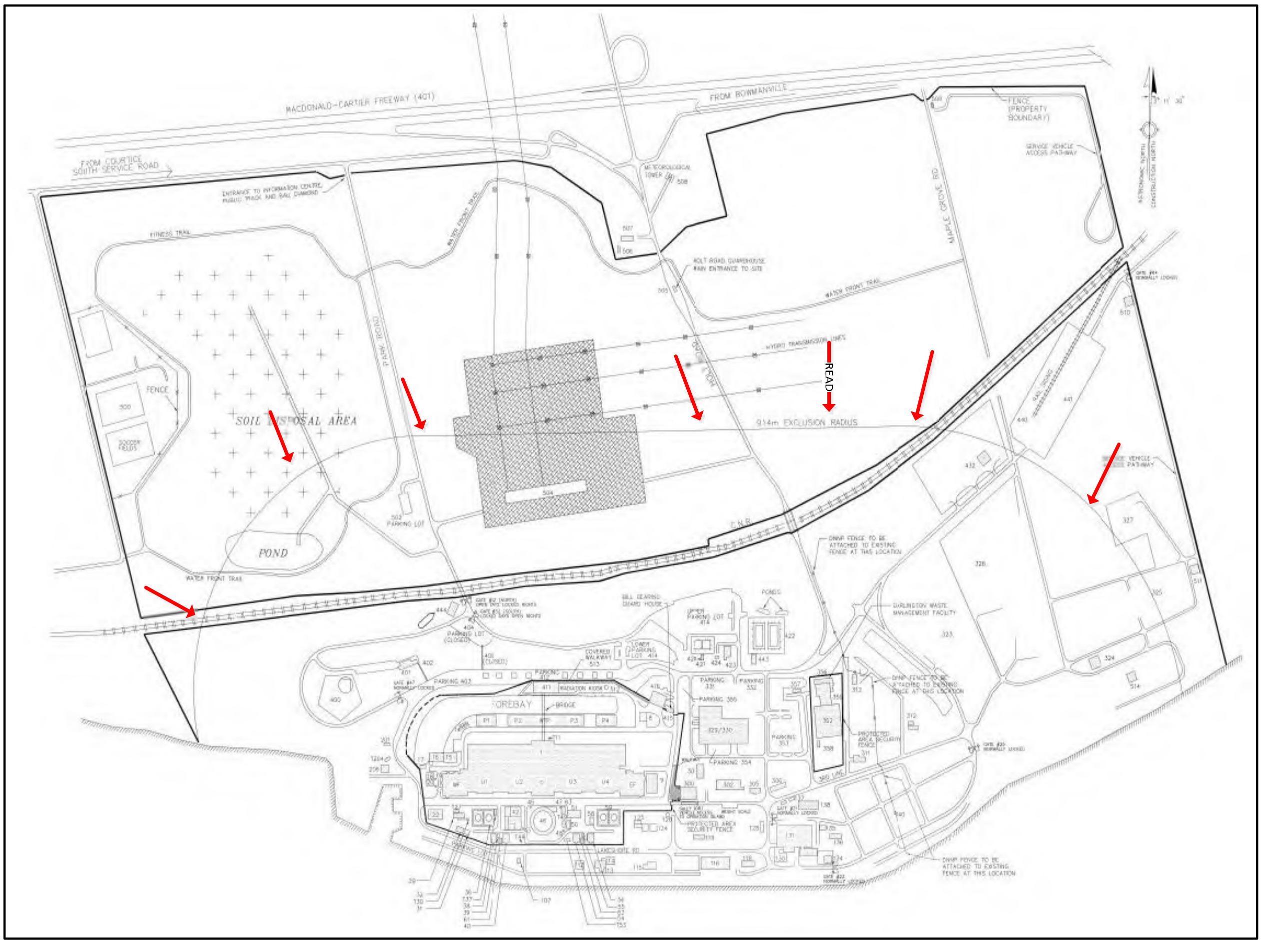
As an example, consider the implications of having the major working portions of a nuclear reactor situated in an underwater chamber, subjected to hydrostatic pressure from all sides. That could be the BWRX-300, if built on the Darlington site. Unlike any of the other three reactor designs considered in the 2009 EIS or the 2011 EA, the BWRX-300 will extend 38 metres underground and well as 35 metres above ground.

Imagine two ten-storey buildings. Each will be about 128 feet tall, or in metric units, 36 metres. Now imagine a ten-storey building turned upside down, going down into the ground, with another ten-storey building going up. Imagine the underground portion to be holding the heart of a 300 megawatt nuclear power reactor. That's the BWRX-300. It is an unusual picture, made more unusual because the underground portion will be in water,

Due to the proximity of Darlington to Lake Ontario, any excavation 38 metres downwards will fill with water very quickly and almost totally, so it will have to be constantly pumped out (dewatered) during construction. Unless dewatering is made permanent – and EIS-2 says it will not be – the hydrostatic pressure on the outside walls of the finished reactor building will be in the range of 300 kilopascals (kPa) at 35 metres depth. That's 6000 pounds (3 tons) per square foot. Yet there is no detailed discussion of the possible implications of such an unprecedented situation in either of the two updated documents, EIS-2 or PPE-2, except for one brief paragraph in EIS-2.

Then there's the geometry. Until the government of Ontario nixed the original DNNP project nine years ago, it was assumed that DNGS A & B (8 large reactors total) would sit side by side. The exclusion zone was designed to accommodate all eight reactors.





In these two images, the dotted lines indicate the boundary of the exclusion zone. The first image is from 1978, the second is from the 2012 Darlington Safety Report.

The DNGS exclusion zone was subsequently redrawn, without commentary, taking in a much smaller area.

Some of the space previously allocated to DNGS B has now been reassigned for the storage of nuclear waste.

The two pictures on the next page are both from 2022. The first image is from OPG's documentation supplied for the recent Waste Management Licence extension hearings, the other one is from current DNNP documentation.

Attachment 5 CD# 00044-CORR-00531-01153

Figure 1: Darlington Site

Note: The blue dotted line in this figure is the DNGS exclusion zone.

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NEDO-33951 REVISION 1
NON-PROPRIETARY INFORMATION

Figure 2.1.1-2: Darlington Nuclear Generation Station and Darlington New Nuclear Project Lands

In each of these two diagrams, green circles represent the boundary of the exclusion zone.

In the aftermath of the Fukushima triple meltdown of 2011, we have a better understanding of the dangers of co-locating reactors. It is perhaps a blessing in disguise that DNGS B never got built. Be that as it may, OPG and CNSC are now considering up to 4 new reactors of the BWRX-300 variety to fit into this rather crowded space, with spent fuel dry storage facilities now occupying some of the space originally intended for DGNS B.

It appears that the first BWRX-300 will be right inside the redrawn DNGS exclusion zone, Its own exclusion zone (circle below, radius 350 m) largely overlaps the one from DNGS.

NEDO-33950 REVISION 2
NON-PROPRIETARY INFORMATION

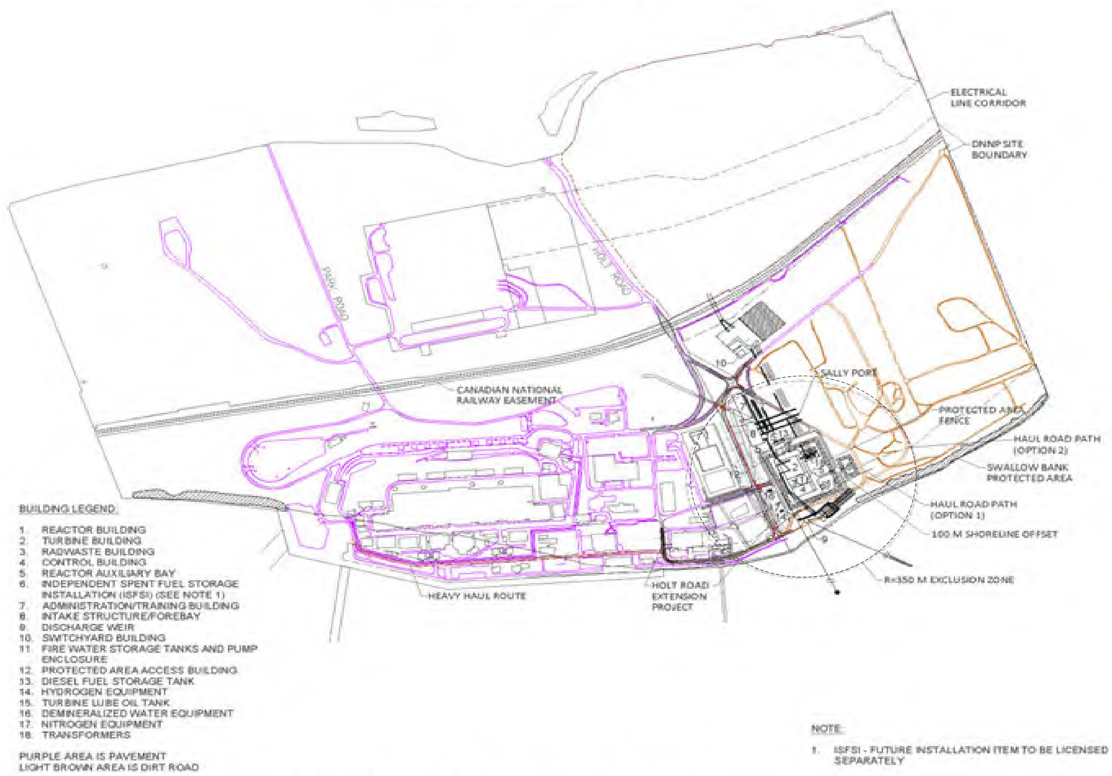

Figure A1.1-2: Darlington Nuclear Site (DNNP Proximity to DNGS)

In light of the lessons we have learned from Fukushima, CCNR believes it is unacceptable to have a new reactor built inside the exclusion zone of an existing reactor. In the event of a severe accident at one or more of the existing Darlington reactors, the entire construction crew of 1,000 to 2,000 workers could receive radiation exposures greater than 25 rems (250 mSv) within two hours. There is no reason to expose the workers to such a risk. They are not even classified as radiation workers.

The exposure of 25 rems in two hours, mentioned in the previous paragraph, is based on the precise definition of an exclusion zone given by the U.S. Nuclear Regulatory Commission (NRC). That definition is explained in the next section. Judging by the rather cavalier way in which the Darlington exclusion zone has been drawn and redrawn, and how the much smaller exclusion zone for the BWRX-300 has been drawn as a perfect circle, CCNR is convinced that CNSC is not doing its job by requiring OPG to define meaningful science-based exclusion zones using quantitative criteria and a detailed analysis of potential radiation exposures.

1.5 Defining the Exclusion Zone

CNSC has signed a Memorandum of Understanding (MOU) with NRC to harmonize regulations, and the two agencies are working together on BWRX-300 licensing matters. It is therefore appropriate to expect consistency between the two bodies in the definition of nuclear reactor exclusion zones.

U.S. Nuclear Regulatory Commission (NRC) document 10 CFR 100.11 details how to determine exclusion zones around nuclear power plants. The document is reproduced in Annex B.

According to 10 CFR 100.11, the applicant must begin by assuming a significant fission product release from the core of the reactor. "The fission product release assumed for these calculations should be based upon a major accident . . . that would result in potential hazards not exceeded by those from any accident considered credible. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release of appreciable quantities of fission products." See Annex C of this report.

Document 100.11 makes special mention of sites with "multiple reactor facilities" such as Darlington. Again, see Annex B. "If the reactors are interconnected to the extent that an accident in one reactor could affect the safety of operation of any other, the size of the exclusion area . . . shall be based upon the assumption that all interconnected reactors emit their postulated fission product releases simultaneously." The document discusses other factors that might be brought to bear so as to reduce this requirement to some degree. However, any reduction would have to be justified to the satisfaction of the Commission.

Once the fission product release from the core has been established, the applicant must then proceed to calculate how much escapes into the atmosphere by using "the expected demonstrable leak rate from the containment". The meteorological conditions pertinent to the specific site shall then be used to derive an exclusion zone "of such size that an individual located at any position on its boundary would not receive a total radiation dose to the whole body in excess of 25 rem [250 millisieverts] or a total radiation dose in excess of 300 rem [3 sieverts] to the thyroid from [radioactive] iodine exposure."

Recommendations:

7. That OPG be required by CNSC to derive science-based exclusion zones for both Darlington NGS and for the proposed BWRX-300 reactor according to the criteria laid out in U.S. NRC document 100.11.

8. That no new reactor be allowed by CNSC to be built within the exclusion zone of any other existing reactor.

Lest CNSC or OPG staff or any other party mistakenly think that these criteria make it acceptable for ordinary construction workers to work within the exclusion zone of an existing operating reactor, the NRC offers the following clarification:

> "The whole body dose of 25 rem referred to above corresponds numerically to the **once in a lifetime accidental or emergency dose for radiation workers** which, according to NCRP recommendations may be disregarded in the determination of their radiation exposure status (see NBS Handbook 69 dated June 5, 1959). However, neither its use nor that of the 300 rem value for thyroid exposure as set forth in these site criteria guides are intended to imply that these numbers constitute **acceptable limits for emergency doses to the public under accident conditions**. Rather, this 25 rem whole body value and the 300 rem thyroid value have been set forth in these guides as reference values, which can be used in the evaluation of reactor sites with respect to potential reactor accidents of exceedingly low probability of occurrence, and low risk of public exposure to radiation." *[Footnote #2, US NRC 100.11]*

Just to be perfectly clear, NRC states that these calculated doses (25 rem whole body, 300 rem to the thyroid) are **NOT "acceptable limits for emergency doses to the public under accident conditions".** That implies that people who are not radiation workers should not be working in the exclusion zone of an operating nuclear reactor.

The mandate of the CNSC is to protect people against radiation exposure. There is nothing in the mandate of the CNSC having to do with progress. The question is, will CNSC live up to its real mandate? Or will it pursue a fictitious mandate of its own making?

CCNR believes that if CNSC allows OPG to site the BWRX-300 reactor within the exclusion zone of the Darlington Nuclear Generating Station, it will be acting in dereliction of its duty as defined under the Nuclear Safety and Control Act.

1.6 The relevance of the Fukushima accident

The original 2009 EIS and PPE documents were written for a Darlington New Nuclear Project that never came to pass. Those documents were conceived in complete ignorance of the triple meltdown that was about to take place at the Fukushima Daiichi nuclear complex in March 2011. As a result, the two reports do not incorporate any of the lessons learned from the Fukushima disaster – lessons which go far beyond the merely technical.

The reactors that melted down in Japan were Boiling Water Reactors (BWRs) of an early design (circa 1960) supplied by General Electric (GE), Toshiba and Hitachi. They were early precursors of the GE-Hitachi BWRX-300 reactor now under consideration by OPG.

There were six such BWRs co-located at the Fukushima Daiichi site. Unit 1 was rated at 461 megawatts of electrical power (MWe) (half again as large as the BWRX-300) while units 2 to 5 were rated at 780 MWe each. Unit 6 was the largest, rated at 1100 MWe –two and a half times the power of unit 1 and almost 4 times that of BWRX-300.

On March 11, 2011, a powerful 9.1 magnitude earthquake offshore led to the safe shutdown of all these reactors. But within 30 minutes a gigantic tsunami struck, disabling the backup electrical generators and causing a prolonged total station blackout. Without power to run the pumps, there is no way to remove the intense radioactive decay heat from the spent fuel inside the core. In units 1, 2, 3, the fuel began to melt, releasing radioactivity.

Radioactive gases mingled with superheated steam and explosive hydrogen inside the reactor containment vessel. The gases were vented in order to to relieve the pressure that was rapidly building up inside. Once released, the hydrogen gas exploded, punching holes in the outer containment building and spreading radioactive contamination over a vast area. 120,000 people living nearby were evacuated in 2011. Twelve years later, 30,000 of those evacuees are still unable to go home.

An important lesson from Fukushima is that mathematical probability calculations do not protect people from catastrophic events. Before 2011, few in the nuclear industry would have believed that a simultaneous triple meltdown was a credible event. Yet that’s what happened. There was a “common cause” for all three meltdowns.

Lessons from Fukushima

1. Simultaneous nuclear disasters can occur at a multi-unit nuclear power plant due to a “common cause” that cannot be predicted accurately ahead of time.

2. For emergency planning one must "expect the unexpected" by postulating a possible radioactive release that may be regarded as having a vanishingly small probability.

Units 1, 2, and 3 are the ones that melted down. Unit 4 was defueled at the time of the disaster, but its outer containment structure (not the reactor containment vessel) was blown apart by one of three violent hydrogen gas explosions. No one knows the exact cause of the unit 4 explosion to this day. The blast blew off the roof of the building and exposed the spent fuel pool to the open air, situated as it was several stories above ground level.

Planes and helicopters were used as water bombers, to douse the spent fuel pool of unit 4. This was done to prevent extensive fuel damage caused by inadequate cooling. If the fuel in the pool had been uncovered by water, overheating could have released far more radioactivity into the atmosphere than had already been released from the 3 reactors that were melting down. Unlike the core which is situated inside a sturdy containment vessel, the pool had no containment at all. Had the uncovered spent fuel become exposed to the open air, a raging zirconium fire could have been ignited amongst the overheated fuel assemblies, leading to unparalleled radioactive releases.

Fukushima has taught us that spent fuel pools are particularly vulnerable to large radioactive releases under certain extreme conditions. Even raging metallic fires are possible when the fuel is not fully covered with water. Even years later, when the risk of overheating has subsided, spent fuel remains intensely radioactive and deadly when dispersed – whether that happens years or decades, or indeed even centuries after removal from the reactor core.

A typical dry storage container for Pickering used fuel weighs 60 tons when empty, and 70 tons when fully loaded. The reason why the dry storage containers designed to hold spent fuel are so much heavier (six times heavier) than the inventory of used nuclear fuel they contain inside, is for one reason only: shielding. Without massive shielding, the penetrating radiation would not be abated and the external risk would be prohibitive

Cooling is another concern. For the last 12 years, hundreds of tonnes of water have been used each day to cool the melted nuclear fuel from the stricken reactors. The water becomes contaminated with fission products flushed out of damaged fuel. Not all radionuclides can be filtered from the water; some, like tritium, can't be removed at all, others remain in residual amounts. More than a million tonnes of radioactive water is currently stored in over 1000 steel tanks.

Despite objections from China, Korea and local fishers, Japan plans to begin dumping that huge inventory of contaminated water into the Pacific Ocean very soon this year. The Pacific Ocean is at least 30,000 times larger in volume than the Great Lakes. It is daunting to think what would happen if such an enormous amount of radioactive water had to be discharged into the Great Lakes basin, the source of drinking water to 40 million people.

Nuclear proponents and supporters say that, on the whole, nuclear power is acceptably safe. But no insurance company in the western world believes that the risk of a nuclear accident is acceptable on actuarial grounds. Every homeowner's insurance policy, without fail, contains a nuclear exclusion clause that voids all coverage in the event of radioactive contamination of property or persons due to a nuclear accident.

1.7 Lessons learned from Fukushima applied to BWRX-300

There are so many lessons to be learned. We now know that co-located reactors may be vulnerable to "common cause" events that can trigger severe core damage in several units at once. It doesn't have to be an earthquake or a tsunami.

It could be a fire that disables all the pumps and electrical controls for example. That nearly happened at the Brown's Ferry nuclear plant in Alabama in 1975. The risk of losing complete control of a nuclear reactor in this way is exacerbated by the continued use of flammable insulating material in nuclear power plant electrical systems – materials that are so flammable they can turn a small fire into a raging inferno.

There is no information in the DNNP documentation about the vulnerability of BWRX-300 to electrical fires. Nor is there any information about the electrical insulation material used in that plant, or about its ability to feed a fire once a fire has started. There is also no information about duplication of wiring systems within the BWRX-300 layout, or the degree of separation between those duplicated wires so that the chances of one fire eliminating all electrical circuits vital for safety by burning up all the wires at once, even the duplicated ones, is minimized.

Fukushima shows us that station blackouts can be especially challenging. Radioactivity cannot be shut off. Therefore effective cooling of spent fuel is essential long after the reactor is shut down.

At Fukushima we also witnessed how much damage hydrogen gas explosions can do. We see how important it is not to underestimate the amount of hydrogen or miscalculate the risk of detonation. A severe nuclear accident always gives rise to hydrogen gas formation in a water-cooled reactor, because hot metals will react with hot steam, stealing the oxygen atoms out of the water molecules and releasing the hydrogen gas into the air.

In Annex C of this report, entitled "Unmet Challenges to Successfully Mitigating Severe Accidents in Multi-Unit CANDU Reactors", Dr. Sunil Nijhawan goes through a litany of examples of how things can go wrong in a multi-unit plant like the Darlington Nuclear Generating Station. Among other things, he discusses the frequent miscalculation of the amount of hydrogen gas buildup in a damaged CANDU reactor core, and the subsequent risk of explosion, which increases the potential radioactive releases from the plant and which serves to increase the area of the exclusion zone – assuming we use the scientific approach laid out by the US Nuclear regulatory Commission, as spelled out in Annex B of this report, instead of the OPG and CNSC practice if simply drawing perfect circles of an arbitrary radius and calling it an exclusion zone.

This entire discussion of CANDU safety would be beside the point and would have no bearing in the siting of the BWRX-300 reactor, were it not for the fact that OPG wants to put the new reactor smack dab inside the exclusion zone of the Darlington multi-unit nuclear power plant.

Of course, when the four CANDU reactors were first built, they were all built within the exclusion zones of each other. However, during the construction period (which began at Darlington in 1981 and finished in 1993) most of the work was done when none of the reactors were operating, The first unit startup was in 1990, so there was less than 3 years of working in the shadow of an operating reactor.

But this was long before the Fukushima experience. We now know better. Fukushima taught us to treat nuclear reactor disasters with respect and not dismiss them as inconsequential because they are unlikely. Knowing what we know now, it would be wrong to allow thousands of workers to labour within the exclusion zones of operating nuclear reactors. Those day are gone.

If the currently chosen site for the BWRX-300 were adopted – and OPG is diligently working on that site right now, even as we speak – the workers would be labouring not only within the exclusion zone of a 3500 megawatt nuclear power complex – one of the largest in North America – but also within a stone's throw of spent fuel in dry storage casks stored in warehouses quite close to the construction site.

The amount of radioactive material inside these spent fuel facilities equals or exceeds the amount inside the cores of the four reactors, because the waste warehouses will accommodate years and years of used fuel bundles that have been accumulating for a long time. A disaster that liberated the radioactive poisons from those containers would constitute a grave threat. Yet OPG and CNSC do not bother to even include them as a "blip" in their risk perception radar, for they do not ascribe any exclusion zone to the spent fuel itself. Only to the reactors.

The lessons of Fukushima are not limited to the physical domain. The breach of trust, the sense of betrayal, can be felt so deeply that it amounts to a rending of the social fabric. In Japan, the greatest sorrow was not related only to the nuclear mishap, enormous as that grief was, but to the fact that people felt they had been lied to by people they trusted. Scientists had repeatedly assured them that nuclear power is safe, safe, safe, and they were stunned and shocked to learn that this was a complete falsehood. A betrayal. How can one learn to trust such people ever again?

What caused the Fukushima nuclear catastrophe? Most people blame the tsunami. The Commission of Investigation in Japan concluded otherwise. In its report to the National Diet, the Commission found that the root cause was a lack of good governance.

The accident "was the result of collusion between the government, the regulators and TEPCO [the nuclear company], and the lack of governance by said parties. They effectively betrayed the nation's right to be safe from nuclear accidents. Therefore, we conclude that the accident was clearly 'man-made.' We believe that the root causes were the organizational and regulatory systems that supported faulty rationales for decisions and actions…" *[Executive Summary of the Commission report to the National Diet of Japan]*

The Commission chairman wrote: "What must be admitted — very painfully — is that this was a disaster 'made in Japan.' Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity... Nuclear power became an unstoppable force, immune to scrutiny by civil society. Its regulation was entrusted to the same government bureaucracy responsible for its promotion."

Canada has not heeded these warnings. After Justin Trudeau was elected in 2015, his government did away with environmental assessments for any new reactors below a certain size, thus eliminating – or at least sharply limiting – scrutiny by civil society. This leaves all decision-making in the hands of the Canadian Nuclear Safety Commission (CNSC). CNSC was previously identified by an Expert Review Panel (reporting to the Minister of Environment) as an agency that's already widely regarded as a captured regulator.

The CNSC, mandated to protect the public and the environment, reportedly lobbied government to abolish full impact assessments for most "small modular nuclear reactors" (SMNRs). The government of Canada complied. That's why there is no full impact assessment for the BWRX-300 reactor today. And that's why the regulator has cobbled together this charade of allowing OPG to spruce up its PPE and rewrite its EIS of 15 years ago so as to pretend that the public is not being deprived of a genuine opportunity to speak up on behalf of the public interest.

Apparently the Canadian Nuclear Safety Commission feels that it has a more mature appreciation of the public interest than most. In the Globe and Mail, journalist Shawn McCarthy wrote: "The CNSC encourages the government to exempt small modular reactors from the list of designated projects that would receive a full [environmental assessment] panel review, and warns that lengthy regulatory delays could kill a promising industry" Who knew that an "independent regulator" would be so dedicated to the well-being of the industry it is mandated to regulate? Who knew that regulatory delays would be so galling to the regulator? Could it be because CNSC receives most of its operating budget from the licensees? Or has the CNSC adopted a higher purpose, more appealing than the one parliament deigned to give to it?

During the 17 days of Environmental Assessment hearings, held from March 21 to April 8, 2011, many intervenors raised the Fukushima accident in their testimony to the Joint Review Panel. In their EA Report, the JRP mentioned the Fukushima accident 19 times. Here are some examples:

"Participants explained that they felt that the OPG safety analysis was probabilistic and not deterministic or realistic enough. They felt that worst-case beyond design basis accidents were not fully considered, despite the fact that nuclear accidents can and do happen, such as at Three-Mile Island (1979), Chernobyl (1986) and Fukushima Daiichi (2011). Participants noted that accidents could be caused by a combination of factors, including human error, severe weather, equipment failure and improper design. Participants felt that even if the probability of an accident is low, the consequences would be unacceptable should one occur."

"The Panel … notes that the Long-Term Energy Plan and Supply Mix Directive were developed before the Fukushima Daiichi nuclear accident. Since this accident, more concerns have been raised about nuclear power generation globally…. The Panel wishes to acknowledge the desire expressed by many participants for a re-examination of the Ontario energy alignment."

The people of Ontario, indeed the people of Canada and the world, deserve to have an independent and thorough Environmental Assessment of this new, untested reactor, the BWRX-300, especially as it is intended to be built within the exclusion zone of a very large nuclear power complex, not far from major rail line and highway linking Toronto to Montreal, and within a relatively short distance (as the crow flies) from one of Canada's largest cities and most important manufacturing centres.

The Canadian Coalition for Nuclear Responsibility is confident that an independent environmental impact review would conclude that the proposed siting of this proposed reactor is quite simply wrong.

PART 2: A REVIEW OF THE ENVIRONMENTAL IMPACT STATEMENT AND PLANT PARAMETER ENVELOPE FOR ONTARIO POWER GENERATION'S DARLINGTON NEW NUCLEAR PROJECT.

Canadian Coalition for Nuclear Responsibility

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Summary of findings and review

Siting a new reactor within the exclusion area boundary (EAB)of an operating reactor that has significant and unresolved vulnerabilities to severe core damage is contrary to safety principles, regulatory requirements as well as requisite stakeholder obligations to worker security and public safety. Even the currently accepted US NRC inspired 1000 yard (914m) EAB on the existing nuclear installations will not meet the U.S 10CFR100.11 requirements, and public expectations to consider source term from a severe accident core melt. Therefore, the indicated EAB for BWRX-300 of 350m is incredulous as is its full inclusion within the 40 year old EAB for the Darlington plant and within the EAB for the dry storage shed structures housing > 130 reactor core loads of spent fuel in concrete casks with > 70% of volatile, high dose sensitive fission product species still active. The CNSC needs to exercise due diligence in requiring OPG to resolve existing critical safety issues with Darlington CANDU severe accident mitigation before an event causes all reactors on site to have to be abandoned. Mere siting of BWRx-300 next to sheds containing hundreds of reactor years of spent fuel and 50 odd meter separation of its switchyard from an operating public railway line is another step in the Ontario Power Generation sleep walk towards an impending disaster at Darlington. GE-H should reconsider this siting plan for their own corporate interests. Their design is neither small, nor so modular as a first of kind construction and requires a comprehensive Environmental Assessment to protect Canadian public interests, previous actions in this regard notwithstanding.

The Plant Parameter Envelope document sent for review is grossly incomplete; has seen no substantive OPG additions in 12 years; and the US 10CFR52 process of site qualification it mimics is of no relevance today as a vendor GE-Hitachi and their BWRX-300 design has already been selected by OPG. Once a new site for the reactor is identified, a detailed reactor design information binder will help qualify that site for the chosen design. There has to be an independent technical review of vendor GE-Hitachi claims of enhanced safety in their BWRX-300 design with access to their actual safety reports with detailed analytical assumptions, code descriptions and accident simulation results with numerical information they have been unable to reveal so far.

Contents

1. REVIEW OF PROPOSED SITING OF OPG'S NEW NUCLEAR PLANT

In the U.S, a principal policy objective of 10 CFR Part 52 in the development of a Plant Parameter Envelope (PPE) process reflects the NRC objective to decouple siting from design for early resolution of safety and environmental issues. The driving force behind this process is that siting issues are to be resolved with the same finality as was done under 10 CFR part 50 for a specific design. This means that siting decisions must meet the regulatory requirements for any of the designs considered within the Plant Parameter approach allowed for some under 10CFR52. Canada has signed onto that process in its CNSC memorandum of understanding with the US NRC.

Siting criteria for new builds the world over now consider core melt down as clearly stated, for example for the US in 10CFR100.11 (see a listing in Appendix 2) . As an example, see the exclusion area boundary for ESBWR at North Anna for Dominion Energy below. It extends upto 1.7 km which is about double of the 0.914 km widely accepted before Fukushima and was developed on consideration of the whole range of releases, including likely from a severe core damage accident.

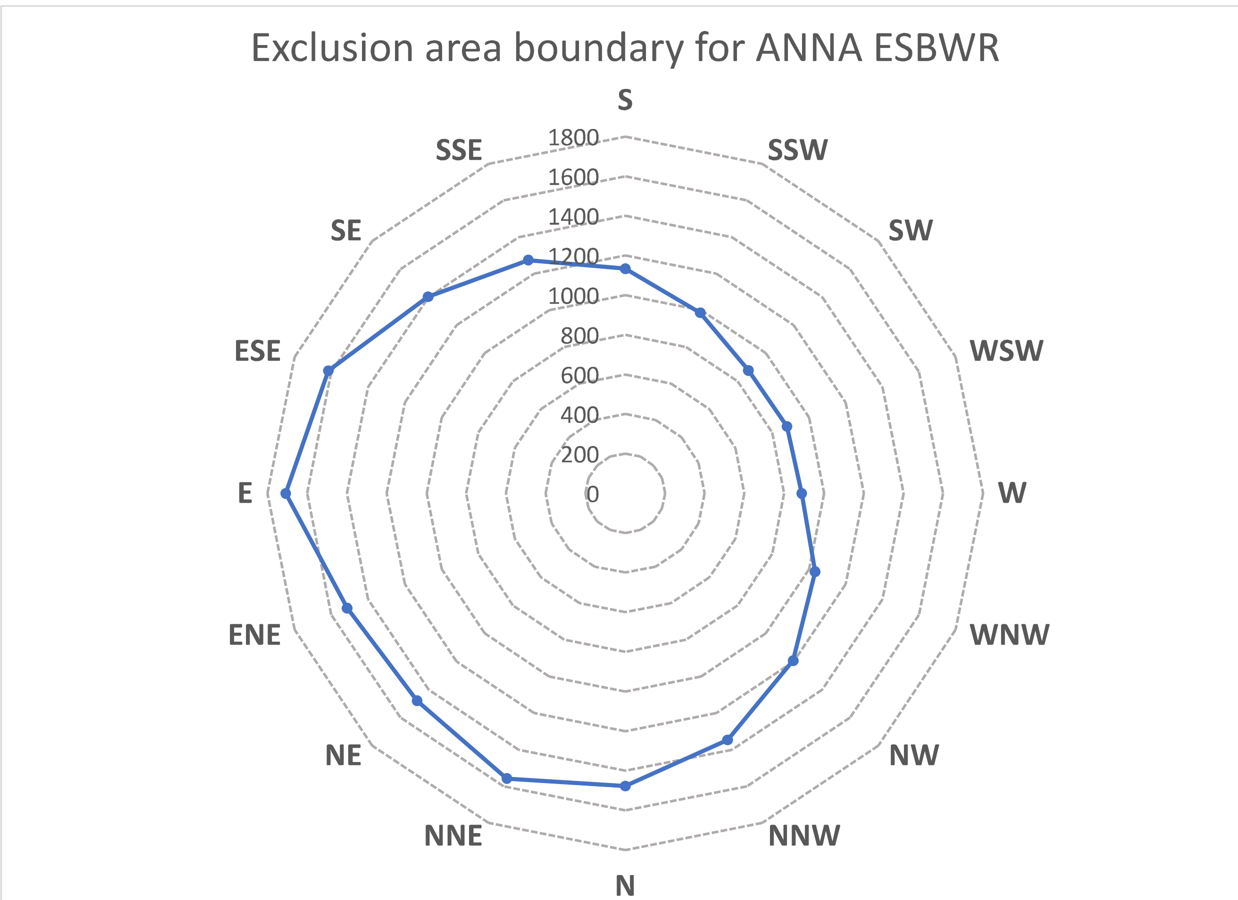


Figure 1 : Exclusion Area Boundary for a modern Nuclear Power Plant is double of what was for older power plants pre Chernobyl.

1.1 OPG's new nuclear plant siting proposal at existing lands they own for DNGS

OPG proposed in 2007 that they plan to build a new nuclear station within the lands they own in Bowmansville, part of which were used for DNGS-A. Several reactor designs were considered, and a PPE process was undertaken. The exact location of the new station was not revealed initially but a site preparation license and funding was approved over 10 years ago.

It seems now that a site preparation license was issued to OPG for their new build without consideration of a number of issues, some of which significantly affect their MOU for harmonization of licensing issues with NRC that only occurred a decade later.

1.2 DNGS exclusion area boundary

The original exclusion area boundary (EAB) for Darlington reactors was designated long before TMI accident in 1979 and was based without an understanding of nuclear safety principles and proper risk assessments that the 3 severe core damage accidents in 15000 reactor years of experience have taught us. We now look at severe core damage as credible and responsible regulatory bodies have enshrined their implications in reactor designs, siting, safety assessments and emergency planning.

The Darlington 1000 yard (914m) wide exclusion zone taken from end of the reactor building footprints was a copy of what the US NRC had for their older reactors and the Canadian utilities were able to show to AECB then that it was sufficient for their benign operational release estimates compared to the so called Derived Emission Limits from operational releases and from extensive and conservatively stylized 'design basis' accidents they did consider. The original 1978 Exclusion area boundary was based on the plan of building two identical 4-unit CANDU stations DNGS-A and DNGS-B. The planned Station B was slowly abandoned and the designated space used for spent fuel dry storage that was not envisioned in the original design of the two reactor station complex, as a permanent storage solution for fast accumulating after ~10 years in the spent fuel pool wet storage was never found. AECL and OPG scrambled then to design dry storage solutions.

As Darlington B idea was abandoned over the years, the space that was to be used for that 'B' station was used for an extensive field of dry storage industrial buildings. The exclusion zone remained the same, (Figure 3) as was illustrated in the Darlington 2012 safety report and perhaps even later.

The existing exclusion zone included spent fuel cask storage buildings that contain about 30 years' worth of spent CANDU nuclear fuel with about 2000 concrete casks, each containing 384 spent fuel bundles (6.15% of a full core charge of fuel bundles in each cask). These large buildings now contain about full 120 reactor loads of spent dry fuel. While the decay heat has waned over the period to about 4kW per cask, there is still over 70% of the original volatile inventory of long lived fission product species. There are significant safety and security issues associated with this accumulating dry fuel casks and the safety and security problem is no different than with spent fuel from other reactor types in other countries. With such large quantities of the highly volatile and of amongst many other fission products, of high dose conversion factor like element - Cs-137, the exclusion zone should have been even bigger than for an operating station, but the existing EAB of 1978 and 2012 in Figure 2 and Figure 3 was deemed acceptable over this period.

1.3 Redrawing of EAB for Darlington Nuclear Generating Station and its Dry Fuel Storage complex

Then suddenly for us who follow developments in the nuclear industry, and inexplicably, in the 2022 application for an extension to operating license for the dry storage facility the exclusion zone for Darlington station was redrawn as in **Figure 4**. The 2023 public edition of the BWRX safety report, with area demarked for its operations in yellow mimicked the same diminished exclusion zone for Darlington CANDU reactors as in Figure 5. No exclusion area was added for the large dry spent fuel cask storage structures.

It is proposed now by OPG that this yellow area that overlaps even the diminished EAB for DNGS be set aside for BWRX-300.

1.4 Disturbing information about the siting of first BWRX

As details emerged from what we typically saw as only highly redacted versions of BWRX-300 documents, and some rough sketches of BWRX-300 buildings were seen, it became apparent that there were these interesting characteristics of that site:

1. An active CN rail line bisected the lands designated now for the proposed new build (Figure 5)
2. The siting of the first unit was smack in the middle of the exclusion area for only the Darlington station that we had known for over 40 years (Figure 2 and Figure 3).
3. The siting of the first BWRX unit was next to the dry storage buildings and included parts of even the now reduced 914m EAB around DNGS-A.
4. The switchyard for the BWRX unit was a meter 58m from the active CN railway line.

1.5 EAB for first unit of BWRX

The newly released redacted publicly available safety report for BWRX claimed a exclusion area boundary radius of 350m. That seems to be an arbitrary number as no source term for any accident within the design basis or beyond design basis was provided in the PPE. Given our experience analysing reactor accidents at various pedigrees of nuclear power plants, it the following cam up quickly:

1. BWRX vendor seems to claim immunity from severe accidents.
2. The regulatory expectations currently respected world over are ignored.
3. Siting next to a huge field of spent fuel casks with enormous amount of fission products, safety and security concerns, seems odd.
4. Siting within the exclusion boundary of an operating station seems to have been done with real estate considerations only; not for safety of and from a nuclear reactor..
5. There was no consideration of risk profile of the two neighbourhood nuclear installations - the 4 reactor units of DNGS-A whose vulnerabilities we had examined for years; and the expansive spent fuel field in metal buildings not much stronger than a Costco warehouse.

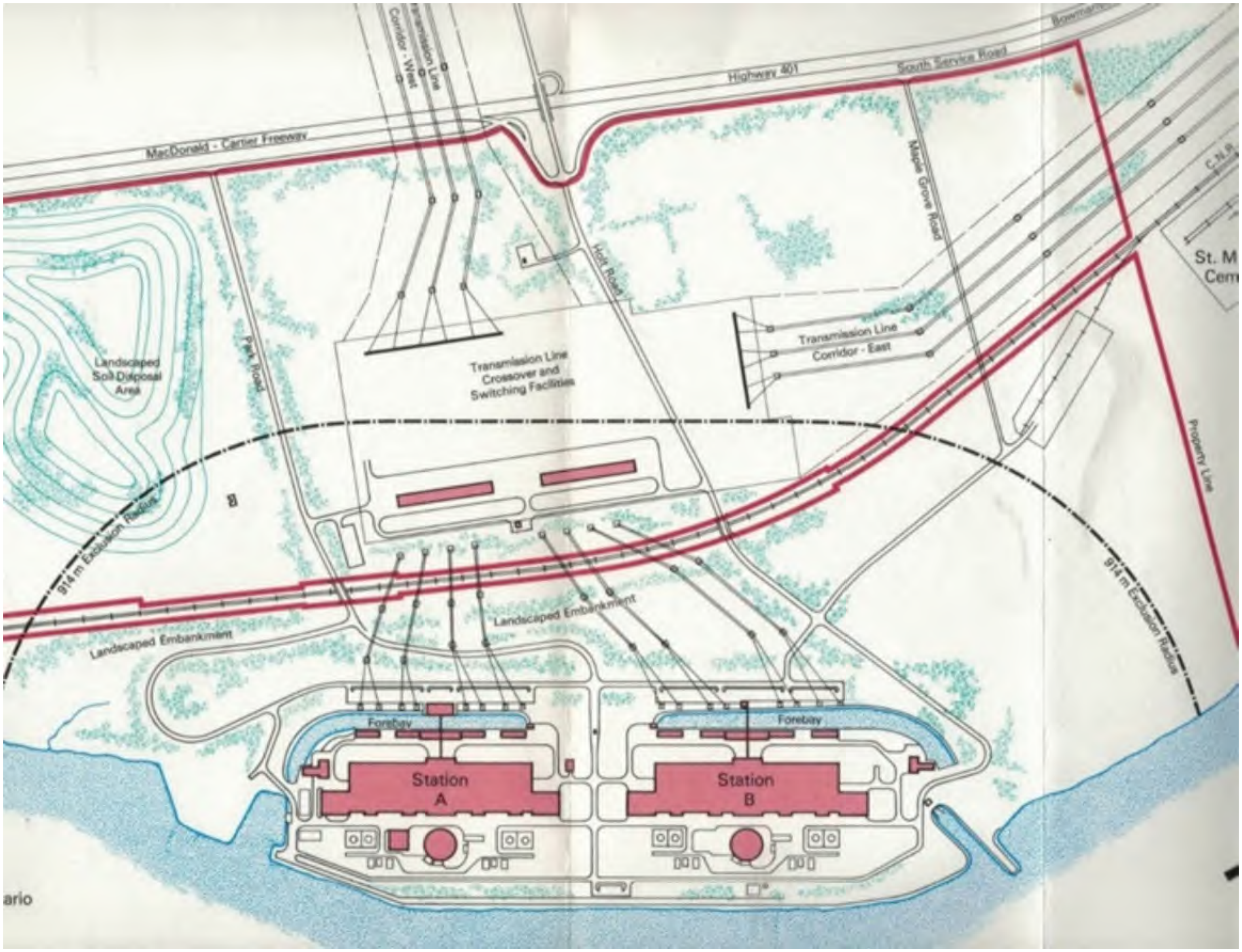


Figure 2 : The 1978 Exclusion area boundary based on two 4 unit stations. Station B space now taken by dry storage.

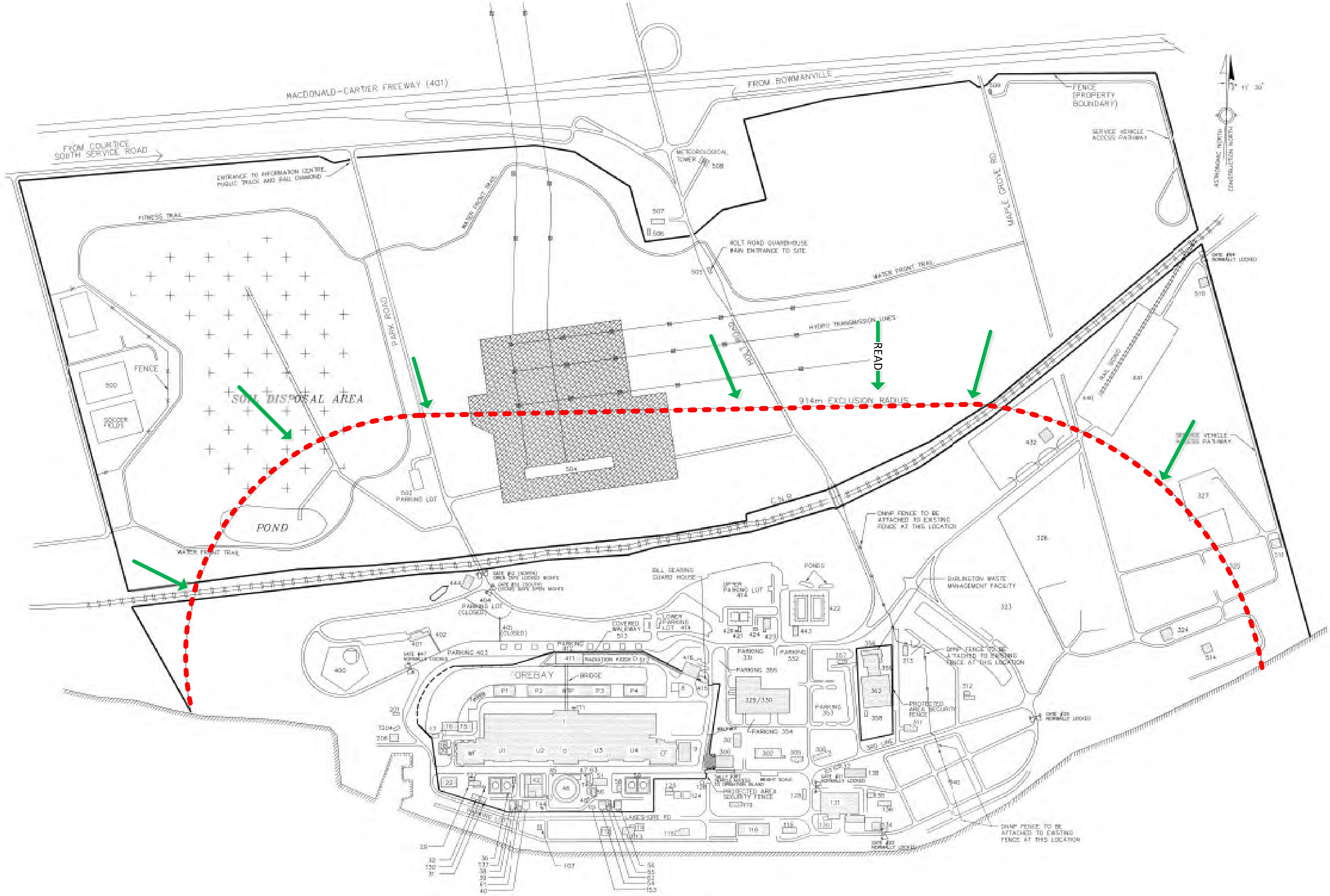


Figure 3 : DNGS Exclusion zone remained the same for at least 34 years as again so represented by OPG in 2012 Darlington Safety Report.

Figure 4: DNGS exclusion Area Boundary in 2022 Application for Waste Management Facility License Extension

Figure 5 Redefined DNGS Exclusion Area Boundary from NEDO-33952

Figure 6 : DNNP stated Exclusion Area Boundary of 350m!

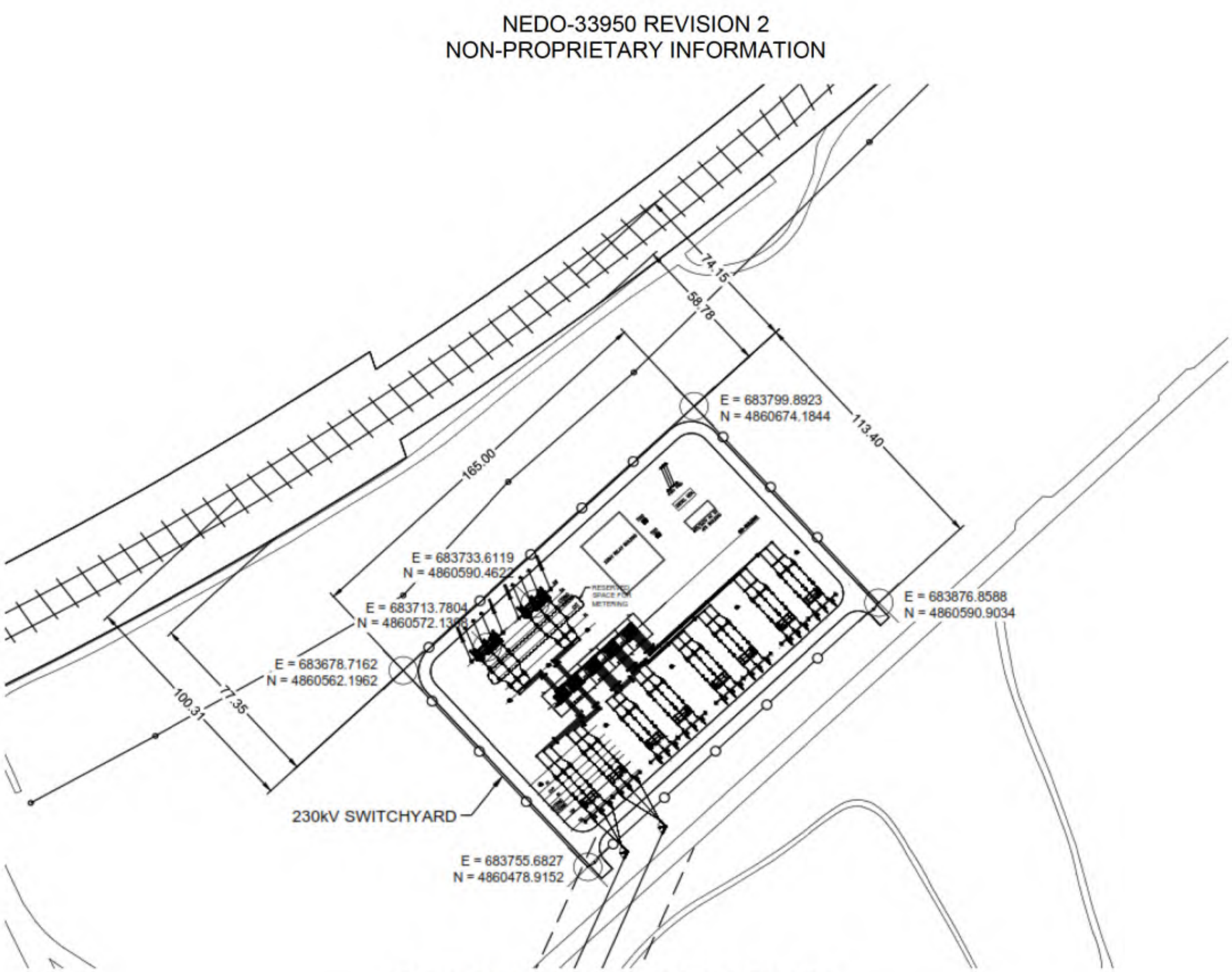


Figure A1.4-2: DNNP Switchyard Site Plan

Figure 7: BWRX- switchyard is 58 meters from railway line. My house is at a greater distance from a line and shakes when trains go by relatively slowly.

2. Review of the siting proposal

After careful consideration and mindful of the minor cost associated with abandoning the proposed site for BWRX compared to the trillion dollar and hundreds of sq. km land loss consequence similar to what Fukushima is going to cost the Japanese society, we have strong and compelling reasons to recommend that the chosen site for BWRX be abandoned in favour of one that actually meets the nation's long stated requirements for safety of and security from a new build nuclear plant. Nobody should be allowed to manufacture alternate facts, especially for preordained commercial decisions that can have such profound effect on the nation's destiny. Not a wayward federal regulatory body or a misguided provincial utility, for sure.

2.1 Rationale for the recommendation that the present DNGS site is wrong for the purpose and dangerous.

As our understanding of reactor accidents and their unfathomable consequences has become clearer, both the regulatory requirements, reactor designs and their containments became sturdier. Even ESBWR, the so called safest incarnation of a BWR has an exclusion zone of over 1700m at North Anna for Dominion Enetrgy.

Then came TMI and the world woke up to a new reality and the US laws were toughened to include a requirement that the dose to a person at the boundary of the exclusion area after a core meltdown must be considered (10.CFR. 100.11). In Canada we kept dreaming up excuses and never did a comprehensive severe accident progression and consequence assessment. Exclusion zones remained the same. When an idiot doing experiments 1m 1985 with low power operation at Chernobyl blew the roof off after a reactivity induced power excursion there, the Canadian submissions to Hare Commission in Ontario boasted of a Pickering containment that would just crack to relieve the pressure and then just closeup even if a reactivity induced accident did happen at Pickering A that had only a single shutdown system. None of us ever saw a wakeup call in the slow pressurization induced, year 2001 blowing up of a 150 million dollar quarter scale containment in integrity experiment at Sandia that created this image:

Figure 8 : Containments will not crack and reclose; they will burst. Results of SANDIA joint Japanese-U.S tests.

Off-site consequences of a containment failure for various fractions of fission product inventories show that the only hope of meeting the regulatory limits is to have a containment that is robust or a reactor design that is low risk. Here in Figure 10is a simple parametric analysis of doses at various distances from the reactor from releases of just Nobles gases, Iodine-131 and Tritium. Longer term releases from a severe accident of Cs-137 etc. not included.

Locating a new nuclear reactor within the now suddenly and artificially narrowed exclusion area boundary of an existing, operating reactor that has long been identified to have an enhanced risk profile and dozens of unresolved design vulnerabilities is not in any one's interest. For GE-H, the existing Darlington reactors can incapacitate their new build any day. This is not an anti-nuclear activist's warning. This is a scream of warning from a Canadian nuclear engineer who loves his country and has examined Darlington design for 40 years, contributed substantially to it's original licensing in 1980s and since then pointed out reactor design vulnerabilities that if left unaddressed will likely cause damage to this nation. Locating BWRX-300 practically next to Darlington station is not a sane decision.

As a Canadian nuclear industry professional I have spent over 40 years analyzing nuclear reactor designs, accident initiators, accident progression and accident consequences that define risk from reactor accidents and documenting the vulnerabilities of our current fleet of CANDU reactors. To me, as it to others with similar background, the proposal to site the BWRX-300 within the exclusion zone of an operating four unit Darlington station (and practically abutting industrial sheds containing over 130 reactor loads of dry spent fuel storage in 2000 unmonitored concrete casks) is an inconceivable act of recklessness by both the vendor GE-H and the host utility OPG. Just the idea that an application to that effect is forthcoming may just be on GE-Hitachi's part, simply in ignorance of the perils in the decision. To me, the CNSC continues to go down the path that the Japanese regulator led the Japanese nation to in its subservient collusion with the Japanese electric utilities – Fukushima. I present information in plain language on why I consider this decision to have far reaching negative and history altering public safety, economic and environmental consequences. I am happy to present detailed technical arguments on Darlington as well and challenge the CNSC and OPG staff to an honest discussion.

My hope is that saner heads will prevail and if nothing, corporate self-interests and a hard cold look at the enhanced economic risk such a path entails – (like in losing the use of the new reactor even before it can go online) - will dissuade going any further with such an irresponsible decision. Ontario has a huge land mass; there likely are a dozen good sites close to the transmission corridors we already have for a safe new nuclear station.

It is irrelevant that the CNSC just this last week sent out a missive stating that they approve of the BWRX-300 design. For some unknown reason they have occupied the mantle of knowing better than us all, while having knowingly pushed such dangerously wrong and technically impossible and socially irresponsible positions on progression of accident (reference 1) and on consequences to environment of severe accidents in the existing reactors (reference 2) and done nothing for 22 years on simple to understand but extremely critical to public safety issues like what an ASME code compliant reactor primary coolant overpressure protection should look like and how the ones at Canadian CANDUs violate those basic tenants of proper engineering. That is either an extreme level of callous disregard for public safety or gross incompetence but certainly contrary to their legislated public duty, irresponsible and shocking (reference 3). This specific design error can cause a pressure boundary rupture that can lead to a core damage accident of potentially inordinate off-site consequences. Therefore, my submission is directed to those in the board room of GE-H and OPG asking them to not go down that path for their own corporate self preservation without addressing the issues that the host reactor presents. Look for another site and then we can have an honest technical review of the merits of BWRX-300 and its environmental impact. I also hope that a CNSC Commissioners may stumble upon this report one day and begin to ask the requisite questions.

I reserve expressing my opinion on BWRX-300 risk profile at this time because that is irrelevant to the task at hand and at this juncture.

The regulatory body staff whose lethargy, 'safety culture' and inactions I amply dissect in this submission, has nothing to lose in this process as their organization's financial interests are in billing for their services to any new project they can find, under their cost recovery arrangement. AECL already spent a billion dollars of public money on reactor designs that the CNSC 'approved' or found no impediments to the licensing of, but got nowhere because others saw deficiencies in those designs that CNSC conveniently overlooked.

It is not private funds that are driving this project. These are public funds. This country certainly cannot afford the negative consequences associated with the proposed site for BWRX–300 as well as the process being followed in likely granting OPG a construction license as soon as possible, bypassing the processes of the past by now using this Plant Parameter Envelope (PPE) process that has no meaning since a reactor design was decided upon years ago (see my comments in next section 3 on page 22 on the Darlington site PPE report).

I begin by pointing out that that the lethargy and intransigence that the CNSC staff have exhibited in rectifying known errors and inadequacies in the operating CANDU reactors at Darlington post Fukushima, contribute strongly to my premise that BWRX-300 cannot be built at the proposed location. I have detailed the underlying issues on the risk profile of the 'host' power plant in the technical paper attached as Appendix 1 and will use some examples in this section to demonstrate why the risk to environment and public is unacceptably high of putting in upto 4200 construction workers on the site for 4-5 years. This first begs the question – why we need permission for that many workers there if this site is really for a small, modular reactor?.

An approval of siting of the any new nuclear power plants within the exclusion area boundary of another operating nuclear station is contrary to modern safety principles and understandings that govern licensing and operation of such facilities. See for example see – *US Code of Fedetral regulations 10 CFR 11 Determination of exclusion area, low population zone, and population center distance*. While the CANDU design in building sister units was acceptable and met the knowledge base, safety culture and regulatory expectations of 40-50 years ago but was found later to be severely wanting in its provision of a safe, low risk, operating envelope today, it cannot host a new reactor next to it without transferring its inherent risk to the new addition and to the construction workers.

Siting a BWRX-300 within the boundaries of a multi-unit CANDU station cannot be permissible until the so glaring vulnerabilities in the CANDU station's operation are resolved completely. Such a siting is also in direct conflict with public expectations of minimal risk as we no longer describe severe core damage accidents as 'hypothetical' and better understand certain specifics of design of our operating reactors that we recognize today as vulnerabilities that, if not mitigated properly and honestly, can cause severe damage to this nation.

We have summarized what we understand today as errors in design of Darlington CANDU station and shortcomings in improvements made over the years in a number of papers and reports. A number of these errors/vulnerabilities can come into play not just in a severe core damage accident but in a design basis, higher probability accident – like a simple rupture of a feedwater inlet pipe due to wall thinning, something that has occurred at a dozen power plants already, and following an uncontrolled over-pressurization of the primary coolant circuit due to improperly sized safety relief valves, cause a rupture of boilers tubes. Resulting release of radioactivity into the atmosphere will incapacitate and render useless a new reactor being built within its exclusion area boundary and affect health and well-being of workers on site.   Another example is the mindless placement of the pressurizers in all units at Darlington.

One of the reports that details the perils of the design errors that we have identified is reproduced in the appendices.. We have also included in that report the blame that the regulatory body CNSC must be assigned in promoting some false narratives and accepting some very bizarre and questionable submissions from CANDU utilities post Fukushima as well.

Darlington station with four interconnected reactor units was designed in mid 1970s. After living through three severe core damage accidents at TMI, Chernobyl and Fukushima since that time, we have had an opportunity to subject our designs to intense scrutiny using increasingly sophisticated analytical methods. Our investigations were supported by research in various allied sciences, technologies and industries world-over. Today we do not look at our Darlington reactors designed in the era of rotary phones and slide rules as 'state of the art' as many decisions were made by designers who were handicapped by what was at their disposal. Today we can do better.

When we look back at the conclusion drawn by investigation commissions into root causes of Fukushima, we know that the Japanese regulatory bodies played a pivotal role in causing that trillion dollar fiasco. They were too eager to accept anything that the utilities wanted. In Canada we are following the same path. We have so far not learnt the Fukushima lessons, but must do better. <u>The new BWRX-300 reactor that is being proposed may very well be one that best minimizes risk, but the Darlington site is the wrong place to build it on many counts</u>. In addition, the process of ramming its acceptance through, not least of which is the utter lack of any numerical information under guise of being 'proprietary' is looking very suspect. Just go and look at the volumes of information that was made public when new Canadian reactor designs like CANDU-1250, CANDU 950, ACR-1000, ACR-700 and CANDU-3 were conceptualized, designed, revealed and marketed or how much information on our existing reactors is in public domain.

Today as we have an improved understanding of risks associated with operation of nuclear power plants of any pedigree, it is apparent that siting the BWRX or any other new reactor next to the exiting Darlington units and within its exclusion boundary is also not in the economic interest of the utility or the vendor. There are many very obvious reasons. I will try to allude to a few here and will be happy to brief you all once again on the long outstanding issue of the design vulnerabilities of the design of operating reactor units at Darlington which I have summarized in Appendix 1. There is a great chance of the Darlington A reactors causing accidental releases which will definitely jeopardize construction, commissioning and operation of the proposed BWRX-300 reactor(s).

I reserve for now any judgment on veracity of claims of near absolute safety claims by GE-H of its ESBWR and BWRX-300 as that discussion is moot, as I present to you the dangers and risk within the original exclusion area boundary of DNGS ( ) which in its 1978 safety report was drawn at the north

American standard 1000 yard (814m) distance from the reactor boundaries and envisioned another identical station with its four 800 MW CANDU units.

As nuclear engineers our generation has lived through 3 severe core damage accidents that hit pretty close to home for me - at Three Mile Island in 1979 (a mere hundred miles from where I was finishing my PhD), Chernobyl in 1985 (in the country where I got my first masters degree) and Fukushima in 2011 (in a country where my God daughters Sumiko and Noriko live). Economic damage to these three countries from these 3 severe core damage accidents is in trillions of dollars and the cleanup and retributions are still ongoing. I specialize in evaluation of consequences of severe core damage accidents and have developed a half dozen computer codes to that effect. Industry uses my codes but manipulates the results that make no sense to me but presents a rosy picture of the reactors they operate.

2.2 Range of Consequences of a loss of fuel cooling

Adverse health consequences of fission product releases entering the public domain with or without a core damage accident at the subject nuclear station are not debatable. Just look in Figure 9 at the definition of various dose magnitudes, our AECB/CNSC definitions of dose classes, and how they sit with respect to probabilities of a resulting fatality. Then, please look at Figure 10.

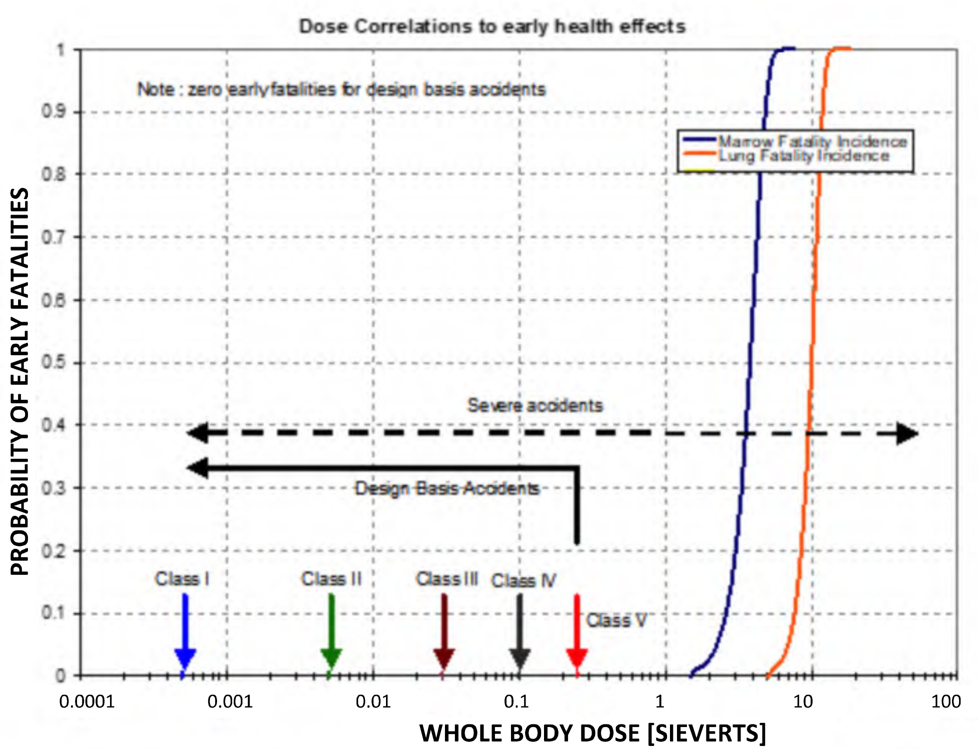


Figure 9: Canadian dose classes and probability of an earlier fatality

Here is a simple exercise. Even loss of primary fluid inventory with maximum permissible operational levels of Tritium, I-131 and Noble gases into the atmosphere can cause high doses 1.0 km away and just short of what can cause immediate fatalities. Such an event is possible if an unmitigated overpressure would cause some boiler tubes to rupture and the primary fluid is discharged into the atmosphere. At Darlington the overpressure protection – on of the most elementary things to design at a power plant - is a at least 25 times smaller than required. At Pickering it is 1000 times too small. CNSC staff know it and have done nothing to ask the utilities, who themselves were told about it a dozen times, to fix it.

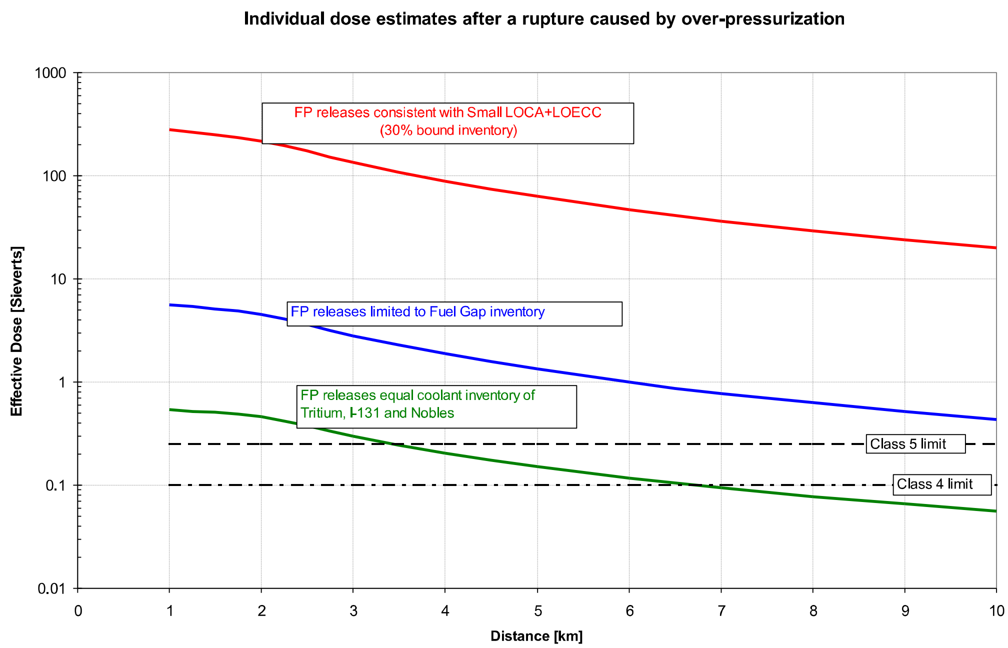


Figure 10 : Sample dose calculations using PEAR

Then look at doses from just 30% of bound inventory along with Iodines and Noble gases and look at the probability of fatalities at distances upto 10 km. A design basis accident, an unmitigated LOCA+LOECC will not only under certain circumstances causes such fission product releases but will also cause explosive amounts of hydrogen (mostly Deuterium really) accumulation in Darlington containment. Utility analysts do not include that in safety reports because the accident consequences are calculated only for an hour and they conveniently ignored hydrogen production by oxidation of our carbon steel feeders. I quantified that source of the highly combustible gas and demonstrated by extensive analyses that oxidation of feeders whose surface area for oxidation by steam alone is over 2000m^2, is more energetic and faster and starts at a lower temperature than for Zircaloy. Thus, feeders become major sources of explosive hydrogen. We have been asking the industry to accept that reality for ages but the Trumpian handling of truth at the management level has been a big roadblock. No effective hydrogen mitigation systems have been out into place and we still continue to rebuild the Darlingtom reactors with low Chromium carbon steel feeders. So the hydrogen source term has not been reduced and the reactor will create a LOCA just because on a loss of heat sinks, the inadequate in their steam relief capacity – relief valves will let the overpressure lead to a LOCA and on a loss of ECC to inject into the over pressurized cooling circuit, the hydrogen generated by iron feeders and Zircaloy will cause the reactor containment to blow up.

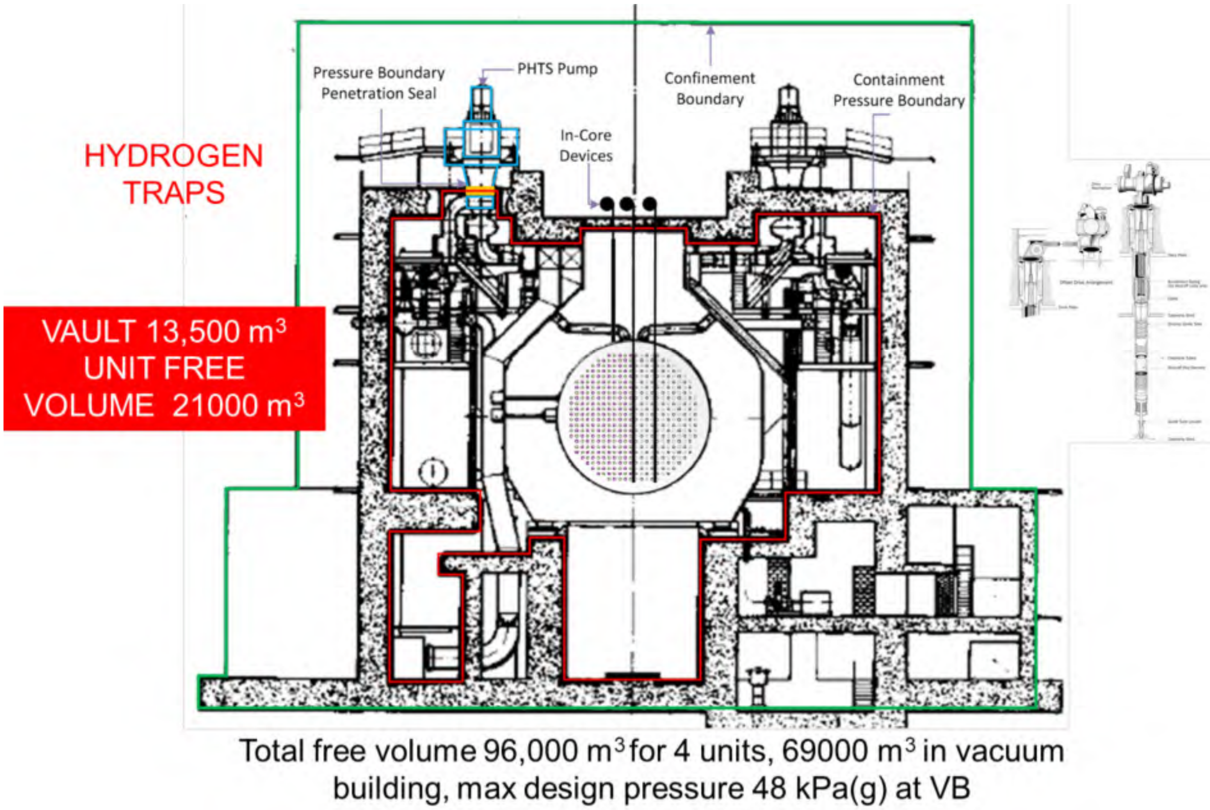


Figure 11: Darlington reactor vault allows no release path for any hydrogen produced in a core damage accident

Explosion of hydrogen in a Darlington containment in early stages of a severe core damage accident is of a great probability because there is little pathway for it's escape from the congested top of the inverted-cup shaped reactor vault where it will accumulate and escapes to, in an accident which we fondly call Limited Core Damage Accident a LOCA with a Loss of ECC. In a severe core damage accident whose hydrogen production will be 10 times more than the 65 kmole that the industry has claimed. No matter what the total amount of hydrogen produced, an accumulation above 4% by volume in air will start a fire and above 8% an explosion. That means a Fukushima like ending. We also point out that Darlington does not have a containment to speak of, once the vacuum building has spent itself. Top of the reactivity decks is an industrial building roof.

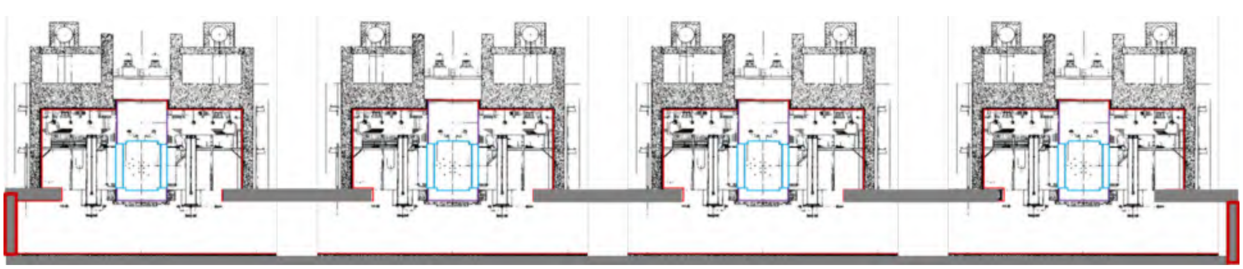


Figure 12 : 4 reactor units interconnected with common duct

This is illustration but a small number of vulnerabilities that can affect the environ around the existing Darlington units. Spending a couple billion dollars each to put in 4 more units there would be fool hardy, unless of course worker and public safety was of no concern in the rush to put in the first of a kind reactors on our soil. Attached. presentation slides and paper include a summary of some of the Darlington station vulnerabilities .

2.3 EXAMPLES OF DARLINGTON MULTI UNIT SEVERE ACCIDENT PROGRESSION & MITIGATION CHALLENGES

The following is a partial list for illustration Please read the whole paper in APPENDIX 1)

2.3.1 Weak and leaky Containment

- Low containment design pressure (<0.9 bar) and high design leakage at design pressure(48% per day)
- Reactivity devices, steam generators, pumps and other equipment critical for long term heat removal are outside the containment and located under an industrial building .
- Containment bypass from over-pressure and thermal creep induced steam generator tube ruptures and from reactivity device failure a likely outcome after a severe core damage.
- Reactor vaults shaped and arranged to be highly likely traps for combustible gases.

2.3.2 Poor Reactor Overpressure Protection Design in a number of systems

- Safety relief valves not directly on the main cooling circuit (ASME section III , NB-7141 (b) requires a direct and unobstructed relief path) and require another pair of downstream valves to open. All valves designed for liquid relief.
- Only two safety relief valves (called 50% capacity valves but the 'capacity' is misrepresented) - contravenes single failure criteria
- Undersized over pressure protection with steam relief capacity of the 2 safety relief valves by a factor of upto 10 - contravenes common sense - relief capacity must exceed anticipated loads, which will always exceed decay heat.
- Inadequate primary cooling circuit relief inherently forces reactor damage by uncontrolled over-pressurization even before an ECC is given a chance to avoid severe core damage. An uncontrolled relief through a rupture in pressure boundary is an unacceptable outcome.
- Accelerated depletion of moderator inventory due to expulsion through pressurized Calandria rupture disks upon channel voiding and fuel heatup to cause moderator boiling.

2.3.3 Poor Pressure and inventory control

- No provisions for direct manual depressurization of the Primary Heat transport system.
- Pressurizer located well below the core can drain water from primary coolant system upon cooling upon loss of power and inhibit thermos-syphoning flows.

• No systems for high pressure ECC or any emergency measures for high pressure primary makeup intervention / injection.

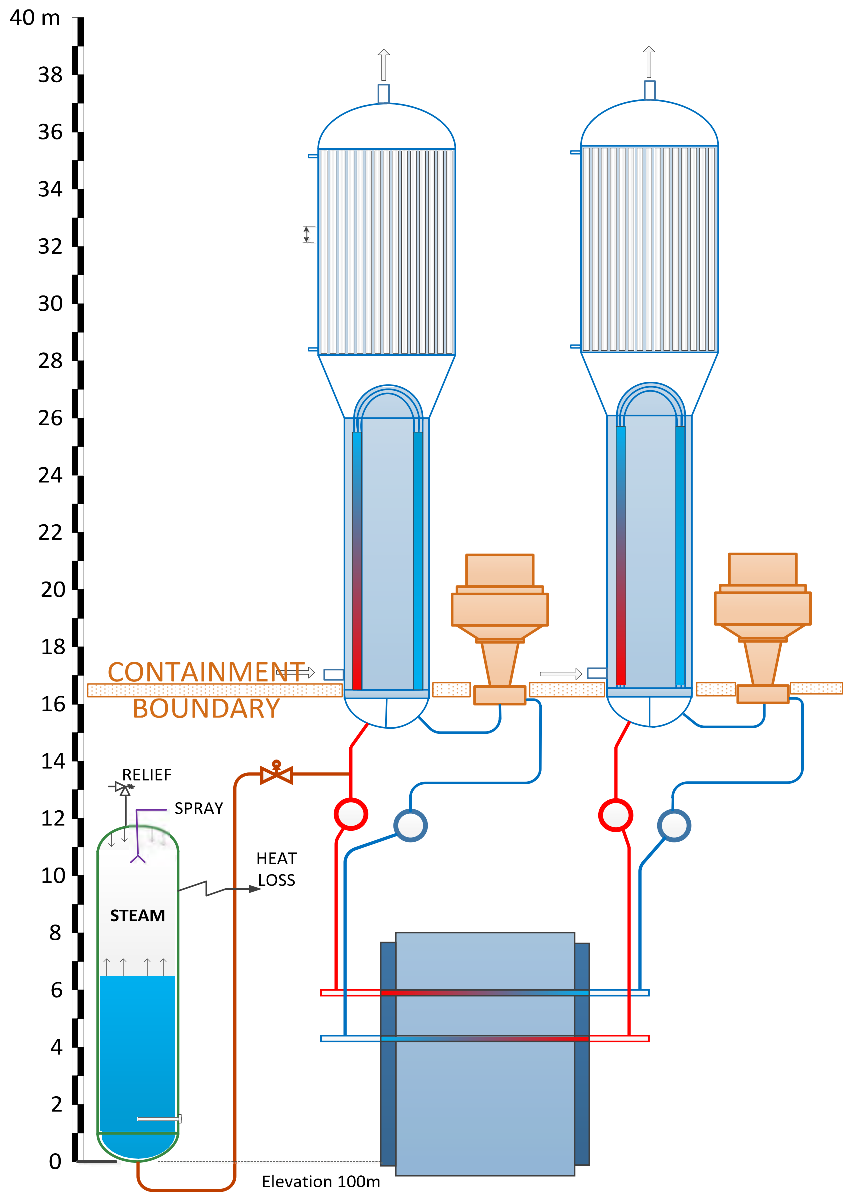


Figure 13 : Lower than core placement of pressurizer that will drain boiler tube inventory at Darlington/Bruce reactors in SBO

The strange choice of pressurizer location below the boilers and reactor will cause draining into it of primary coolant from boiler tubes in a SBO to an extent that boilers will become useless as heat sinks and no amount of emergency measures to add water to boilers will restore cooling to the reactor core unless the primary cooling system was replenished as well, something that cannot be done after an SBO in the present design and presently configured SAMGs.

2.3.4 Lack of a pressure vessel causes direct containment contamination

- Onset of severe core damage puts activity directly into the containment. There is no isolation of damaged core and its activity in a closed vessel like in a PWR pressure vessel.

2.3.5 Poor Deuterium Hydrogen mitigation systems

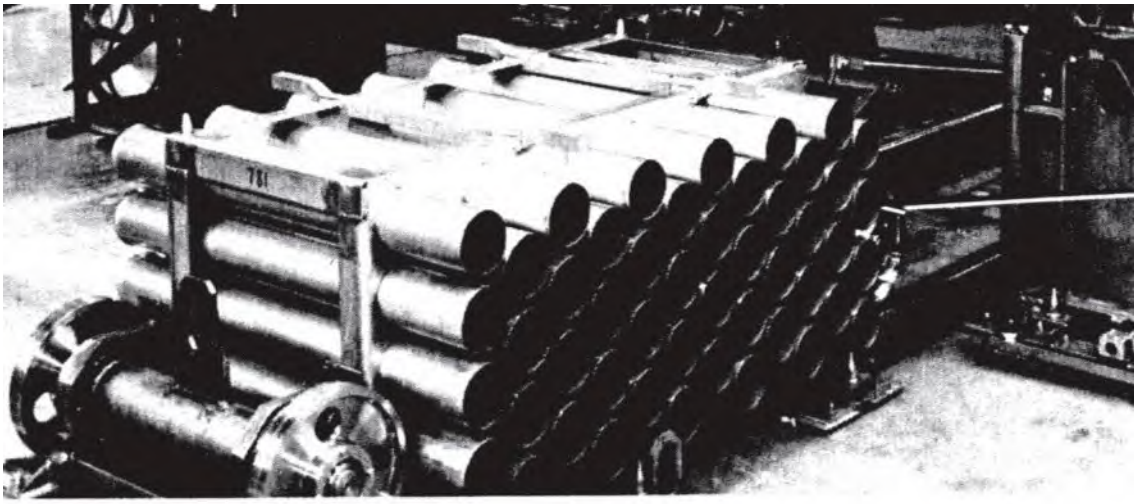
- Significantly higher sources of hydrogen from large amounts of carbon steel and Zircaloy.
- Currently planned hydrogen mitigation systems (igniters + a small number of PARS) inadequate and potentially dangerous. Poor combustible gas mitigation measures. Small number of Autocatalytic Recombiners inadequate for severe accident scenarios and will cause explosions.
    - All hydrogen detection and mitigation systems designed for H_2, not D_2 as required.

2.3.6 Calandria vessel a very unlikely core catcher

- Calandria vessel is designed to hold warm water at a low pressure, It is constructed by welding together a dozen 28mm thick stainless steel plates, bent to 120^o and joined by a thinner annular plate. It is a non nuclear Class 2C vessel not designed to take any pressure pulse from a BLEVE event
- Energetic interactions of disassembling core debris with underlying boiling moderator water in the low pressure Calandria vessel can cause vessel structural failures.
- Calandria vessel failure by weld failures is a likely outcome even before debris melt. There are a number of pipe penetrations at the bottom of the vessel that can fail by thermal interactions with hot debris.
- Should the Calandria vessel fail, interaction of hot debris with Shield Tank water also similarly challenging to integrity of structures holding the reactor vessels connected to the reactivity deck at the containment pressure boundary
- Calandria vessel likely cannot contain melting reactor core debris and can fail catastrophically at welds causing energetic interactions with potential for gross structure failures.

2.3.7 Spent Fuel storage

The spent fuel medium term storage in spent fuel pools is poorly designed and highly susceptible to Zircaloy fires.



2.3.8 Backup Diesel Generators

These are located at the lowest grade elevation in the plant and are no more than 2m above the water line at Darlington and 3m at Bruce. The tunnel carrying the cables is below the water line by about 4m and can get deluged with water. Pickering station has seen its basement level flooded in the past from water swell in the lake. Location of backup diesel generators has been pointed out as the single most critical error at Fukushima; something that has escaped the CNSC despite repeated warnings.

And…

- Inadequate instrumentation and control for severe accidents
- Poor equipment survivability due to poor containment layout
- No dedicated operator training / simulators for severe accidents.
- Severe accident simulation methods are outdated, crude and inadequate.
- No significant design changes implemented. Known problems ignored for decades.
- Current SAMGs are unrealistic and inadequate. Many potentially favourable emergency hookups not implemented.
- Environmental assessments for off-site releases after a severe accidents performed with a source term that represents barely 0.15% of the total core inventory

3. REVIEW OF PLANT PARAMETER ENVELOPE DOCUMENT

CNSC provided a Darlington New Build Plant Parameter Envelope report in February 2023. This, the 5th revision of the subject report (reference 4), was issued by OPG in October 2022 and is almost an exact copy of original Rev. 1 issued in 2009. OPG changed only 6 entries for BWRX-300 in the only substantial revision made to the PPE report in 12 years. Four managers signed off on inclusion of this sparse data that actually disclosed nothing about the reactor except the reactor power, depth and height ofvthe building along with some unreferenced data on normal duty emissions.

Given what the original purpose of a PPE was, issuance of this outdated and incomplete report for public comments or its use as a surrogate for site suitability assessments and pseudo design reviews makes no sense as a specific design has long been chosen for the site. What is amusing is that and there is little numerical information on the chosen BWRX-300 design in this PPE. A mere 75% of a single page is devoted to describing the BWRX-300 design on the last page of the PPE.

It is also of considerable concern that most important lessons learnt from Fukushima are lost both on the proponents of the four designs whose data was never updated for any severe accident related information as well as on the regulatory body who totally ignored it, as has been usually the case, especially in this habitual hurry to push through a preordained decision, any such omissions by the utility whose outdated, incomplete and devoid of any engineering analysis, Plant Parameter Envelope (PPE) was put out for public reviews.

On top of all that, the documents now issued were neither complete nor comprehensive in making a case for acceptability of the chosen site, and much less in using the exclusion area of an operating reactor for siting and almost totally devoid of any technical analysis of data in this fourth new revision put out for consideration. Significant amount of data pertinent to effect on site suitability is plain missing. More than anything else, the location.

Without going into the benefits or drawbacks of abandoning at this stage, the traditional, prescriptive expectations of standard design review plans in Canadian Regulatory Guides for new builds and the difficulty in the public evaluating a new reactor proposal of a reactor design without any detailed safety assessments, environmental impact analyses , socio-economic impacts, or risk assessments, it is very clear that neither the CNSC, nor OPG have taken this process seriously and in ramming substandard documentation through what there should have been due diligence, they are making a mockery of the legislated public participation process. It is also possible that the OPG is out of its depth as an electric utility in evaluating advanced reactor designs and having used external help (Condesco) in creating the original PPE in 2009 and done practically nothing on it for 13 years, finds itself unable to complete even the elementary stages of a new reactor licensing application process. Even the preliminary safety analysis report, stripped of any data that would reveal any meaningful details about the reactor or the accidents considered, reads as totally prepared by the vendor.

We understand that neither NRC, nor CNSC have any regulatory requirements for the process used by an applicant on which information to gather and how to go about deriving it or on how to present that information that would allow the applicant 'to assume certain design parameters for an early site permit (ESP) application when a specific reactor technology has not been selected for a proposed site. A PPE serves in its inclusion of design data as a surrogate for design information of a specific design and bounding site parameters for comparison with its actual site characteristics in an elementary impact assessment on environmental, socio-economic and safety issues.

The report also does not meet the current industry guidelines from NEI issued almost one and a half years earlier on how to collect information from vendors whose designs the early site permit applicant wishes to be bounded by the plant parameter envelope (PPE). It ignores lessons learnt from NRC reviews of past practices by other utilities following the same PPE process, ignores regulatory expectations in the only jurisdiction where such documents have been reviewed as well as the Canadian public expectations for being kept informed of the industry decision process. The latest mid-March 2023 pronouncement by CNSC on the vendor understanding the regulatory process; while acting within a MOU to harmonize the licensing process with NRC whose elementary requirements on consideration of core melt in determining the exclusion zone are totally ignored. There are no grounds, without doing a proper severe core damage progression and consequence assessment on both stations at Darlington, on which BWRX cannot be located a few hundred meters from station boundary, next to a station with little mitigation capabilities to handle a core damage accident and with an exclusion 'radius' of only 350m, and across the road from a dry spent fuel storage complex. It would be prudent for CNSC to take a few steps back and do due diligence instead of ramming this process through a hoax of a public consultation process.

We understood that our review was to be conducted to see if the bounding information presented was such that an educated commentary can be made of its veracity and completeness for the purpose and see if the regulatory bodies have the right information to decide that the content, values, rationale are reasonable and sufficient to comply with traditional regulatory expectations and that public participation in the process is meaningful.

It is not apparent to us, however, why CNSC has not asked OPG to do better. Given that CNSC has a MOU with NRC on licensing new designs like the BWRX-300, the DNNP PPE does not venture at all into the suggestions made by NRC in its own reviews of the four sets of submissions by xx,yy,zz,tt utilities or the development of various safety guides like DG-4029 that venture into expectations from new builds.

3.1 SUMMARY OF FINDINGS ON PLANR PARAMETER ENVELOPE

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1. The report has not fully considered the industry guidelines for such a report that were issued by NEI almost one and a half years earlier. It does not address all data suggested by NEI-10-Rev-2. It does not reflect any industry experience, NRC queries or advances in reactor safety expectations that NEI says were reflected in this revision. Some of these questions are quite central to a safe design, Many numbered subject headings that were not broached. These include:
    a. Soil characteristics to bear dynamic loads
    b. Design basis maximum hurricane data (3 second gust speed)
    c. Water intake into condenser and service water and its temperature rise
    d. Water blowdown rate and temperature into the lake upon an accident
    e. Exhaust stack height
    f. Heat rejection rate into the atmosphere upon an accident
    g. Any Items unique to non-water Fire Protection Systems
    h. The design radiological dose consequences due to airborne releases from postulated accidents.
    i. The annual activity, by radionuclide, contained in routine plant liquid effluent streams.
    j. The assumed activity, by radionuclide, contained in accidental liquid radwaste release from postulated tank failure,
    k. The assumed volume of accidental liquid radwaste release.
    l. Detailed information on spent fuel; spent fuel pool
        i. Spent Fuel Pool Capacity - the number of spent fuel assemblies capable of being stored in the spent fuel pool.
        ii. Fuel Bundles Discharged per Refuel Outage - The number of spent fuel assemblies discharged to the spent fuel pool for a typical refuel outage.
        iii. Fuel Cycle Duration
        iv. Fuel Bundles Discharged During Licensed Operation - The total number of spent fuel assemblies discharged during the 40 year operating license life of the plant.
    m. Detailed information on gas turbines
        i. The total generating capacity of the gas turbine generating system.
        ii. The elevation above finished grade of the release point for standby gas turbine exhaust releases.
        iii. The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby gas-turbine generators. Provide in Table 6.
        iv. The maximum expected sound level produced by operation of gas turbines, measured at 1000 feet from the noise source.
        v. The type of fuel oil required for proper operation of the gas turbines.
    n. The weight of the heaviest SMR component that is expected to be shipped to the site.
    o. Information on Fuel:
        i. 18.1 Maximum Fuel Enrichment
        ii. 18.2 Maximum Average Assembly Burnup
        iii. 18.3 Peak fuel rod exposure at end of life

    iv. 18.4 Maximum Average Discharge Batch Burnup
    v. 18.5 Maximum Thermal Power
    vi. 18.6 Mass of uranium in the reload batch.
    vii. 18.7 Clad Material

2. Concept of PPE, the plant and site data that it collects was developed before the Fukushima disaster struck in 2012. That was also long before we all took a good look at the vulnerabilities to severe accidents that our reactors inherited and developed a semblance of accident management guidelines, engineered measures, new systems and coordination mechanisms for emergency planning. Given that the OPG PPE is so wanting in detail and the new reactor design make unsubstantiated claims about their infallibility, there is a need to reflect these topics in that in the PPE data. Both common sense and NEI-10-Rev. 2 guidelines require that severe accident mitigation related information be included and with clarity and detail. It feels like the parties never heard of Fukushima or the conclusions of its investigations into the root causes.

3. An important omission in the PPE and site description is in discussion of why the new build HAS TO BE within an existing station's exclusion boundary, in spite of all the risks such a decision entails.

4. The PPE provided bounding values for 3 reactors tabulated in 2009 for them by Condesco with ZERO additions made through the next 13 years or any feedback from any person or organization.

5. A composite spreadsheet for all vendor data was not created (one column for each design). While bounding values (numerically maximum or minimum of data sent in by the vendors without any accompanying description) were identified, no rationale for comparing the supplied data with diverse origins, meaning or credibility was discussed. There was no discussion of any missing data, consistency check within vendor data set or any discussion of any reasonableness of data or error margins. These are actually explicit requirements and expectations in repeated NRC and NEI documents on the subject. A mere dump of bounding values makes no meaningful contribution to the stated intent.

6. Even simple, typically publicly available information on reactor designs was not made available for the design ultimately chosen under the inexplicable guise of being 'proprietary'. Such blatant cover of 'proprietary' information is inconsistent with the vendor's obligations to people of Canada where the vendor hopes to benefit from a proof of concept with public funds. Reactor data on new Chinese reactor designs is more abundantly available than was made available for BWRX-300. This is not a time machine design or a shoulder carried hypersonic missile design.

7. Public relations propaganda about the chosen reactor design's safety was freely dispensed without giving any numerical information on the reactor design that could be verified by nuclear safety experts working in public interest.

8. The process of arriving at the bounding value is not transparent as the data provided by each of the three vendors that dominate the information scape is not individually tabulated or referred to in a separate summary document for the design. That should have been an easy thing to do and with sufficient volume of information on the actual design, a proper way of verifying if the bounding data values were in context of ANY new design that may show up on the horizon layer, just as the BWRX-300 did, many years after the PPE was issued first. Observations on the specific features of a reactor design from which the bounding value was derived were not made.

9. The data set does not contain any information that would be necessary and be specific to the Darlington site where other operating reactors already exist. This includes data on Derived Emission Limits and actual emission history that would be added to that from new units.
10. Site parameter characteristic data on effect of operations of the existing reactors on operation of the proposed new reactor (and vice versa) was not clearly given.
11. Effect of an accident at one of the operating units on construction, operation or decommissioning of the new reactor was not given..
12. Effect of a severe core damage accident at an operating unit on safety of personnel engaged in construction of the new reactor(s) was not considered. The source term data given to the Emergency Management Organizations by utility running the operating reactors is irresponsibly fraudulent and cannot be used to prepare emergency evacuation or sheltering processes for our fellow citizens working on site.
13. The effect of a limiting severe core damage accident on the plant parameter envelope was not considered..
14. When the new entry into the list of potential reactor designs had a parameter that was outside the enveloping limits defined in the earlier incarnation of the PPE, the envelope was extended without any explanation. For example when the BWRX-300 required to be built onto a depth of 38 meters feet underground and above ground, equivalent to a total structure height of a 25 story building – the PPE was merely re-written to make these parameters acceptable.
15. Source term from normal operation from a number of release points was provided (also recommended by NRC in its review of NEI-10) with certain entries missing. Source term from regular emissions was provided without providing any information on it's nature (continuous or frequency of puffs if any) and what sources it includes, of basis of its derivation, analytical assumptions and tools.
16. No comparison of source terms between 4 reactors without giving any information about the reactors, their vulnerabilities, accident scenarios, release locations, release frequencies is meaningless.
17. NRC expects a clear statement on margin of error on the bounding values chosen. CNSC should too. Certain critical data where margins of error are critically important.
18. Some very important lessons were learnt from Fukushima. There is no mention of any comparison of risk between various designs; especially from BWRX-300 except that claims of eternal and near absolute safety are made.
19. Need for radiation monitoring equipment that would detect and save data on normal operation effluents as well as radiation fields from accidents.
20. Information on fuel procurement
21. Decommissioning responsibility
22. Decommissioning costs

3.2 RECOMMENDATION ON PPE

We propose that the current PPE be not accepted as surrogate to anything and a renewed set of documents be prepared that details the actual data for BWRX-300 and issued for comments to me. It should include enough information on each of the reactor designs that were considered (as a summary design description with pictures and tables and references) and a much broader discussion of the chosen BWRX-300 design.

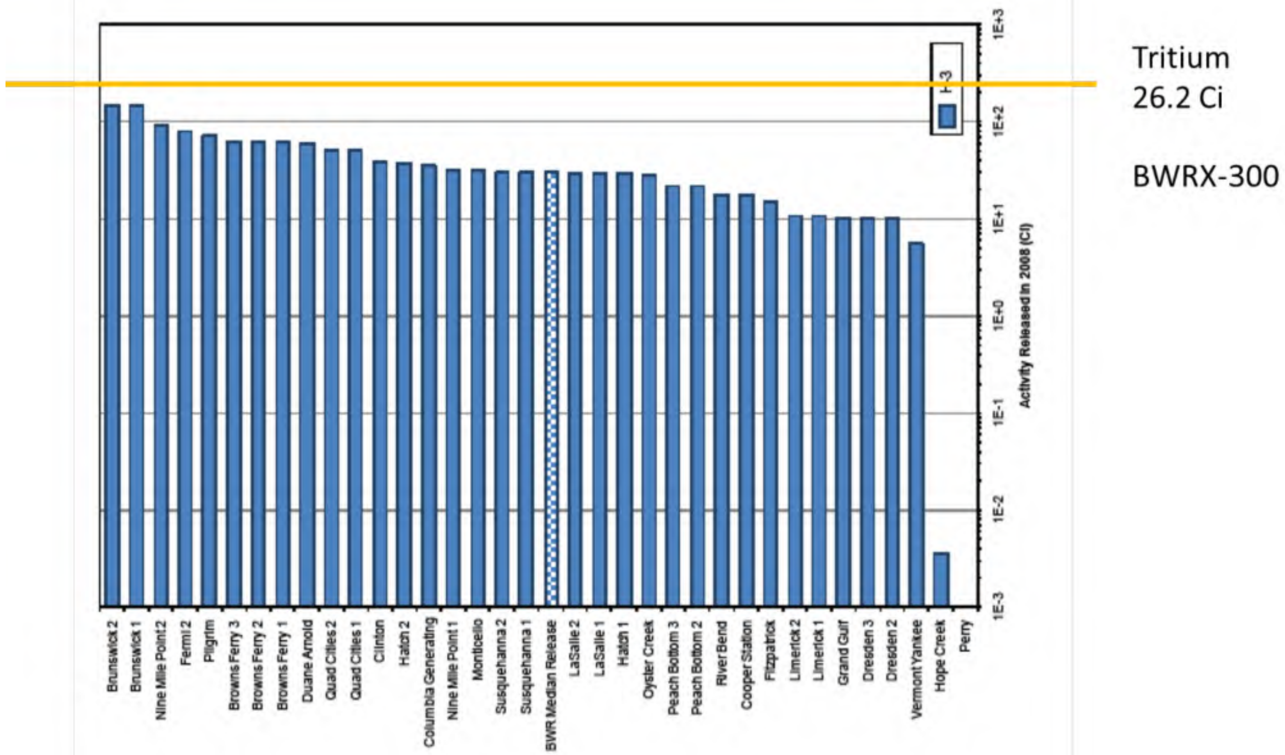

FIGURE 2.4 Tritium (H-3) releases from (A) BWRs and (B) PWRs in 2008.
SOURCE: Daugherty and Conatser (2008).

Figure 14 : Sample results of operational releases of Tritium from US BWRs in 2008 from reference xx and PPE data for BWRX-300,

NOBLE
GASES
BWRX-300
3.67E6 GBq

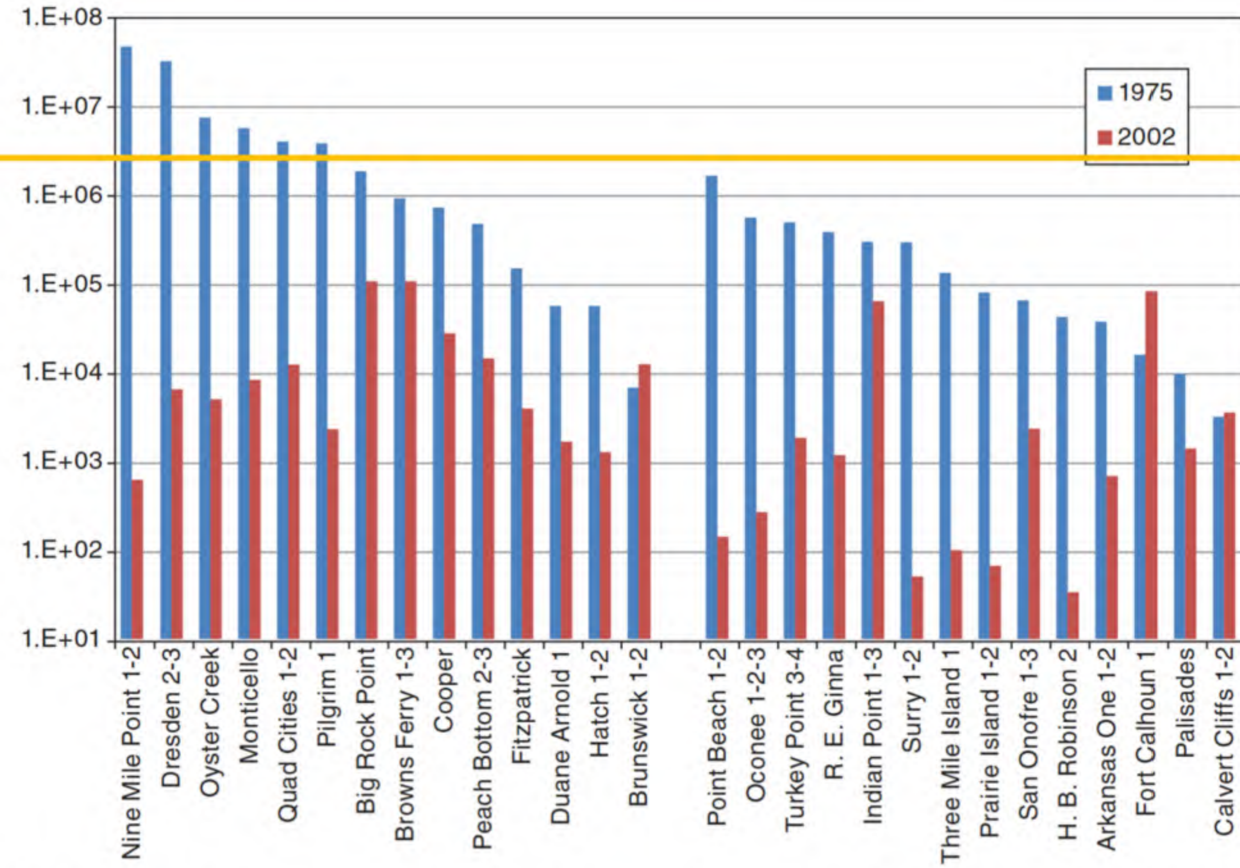

FIGURE 2.5 Comparison of atmospheric releases of noble gases for selected BWRs (left) and PWRs (right) in the United States. The units on the vertical scale are in gigabecquerels (GBq = 0.03 Ci). SOURCE: Data from the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

Iodine -131
BWRX-300
1.08e-2 Ci
=600 Sv

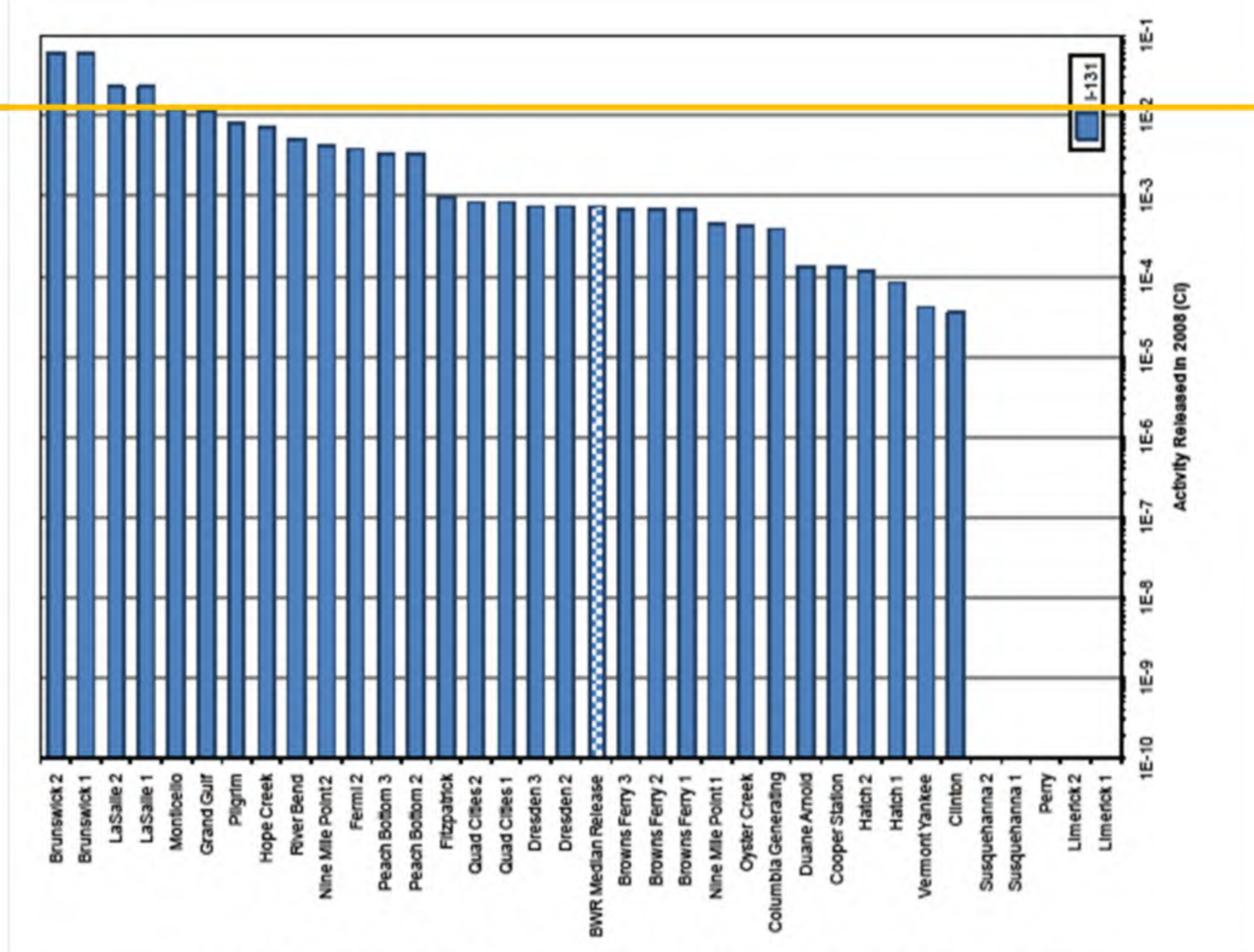

FIGURE 2.2 Iodine-131 releases from (A) BWRs and (B) PWRs in 2008. SOURCE: Daugherty and Conatser (2008).

BWRX-300 no data

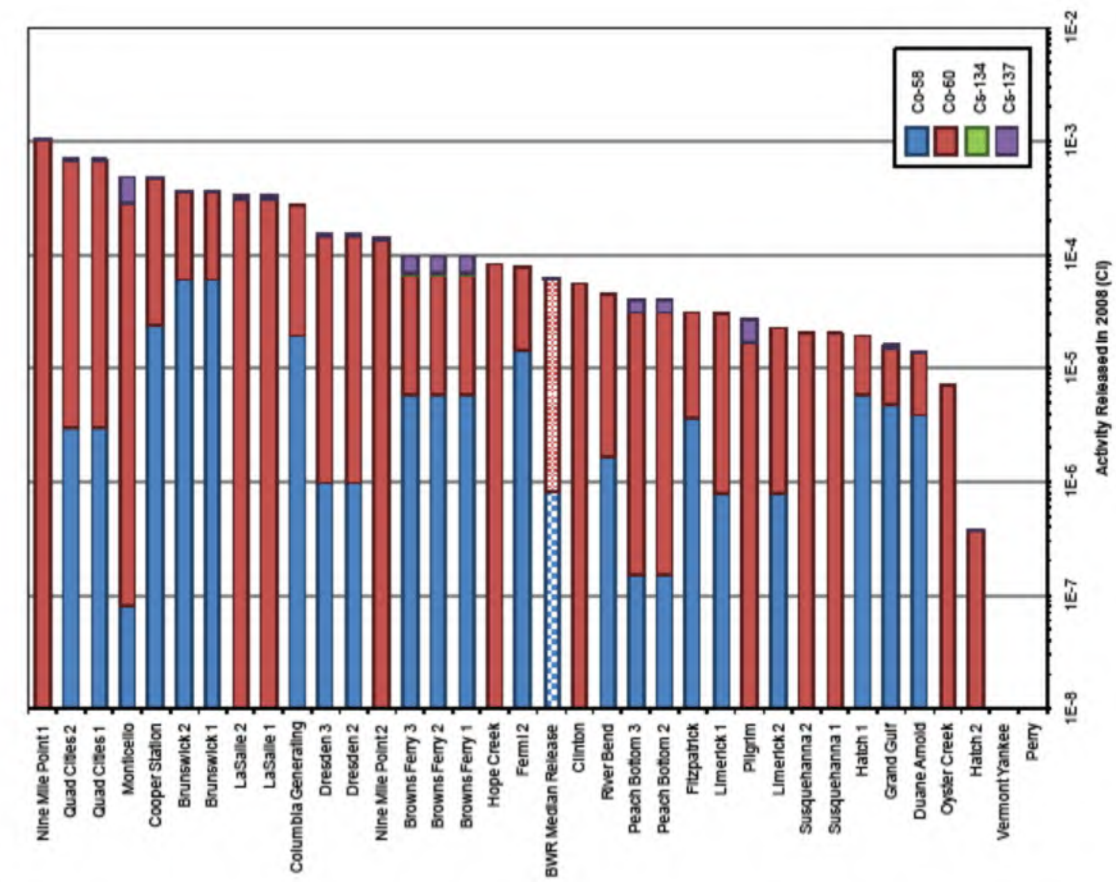

FIGURE 2.3 Particulate releases from (A) BWRs and (B) PWRs in 2008. SOURCE: Daugherty and Conatser (2008).

4. Summary of findings and review

Siting a new reactor within the exclusion area boundary (EAB)of an operating reactor that has significant and unresolved vulnerabilities to severe core damage is contrary to safety principles, regulatory requirements as well as requisite stakeholder obligations to worker security and public safety. Even the currently accepted US NRC inspired 1000 yard (914m) EAB on the existing nuclear installations will not meet the U.S 10CFR100.11 requirements, and public expectations to consider source term from a severe accident core melt. Therefore, the indicated EAB for BWRX-300 of 350m is incredulous as is its full inclusion within the 40 year old EAB for the Darlington plant and within the EAB for the dry storage shed structures housing > 130 reactor core loads of spent fuel in concrete casks with > 70% of volatile, high dose sensitive fission product species still active. The CNSC needs to exercise due diligence in requiring OPG to resolve existing critical safety issues with Darlington CANDU severe accident mitigation before an event causes all reactors on site to have to be abandoned. Mere siting of BWRx-300 next to sheds containing hundreds of reactor years of spent fuel and 50 odd meter separation of its switchyard from an operating public railway line is another step in the Ontario Power Generation sleep walk towards an impending disaster at Darlington. GE-H should reconsider this siting plan for their own corporate interests. Their design is neither small, nor so modular as a first of kind construction and requires a comprehensive Environmental Assessment to protect Canadian public interests, previous actions in this regard notwithstanding.

The Plant Parameter Envelope document sent for review is grossly incomplete; has seen no substantive OPG additions in 12 years; and the US 10CFR52 process of site qualification it mimics is of no relevance today as a vendor GE-Hitachi and their BWRX-300 design has already been selected by OPG. Once a new site for the reactor is identified, a detailed reactor design information binder will help qualify that site for the chosen design. There has to be an independent technical review of vendor GE-Hitachi claims of enhanced safety in their BWRX-300 design with access to their actual safety reports with detailed analytical assumptions, code descriptions and accident simulation results with numerical information they have been unable to reveal so far.

5. 10 CFR 100.11 Determination of exclusion area, low population zone, and population center distance.

(a) As an aid in evaluating a proposed site, an applicant should assume a fission produce release[1] from the core, the expected demonstrable leak rate from the containment and the meteorological conditions pertinent to his site to derive an exclusion area, a low population zone and population center distance. For the purpose of this analysis, which shall set forth the basis for the numerical values used, the applicant should determine the following:

(1) An exclusion area of such size that an individual located at any point on its boundary for two hours immediately following onset of the postulated fission product release would not receive a total radiation dose to the whole body in excess of 25 rem[2] or a total radiation dose in excess of 300 rem[2] to the thyroid from iodine exposure.

(2) A low population zone of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(3) A population center distance of at least one and one-third times the distance from the reactor to the outer boundary of the low population zone. In applying this guide, the boundary of the population center shall be determined upon consideration of population distribution. Political boundaries are not controlling in the application of this guide. Where very large cities are involved, a greater distance may be necessary because of total integrated population dose consideration.

(b) For sites for multiple reactor facilities consideration should be given to the following:

(1) If the reactors are independent to the extent that an accident in one reactor would not initiate an accident in another, the size of the exclusion area, low population zone and population center distance shall be fulfilled with respect to each reactor individually. The envelopes of the plan overlay of the areas so calculated shall then be taken as their respective boundaries.

(2) If the reactors are interconnected to the extent that an accident in one reactor could affect the safety of operation of any other, the size of the exclusion area, low population zone and population center distance shall be based upon the assumption that all interconnected reactors emit their postulated fission product releases simultaneously. This requirement may be reduced in relation to the degree of coupling between reactors, the probability of concomitant accidents and the probability that an individual would not be exposed to the radiation effects from simultaneous releases. The applicant would be expected to justify to the satisfaction of the Commission the basis for such a reduction in the source term.

(3) The applicant is expected to show that the simultaneous operation of multiple reactors at a site will not result in total radioactive effluent releases beyond the allowable limits of applicable regulations.

Note: For further guidance in developing the exclusion area, the low population zone, and the population center distance, reference is made to Technical Information Document 14844, dated March 23, 1962, which contains a procedural method and a sample calculation that result in distances roughly reflecting current siting practices of the Commission. The calculations described in Technical Information Document 14844 may be used as a point of departure for consideration of particular site requirements which may result from evaluation of the characteristics of a particular reactor, its purpose and method of operation.

[27 FR 3509, Apr. 12, 1962, as amended at 31 FR 4670, Mar. 19, 1966; 38 FR 1273, Jan. 11, 1973; 40 FR 8793, Mar. 3, 1975; 40 FR 26527, June 24, 1975; 53 FR 43422, Oct. 27, 1988; 64 FR 48955, Sept. 9, 1999; 67 FR 67101, Nov. 4, 2002]

[1] The fission product release assumed for these calculations should be based upon a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events, that would result in potential hazards not exceeded by those from any accident considered credible. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release of appreciable quantities of fission products.

[2] The whole body dose of 25 rem referred to above corresponds numerically to the once in a lifetime accidental or emergency dose for radiation workers which, according to NCRP recommendations may be disregarded in the determination of their radiation exposure status (see NBS Handbook 69 dated June 5, 1959). However, neither its use nor that of the 300 rem value for thyroid exposure as set forth in these site criteria guides are intended to imply that these numbers constitute acceptable limits for emergency doses to the public under accident conditions. Rather, this 25 rem whole body value and the 300 rem thyroid value have been set forth in these guides as reference values, which can be used in the evaluation of reactor sites with respect to potential reactor accidents of exceedingly low probability of occurrence, and low risk of public exposure to radiation.

Page Last Reviewed/Updated Tuesday, August 29, 2017

6. REFERENCES

1 . Severe accident progression without operator action, Canadian Nuclear safety Commission, Oct 2015, http://www.nuclearsafety.gc.ca/eng/pdfs/Reports/Severe-AccidentProgression-without-Operator-Action.pdf

2 Study of Consequences of a Hypothetical Severe Nuclear Accident and Effectiveness of Mitigation Measures, CNSC, Sept 2015, http://nuclearsafety.gc.ca /eng/resources/health/ hypothetical-severe-nuclear-accident-study.cfm

3 Regulatory Actions That Hinder Development Of Effective Risk Reduction Measures By The Nuclear Industry For Enhanced Severe Accident Prevention And Mitigation Measures After Fukushima, Sunil Nijhawan, ICONE24-60700, Proceedings of the 2016 24th International Conference on Nuclear Engineering ICONE24, June 26-30, 2016, Charlotte, North Carolina, USA

4 Use of Plant Parameters Envelope to Encompass the Reactor Designs being considered for the Darlington Site, N-REP-01200-10000-R005, Ontario Power Generation, 2022-Oct-4

Joint Review Panel Recommendations (10 pages)

Prior to Site Preparation

Recommendation # 2 (Section 4.5):
The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to conduct a comprehensive soils characterization program. In particular, the potentially impacted soils in the areas OPG identifies as the spoils disposal area, cement plant area and asphalt storage area must be sampled to identify the nature and extent of potential contamination.

Recommendation # 6 (Section 4.6):
The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to update its preliminary decommissioning plan for site preparation in accordance with the requirements of Canadian Standards Association Standard N294-09. The OPG preliminary decommissioning plan for site preparation must incorporate the rehabilitation of the site to reflect the existing biodiversity in the event that the Project does not proceed beyond the site preparation phase. OPG shall prepare a detailed preliminary decommissioning plan once a reactor technology is chosen, to be updated as required by the Canadian Nuclear Safety Commission.

Recommendation # 7 (Section 4.6):
The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require that OPG establish a decommissioning financial guarantee to be reviewed as required by the Canadian Nuclear Safety Commission. Regarding the decommissioning financial guarantee for the site preparation stage, the Panel recommends that this financial guarantee contain sufficient funds for the rehabilitation of the site in the event the Project does not proceed beyond the site preparation stage.

Recommendation # 8 (Section 5.1):
The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to develop a follow-up and adaptive management program for air contaminants such as Acrolein, NO_2 , SO_2 , SPM, $PM_{2.5}$ and PM_{10} , to the satisfaction of the Canadian Nuclear Safety Commission, Health Canada and Environment Canada. Additionally, the Canadian Nuclear Safety Commission must require OPG to develop an action plan acceptable to Health Canada for days when there are air quality or smog alerts.

Recommendation # 9 (Section 5.1):
The Panel recommends that the Canadian Nuclear Safety Commission, in collaboration with Health Canada, require OPG to develop and implement a detailed acoustic assessment for all scenarios evaluated. The predictions must be shared with potentially affected members of the public. The OPG Nuisance Effects Management Plan must include noise monitoring, a noise complaint response mechanism and best practices for activities that may occur outside of municipal noise curfew hours to reduce annoyance that the public may experience.

Recommendation # 10 (Section 5.2):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to undertake a detailed site geotechnical investigation prior to commencing site preparation activities. The geologic elements of this investigation should include, but not be limited to:
· collecting site-wide information on soil physical properties;
· determining the mechanical and dynamic properties of overburden material across the site;
· mapping of geological structures to improve the understanding of the site geological structure model;
· confirming the lack of karstic features in the local bedrock at the site; and
· confirming the conclusions reached concerning the liquefaction potential in underlying granular materials.

Recommendation # 12 (Section 5.3):
The Panel recommends that before in-water works are initiated, the Canadian Nuclear Safety Commission require OPG to collect water and sediment quality data for any future embayment area that may be formed as a consequence of shoreline modifications in the vicinity of the outlet of Darlington Creek. This data should serve as the reference information for the proponent's post-construction commitment to conduct water and sediment quality monitoring of the embayment area.

Recommendation # 13 (Section 5.3):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to collect and assess water quality data for a comprehensive number of shoreline and offshore locations in the site study area prior to commencing in-water works. This data should be used to establish a reference for follow-up monitoring.

Recommendation # 20 (Section 5.5):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to perform a thorough evaluation of site layout opportunities before site preparation activities begin, in order to minimize the overall effects on the terrestrial and aquatic environments and maximize the opportunity for quality terrestrial habitat rehabilitation.

Recommendation #22 (Section 5.5):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop a follow-up program for insects, amphibians and reptiles, and mammal species and communities to ensure that proposed mitigation measures are effective.

Recommendation # 25 (Section 5.5):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to conduct more sampling to confirm the presence of Least Bittern before site preparation activities begin. The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop and implement a management plan for the species at risk that are known to occur on site. The plan should consider the resilience of some of the species and the possibility of off-site compensation.

Recommendation # 38 (Section 5.9):
The Panel recommends that the Canadian Nuclear Safety Commission require that the geotechnical and seismic hazard elements of the detailed site geotechnical investigation to be performed by OPG include, but not be limited to:

Prior to site preparation:

· demonstration that there are no undesirable subsurface conditions at the Project site. The overall site liquefaction potential shall be assessed with the site investigation data; and
· confirmation of the absence of paleoseismologic features at the site and, if present, further assessment to reduce the overall uncertainty in the seismic hazard assessment during the design of the Project must be conducted.

During site preparation and/or prior to construction:

· verification and confirmation of the absence of surface faulting in the overburden and bedrock at the site.

Prior to construction:

· verification of the stability of the cut slopes and dyke slopes under both static and dynamic loads with site/Project-specific data during the design of the cut slopes and dykes or before their construction;
· assessment of potential liquefaction of the northeast waste stockpile by using the data obtained from the pile itself upon completion of site preparation;
· measurement of the shear strength of the overburden materials and the dynamic properties of both overburden and sedimentary rocks to confirm the site conditions and to perform soil-structure interaction analysis if necessary;
· assessment of the potential settlement in the quaternary deposits due to the groundwater drawdown caused by future St. Marys Cement quarry activities; and
· assessment of the effect of the potential settlement on buried infrastructures in the deposits during the design of these infrastructures.

Prior to operation:

· development and implementation of a monitoring program for the Phase 4 St. Marys Cement blasting operations to confirm that the maximum peak ground velocity at the boundary between the Darlington and St. Marys Cement properties is below the proposed limit of three millimetres per second (mm/s).

Recommendation # 41 (Section 6.1):
The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission coordinate discussions with OPG and key stakeholders on the effects of the Project on housing supply and demand, community recreational facilities and programs, services and infrastructure as well as additional measures to help deal with the pressures on these community assets.

Recommendation # 47 (Section 6.7):
The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission ensure the OPG Traffic Management Plan addresses the following:
· contingency plans to address the possibility that the assumed road improvements do not occur;
· consideration of the effect of truck traffic associated with excavated material disposal on traffic operations and safety;
· further analysis of queuing potential onto Highway 401; and
· consideration of a wider range of mitigation measures, such as transportation-demand management, transit service provisions and geometric improvements at the Highway 401/Waverley Road interchange.

Recommendation # 48 (Section 6.7):
In consideration of public safety, the Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission coordinate a committee of federal, provincial and municipal transport authorities to review the need for road development and modifications.

During Site Preparation

Recommendation #5 (Section 4.6):
To avoid any unnecessary environmental damage to the bluff at Raby Head and fish habitat, the Panel recommends that no bluff removal or lake infill occur during the site preparation stage, unless a reactor technology has been selected and there is certainty that the Project will proceed.

Recommendation # 19 (Section 5.4):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to expand the scope of the groundwater monitoring program to monitor transitions in groundwater flows that may arise as a consequence of grade changes during the site preparation and construction phases of the Project. The design of the grade changes should guide the determination of the required monitoring locations, frequency of monitoring and the required duration of the program for the period of transition to stable conditions following the completion of construction and the initial period of operation.

Recommendation # 21 (Section 5.5):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to compensate for the loss of ponds, like-for-like, preferably in the site study area. The Panel also recommends that the Canadian Nuclear Safety Commission require OPG to use best management practices to prevent or minimize the potential runoff of sediment and other contaminants into wildlife habitat associated with Coot's Pond during site preparation and construction phases.

Prior to Construction

Recommendation # 1 (Section 4.5):
The Panel understands that prior to construction, the Canadian Nuclear Safety Commission will determine whether this environmental assessment is applicable to the reactor technology selected by the Government of Ontario for the Project. Nevertheless, if the selected reactor technology is fundamentally different from the specific reactor technologies bounded by the plant parameter envelope, the Panel recommends that a new environmental assessment be conducted.

Recommendation # 3 (Section 4.5):
The Panel recommends that the Canadian Nuclear Safety Commission require that as part of the Application for a Licence to Construct a reactor, OPG must undertake a formal quantitative cost-benefit analysis for cooling tower and once-through condenser cooling water systems, applying the principle of best available technology economically achievable. This analysis must take into account the fact that lake infill should not go beyond the two-metre depth contour and should include cooling tower plume abatement technology.

Recommendation # 14 (Section 5.3):
The Panel recommends that following the selection of a reactor technology for the Project, the Canadian Nuclear Safety Commission require OPG to conduct a detailed assessment of predicted effluent releases from the Project. The assessment should include but not be limited to effluent quantity, concentration, points of release and a description of effluent treatment, including demonstration that the chosen option has been designed to achieve best available treatment technology and techniques economically achievable. The Canadian Nuclear Safety Commission shall also require OPG to conduct a risk assessment on the proposed residual releases to determine whether additional mitigation measures may be necessary.

Recommendation # 16 (Section 5.3):
The Panel recommends that prior to the start of construction, the Canadian Nuclear Safety Commission require the proponent to establish toxicity testing criteria and provide the test methodology and test frequency that will be used to confirm that stormwater discharges from the new nuclear site comply with requirements in the Fisheries Act.

Recommendation # 17 (Section 5.4):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to provide an assessment of the ingress and transport of contaminants in groundwater on site during successive phases of the Project as part of the Application for a Licence to Construct. This assessment shall include consideration of the impact of wet and dry deposition of all contaminants of potential concern and radiological constituents, especially tritium, in gaseous emissions on groundwater quality. OPG shall conduct enhanced groundwater and contaminant transport modelling for the assessment and expand the modelling to cover the effects of future dewatering and expansion activities at the St. Marys Cement quarry on the Project.

Recommendation # 26 (Section 5.5):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop a comprehensive assessment of hazardous substance releases and the required management practices for hazardous chemicals on site, in accordance with the Canadian Environmental Protection Act , once a reactor technology has been chosen.

Recommendation # 27 (Section 5.6):
The Panel recommends that prior to any destruction of the Bank Swallow habitat, the Canadian Nuclear Safety Commission require OPG to implement all of its proposed Bank Swallow mitigation options, including:
· the acquisition of off-site nesting habitat;
· the construction of artificial Bank Swallow nest habitat with the capacity to maintain a population which is at least equal to the number of breeding pairs currently supported by the bluff and as close to the original bluff site as possible; and
· the implementation of an adaptive management approach in the Bank Swallow mitigation plan, with the inclusion of a threshold of loss to be established in consultation with all stakeholders before any habitat destruction takes place.

Recommendation # 35 (Section 5.7):
In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to operation, the Canadian Nuclear Safety Commission require OPG to include the following in the surface water risk assessment:
· the surface combined thermal and contaminant plume; and
· the physical displacement effect of altered lake currents as a hazardous pulse exposure to fish species whose larvae passively drift through the area, such as lake herring, lake whitefish, emerald shiner and yellow perch.
If the risk assessment result predicts a potential hazard then the Canadian Nuclear Safety Commission shall convene a follow-up monitoring scoping workshop with Environment Canada, Fisheries and Oceans Canada and any other relevant authorities to develop an action plan.

Recommendation # 37 (Section 5.7):
In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to determine the total area of permanent aquatic effects from the following, to properly scale mitigation and scope follow-up monitoring:
· the thermal plume + 2_{o} C above ambient temperature;
· the mixing zone and surface plume contaminants;

· physical displacements from altered lake currents; and
· infill and construction losses and modifications.

Recommendation # 39 (Section 5.9):
The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to prepare a contingency plan for the construction, operation and decommissioning Project stages to account for uncertainties associated with flooding and other extreme weather hazards. OPG shall conduct localized climate change modelling to confirm its conclusion of a low impact of climate change. A margin/bound of changes to key parameters, such as intensity of extreme weather events, needs to be established to the satisfaction of the Canadian Nuclear Safety Commission. These parameters can be incorporated into hydrological designs leading up to an application to construct a reactor, as well as measures for flood protection. OPG must also conduct a drought analysis and incorporate any additional required mitigation/design modifications, to the satisfaction of the Canadian Nuclear Safety Commission, as part of a Licence to Construct a reactor.

Recommendation # 40 (Section 5.9):
The Panel recommends that **prior to construction**, the Canadian Nuclear Safety Commission require OPG to:
· establish an adaptive management program for algal hazard to the Project cooling water system intake that includes the setup of thresholds for further actions; and
· factor the algal hazard assessment into a more detailed biological evaluation of moving the intake and diffuser deeper offshore as part of the detailed siting studies and the cost-benefit analysis of the cooling system.

Recommendation # 52 (Section 6.8):
The Panel recommends that **prior to construction**, the Canadian Nuclear Safety Commission require OPG to make provisions for on-site storage of all used fuel for the duration of the Project, in the event that a suitable off-site solution for the long-term management for used fuel waste is not found.

Recommendation # 53 (Section 6.8):
The Panel recommends that **prior to construction**, the Canadian Nuclear Safety Commission require OPG to make provisions for on-site storage of all of low and intermediate-level radioactive waste for the duration of the Project, in the event that a suitable off-site solution for the long-term management for this waste is not approved.

Recommendation # 57 (Section 7.2):
The Panel recommends that **prior to construction**, the Canadian Nuclear Safety Commission require OPG to undertake an assessment of the off-site effects of a severe accident. The assessment should determine if the off-site health and environmental effects considered in this environmental assessment bound the effects that could arise in the case of the selected reactor technology.

Recommendation # 58 (Section 7.2):
The Panel recommends that **prior to construction**, the Canadian Nuclear Safety Commission confirm that dose acceptance criteria specified in RD-337 at the reactor site boundary—in the cases of design basis accidents for the Project's selected reactor technology—will be met.

Recommendation # 63 (Section 8.1):
The Panel recommends that **prior to construction**, the Canadian Nuclear Safety Commission require OPG to evaluate the cumulative effect of a common-cause severe accident involving all of the nuclear reactors in the site study area to determine if further emergency planning measures are required.
During Operation

Recommendation # 15 (Section 5.3):
The Panel recommends that following the start of operation of the reactors, the Canadian Nuclear Safety Commission require OPG to conduct monitoring of ambient water and sediment quality in the receiving waters to ensure that effects from effluent discharges are consistent with predictions made in the environmental impact statement and with those made during the detailed design phase.

Recommendation # 18 (Section 5.4):
The Panel recommends that based on the groundwater and contaminant transport modelling results, the Canadian Nuclear Safety Commission require OPG to expand the Radiological Environmental Monitoring Program. This program shall include relevant residential and private groundwater well quality data in the local study area that are not captured by the current program, especially where the modelling results identify potential critical groups based on current or future potential use of groundwater.

Recommendation # 36 (Section 5.7):
In the event that a once-through condenser cooling system is chosen for the Project the Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to undertake adult fish monitoring of largebodied and small-bodied fish to confirm the effectiveness of mitigation measures and verify the predictions of no adverse thermal and physical diffuser jet effects.

Recommendation # 54 (Section 7.1):
The Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to implement measures to manage releases from the Project to avoid tritium in drinking water levels exceeding a running annual average of 20 Becquerels per litre at drinking water supply plants in the regional study area.

Recommendation # 61 (Section 8.1):
The Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to monitor aquatic habitat and biota for potential cumulative effects from the thermal loading and contaminant plume of the discharge structures of the existing Darlington Nuclear Generating Station and Over the Life of the Project

Recommendation # 4 (Section 4.6):
The Panel recommends that the Canadian Nuclear Safety Commission exercise regulatory oversight to ensure that OPG complies with all municipal and provincial requirements and standards over the life of the Project. This is of particular importance because the conclusions of the Panel are based on the assumption that OPG will follow applicable laws and regulations at all jurisdictional levels.

Recommendation # 11 (Section 5.2):
The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop and implement a follow-up program for soil quality during all stages of the Project.

Recommendation # 43 (Section 6.2):
The Panel recommends that the Canadian Nuclear Safety Commission engage appropriate stakeholders, including OPG, Emergency Management Ontario, municipal governments and the Government of Ontario to develop a policy for land use around nuclear generating stations.

Recommendation # 56 (Section 7.1):
The Panel recommends that over the life of the Project, the Canadian Nuclear Safety Commission require OPG to conduct ambient air monitoring in the local study area on an ongoing basis to ensure that air quality remains at levels that are not likely to cause adverse effects to human health.

Fisheries and Oceans Canada

Prior to Construction

Recommendation # 30 (Section 5.7):
In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that **prior to the construction** of in-water structures, Fisheries and Oceans Canada require OPG to conduct:
· additional impingement sampling at the existing Darlington Nuclear Generating Station to verify the 2007 results and deal with inter-year fish abundance variability and
· additional entrainment sampling at the existing Darlington Nuclear Generating Station to better establish the current conditions. The program should be designed to guard against a detection limit bias by including in the analysis of entrainment losses those fish species whose larvae and eggs are captured in larval tow surveys for the seasonal period of

the year in which they occur. A statistical optimization analysis will be needed to determine if there is a cost-effective entrainment survey design for round whitefish larvae.

Recommendation # 32 (Section 5.7):
In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that Fisheries and Oceans Canada require OPG to mitigate the risk of adverse effects from operation, including impingement, entrainment and thermal excursions and plumes, by locating the system intake and diffuser structures in water beyond the nearshore habitat zone. Furthermore, OPG must evaluate other mitigative technologies for the system intake, such as live fish return systems and acoustic deterrents.

During Construction

Recommendation # 31 (Section 5.7):
Irrespective of the condenser cooling system chosen for the Project, the Panel recommends that Fisheries and Oceans Canada not permit OPG to infill beyond the two-metre depth contour in Lake Ontario.

Over the Life of the Project

Recommendation # 28 (Section 5.7):
The Panel recommends that Fisheries and Oceans Canada require OPG to continue conducting adult fish community surveys in the site study area and reference locations on an ongoing basis. These surveys shall be used to confirm that the results of 2009 gillnetting and 1998 shoreline electrofishing reported by OPG, and the additional data collected in 2010 and 2011, are representative of existing conditions, taking into account natural year-to-year variability.
Specific attention should be paid to baseline gillnetting monitoring in spring to verify the findings on fish spatial distribution and relatively high native fish species abundance in the embayment area, such as white sucker and round whitefish. The shoreline electrofishing habitat use study is needed to establish the contemporary baseline for later use to test for effects of lake infill armouring, if employed, and the effectiveness of mitigation.

Recommendation # 29 (Section 5.7):
The Panel recommends that Fisheries and Oceans Canada require OPG to continue the research element of the proposed Round Whitefish Action Plan for the specific purpose of better defining the baseline condition, including the population structure, genome and geographic distribution of the round whitefish population as a basis from which to develop testable predictions of effects, including cumulative effects.

Recommendation # 33 (Section 5.7):
The Panel recommends that Fisheries and Oceans Canada require OPG to conduct an impingement and entrainment follow-up program at the existing Darlington Nuclear Generating Station and the Project site to confirm the prediction of adverse effects, including cumulative effects, and the effectiveness of mitigation. For future entrainment sampling for round whitefish, a statistical probability analysis will be needed to determine if unbiased and precise sample results can be produced.

Transport Canada

Prior to Construction

Recommendation # 49 (Section 6.7):
The Panel recommends that **prior to construction**, Transport Canada ensure that OPG undertake additional quantitative analysis, including collision frequencies and rail crossing exposure indices, and monitor the potential effects and need for mitigation associated with the Project.

Recommendation # 50 (Section 6.7):
The Panel recommends that **prior to construction**, Transport Canada require OPG to conduct a risk assessment, jointly with Canadian National Railway, that includes: · an assessment of the risks associated with a derailment or other rail incident that could affect the Project;

· an analysis of the risks associated with a security threat, such as a bomb being placed on a train running on the tracks that bisect the Project;
· a comparative evaluation of the effectiveness of various mitigation measures or combination of measures (e.g., blast wall, retaining wall, recessed tracks, berm and railway speed restrictions within the vicinity of the site);
· a determination of the design criteria necessary to ensure the effectiveness of these measures (e.g., the appropriate height, strength, material and design of a blast wall); and
· a critical analysis to confirm that these measures, when properly designed and implemented, would be sufficient to provide protection to the Project site in the event of a derailment at full speed or other adverse event.

Recommendation # 51 (Section 6.7):
In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that **prior to construction,** Transport Canada work with OPG to develop a follow-up program to verify the accuracy of the prediction of no significant adverse effects to boating safety from the establishment of an increased prohibitive zone. OPG must also develop an adaptive management program, if required, to mitigate potential effects to small watercraft.

Environment Canada

Prior to Site Preparation

Recommendation # 62 (Section 8.1):
The Panel recommends that **prior to site preparation**, Environment Canada evaluate the need for additional air quality monitoring stations in the local study area to monitor cumulative effects on air quality.

During Site Preparation

Recommendation # 24 (Section 5.5):
The Panel recommends that **during the site preparation stage**, Environment Canada shall ensure that OPG not undertake habitat destruction or disruption between the period of May 1 and July 31 of any year to minimize effects to breeding migratory birds.

Prior to Construction

Recommendation # 34 (Section 5.7):
In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that **prior to construction**, Environment Canada ensure that enhanced resolution thermal plume modelling is conducted by OPG, taking into account possible future climate change effects. Fisheries and Oceans Canada shall ensure that the results of the modelling are incorporated into the design of the outfall diffuser and the evaluation of alternative locations for the placement of the intake and the diffuser of the proposed condenser cooling water system.

During Operation

Recommendation # 23 (Section 5.5):
The Panel recommends that Environment Canada collaborate with OPG to develop and implement a follow-up program to confirm the effectiveness of OPG's proposed mitigation measures for bird communities should natural draft cooling towers be chosen for the condenser cooling system.

Health Canada

Over the Life of the Project

Recommendation # 55 (Section 7.1):
The Panel recommends that Health Canada and the Canadian Nuclear Safety Commission continue to participate in international studies seeking to identify long-term health effects of low-level radiation exposures, and to identify if there is a need for revision of limits specified in the Radiation Protection Regulations.

The Canadian Environmental Assessment Agency

General

Recommendation # 64 (Section 8.1):
The Panel recommends that the Canadian Environmental Assessment Agency revise the Canadian Environmental Assessment Agency Cumulative Effects Practitioner's Guide to specifically include a consideration of accident and malfunction scenarios.

The Government of Canada

Prior to Construction

Recommendation # 60 (Section 7.3):
The Panel recommends that **prior to construction**, the Government of Canada review the adequacy of the provisions for nuclear liability insurance. This review must include information from OPG and the Region of Durham regarding the likely economic effects of a severe accident at the Darlington Nuclear site where there is a requirement for relocation, restriction of use and remediation of a sector of the regional study area.

Recommendation # 66 (Section 8.5):
The Panel recommends that the Government of Canada update the Nuclear Liability and Compensation Act or its equivalent to reflect the consequences of a nuclear accident. The revisions must address damage from any ionizing radiation and from any initiating event and should be aligned with the polluter pays principle. The revised Nuclear Liability and Compensation Act, or its equivalent, must be in force before the Project can proceed to the construction phase.

Over the Life of the Project

Recommendation # 65 (Section 8.5):
The Panel recommends that the Government of Canada make it a priority to invest in developing solutions for long-term management of used nuclear fuel, including storage, disposal, reprocessing and re-use.

General

Recommendation # 67 (Section 8.5):
The Panel recommends that the Government of Canada provide clear and practical direction on the application of sustainability assessment in environmental assessments for future nuclear projects.

The Government of Ontario

Over the Life of the Project

Recommendation # 44 (Section 6.2):
The Panel recommends that the Government of Ontario take appropriate measures to prevent sensitive and residential development within three kilometres of the site boundary.

Recommendation # 46 (Section 6.3):
Given that a severe accident may have consequences beyond the three and 10-kilometre zones evaluated by OPG, the Panel recommends that the Government of Ontario, on an ongoing basis, review the emergency planning zones and the emergency preparedness and response measures, as defined in the Provincial Nuclear Emergency Response Plan (PNERP), to protect human health and safety.

The Municipality of Clarington

Over the Life of the Project

Recommendation # 45 (Section 6.2):
The Panel recommends that the Municipality of Clarington prevent, for the lifetime of the nuclear facility, the establishment of sensitive public facilities such as school, hospitals and residences for vulnerable clienteles within the three kilometre zone around the site boundary.

Recommendation # 59 (Section 7.3):
The Panel recommends that the Municipality of Clarington manage development in the vicinity of the Project site to ensure that there is no deterioration in the capacity to evacuate members of the public for the protection of human health and safety.

Ontario Power Generation

Over the Life of the Project

Recommendation # 42 (Section 6.1):
The Panel recommends that on an ongoing basis, OPG pursue its strategy to ensure that Aboriginal students can benefit from the permanent job opportunities that will be available during the lifetime of the Project. In this regard, OPG should collaborate with various secondary and post-secondary education institutions as well as Aboriginal groups to ensure that such programs would be successful.

Annex B: Determination of exclusion zone per US NRC 100.11 (2 pages)

§ 100.11 Determination of exclusion area, low population zone, and population center distance.

(a) As an aid in evaluating a proposed site, an applicant should assume a fission produce release[1] from the core, the expected demonstrable leak rate from the containment and the meteorological conditions pertinent to his site to derive an exclusion area, a low population zone and population center distance. For the purpose of this analysis, which shall set forth the basis for the numerical values used, the applicant should determine the following:

(1) An exclusion area of such size that an individual located at any point on its boundary for two hours immediately following onset of the postulated fission product release would not receive a total radiation dose to the whole body in excess of 25 rem[2] or a total radiation dose in excess of 300 rem[2] to the thyroid from iodine exposure.

(2) A low population zone of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(3) A population center distance of at least one and one-third times the distance from the reactor to the outer boundary of the low population zone. In applying this guide, the boundary of the population center shall be determined upon consideration of population distribution. Political boundaries are not controlling in the application of this guide. Where very large cities are involved, a greater distance may be necessary because of total integrated population dose consideration.

(b) For sites for multiple reactor facilities consideration should be given to the following:

(1) If the reactors are independent to the extent that an accident in one reactor would not initiate an accident in another, the size of the exclusion area, low population zone and population center distance shall be fulfilled with respect to each reactor individually. The envelopes of the plan overlay of the areas so calculated shall then be taken as their respective boundaries.

(2) If the reactors are interconnected to the extent that an accident in one reactor could affect the safety of operation of any other, the size of the exclusion area, low population zone and population center distance shall be based upon the assumption that all interconnected reactors emit their postulated fission product releases simultaneously. This requirement may be reduced in relation to the degree of coupling between reactors, the probability of concomitant accidents and the probability that an individual would not be exposed to the radiation effects from

simultaneous releases. The applicant would be expected to justify to the satisfaction of the Commission the basis for such a reduction in the source term.

(3) The applicant is expected to show that the simultaneous operation of multiple reactors at a site will not result in total radioactive effluent releases beyond the allowable limits of applicable regulations.

Note:

For further guidance in developing the exclusion area, the low population zone, and the population center distance, reference is made to Technical Information Document 14844, dated March 23, 1962, which contains a procedural method and a sample calculation that result in distances roughly reflecting current siting practices of the Commission. The calculations described in Technical Information Document 14844 may be used as a point of departure for consideration of particular site requirements which may result from evaluation of the characteristics of a particular reactor, its purpose and method of operation.

[27 FR 3509, Apr. 12, 1962, as amended at 31 FR 4670, Mar. 19, 1966; 38 FR 1273, Jan. 11, 1973; 40 FR 8793, Mar. 3, 1975; 40 FR 26527, June 24, 1975; 53 FR 43422, Oct. 27, 1988; 64 FR 48955, Sept. 9, 1999; 67 FR 67101, Nov. 4, 2002]

Footnotes - 100.11

[1] The fission product release assumed for these calculations should be based upon a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events, that would result in potential hazards not exceeded by those from any accident considered credible. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release of appreciable quantities of fission products.

[2] The whole body dose of 25 rem referred to above corresponds numerically to the once in a lifetime accidental or emergency dose for radiation workers which, according to NCRP recommendations may be disregarded in the determination of their radiation exposure status (see NBS Handbook 69 dated June 5, 1959). However, neither its use nor that of the 300 rem value for thyroid exposure as set forth in these site criteria guides are intended to imply that these numbers constitute acceptable limits for emergency doses to the public under accident conditions. Rather, this 25 rem whole body value and the 300 rem thyroid value have been set forth in these guides as reference values, which can be used in the evaluation of reactor sites with respect to potential reactor accidents of exceedingly low probability of occurrence, and low risk of public exposure to radiation.

P R O L E T I N C

UNMET CHALLENGES TO SUCCESSFULLY MITIGATING SEVERE ACCIDENTS IN MULTI UNIT CANDU REACTORS

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1. SUMMARY

One sees eerie similarities here in Canada to the cozy relationship between regulator and utilities in 'pre-Fukushima' Japan. Such ties are hardly limited to Canada though. The chronic degradation of real commitments to continued improvements in reactor safety systems and a decline in overall safety culture that discourages critical design reviews and wilfully ignores well justified, safety critical hardware upgrades, has created alarming conditions that are likely inching us towards another nuclear disaster. Operating CANDU reactors are now close to being obsolete but have barely seen any substantive severe accident-related risk reduction upgrades nine years after Fukushima, hoopla in Canada around some minor improvements and premature closure of even otherwise sparse and what were really weak regulatory *'Fukushima Action Items'* notwithstanding.

With a number of common barriers to fission product releases to environment missing or weak, one would expect the regulator to be extra vigilant in promoting prevention and encouraging delays in onset of core damage. On the contrary, it has only made matters worse by its collusion & obfuscation as long summarized in [1] and even denying the additional burden of age-related degradations as in long operating licenses 50% longer than design life at Pickering [2]. Whether the regulatory actions are out of ignorance, inability or intent is debatable but equally disturbing.

The multi-unit CANDU stations sport some of the weakest and leakiest containments in the world. With no reactor pressure vessel to isolate the overheating channel and debris, these leaky containments will directly see un-attenuated fission products releases from the fuel. They will trap combustible D_2 gas in interconnected from below inverted cup like crowded reactors vaults to an increased gas explosion potential. The reactor units have high steam and air oxidation potential on both sides of over 10 km of low carbon steel feeder piping with over 1800 m^2 hot surface areas exposed for each of internal steam and external air oxidation and copious amounts of core Zircaloy (> 50,000 kg, twice of that in a BWR of similar power).

Combustible gas detection and mitigation systems are designed for Hydrogen (H_2) instead of Deuterium (D_2) gas in these D_2O cooled and D_2O moderated PHWRs. The pressure relief systems in primary cooling and moderating systems are dangerously inadequate, resulting likely in pressure boundary ruptures and early containment bypass, accelerated onset of core damage and vessel failures. Backup diesel generators are located low and close to water as in Fukushima. Spent fuel pools are overcrowded with horizontally stacked fuel bundles akin fish in fish-baskets. Yet, the emphasis has shifted to passing wishful thinking of low off-site releases [3] and convenient half-truths of an early core collapse terminating further core degradation and releases into containment as facts and ignoring [4] known design vulnerabilities that amplify risk actively denying [5] even the basic science on high temperature oxidation of carbon steel [6].

Even more dangerous are the unsubstantiated claims being made of near impossibility of off-site releases of long-lived species from these multi-unit reactors by utility management [7] without nay a challenge by the regulators. The life management issues of ageing, elongating, thinning, hydriding, embrittling and deforming CANDU Pressure Tubes is yet to be resolved but these obsolete reactors keep getting ever longer license extensions (e.g. for 10 more years, over 50% beyond original Pickering pressure tube design life - ignoring their own data [8]that suggests that safe operation cannot be guaranteed due to elongation. There are loud, ambiguous references to compliance with un-named IAEA documents and standards. No IAEA document has yet identified or discussed the PHWR design vulnerabilities that may lead to disastrous outcomes and this paper is repeating in forums akin ICONE for the n^{th} time. Of equally great harm to risk reduction are the IAEA team of experts missions (Integrated Regulatory Review Service (IRRS) follow-up missions - for example [9]that issue oversight certifications / seals of approval to the Canadian regulator CNSC without anything resembling a technical evaluation of CANDU design elements that contribute to risk.

Many critical vulnerabilities and proposed engineering fixes that can be undertaken to overcome also been highlighted routinely [10] but are groundlessly rejected as in [11] which begs for an international impartial scrutiny in ingrained obdurate industry intransigence against changes and investments into substantive safety improvements and risk reduction. Emergency preparedness by civil authorities has been illogically conditioned for the smallest possible 'Large Release' source term (of e.g.100 TBq of Cs-137) and available response time for mitigation measures have been exaggerated baselessly. Both acts are irresponsible and dangerous to public and first responder safety. A number of early mitigation measures to externally replenish boiler inventory (a measure common to all PWRs) will not work due to an unusually low, below core, placement of pressurizer that will gradually gravity drain much primary coolant from boiler tubes. So the most important emergency measure to restore core cooling by reflooding boilers to induce natural circulation flows will go to waste. Operators will never know why the core never cooled.

Inability of the utilities to accept responsibility for reactor upgrades and inability of the regulatory management to act independently are the signs of impending implosions in our nuclear industry. It is likely because the regulatory body CNSC is critically dependent upon the licensees financially in a 'cost recovery' plan. Not likely, but perhaps if we get lucky, an impending disaster can be avoided by a return to the first principles, and not mere slogans, of 'safety first'. Right now, an unmitigated station blackout in a CANDU multi-unit station will make the Fukushima disaster look like a walk in the park.

2. INEXPERT REGULATORS AND DESIGN OBSCELENCE

The long ignored severe accident-related design deficiencies, inability to safely, successfully withstand a simple accident such as a station blackout for a reasonable amount of time are amongst many unmet challenges that multi-unit CANDU reactors pose to public safety and very directly to the utility corporate health as well. It is not just that the reactors are now obsolete and were not designed with severe accidents in the design basis so as to make severe accident management predictable and severe accident consequences manageable; it is also that the utilities will do only the minimum they are required to do and that the regulatory body is also neither independent nor technically competent, especially in the field of severe accidents. As a result, a strong culture of privately or silently agreed obfuscation has emerged. Public safety has become secondary to corporate need for uninterrupted power production & regulator's need to exist in significant denial of lessons of Fukushima.

Almost none of the operating 400 odd nuclear power reactors incorporated severe accidents within their design basis. So, all multi-unit CANDU reactors, just like their single unit counterparts and most all operating LWRs share some of the same vulnerabilities to onset of severe core damage accidents. They also share their inability to adequately avoid severe core damage early, incorporate enough passive systems to delay its onset, provide adequate means of early arresting their progression, provide ample opportunities to successfully apply external resources to accident management, include enough design margins to reduce releases into the containment and have strong and tight enough containments to keep the accident source terms from releases by leaks, over-pressurization or explosive outcomes. While LWRs also are of a vintage design and vulnerable to severe core damage, not all have taken the path of denial. Manly utilities, like with NRC's State-of-the-Art Reactor Consequence Analysis Project, are doing a much job of better critical self-examination and risk reduction. Overseas CANDU utilities cite Canadian CNSC actions to justify their inaction and apparent lack of technical expertise.

Detailed technical analyses including sophisticated computer simulations reveal that many of the severe accident related vulnerabilities of multi-unit CANDU PHWR design at Darlington (4 units) Bruce A / Bruce B (4+4 units) and Pickering (8 units) reactors are common with single unit CANDU reactors in Canada, Korea, Argentina, India, Pakistan, Romania and China. A number of inadequacies in severe accident mitigation capabilities are also shared with LWR designs of the same vintage. As discussed in a number of earlier papers on the same issues [12], an evaluation of a station blackout (SBO) accident at the multi-unit Bruce, Darlington and Pickering CANDU stations reveals significant challenges to accident management options. There, however, are easily identifiable indicators and sources, instigators of potentially unacceptable off site radiological consequences as well as engineering fixes to reduce risks. It is unfortunate that only another severe core damage accident will likely force the required change. Right now, the Canadian utilities have the regulator CNSC in a firm capture and are in no mood for a serious dialogue on the topic, irrespective of risk or consequences. It is hoped that professional forums such as ICONE and public awareness will propel the regulators and/or utilities into action.

Design analyses and numerical simulations reveal that opportunities for design improvements and alternate mitigation measures are abundantly clear for certain challenges and not so much for others. But in all cases regulators and utilities reject them in their preference for wild and untrue claims of easy operator actions to bring the reactor under control and benign severe accident consequences even without any operator actions. The regulator has put out glorifying videos without doing any analyses and accepted utility submissions without any meaningful critical technical reviews. These evangelical pronouncements of eternal and near absolute safety in the presently operating, albeit of obsolete design reactors, portray severe core damage accidents in a distorted positive light in defiance of engineered realities (by claiming physically impossible long times to bring in emergency equipment - [13] that claims 5 hours for boilers as heat sinks instead of likely 1 hour when an engineering analyses is undertaken [14]and in defiance of expected professional integrity in ensuring public safety (by claiming extremely low releases of ~ 100 TBq of Cs-137 instead of likely 30,000 TBq from leaky, weak containments without ever doing any numerical analyses or modelling - [3]).

The CANDU PHWRs concept started in 1950s with a 22 MWe Nuclear Power Demonstration (NPD) going critical in 1962 and a first full scale power plant at Douglas Point (220 MWe) in 1966. The 600 to 800 MWe units first entered commercial operation as multi unit power plants in 1971.The basic design of twelve or so, 10 cm diameter 50 cm long fuel bundles in about three to five hundred horizontal Zircaloy pressure tubes within a thermally isolated low pressure, low temperature D_2O moderator has not changed much over these 60 years. Improvements in rolled joints, end fittings and pressure tube materials have increased their reliability but the degradation of Zircaloy pressure tubes has required previously unforeseen 'mid-life' replacements and extensive 'refurbishments' which involve removal and replacement of very radioactive core structural materials and have typically cost more than the original plant did. All units are at the end of their design life, under 'refurbishment' to replace degraded core components (pressure and Calandria tubes, feeders and boilers) or already rebuilt back to the original specs of 1960s and 1970s.

Further development of the CANDU technology has since been almost abandoned in Canada with the design organization AECL, into which literally billions of dollars were invested by the Government of Canada to develop the CANDU reactor concept, was sold with most all its assets minus the liabilities to a private company SNC-Lavalin for the price of a well used corporate jet and all future plans have now shifted to commercializing the so called Small Modular Reactors with renewed promises of riches and safety. The national regulator CNSC is playing the bandleader once again. Attention has shifted away from the high risk obsolete multi unit reactors at Bruce, Darlington and Pickering with their long term licenses in the utility pockets with risk reduction opportunities of no immediate interest to anyone. Unless of course, if we engineers recognize the disservice this does to our future and force them to act in public interest alone.

What has changed over these 60 years is our understanding that these reactors, like all others of that vintage, were more complex than other power reactors and were certainly not designed with core damage accidents within the design basis. Some have been thankfully taken off service at the end of their life (Gentilly-2) or earlier (Gentilly-1, Pickering A units 2,3) while one at Wolsong 1 was removed from service after it was refurbished with new reactor internals at great expense but did not satisfy safe operating envelope expectations. In Canada, Gentilly-2 single unit CANDU was wisely retired after its' design life. It was not the regulator that initiated its closure; it was the utility that did not particularly need the associated risk.

3. CONTRIBUTIONS BY THE NATIONAL REGULATOR

The challenge to public safety is further exasperated by a diminishing safety culture at the regulatory body CNSC that glorifies the obsolete designs, disregards known safety issues and discourages real public discourse and input from outside the regular payroll of the industry[1]. It also spends inordinate times in self adulation and is looking more like a public relations arm of the utilities it is supposed to regulate.

The Canadian regulator CNSC has taken the lead in producing misleading information about CANDU severe accident progression [13] and its consequences [3]. Reactor vulnerabilities have been ignored in defiance of basic science by siding with corporate interests that have had the regulators in firm capture for over a decade. This behaviour is in stark contrast to the practices south of the border where rule based regulations are more the norm; rules are scientific fact based and comprehensive analyses and supporting research are routinely commissioned. A comparison of CNSC generated claims in [3], [13]is instructive with reports such as 'The State-of-the-Art Reactor Consequence Analyses' (SOARCA) project [15] that were undertaken by NRC to systematically summarize accident progression pathways and mitigation strategies with actual numerical analyses using state of the art computational aides without resorting to hyperbole on one hand and artificially generated fog as in [3], [13]on the other.

The continuing insistence by the regulator to be the bugler for an obsolete technology that it explicitly says need not be comprehensively, systematically rejuvenated before its further exploitation and claims in its reports that severe accident consequences are nothing more than benign - are all appalling facts. When the issue of high oxidation potential of feeders, the carbon steel pipes downstream of hot fuel, their first reaction was that feeders cannot get warm and hence any issues of carbon steel oxidation were humbug. The regulator has even told the local emergency management organizations that the worst off-site releases after a severe accident are expected to be as minimal as total releases of 100 TBq of Cs-137 (and other species in proportion) which is from about 0.15% of the fuel and that health effects of a severe accident would be benign. This pronouncement was not based on any analysis but was camouflaged under words deceptively implying that specific analyses for the worst accident without operator intervention were undertaken. This has emboldened the utilities to do practically nothing meaningful to reduce residual risk and push for even longer operating licenses well beyond the original design life of plants whose materials degrade faster than in any other reactor with age (Zircaloy pressure tube thinning, elongating, thinning and increasing in diameter with creep, hydriding and being replaced prematurely at exorbitant costs) and normal exploitation (e.g. thinning of carbon steel feeder pipes that connect the fuel channels to pumps and boilers).

Given the unexpected nature of any accident and severe potential for extreme damage to the environment if the accident results in severe core damage as in a sustained loss of heat sinks after a station blackout as in Fukushima, one would imagine that the regulators would be insisting and utilities would be installing proper measures to reduce the likelihood of occurrence of multiple failures that can lead to severe core damage; and incorporating measures to identify, control, manage and arrest the progression of the accidents early; and ensuring measures to contain the consequences to within the reactor units and most of all, accepting the limitations of the technology and their understanding of it to invest in fundamental research. None of that has happened to a degree consistent with needs. As a result the reactors today are not much better able to mitigate severe accidents than they were before Fukushima and before the shiny pumper fire trucks were bought to provide low pressure heat sinks, filtered containment venting systems installed and a few symbolic but dangerous hydrogen recombiners scattered around the plants. These measures are poorly thought out and even more poorly executed with the large number of other vulnerabilities largely unaddressed. Of course such behaviour has consequences.

The official report of The Fukushima Nuclear Accident Independent Investigation Commission concluded in part that:

“The TEPCO Fukushima Nuclear Power Plant accident was the result of collusion between the government, the regulators and TEPCO, and the lack of governance by said parties. They effectively betrayed the nation’s right to be safe from nuclear accidents. Therefore, we conclude that the accident was clearly ‘manmade.’ We believe that the root causes were the organizational and regulatory systems that supported faulty rationales for decisions

and actions, rather than issues relating to the competency of any specific individual."

It has become very clear that the situation in a number of countries is exactly the same as summarized above for Japan in 2011. While this paper concentrates on the issues arising out of multi unit CANDU PHWR operation in Canada, the path taken by the regulators in other countries with CANDU reactors is not much different. After 3 decades of severe accident progression and consequence assessment evaluations and trying to get the industry to recognize that the reactors do not meet the evolving public expectations of risk, it has become apparent to me and many others that a combination of design weaknesses, corporate intransigence, and regulatory weakness has come together in a form that is detrimental not only to public safety but also to the future of nuclear power. The regulators have recently bestowed on the multi unit reactor utilities unprecedented 10 year license extensions, in some cases in defiance of overwhelming evidence that these reactors pose large risk under SBO accident conditions not dissimilar to Fukushima.

I will make my point by first discussing the design specifics that have cried out for new and innovative mitigating measures as our understanding of severe accidents have matured and then pointing out the specific decisions made by specific people in the Canadian nuclear industry to put the issues under the rug. As a nuclear safety engineer with over 30 years of work in nuclear safety and as one who has developed a dozen computer codes to model accident progression in CANDU reactors, including the CANDU specific parts of the now obsolete MAAP-CANDU code that the industry still uses to analyze severe accidents, I consider it my ethical duty to present the arguments in favour of stepping our game up to meet the unmet challenges to successfully mitigating severe accidents in multi unit CANDU reactors or shutting them all down in interest of public safety and security. In interest of clarity I will use the multi unit reactors at Darlington and Bruce in Canada as examples, although the malaise of poor severe accident mitigation permeates to all CANDU / PHWR units in all countries.

4. CANDU DESIGN VULNERABITY IS NOT A NEWLY DISCOVERED PROBLEM

A number of red flags have been raised over the years and a systematic design evaluation has uncovered a long list of vulnerabilities that make severe core damage accident consequences from multi unit reactors alarmingly unacceptable. The response of the Canadian nuclear industry has varied from silence to outright lies and bullying. The Canadian national regulator has taken the lead in spewing technically impossible positions on severe accident consequences [3] and the collusion between the industry and the regulators has deteriorated progress in resolution to such an extent that the latest position from a utility Bruce Power VP during relicensing hearings is that they will soon see no conditions under which these reactors will release any long lived isotopes following a severe core damage accident [7] and hence a reduction in planning zones is to be in order . This for a design that has a containment unable to be tested above 0.45 atmospheres and a leak rate at design pressure of 2% per hour (500 times more than at a light water PWR such as at Surry), not to mention the other design features that make these multi unit reactors un-licensable in any other jurisdiction in the world. The same VP smugly claimed that Bruce Power adopted new standards faster than others and in special contrast to overseas utilities that would do so only every 30 - 40 years on relicensing. The regulator CNSC similarly makes claims of being the 'world leader' in safety regulation. Their mutual admiration is evident in transcripts of public meetings where the two practically finish each other's sentences. CNSC has also quietly sidestepped its own already watered down regulations to allow the utilities to pressure test their containment every 12 years [16] instead of the already unusual for a nuclear reactor containment leakage test frequency at full design pressure of every 6 years per the CNSC regulatory guide R7 [17].

5. CANDU REACTOR DESIGN VULNERABILITIES TO UNSATISFACTORY OUTCOMES AFTER STATION BLACKOUT

CANDU PHWRs suffer from a number of vulnerabilities to unacceptable outcomes after severe accidents and a number of design features that accelerate failures or exasperate the accident consequences and hence risk to public. Some of these are specific to the D_2O cooled and moderated horizontal fuel channel concept just as the RBMK is with its vertical boiling light water cooled, hot graphite moderated fuel channels. While utilities and the national regulators have long sung the CANDU design praises, some fundamental CANDU vulnerabilities cannot be rectified for existing reactors. For example, absence of a pressure vessel around the core will always directly expel activity into the containment once the channels experience structural damage. Thus the leaky containment becomes the only barrier to release of activity.

The strange choice of pressurizer location below the boilers and reactor headers (in 12 reactor units at Darlington and Bruce stations) will cause draining into it of primary coolant from boiler tubes in a SBO to an extent that boilers will become useless as heat sinks and no amount of emergency measures to add water to boilers will restore cooling to the reactor core unless the primary cooling system was replenished as well, something that cannot be done after an SBO in the present design and presently configured SAMGs.
The low pressure retention capacity (<<0.9 bar) of the rectangular slab industrial buildings that surround the reactor cores and their design leak rate at 2%/hour which is 480 times greater than the 0.1%/day in modern PWRs will always make the containments ineffective repositories of fission and activation product activity put unfiltered into them from the disassembling fuel channels and also make them traps for combustible Deuterium that will come out of the same path into inverted cup like inter-connected rooms called reactor vaults that surround the reactors. Gas explosions in any one reactor vault will cause a huge containment bypass.

What is fundamentally disturbing is that certain long well known design features that may cause an unwarranted pressure boundary failure (*because the primary heat transport system (PHTS) overpressure steam relief capacity is too low*) or accelerate onset of core disassembly (*such as an un-necessary, forced expulsion by flashing of a critical amount of moderator upon onset of boiling because rupture disks actuate instead of a controlled relief through relief valves*) or a lack means of direct depressurization of PHTS or cause the containment to leak profusely at relatively low pressures have not been accepted or rectified. Certain challenges to the containment integrity, such as from high amounts of hydrogen and deuterium produced by oxidation of outside and inside surfaces of feeders after a core damage accident of LOCA+LOECC have been ignored for even design basis accidents without the regulator ever highlighting the omission or recognizing that Carbon steel is more oxidation reactive than Zircaloy at all temperatures.

Potential for steam and air oxidation to produce copious amounts of combustible Deuterium and Hydrogen from the large amount of Zircaloy and carbon steel associated with the fuel channels during a severe core damage accident is easy to see. There is about 50,000 kg of Zircaloy with an oxidation surface area of over 12000 m^2 and over 120 tons of low carbon steel piping over 10 km long with a surface area greater than 1800 m^2 in a Darlington CANDU PHWR associated with fuel channels where a loss of cooling can elevate fuel temperatures such that rate of oxidation of feeder carbon steel will always be greater than that for Zircaloy(Figure 222) and the amount of Deuterium produced by oxidation of steel will exceed that from Zircaloy very early (Figure 3).

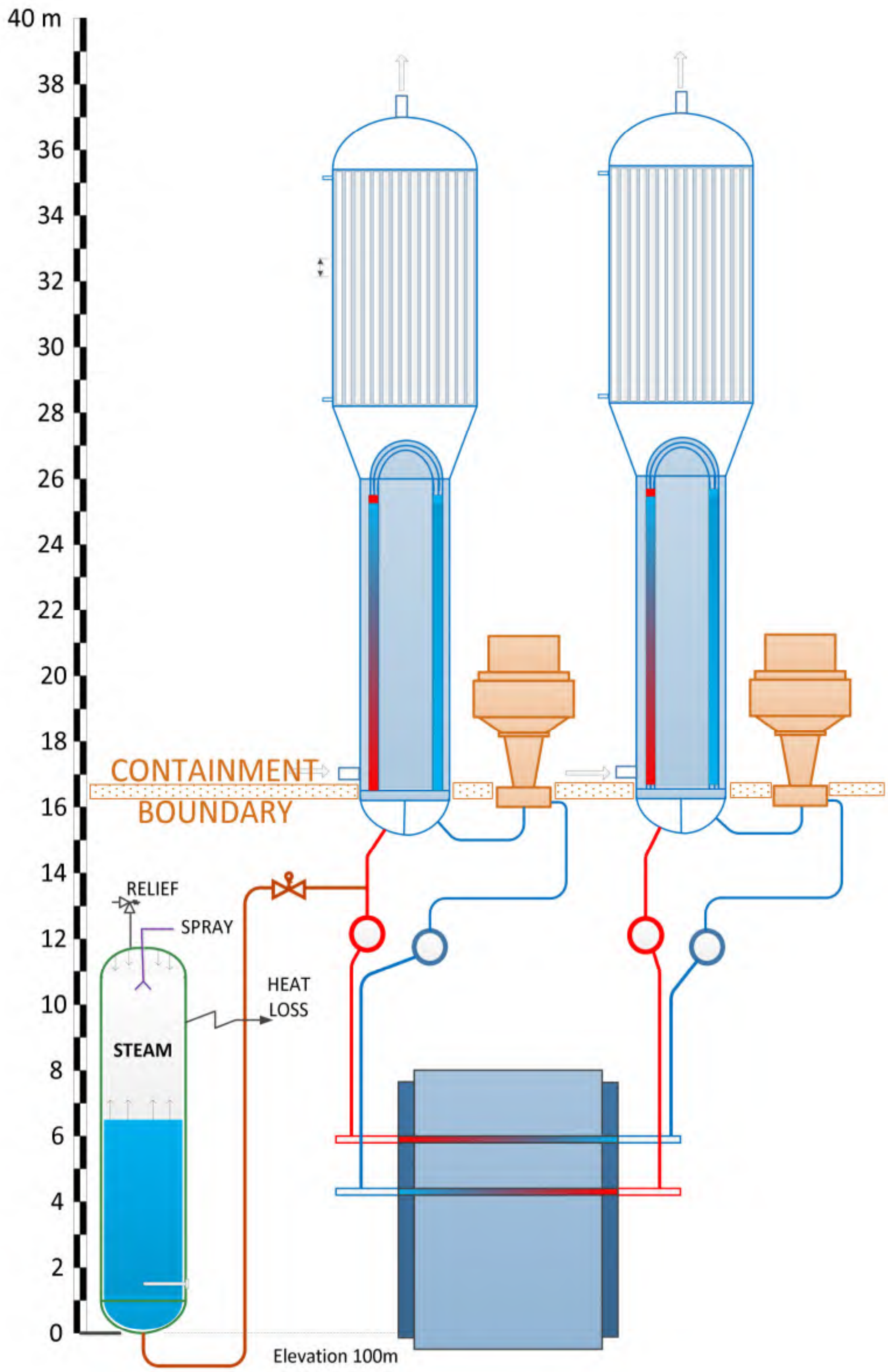

Figure 1 : Lower than core placement of pressurizer that will drain boiler tube inventory at Darlington/Bruce reactors in SBO

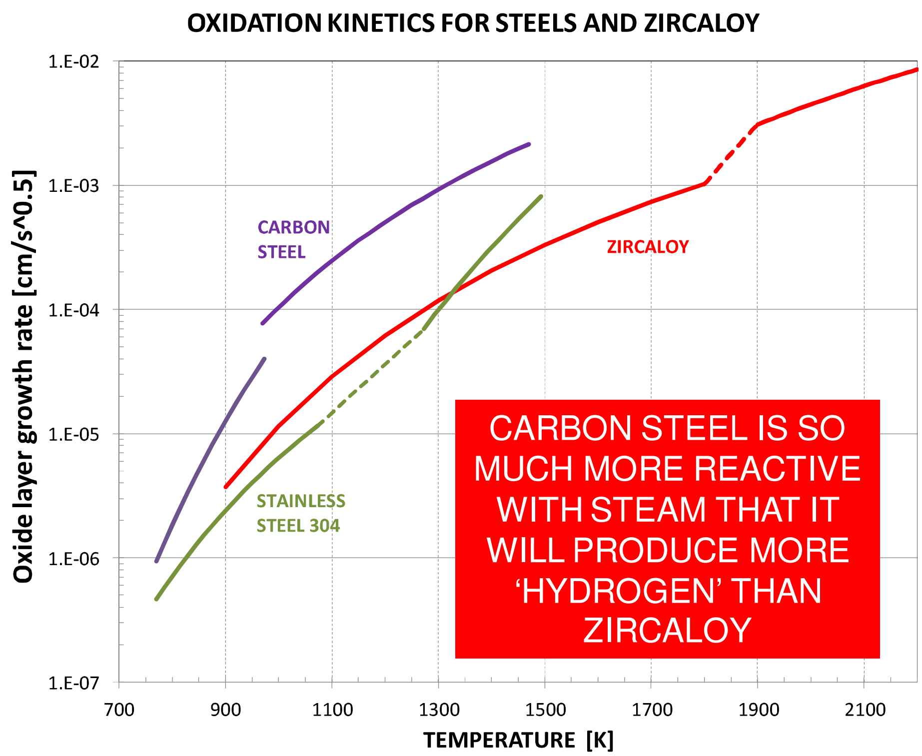

Figure 2: Oxidation kinetics for Zircaloy, carbon steel and stainless steel

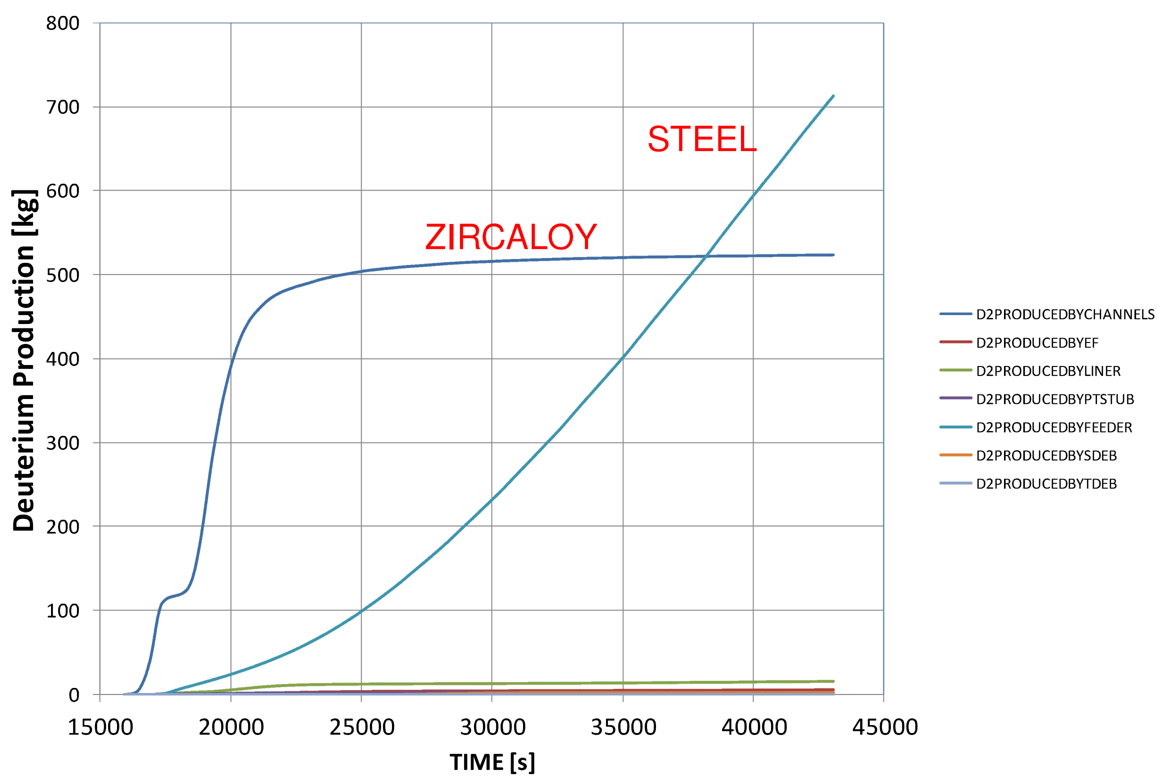

Figure 3 : Sample results for the first 12 hours of combustible gas production in a 600 MWe single unit CANDU

A station blackout (SBO) scenario which with its sustained loss of engineered heat sinks represents a large number of accidents with other initiating failures and is a representative scenario undertaken for all reactors worldwide to assess effectiveness of engineered passive systems that may come into play and of opportunities for emergency mitigating measures.

Engineering analyses reveal that reactor risk profiles are in the alarm territory for a number of very obvious reasons. Early passive heat removal by steam generators after a station blackout is not only short lived (~1.5 hours as opposed to claimed 5 hours) but can also be compromised even earlier by primary coolant from boiler tubes getting drained into a large cooling pressurizer located well below the boilers and the reactor core. (Figure 1, for Darlington). Thus any delay in restoring secondary heat sinks and primary inventory drained by gravity into pressurizer may make the boilers irrelevant and ineffective.

Over-pressure protection systems on main core cooling system is indirect (goes through another vessel and requires two sets of valves in series to successfully actuate) and functionally inadequate to satisfy the heat load. On a loss of boilers as heat sink, a steam relief through relief valves is the only heat sinks for decay heat but the PHTS steam relief capacity is only ~20% of decay heat equivalent, let alone for other anticipated severe accident loads [18]. This can likely cause an early over pressure failure and hence a containment bypass by steam generator tube ruptures or another uncontrolled pressure boundary rupture, something that the ASME code or common engineering sense would require that not ever happen. This very fundamental error in design has been known to the utilities for 20 years without resolution or nay an understanding of its consequences. When an industry starts accepting a pressure boundary failure as an acceptable outcome rather than re-engineer the safety valves, it is time for that industry to shut operations or as an ex NRC chairman Gregory Jaczko put it 'is Going Away'[19]. As a nuclear engineer with great confidence in my peers, I find such a direction and such an outcome for my industry also likely but otherwise unacceptable.

Inability to manage a loss of heat sinks accidents is exacerbated by handicaps like no external emergency means of high pressure water addition to the heat transport system. Any addition of emergency coolant requires that boilers be manually depressurized successfully first for the PHTS to be hopefully, indirectly depressurized. A manual depressurization of boilers is actually an operator assisted process of forcing the relief valves to stay open in a process that forcibly removes a third or so of the boiler liquid inventory by flashing and dumps it into the atmosphere without a foolproof guarantee that any subsequent action to replenish the same inventory would be successful. A high pressure makeup feedwater injection with a passive steam driven turbine would have easily solved both problems without breaking a sweat. This has been the logical backup solution at a number of PWRs but the CNSC brass totally trashed the idea a number of times citing some unrelated steam turbine failures at Fukushima. A steam driven auxiliary feedback system is as passive as they get. In fact one has been at the single unit CANDU at Pt. Lepreau forever. The issue is really not the merit of this or that solution to the various vulnerabilities in multi unit CANDU stations; the issue is the attitude and a collusive decision to do absolutely nothing more than what little they have done, even if the decisions such as low pressure pumper fire trucks to add water to the boilers is now recognized in private conversations to be not the wisest one.

The current SAMGs erroneously credit gravity feed of water into the boilers after their depressurization through the feedwater train from de-aerator. This will really not work. Flashing of the ~160^{o}C water inventory and unavoidable high pressure back leakage of boiler inventory through the check valves would vapour bind the feedwater flow path. In addition, there will not be enough driving force to open and then keep the feedwater check valves open.

With more and more channels losing their heat sinks and dumping their decay and chemical heat into the moderator, onset of moderator boiling causes the rupture disks on the Calandria vessel to open up, creating a direct path for release of steam, fission products, hot and combustible gases into the inverted-cup reactor vault over the common duct in the containment.

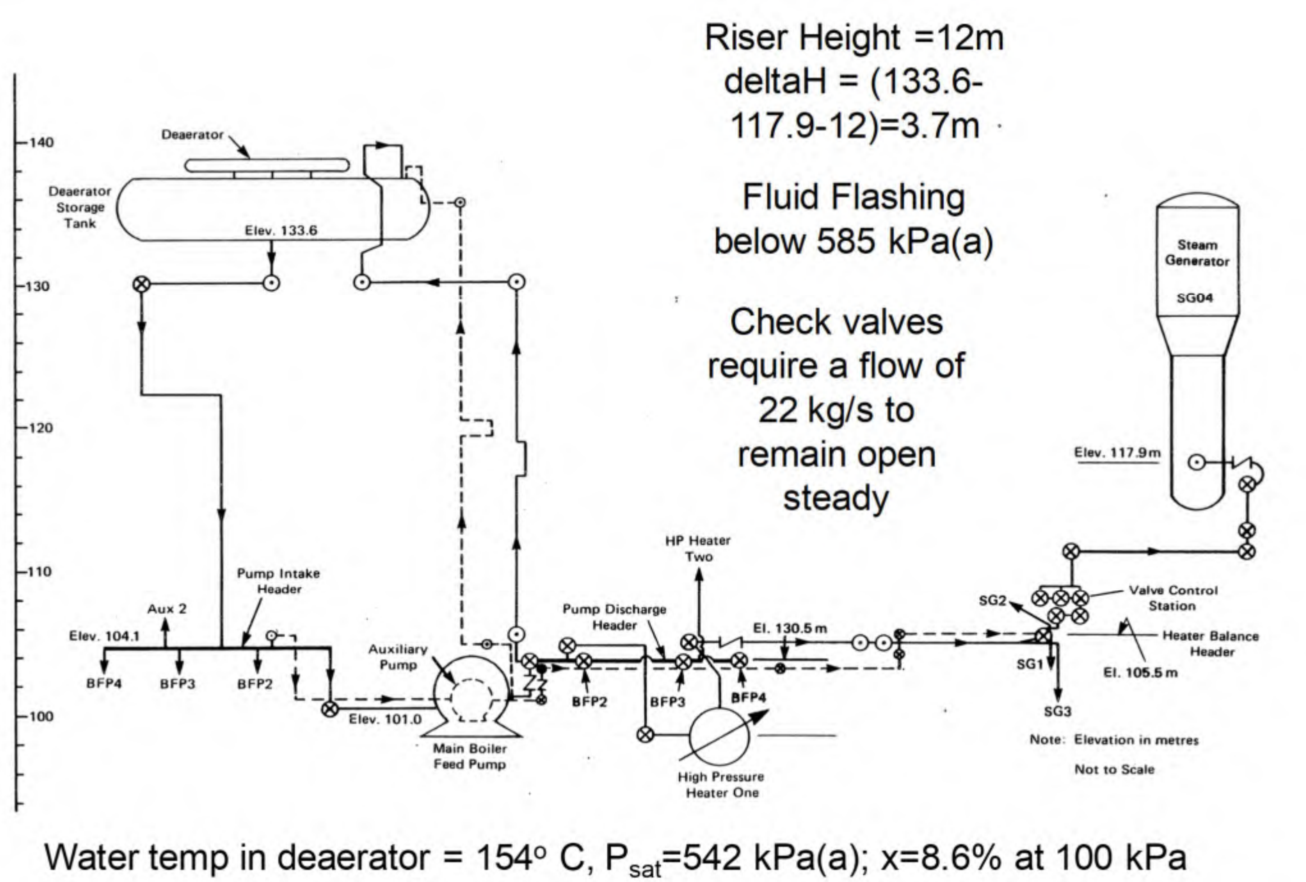

Figure 4 : Looking into gravity feed into the boilers from de-aerator

This happens as a lack of a decay heat level controlled steam relief on the Calandria vessel (which contains the moderator) accelerates severe core damage by ejecting a significant amount of moderator when it becomes the dominant heat sink for fuel channels, boils and causes the rupture disks on its large piping to burst to eject water by flashing and carryover. By ignoring the extra 30-60 min such a design omission subtracts from time to onset of severe core damage, the industry reinforces its intransigence and inability to think through that public safety supersedes all other considerations.

An important claim by the industry on debris creation and potential retention of 'melt' in the Calandria vessel is examined below:

Disassembly of a reactor fuel channel is its partial breakup into single or multiple bundle length pieces and in some cases even separation from the rolled joints at end shields. Breakup into pieces can occur when both the primary coolant from inside of the fuel channel and the moderator coolant from outside the fuel channel are depleted and the pressure tube perforates with it being unable to sustain the weight of fuel within or above it. Fuel channels begin to heatup individually once they are devoid of coolant and the moderator becomes the sole heat sink. A widespread core damage accident in a CANDU would only occur gradually because of the large variability in the inventory of water associated with each channel, variability in channel powers and variability in time at which the moderator outside each channel may drain or be boiled off. In all cases a fuel heatup to temperatures high enough to cause the pressure and Calandria tubes to deform and perforate are required and disassembly of different channel segments would take a finite time and with a finite stagger between channels.

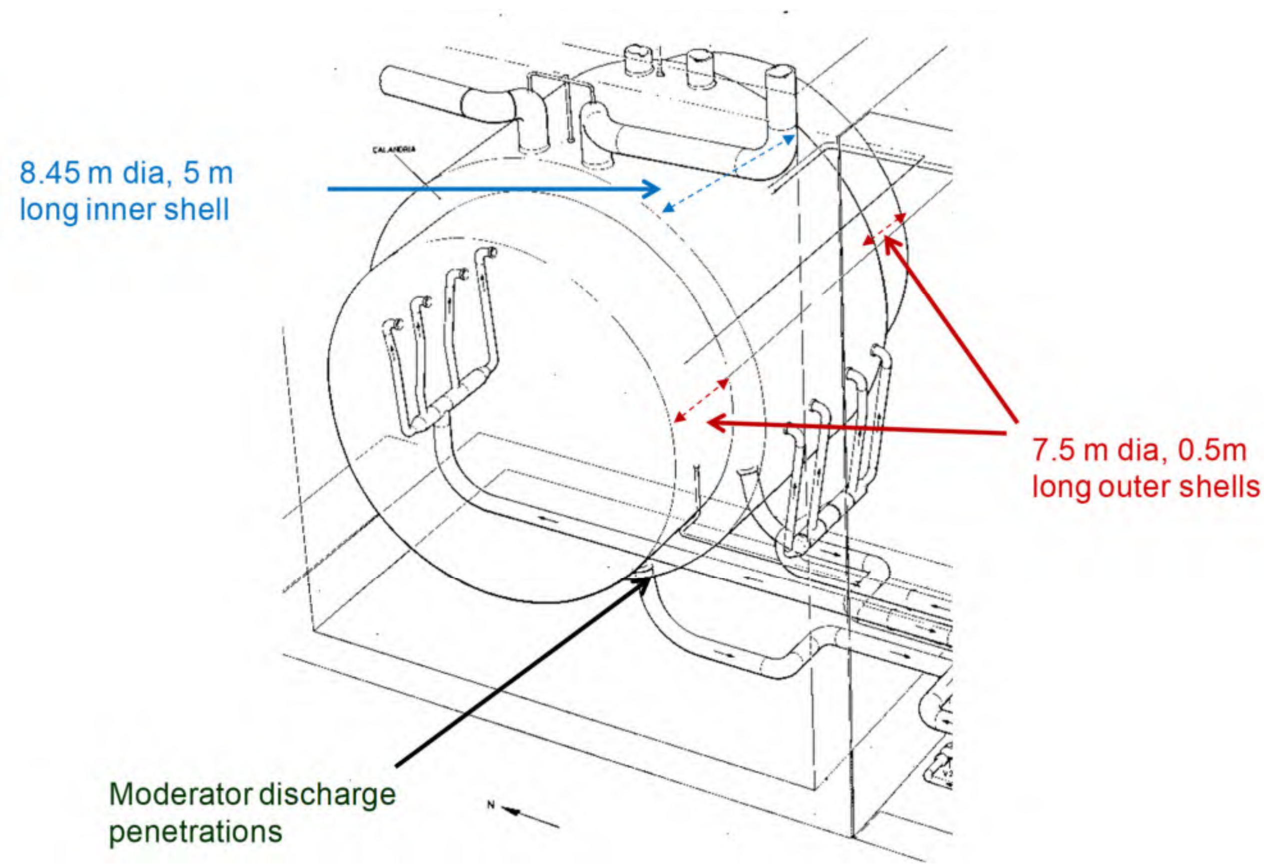

Figure 5: Calandria vessel, a stepped stainless steel vessel with welded annular plate

Accident termination by retention of molten core debris in a vessel has been adopted from PWRs without consideration of the design specifics of the stepped low pressure and thin CANDU moderator vessel. The debris formation in a CANDU reactor is in solid chunks of fuel channel and its eventual retention upon Zircaloy melting in the Calandria vessel cannot be guaranteed as the relatively thin walled stepped and welded vessel (wall thickness varying between 19 and 28 mm) may fail at welds by thermal loads long before any gross melting thus violently introducing water from the shield tank onto hot debris.

Any claims of an LWR like in-vessel retention of molten uranium debris are not credible or consistent with the gradual core disassembly of CANDU cores in case of a station blackout scenario with a sustained absence of heat sinks. The Calandria vessel has a wall thickness that varies between 19mm at annular plates to 28 mm in main shell. The weld failure upon differential expansion of the two shells, with outer shell constrained, is easy to demonstrate (Figure 6 and Figure 7).

The effect of Calandria vessel weld failure can vary from additional hydrogen production, accelerated fission product releases as one mode of outcome for small weld cracks and slow leaks, to catastrophic vessel failures by energetic interactions of incoming water with the hot and molten solid-liquid debris at the bottom of the Calandria vessel as the other mode.

As a result of absence of a retaining vessel, direct un-attenuated releases into the containment, weak containment structures and significant likelihood of energetic interaction of hot debris with water and Deuterium burns /explosions causing challenges to containment integrity, large releases of radioactivity from failed containment structures are inevitable.

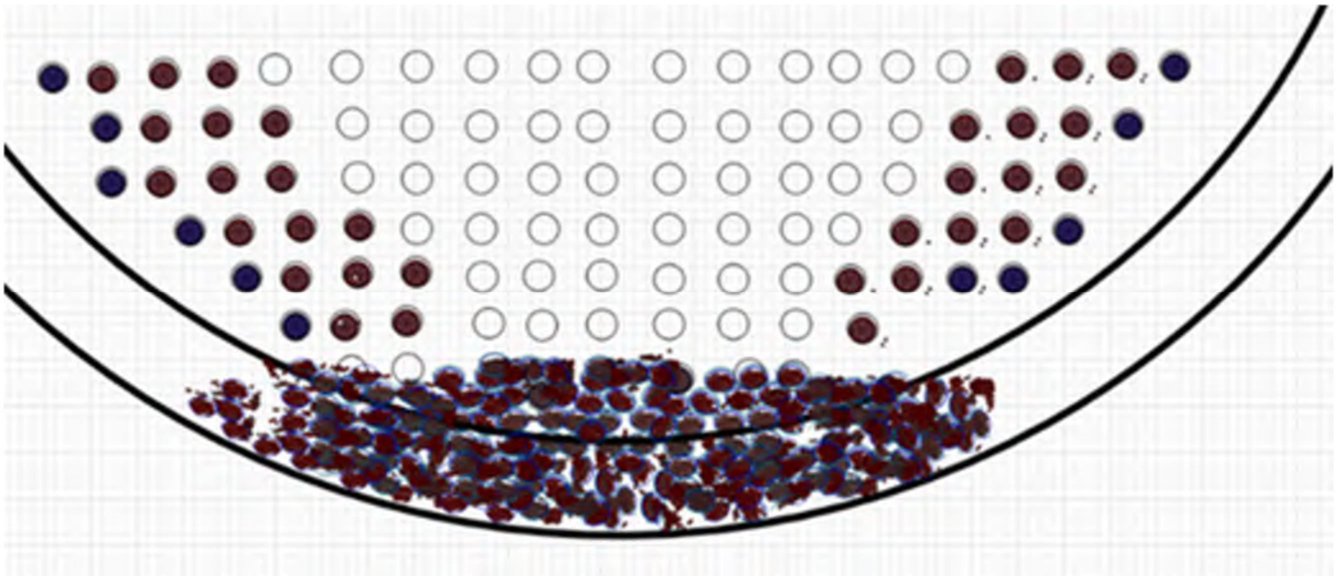

Figure 6 : Likely state of debris upon Calandria weld failure

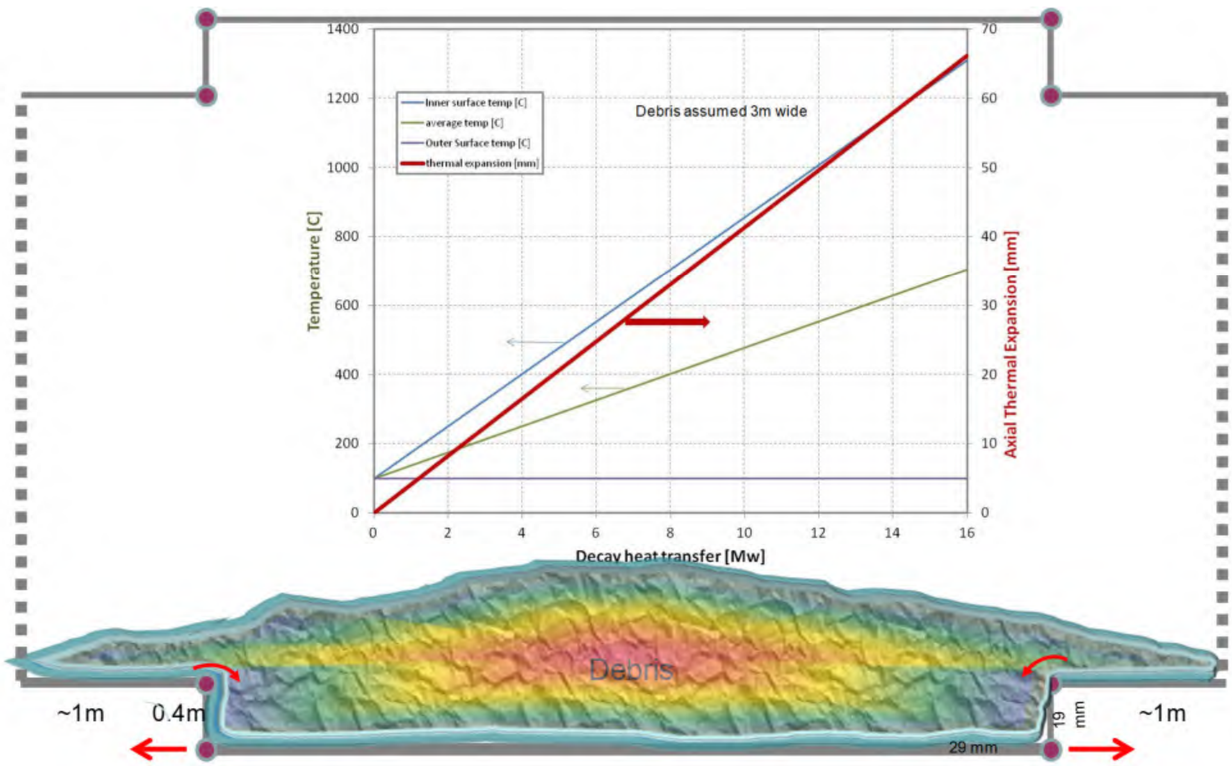

Figure 7: Calandria shell elongation as an indicator of stresses that will cause weld failure

6. WEAK AND LEAKY CONTAINMENT STRUCTURES

In all cases in absence of a retaining LWR like pressure vessel, the disassembling channels would continuously and over many hours release fission products without attenuation through the rupture disk pipes and directly into the box like containments (Figure 9) that are at 48% per day design leak rate at design pressure very leaky and at less than 1 bar design pressure, structurally weakest of all operating reactor containments (typical PWR building design pressure is 5 times higher and leakage at design pressure is 480 times lower).

Another containment bypass potential is in high temperature disassembly of in-core devices along with hot channels. Recall that the in-core device controllers and drives are outside the containment on the reactivity deck. So certain release of fission products onto the reactivity deck cannot be avoided once these devices heatup and melt.

The reactor buildings around each individual reactor core are inverted cup like traps for combustible gases (Figure 8). A large number of safety significant components like the steam generators, pumps and the reactivity control devices are all outside the containment envelope and vulnerable to failures by external impact or otherwise of the weak structures on top of the reactivity decks. These are some of the vulnerabilities that can be fixed.

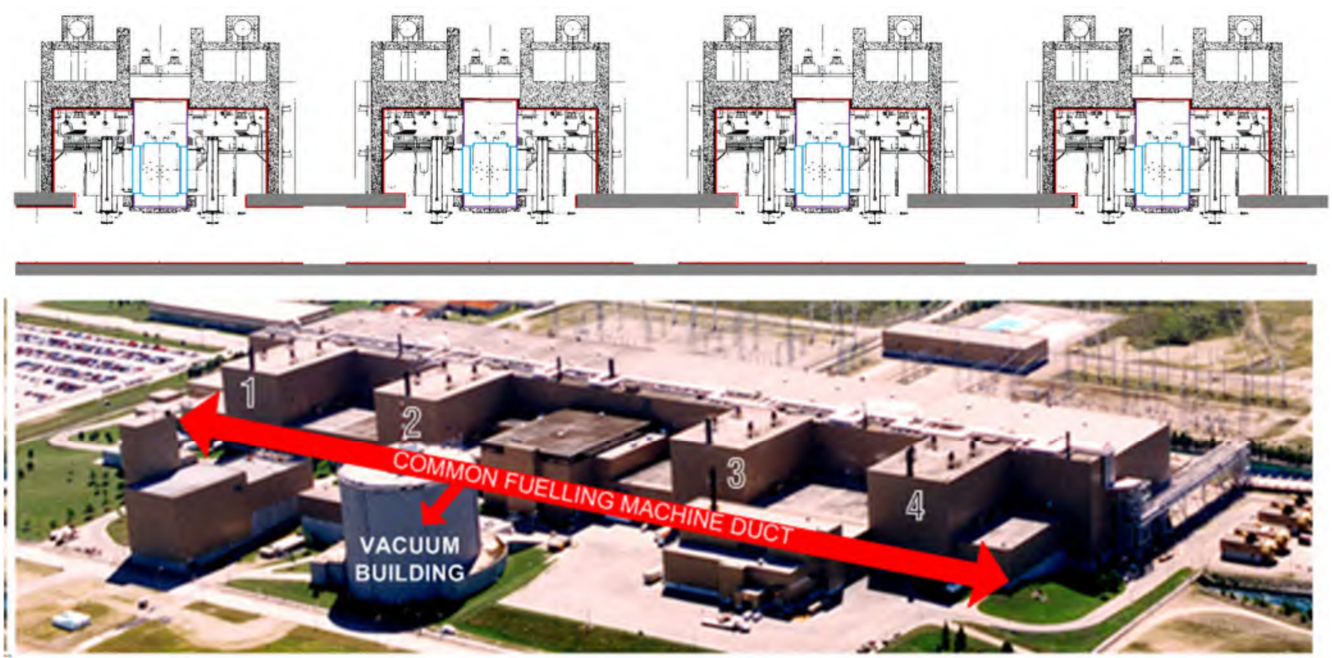

Figure 8: Multi unit layout at Bruce station

7. REACTOR VAULT A TRAP FOR HYDROGEN

The containment layout is such that even a 1% oxidation of any of these materials will cause stagnated and explosive pockets of combustible Deuterium and Hydrogen in reactor vaults shaped like interconnected inverted cups. The reactor vault is the direct recipient of products of reaction with hot fuel as the moderator relief pipes vent into the reactor vault.

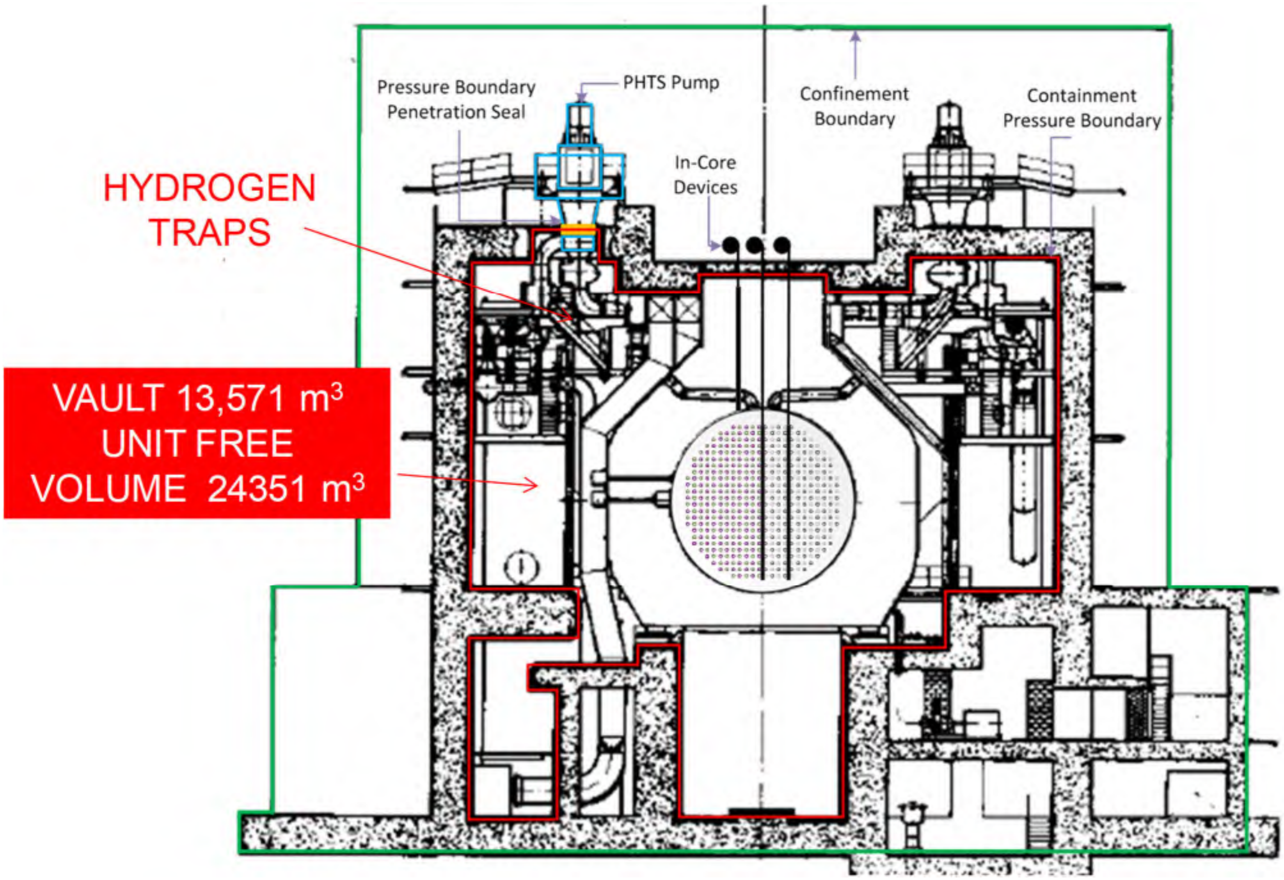

Figure 9: Single unit reactor assembly in a crowded vault with common fuelling machine duct below

The production of combustible Deuterium gas from over ten km of carbon steel piping and over 50 tons of Zircaloy in each Darlington / Bruce unit can be extremely high with steel oxidation more problematic over the longer term; making the installed numbers and types of PARS not only inadequate but as early ignition sources also dangerous.

These conclusions are based on thirty years of working on severe accident related issues at CANDU reactors, conducting extensive design reviews and developing integrated computer codes (MAAP-CANDU [20] and ROSHNI [21]) and supporting numerous analytical methods for PHWR accident progression and consequence assessments.

It was hoped that open discussions by professional engineers would foster change in name of public safety. That has not happened for a number of reasons, allegiances and self-interests. It is now feared that nothing will change unless an accident occurs and an ensuing national inquiry unveils a naked collusion between the regulator and the utility as in Japan prior to Fukushima. A lax and uninformed regulatory regime blindly supporting an intransigent industry resisting basic design enhancements has further exasperated, like it did in Japan, the severe accident related risk from continued operation of these reactors.

It is unfortunate that assumptions in evaluations of accident progression are made by the industry and the regulatory bodies acting in unison that make the accident consequences look benign. One such assumption of a 'core collapse' due to disassembly of higher elevation channels is essentially a numerical trick that gives a false impression of the whole core suddenly falling into cold water in the moderator and ceasing to emit radiation for 8 hours or so. As a result the accident consequences can actually be engineered to look benign.

Actual improvements after Fukushima are perfunctory and the analytical methods in support of severe accident management procedures are outdated and incomplete. A widely used computer code MAAP-CANDU (developed 25 years ago by this author on the MAAP LWR code) is incapable of providing the source terms required to evaluate containment response, design mitigation equipment or off-site releases. I developed that code over 25 years ago integrating CANDU specific models with the LWR code MAAP at a time when we used Pentium 286 machines and have made public [12] a large number of limitations that make it ill suited to meet today's post Fukushima requirements.

8. A PHWR WILL PRODUCE DEUTERIUM, NOT HYDROGEN :D_2-H_2 DIFFERENCE

Given that the reactor is cooled and moderated with D_2O, one would expect the mitigation measures and detection measures designed for D_2, but almost all research and development and implementation has been for H_2. On top of public denial of the almost two fold difference in transport properties between D_2 and H_2, differences in recombination rates have been loudly professed by the regulator and the utilities to be negligible, in defiance of hosts of research papers that have shown that except for chemical reaction of formation, the two gases are really not identical in any meaningful way that would allow the utilities to treat them as one and the same. In addition to differences in transport properties differences in recombination on metallic catalysts has also shown to be different for the two gases [22, 23]. In addition, there are scenarios in which H_2 would also be produced by external surface air oxidation of carbon steel feeders. This also has to be considered in design of systems for mitigation and detection.

8.1 MANAGEMENT CLAIMS OF NO FUTURE RELEASES

Meanwhile the largest of multi unit reactors continue to operate with 5 to 10 year license extensions in the middle of the most densely populated parts of Canada with almost no new systems in place to retard the progression of a severe core damage accident with the management claiming publically[7], to the horror of those who understand these reactors that the improvements made so far will make the chances of long lived radioactive species escaping from these reactors after a severe accident an impossibility.

8.2 A 'HOLISTIC' APPROACH TO SAMG

Utilities have recently touted a new and bizarre 'holistic' approach to severe accident management. For example, Bruce Power say that by claiming in-vessel retention of core melt and a filtered containment venting it needs to not install adequate hydrogen mitigation systems or over pressure protection systems or rectify any one of the dozens of design deficiencies[10]. In denying the risk reduction capability of such simple measures such as adequate safety relief valves for over pressure protection of the primary and the moderator cooling loops, it is acting against public interest, forgetting that according to good engineering practices and IAEA guidelines probabilistic analyses should not be considered as a substitute to a design approach based on deterministic requirements but as a part of the process to identify potential safety enhancements and to judge their effectiveness.

9. STATION BLACKOUT AT A MULTU UNIT CANDU

Let us go back to a Station Blackout scenario with an unmitigated loss of all AC power in a multi-unit CANDU plant at Darlington or Bruce station. This scenario implies that no AC power is available for a specified recovery period, usually taken at 12-24 hours for consequence analyses.

As the reactor trips, turbines trip and feedwater flow ceases, nuclear steam discharges to the atmosphere through Main Steam Safety Valves (MSSVs). Necessary condition for the atmospheric discharge of steam to remain a heat sink is that fluid inventory in maintained both within the boiler tubes and outside the boiler tubes. Early passive heat removal by thermosyphoning flows from core to the steam generators is maintained as long as the primary fluid inventory can be carried over the U tubes. It is unfortunately jeopardized early at Darlington and Bruce multi unit stations by the low elevation positioning of the large pressurizer vessel. It's free steam volume a couple of minutes after a reactor trip is about equal to the volume of the coolant in the boiler tubes (65 m^3) upon a loss of power to the pressurizer heaters[24]. So the pressurizer can slowly swallow the volume of the heat transport coolant in the boiler tubes. As a result, the boilers stop being a heat sink even before they run out of water on the secondary side. No further addition of water to the boilers by AFW pumps or any other means will restore a heat sink for the core decay heat.

Even if the lost water inventory in the boilers tubes can be replenished by a major change in emergency management procedures, with no passive steam driven auxiliary feedwater pumps or a method to easily replenish the steam generators with a high pressure emergency water injection the boilers stop being an effective heat sinks after less than 2 hours. Back leakage through the feedwater line check valves will cause vapour binding in the feed pumps and only alternate paths for water addition to the boilers will be effective.

With no effective heat sinks, the primary cooling system re-pressurizes and with an inadequate steam relief capacity of the safety relief valves on the degasser condenser vessel in path of the relief, an uncontrolled over-pressurization leads to a pressure boundary rupture. There neither are any provisions for passive or manual depressurization of the reactor loops after a loss of steam generator heat sinks nor a capability for a high pressure coolant injection into the pressurized heat transport loops and an uncontrolled rupture becomes an unnecessary inevitability with a potential for an early containment bypass as the most atypical of any reactor overpressure protection system fails to provide adequate relieve steam through dual valves in series qualified only for liquid relief. In absence of a retaining pressure vessel like in LWRs, an ensuing gradual onset of fuel channel heatup and disassembly upon loss of moderator coolant puts energy, radioactivity and combustible gases directly into the relatively weak reactor buildings. These structures are quite different from a traditional PWR cylindrical dome building and are rectangular structures built to old industrial standards. There are significantly high sources of combustible Deuterium gas (‘heavy hydrogen’) from large amounts of carbon steel in feeders and Zircaloy in fuel and fuel channels. Given the layout of the reactor units mimicking four inverted volumes interconnected at the bottom by a common duct, separation and accumulation of combustible gases in these unventable, inverted cup like geometries makes for impracticable combustible gas control. The small number of Passive Autocatalytic Recombiners planned and/or installed are neither quantified / qualified for severe accidents nor for the actual gas (Deuterium) they must recombine and can become early ignition sources. There is an enhanced potential for energetic interactions of fuel debris with bodies of water enveloping the hot fuel channels. Pressure relief in relevant reactor systems (PHTS, Calandria, Shield Tank, and Containment) is inadequate for anticipated severe accident loads. With the reactor units directly attached to the containment pressure boundary and a significant number of reactor systems outside the containment, a containment bypass, as for example from reactivity device failure following fuel and debris heatup, is a likely outcome after a severe core damage. The Calandria Vessel, long heralded as a core catcher, is a thin ~1” thick stainless steel welded low pressure vessel that has been assessed to fail catastrophically at welds and not able to contain hot molten debris. This failure can not only lead to enhanced combustible gas production but also severe energetic explosions leading to failure of structures at the containment pressure boundary. The Shield Tank also cannot contain pressure upon boiling and can fail.

Given that unmitigated expulsion of hot gases and fission products targets the small reactor buildings, there is potential for poor equipment survivability. The in-reactor instrumentation for monitoring and control is neither adequate nor qualified for conditions after a severe accident. Severe accident simulation methods are outdated, crude and in dire need of upgrades. There are no dedicated simulators for severe accidents and the perfunctory desktop exercises with high-level Severe Accident Management 'Guidelines' are inadequate. No significant design changes have been implemented since Fukushima that may prevent a severe core damage scenario and some well known design problems like inadequate over pressure protection have been ignored. Yet, there are opportunities for engineered upgrades that can substantially eliminate a large number of vulnerabilities. However, the regulatory regime in Canada is lax and regulatory staff does not have the technical capability or guidance to independently verify assessments and analyses presented by the utilities not motivated to invest in design upgrades for low probability events they want to ignore. As a result, a continued exploitation of an outdated design with refurbishments that extend the life by another couple of decades is not only a risk to public but also to the utilities.

10. CONTAINMENT STRUCTURE VULNERABILITIES

The multi-unit CANDUs at Darlington and Bruce house four reactor units in an interconnected slightly sub-atmospheric containment attached to a normally isolated vacuum building maintained at about 7 kPa(a) and of about 75% of the containment volume. Each reactor sports a containment structure that is common and contiguous to 4 relatively large reactor power units. Each reactor is capable of putting un-attenuated fission products from the ~2700 MW(th) fuel fission sources as well as combustible Deuterium from over 50,000 kg of Zircaloy and 2000 m^2 of the 120,000 kg of carbon steel. As a result, any accident that results in activity releases into the containment, whether within the design basis or not, is likely to contaminate and disable from service all four reactor units.

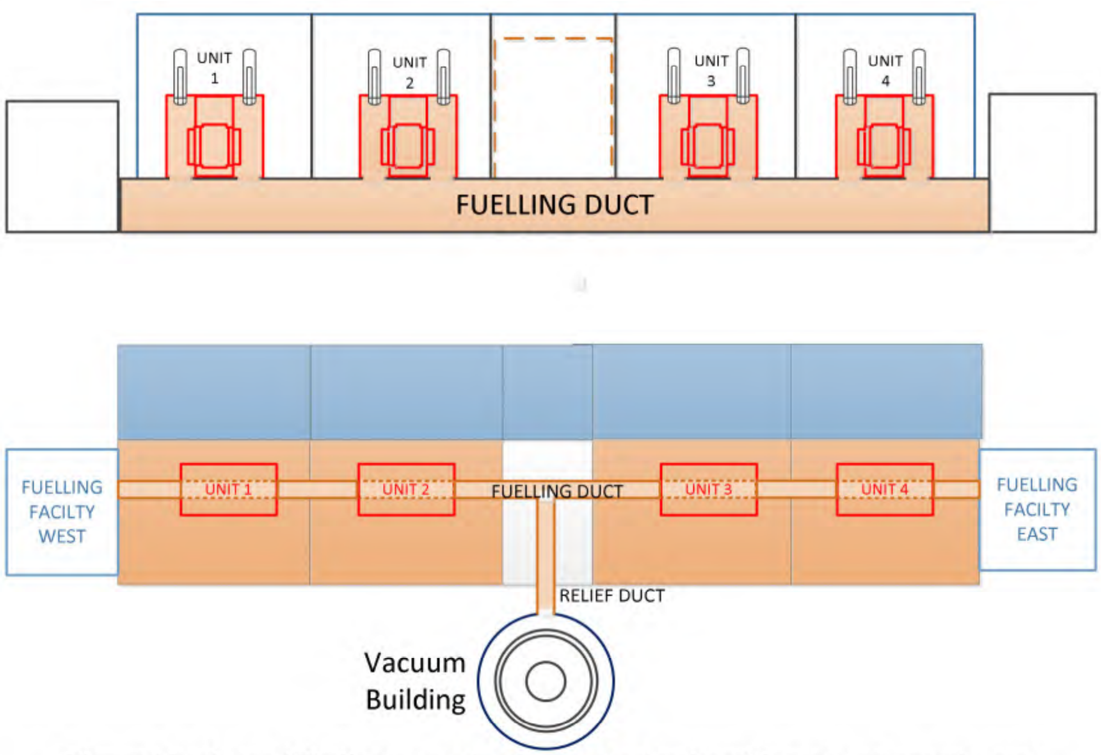

Figure 10 : Bruce / Darlington station layout for 4 units with common containment

With an over pressure retention capability of less than a bar (at design and significantly deteriorated after 20+ years such that all containments are no longer tested at design pressure or at the required frequency of 6 years) and a containment structure made up of rectangular concrete slabs and about 500 times leakier than the 1%/day leakage at design pressure for PWRs, a number of critical equipment are outside the containment and some critical equipment like pressurizers are placed below the mid elevation of the reactor core inside the containment. A common Fuelling Machine Duct underlying the 4 reactors connects the containment volume via a Pressure Relief Duct to a Vacuum building whose volume is deemed adequate for most design basis accidents in a single unit but its effectiveness to mitigate a severe accident in all 4 units is very obviously lacking as the effective volume per reactor unit is less than half of that for a typical PWR and the structures are weaker and with greater likelihood of trapping combustible gases . The containment is built to the National Building Code as are the access requirements, fire protection, smoke detection, etc. It is not built to modern nuclear containment standards.

A number of reactor systems including the reactivity control mechanisms, primary pumps and steam generators are located outside the containment boundary above the reactor cores. The reactor core related structures themselves are within a tank attached at the containment pressure boundary. Critical structures essential for maintaining core cooling being outside the containment are likely vulnerable to certain externally induced challenges. The stations have not considered reactor building reinforcements to avoid building failure or added additional reinforcements with special emphasis on confinement space on top of reactivity decks to mitigate external impact hazards. While a PWR containment may be expected to withstand an aircraft impact, there is such no protection in a multi unit CANDU.

There are no new improvements to pressure suppression system in reactor building as the vacuum building is an inadequate volume supplement to avoid building failure after a multiunit core damage accident or even due to pressurization caused by hydrogen burns. Measures to reinforce the confinement pressure boundary (space occupied by safety and process systems outside the containment) are missing.

The basement of the reactor buildings (fuelling machine duct and the pressure relief duct) is located below the level of the water in the lake. To the credit of the utilities, new portable Emergency Diesel Generators have been to be located at elevations higher than the original backup Diesel Generators that are at lower grade elevations, about 3m higher than the water, not dissimilar to what sank Fukushima. They are yet to be relocated to higher elevations. If that was done a failure similar to that at Fukushima could be avoided.

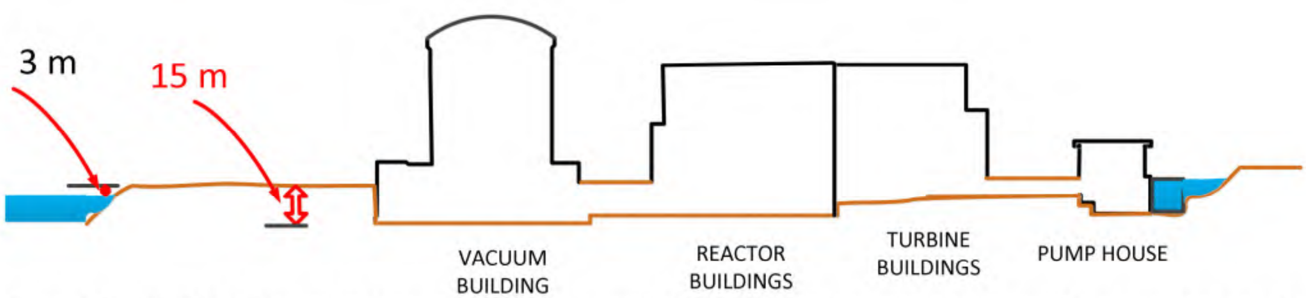

Figure 11 : Building basement layout below Lake water level. The emergency power supply generators are at grade level with cable tunnel 6m under.

The containment structures are rectangular slabs different significantly from typical cylindrical PWR containments and have a relatively weak design pressure (0.6 to 0.9 bar) with relatively high design leakage at design pressure (up to 2% volume per hour or up to 48% per day comparing very unfavourably to a typical PWR with 0.1% leakage per day (Figure 4) at a design pressure that is typically 5 times higher).

The containments are tested for pressure retention most infrequently of any power reactor in the world. Darlington now tests containment for pressure every 12 years while the regulations under which it was originally licensed required a 6 year test interval. The last pressure test was described as a difficult and arduous process that took 6 months of planning.

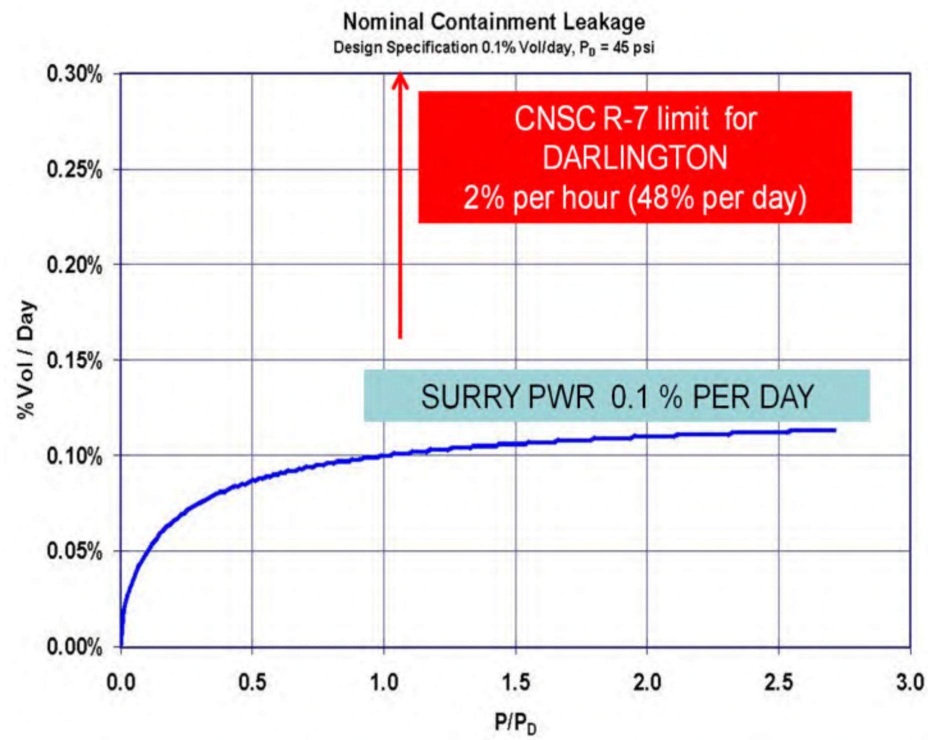

Figure 12 : Comparison of a PWR containment design pressure leakage with that for a Multi unit CANDU.

The individual reactor buildings can be envisioned to be inverted cups on top of a common duct such that retention of flammable gases and fission products after the vacuum building becomes ineffective is a concern. The reactor building volumes are about 14000 m^3 each with a combined volume of the 4 unit reactor buildings and the common fuelling machine and pressure relief ducts of about 120,000 m^3. The normally isolated vacuum building is an additional 95,000 m^3 and it is maintained originally at an isolated pressure of 7 kPa(a) with the main containment volume slightly sub atmospheric. For a multi unit severe accident, the containment volume per unit power is among the smallest of any other similar power reactor in the world.

11. SUMMARY OF MULTI UNIT SEVERE ACCIDENT PROGRESSION & MITIGATION CHALLENGES

11.1 Containment

- Low containment design pressure (<0.9 bar) and high design leakage at design pressure(48% per day)
- Reactivity devices, steam generators, pumps and other equipment critical for long term heat removal are outside the containment and located under an industrial building .
- Containment bypass from over-pressure and thermal creep induced steam generator tube ruptures and from reactivity device failure a likely outcome after a severe core damage.
- Reactor vaults shaped and arranged to be highly likely traps for combustible gases.

11.2 Poor Overpressure Protection Design

- Safety relief valves not directly on the main cooling circuit (ASME section III , NB-7141 (b) requires a direct and unobstructed relief path) and require another pair of downstream valves to open. All valves designed for liquid relief.
- Only two safety relief valves (called 50% capacity valves but the 'capacity' is misrepresented) - contravenes single failure criteria
- Undersized over pressure protection with steam relief capacity of the 2 safety relief valves by a factor of up to 10 - contravenes common sense - relief capacity must exceed anticipated loads, which will always exceed decay heat.
- Inadequate primary cooling circuit relief inherently forces reactor damage by uncontrolled over-pressurization even before an ECC is given a chance to avoid severe core damage. An uncontrolled relief through a rupture in pressure boundary is an unacceptable outcome.
- Accelerated depletion of moderator inventory due to expulsion through pressurized Calandria rupture disks upon channel voiding and fuel heatup to cause moderator boiling.
- Shield Tank cannot contain anticipated pressurization upon boiling and can fail. Restoration of cooling after water depletion problematic as pump flow inlet at the top of vessel that can be voided.

11.3 Poor Pressure and inventory control

- No provisions for direct manual depressurization of the Primary Heat transport system.
- Pressurizer located well below the core can drain water from primary coolant system upon cooling upon loss of power and inhibit thermosyphoning flows.
- No systems for high pressure ECC or any emergency measures for high pressure primary makeup intervention / injection.

11.4 Lack of a pressure vessel causes direct containment contamination

Onset of severe core damage puts activity directly into the containment. There is no isolation of damaged core and its activity in a closed vessel like in a PWR pressure vessel.

11.5 Poor Deuterium Hydrogen mitigation systems

Significantly higher sources of hydrogen from large amounts of carbon steel and Zircaloy.

Currently planned hydrogen mitigation systems (igniters + a small number of PARS) inadequate and potentially dangerous. Poor combustible gas mitigation measures. Small number of Autocatalytic Recombiners inadequate for severe accident scenarios and will cause explosions.

11.6 Moderator vessel an unlikely core catcher - poor

Energetic interactions of disassembling core debris with underlying boiling moderator water in the low pressure Calandria vessel can cause vessel structural failures.

Calandria vessel failure by weld failures is a likely outcome even before debris melt. There are a number of pipe penetrations at the bottom of the vessel that can fail by thermal interactions with hot debris.

Should the Calandria vessel fail, interaction of hot debris with Shield Tank water also similarly challenging to integrity of structures holding the reactor vessels connected to the reactivity deck at the containment pressure boundary pressure relief in ALL relevant reactor systems in inadequate (PHTS, Calandria, Shield Tank, Containment) to remove decay heat

Calandria vessel likely cannot contain melting reactor core debris and can fail catastrophically at welds causing energetic interactions with potential for gross structure failures.

11.7 Spent Fuel Storage.

The spent fuel medium term storage in spent fuel pools is poorly designed and highly susceptible to Zircaloy fires.

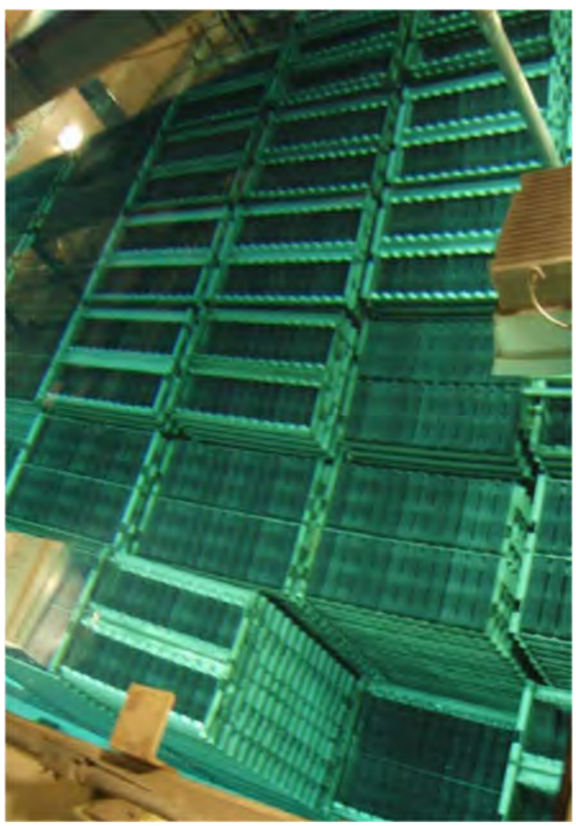

Figure 13: Spent fuel bundles stacked like fish in a fish basket, 16 or more trays high

11.8 Backup Diesel Generators

These are located at the lowest grade elevation in the plant and are no more than 3m above the water line at Darlington and ~4m at Bruce. The tunnel carrying the cables is below the water line by about 4m and can get deluged with water. Pickering station has seen its basement level flooded in the past from water swell in the lake. Location of backup diesel generators has been pointed out as the single most critical error at Fukushima; something that has escaped the CNSC despite repeated warnings. In fact, CNSC staff provided misleading information as to the actual location of the diesel generators in Bruce reactor relicensing public hearings in 2018by claiming that they were located 40-50 feet higher than the lake water.

In Bruce the diesel generators are at 591' elevation while the grade varies from 614.5' at the north side to 590.5 ft at the south side. So the diesel generators are at lowest grade in the station grounds and certainly below the average grade. The tunnel carrying the cables from the water treatment plant (where the generators are) is at 569' with the water line higher by 10' at 579'. So the tunnel is below water line. The tunnel can be flooded by a deluge or a flood or a seismic activity. So if the grounds which are at 591' in that area ever get flooded by a wave, a tsunami, ice dam or whatever, the diesel generators will get flooded at Bruce, just like at Fukushima. The cables from the diesels are in the trench at a much lower elevation, below water line. Design of structures housing backup diesel generator at Darlington is a copy of the one at Bruce.

And…

- Inadequate instrumentation and control for severe accidents
- Poor equipment survivability due to poor containment layout
- No dedicated operator training / simulators for severe accidents.
- Severe accident simulation methods are outdated, crude and inadequate.
- No significant design changes implemented. Known problems ignored for decades.
- Current SAMGs are unrealistic and inadequate. Many potentially favourable emergency hook-ups not implemented.
- Environmental assessments for off-site releases after severe accidents performed with a source term that represents barely 0.15% of the total core inventory

The lessons learned from Fukushima disaster have been poorly accepted despite the hoopla surrounding development of Fukushima Action items by the National Regulator. Risk to public can only be reduced by much needed design upgrades, starting with an open discussion of the severe accident related vulnerabilities, and an acknowledgment that the reactors not designed with consideration of any severe accidents within the design basis; cannot be expected to provide mitigation measures necessary to meet the newly emerging understanding of progression and consequences of a severe accident and current public expectations.

12. SUMMARY MAJOR AVENUES OF DESIGN UPGRADES

Following is a partial list of design improvements that require serious and immediate consideration to meet some of the vulnerabilities of the multi-unit CANDU design.

1. Passive makeup by steam driven auxiliary feedwater pumps for high pressure water addition to boilers
2. PHTS overpressure protection enhancements for avoidance of uncontrolled ruptures (replace PHTS relief valves)
3. Emergency power hook-ups to pressurizer heaters for early re-establishment of pressure control, or Relocate pressurizer to higher elevation
4. High pressure makeup of PHTS inventory loss (high pressure emergency water injection pumps)
5. Pressure relief valves on Pressurizer for manual PHTS depressurization
6. Calandria vessel overpressure protection enhancements for avoidance of deliberate voiding (relief valves with decay heat capacity in addition to rupture disks)
7. Calandria vessel structural design enhancements for better likelihood of retention of core debris
8. Shield tank overpressure protection enhancements for avoidance of structural failure
9. Shield tank heat removal capacity enhancements for retention of debris in Calandria vessel
10. Containment penetration reinforcement for avoidance of overpressure failures
11. Containment pressure suppression improvements: local sprays and external support to coolers
12. Instrumentation enhancements for detection of important accident parameters
13. Filtered containment cooling for avoidance of imminent structural failures
14. Emergency hook-ups for water and power to safety critical systems at appropriate pressures
15. Improved Class 1 batteries., better definition of anticipated loads over prolonged periods of loss of AC power.
16. Combustible gas detection, measurement and recombination systems calibrated for Deuterium
17. External water makeup to a stranded fuelling machine after a LOCA
18. External water makeup and heat removal from the spent fuel bay
19. Off-site measurements of activity magnitude and energy for identification of radioactive species in releases and correlating them to source terms;
20. Upgraded consequence assessment codes dedicated for PHWRs (current codes are not entirely fit for intended use)

13. UNEXPLORED AVENUES OF RESEARCHOR THINGS WE DO NOT KNOW / UNDERSTAND WELL ENOUGH

There are a number of phenomena associated with accident progression that require separate effect quantification with research and have not been addressed properly. These include:

1. Effect of uncontrolled pressurization of the heat transport system before core degradation. With over-pressure relief valves unable to remove decay heat an uncontrolled re-pressurization of the PHTS is inevitable. Typical design failure pressures in a CANDU reactor for level C conditions in Table 1indicate that the ever so vulnerable boiler tubes have the lowest pressure retention capacity and are thus are prime candidates for failure. However, the degradation of feeders by thinning (~0.1 mm/yr) and of pressure tubes by hydriding, creep - thinning, elongating etc. makes the issues more complex.

Table 1: PHTS COMPONENT PRESSURE RETENTION CAPACITY

CANDU 6 REACTOR COMPONENT	**Level B**	**Level C**	**Level C with Seismic**
Inlet Header	14.81	18.96	18.96
Outlet header	12.49	17.58	17.58
Pressure Tube Outlet	11.81	22.22	15.10
Rolled joint outlet	12.46	21.65	10.14
thickness	12.11	16.52	13.71
SG tubing	13.43	14.34	12.72
Pressurizer	12.13	16.00	16.00
Degasser Condenser	11.77	15.51	15.51
header interconnect	17.46	30.99	11.68

2. Reflux condensation holdup of water in boiler tubes on feedwater recovery. This becomes important in case of boiler recovery after PHTS is voided and can lead to early channel heatup of voided channels and their failures at high pressures when natural circulation flows cannot be re-established.

3. Core and Channel thermal hydraulics under loss of forced circulation - during PHTS blowdown, voiding by boiloff and depressurization ; intra channel fluid interactions
4. Mechanisms of high temperature fuel bundle deformations and quantification of bundle geometry parameters
5. Fuel bundle oxidation with air, oxygen at various stages of its disassembly.
6. Mechanisms of high pressure rupture failure of CANDU channels by hot fuel and melt interactions with pressure tubes
7. Channel failures by their deformations; melt through to channel disassembly at low pressures
8. Gross core disassembly, debris retention, displacements, interactions and collapse of individual columns of channels
9. Effect of recovery actions to reflood fuel channels

10. Steam explosion potential during debris and melt relocation to underlying water in Calandria vessel
11. Solid debris behaviour in Calandria with accumulation over many hours and without water ingress
12. Solid debris interactions with air drawn from Calandria overpressure relief ducts
13. Thermo-mechanical behaviour of stepped welded Calandria vessel under load of hot debris
14. Response of boiler tubes following core heatup (consequential boiler tube failure) at high pressures and at low pressures with boilers dried out
15. Component and system failure modes for interfacing systems, in-core device failures that may create containment bypass.
16. Interaction of debris with an intact loop in case of coolant loss and core damage restricted to one loop.
17. Oxidation of end fittings, feeders, Calandria by steam and air
18. Fission product release mechanisms under different fluid conditions from fuel pins in bundles, debris, corium
19. Effect of recovery actions in Calandria, shield tank, fueling machine duct in presence of debris
20. Effect of Calandria vessel weld failures including interaction of water ingress on solid and molten debris
21. Containment response to sharp pressurization loads (energy, mass addition ; hydrogen combustion)
22. Hydrogen / Deuterium distribution in reactor vaults and rest of containment
23. Hydrogen / Deuterium burns, detonation, deflagration in reactor vaults and failure modes of structures
24. Effectiveness and adverse effects of recombiners, igniters (auto-ignition and explosions)
25. Containment response to sharp pressurization loads (energy, mass addition ; hydrogen combustion)
26. Potential and effects of consequential floods, fires in containment
27.

14. COMPUTER CODES USED FOR SEVERE ACCIDENT PROGRESSION & CONSEQUENCE ASSESSMENTS

The currently used computer code MAAP-CANDU suffers from the following errors and deficiencies :

1. No consideration of heavy water, deuterium gas (light water and H_2properties used)
2. No momentum equation for PHTS
3. Channel degradation during channel boiloff before dry steam/D_2 heatup not modelled - Initial fuel temperatures at onset of heatup are arbitrary
4. Channel hydraulics based on assumed header to header Δp and no overall core thermal hydraulics. No intra channel flows. No consideration of fluid discharge paths.
5. A limited number of channels modelled.
6. No explicit fuel sheath modeling.
7. No modelling of out of flux pressure tube lengths.
8. No modelling of water retention in end fittings after boiloff or blowdown
9. No thermal modelling of feeders and end fittings
10. No consideration of differences in burnup and power profiles between various channels
11. No modelling of in-core devices and their effect on individual fuel bundle displacements.
12. No modelling of piping into Calandria vessel.
13. Crude modelling of core disassembly & a physically impossible model of 'core collapse'
14. Primitive modelling of suspended solid debris
15. Solid debris interactions with air not modelled
16. Deuterium / Hydrogen generation by steel oxidation and Uranium-steam oxidation ignored.
17. Fission product releases from debris crudely modelled.
18. Fission products do not decay.
19. As ‘engineered’ codes with specific accident progression pathways – many scenario paths not considered.
20. Difficult I/O; primitive post processing

It is incomprehensible that above deficiencies have not been rectified in the 25 years since the control of code development left Canadian hands. No SAMGs, design assist or other accident management or training measures are possible without properly modelling the reactor, its phenomenology and all potential accident progression pathways. Without modelling the behaviour of each fuel channel individually, for example, the erroneous conclusions drawn from models such as for a total, global core collapse can give misleading and dangerously inaccurate results.

15. CONCLUDING REMARKS

The purpose of the paper is to foster an open discussion of design vulnerabilities so that the industry feels encouraged to develop engineering solutions that can help reduce risk. Our commitment to reactor safety should not just be defensive but also honest. The recent claims by the industry of the infallibility of the design and relative benign consequences of a severe accident prompting the regulator to suggest that local authorities may not even need any evacuation for 24 hours is a very disturbing trend. The purpose of this paper is also to reiterate that as professional engineers, we are bound by our professional ethics to keep the public safety first in our list of concerns and that sweeping under the rug of design deficiencies and knows vulnerabilities to unfavourable outcomes or knowingly stretching the truth is contrary to our professional obligations. Damage done by radiation to the countryside at Chernobyl and Fukushima far exceeds the economic and other benefits from operation of all 400 odd nuclear reactors that have been operated so far. In both cases it was not just the technology that was wanting; it was also the organization and the abysmal safety culture that was the root cause. Those accidents required a number of professionals to be complicit in putting the corporate priorities first over public safety concerns.

Fukushima reviews by the industry have increased the awareness of the potential of a CANDU severe core damage but not understanding of its implications. Some newly implemented mitigating measures like mobile emergency hook-ups will partly reduce the likelihood of progression to a severe core damage but are not passive or well thought through. Some long planned measures like PARS and Containment Venting will help reduce off-site consequences but implementation is dangerously incomplete and backup analyses are questionable. There is significant resistance to understanding, acceptance and targeting of inherent reactor design deficiencies by the utility management. Restructuring of CANDU nuclear industry has affected progress and granting of long term licenses by the CNSC has further retarded progress towards risk reduction from ageing and obsolete reactors. Significant opportunities exist in further reducing risk to owners and the public but regulatory actions have had a negative effect. There has been little progress in enhancing analytical capabilities to help identify and quantify vulnerabilities; justify and introduce new risk reduction measures. Unless corrective action is taken, a disaster is looming. At a minimum it will consume the utility with no upper limit in sight of the damage it can cause to the nation.

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Comments on OPG's Environmental Impact Statement for New Nuclear Build at Darlington NGS

by F. R. Greening – for le Mouvement vert Mauricie's Intervention on the Darlington New Build Environmental Assessment Hearings in 2011

The complete MVM Intervention is found at www.ccnr.org/MVM_final.pdf

Radioactive Emissions from Darlington New Build

1.0 Introduction

OPG's September 2009 Environmental Impact Statement (EIS) for the construction of up to 4800 MW of new nuclear generating capacity on the Darlington NGS site shows that the projected radioactive emissions from such a significant addition to the pre-existing nuclear facilities at Darlington are potentially very large.

This simple fact underscores the need for these emissions to be properly assessed in relation to the applicable release limits for radioactive species in gaseous and liquid discharges. Indeed, only a detailed assessment of all such emissions can ensure the new nuclear build is in compliance with these limits.

The question of the projected radioactive emissions from the proposed new nuclear build at Darlington is discussed in two Technical Support Documents (TSDs) issued as Volumes 15 and 16 of OPG's EIS:

Volume 15: "Radiation and Radioactivity Environment Existing Environmental Conditions"

Volume 16: "Radiation and Radioactivity Environment Assessment of Environmental Effects"

From these documents we see that OPG's approach to assessing the radiological impact of new nuclear reactors at the Darlington NGS site is to first consider the concentrations of natural and man-made radioactive species already present in the air, soil and groundwater around the site, and then to predict the expected increases in the concentrations of radioactive species emitted as a consequence of adding up to 4800 MW of nuclear generating capacity at the Darlington NGS site.

OPG's methodology for predicting the environmental emissions from the proposed reactors involves the evaluation of parameters that influence the release and dispersal of radioactive species from normal operation of the new reactors. For simplicity, and as a reasonable approximation, the reactors are considered to be one or more point sources of emission of a particular radioactive species that is subsequently traced in the near-field and far-field environments using atmospheric dispersion and water dilution factors in suitable plume-tracing models.

What is most significant about this approach is that while the air dispersion and water dilution factors of many radioactive species are well-known from studies by organizations such as the U.S. EPA and the NCRP, the source terms for the numerous radioactive species emitted by a newly designed, but yet to be operated, reactor tend to be quite uncertain.

Thus we need to ask the simple question: is OPG's EIS based on sound scientific principles whereby radioactive emissions are accurately predicted or is it merely a self-serving prophecy based on wishful thinking by OPG?

2.0 Issues Arising from Alternative Reactor Designs

At the present time OPG is considering four reactor designs:
- The ACR-1000, a heavy water reactor offered by AECL
- The AP1000, a PWR offered by Westinghouse
- The US EPR, a PWR offered by Areva
- A "modified" CANDU-6, based on AECL's existing CANDU-6

There are a number of issues arising from the fact that the type of reactor to be built at Darlington is yet to be selected by OPG:

(i) Modern nuclear reactors are very complex facilities that utilize a wide range of water and gaseous process streams and also generate large quantities of solid wastes. A detailed accounting of how radioactive wastes will be produced, managed and disposed of is required for each reactor design for a meaningful assessment of the environmental impact of these reactors to be made.

(ii) Interim storage of some effluent streams and solid wastes may (or may not) be used to delay the environmental release of relatively short-lived radioactive species; the potential for varying degrees of holdup of effluents for each reactor design serves to add uncertainty to environmental impact assessments.

(iii) The ACR-1000 and CANDU-6 utilize heavy water as a moderator – technologies that produce, and inevitably release, far more tritium than any comparable light water reactor design. This is of special concern to the Darlington EIS review because of the on-going debate as to an appropriate standard for tritium in Ontario's drinking water supply (as reflected in the ACES and ODWAC recommendations).
In view of these issues it is necessary to closely examine not only the conclusions reached by the requesting party – OPG in the present case – but also the claims made in the submissions to OPG by the reactor vendors. In this regard it is perhaps a happy coincidence that the three companies that have submitted proposals to OP – namely, AECL, Westinghouse and Areva – have all recently made similar submissions to the UK's Environment Agency (UK EA) for the purpose of assessing the expected performance of new nuclear power stations to be built in England and/or Wales.

Thus it is possible to compare the vendors' predictions for the environmental impact of the ACR-1000, the AP1000 and the EPR reactors with the responses of two requesting parties: namely, OPG and the UK EA. Fortunately the three different reactor designs currently under scrutiny by OPG and the UK EA employ similar radioactive gaseous and liquid waste management systems. Nevertheless, to be in compliance with regulatory emission limits, it must first be proven that the proposed monitoring techniques for each reactor design are adequate to quantify the radioactive content of a particular discharge at the required level of detection. In addition the vendors must demonstrate that the various wastes arising from their respective reactors meet appropriate criteria for disposal in waste repositories.

It is significant that the UK EA's initial comments on the submissions it received in 2008 from the vendors of the ACR-1000, the AP1000 and the EPR, has been to state over and over again that: "insufficient information has been supplied for us to draw any conclusions". In the case of AECL's submission, the UK EA have requested that detailed information on the source/location, height, diameter and volume flow of gaseous and liquid discharges should be provided and add that "designs rather than concepts should be described".

It is rather telling, and somewhat disturbing, that no complaints about insufficient information on the three reactor designs under assessment have been forthcoming from OPG. Furthermore, as recently as November 2009, the UK's Health and Safety Executive said it could not recommend plans for new reactors because of wide-ranging concerns about their safety.

3.0 Radioactive Emissions: General Comments

As listed in Table 3.1 below, a large number of radionuclides are produced by the operation of water-cooled reactors. Most of these radioactive isotopes are created either through neutron activation or uranium fission (yielding "activation products" and "fission products"). In addition, a number of "transuranic isotopes" are created when non-fissile uranium atoms absorb one or more neutrons, subsequently transmuting into various isotopes of neptunium, plutonium, americium, curium, and so forth.

After an induction period, varying from a few days to several years, most of the radionuclides in question attain relatively constant (equilibrium) concentrations within the various systems in which they are produced – such as the reactor fuel bundles, coolant pipes, moderator tanks, heat exchanger tubes or cover gas plenums.

Inevitably some radioactive isotopes leak or otherwise escape from the systems in which they are produced and enter one or more liquid or gaseous waste effluent steams. It is these streams that must be assayed by continuous monitoring, or by the analysis of frequent "grab" samples, to determine the radionuclide content of the systems involved.

This type of data is essential for the control of radioactive emissions because it allows a reactor operator to follow the movement of radioactivity throughout the nuclear station under his or her control. Furthermore, only with this level of detailed radiation monitoring may all radioactive releases from a nuclear facility be reliably reported to the appropriate regulatory agencies as a "source term" for each radionuclide. Radiation dose calculations require radionuclide source terms – usually expressed as a time averaged flux – to determine the rate of release of a radioactive species and derive an associated radiation dose.

However, as we have seen, source terms for a "first-of-a-kind" reactor are problematical because they cannot be measured beforehand. Even a longstanding nuclear power station generally has insufficient data to accurately quantify all of its radioactive emissions and radiation doses.

Consider the problem of estimating the radiation dose at a location 1 km from an operating nuclear reactor. The expected dose could be calculated from a measurement of the mean annual concentration of radionuclides at the location of interest – but such data are usually not available.

The only practical way to make up for this lack of knowledge of the detailed dispersion of escaping radioactive species is to use source terms measured at the outlet of a contaminating stack or liquid effluent pipe and then determine the dose at a remote location using plume tracing models. However, this approach still requires reliable analytical data for the rate of emission of all the radionuclides, including those shown in Table 3.1. This entails the measurement of the concentration of at least forty radionuclides in every effluent stream.

The analysis of a wide range of radionuclides, such as those listed in Table 3.1, is not a trivial task.

Gamma spectrometry is probably the most useful technique to quantify the gamma emitters (γ-emitters) in a sample using a single detector, but is of no use in quantifying the so-called "pure" beta-emitters (β-emitters) such as

• H-3 (tritium, which is radioactive hydrogen, usually given off in the form of radioactive water molecules),
• C-14 (carbon-14, usually given off as radioactive carbon dioxide),
• Cl-36 (chlorine-36),
• Ni-63 (nickel-63),
• Sr-90 (strontium-90) and
• I-129 (iodine-129).

These pure beta-emitters require specialized, isotope-specific, analytical techniques.

The same holds true for uranium and most of the transuranic isotopes in Table 3.1 such as Pu-239 (plutonium-239), where α-spectrometry must be used on specially prepared samples.

Reactor operators, faced with the daunting task of measuring the concentrations of up to 40 radionuclides in all the gaseous and liquid effluent streams in a nuclear power station, generally resort to collecting analytical data for a much-reduced list of “high priority radionuclides”, leaving the remaining radioactive species to be checked occasionally or not at all (see Section 3.4 for more details on this).

However, as we shall see, many of the most important radionuclides, such as tritium and carbon-14, are also the most difficult to determine with good precision and accuracy – an issue that is not addressed in OPG’s EIS for Darlington new build.

TABLE 3: Important Long-Lived Radionuclides in Reactor Waste Streams
EC = Electron capture; UF = Uranium fission; α = alpha; β = beta, γ = gamma

Radio-nuclide	Half-life	Mode of Production	Mode of Decay	Principal Gamma Energies (keV)
H-3	12.3 y	^{2}H(n,γ)	β	No γ-rays
C-14	5730 y	^{14}N(n,p) ^{17}O(n,α)	β	No γ-rays
Cl-36	3.0 x 10^5 y	^{35}Cl(n,γ)	β	No γ-rays
Ar-41	1.8 h	^{40}Ar(n,γ)	β, γ	1293
Cr-51	28 d	^{50}Cr(n,γ)	EC	320
Mn-54	313 d	^{54}Fe(n,p)	EC	835
Fe-55	2.7 y	^{54}Fe(n,γ)	EC	No γ-rays
Fe-59	45 d	^{58}Fe(n,γ)	β, γ	1099, 1292
Co-60	5.27 y	^{59}Co(n,γ)	β, γ	1173, 1332
Ni-63	100 y	^{62}Ni(n,γ)	β	No γ-rays
Zn-65	244 d	^{64}Zn(n,γ)	EC	1115
Kr-85	10.7 y	UF	β, γ	517
Sr-90	29 y	UF	β	No γ-rays
Zr-95	66 d	UF, ^{94}Zr(n,γ)	β, γ	724, 757
Nb-94	2.0 x 10^4 y	^{93}Nb(n,γ)	β, γ	703, 871
Nb-95	35 d	UF, ^{95}Zr(β)	β, γ	766
Tc-99	2.1 x 10^5 y	UF	β	No γ-rays
Ru-103	40 d	UF	β, γ	497
Ru-106	369 d	UF	β, γ	512, 622
Ag-110	252 d	UF	β, γ	658, 884
Sb-124	60 d	UF, ^{123}Sb(n,γ)	β, γ	603
Sb-125	2.73 y	UF, ^{125}Sn(β)	β, γ	176, 428
I-129	1.6 x 10^7 y	UF	β	No γ-rays
I-131	8.0 d	UF	β, γ	364
Xe-133	5.3 d	UF	β, γ	81
Cs-134	2.1 y	UF	β, γ	605, 796
Cs-137	30 y	UF	β, γ	662
Ce-141	33 d	UF	β, γ	145
Ce-144	284 d	UF	β, γ	133
Eu-152	13 y	UF	EC	122, 1408
Eu-154	8.6 y	UF	β, γ	725, 1272
U-235	7.0 x 10^8 y	Natural	α	No useful γ-rays
U-238	4.5 x 10^9 y	Natural	α	No useful γ-rays
Pu-238	88 y	^{238}U(n, β), etc	α	No useful γ-rays
Pu-239	2.4 x 10^4 y	^{238}U(n, β), etc	α	No useful γ-rays
Pu-240	6540 y	^{238}U(n, β), etc	α	No useful γ-rays

Pu-241	15 y	^{238}U(n, β), etc	β	No useful γ-rays
Am-241	433 y	^{238}U(n, β), etc	α	59
Cm-242	163 d	^{238}U(n, β), etc	α	No useful γ-rays
Cm-244	18 y	^{238}U(n, β), etc	α	No useful γ-rays

3.1 Tritium

In light water reactors such as AP-1000 and EPR, tritium (hydrogen-3) is produced by ternary fission within the fuel assemblies or by neutron activation of lithium (added for pH control), or boron (added for chemical "shim"), in the cooling water.

By comparison, for an advanced CANDU reactor such as the ACR-1000, or a modified CANDU-6, a far greater amount of tritium is produced by the neutron activation of non-radioactive heavy hydrogen atoms (hydrogen-2) contained in the heavy water molecules that are used as the moderator.

The relative magnitudes of the various tritium production routes in the three reactor designs under consideration by OPG shows that an ACR-1000 reactor or a modified CANDU-6 produces about 100 times more tritium than either the AP-1000 or the EPR reactors. Nevertheless, experience with the operation of OPG's fleet of heavy water reactors suggests that tritium emissions from large CANDUs can be controlled to some degree by the implementation of strategies to limit heavy water spills and leaks and the optimization of vapor recovery drier performance.

This probably explains why AECL's estimated HTO release to water, reported in Table D.2-1 of OPG's EIS, is only about ten times (rather than 100 times) higher than the equivalent tritium release data estimated by the vendors of the AP-1000 and the EPR reactors – but is this number realistic? First note that none of the estimated tritium discharges provided by the three vendors is accompanied by documentation showing any rationale behind the reported values, nor the extent of any possible variability in the discharges. Neither is information provided on how specific events such as start-up, shutdown, maintenance, system leaks, fuel failures, etc, might impact on the reported tritium discharges.

Available tritium release data for OPG units show that high tritium emissions are associated with maintenance activities on certain systems.

Thus variable tritium emissions should be expected if an ACR-1000 or CANDU-6 is selected as the Darlington new nuclear build.
This conclusion is further supported by tritium monitoring data for CANDU units at Bruce, Pickering and Darlington over the past 20 years, which show that tritium emissions can vary by more than a factor of two for a given unit from one year to the next.

Tritium emission data for AECL's CANDU reactors at Point Lepreau and Gentilly-2 also show a very similar degree of year-to-year variability.
But let's take a closer look at the projected HTO ("tritiated water") emissions for four projected ACR-1000 reactors as reported in Tables D.1-1 and D.2-1of OPG's EIS. The projected airborne tritium release for the ACR-1000 is stated to be 0.48 Peta-Bq, while the projected waterborne release of an ACR-1000 is about three times higher at 1.4 Peta-Bq.

This is somewhat surprising because CANDU reactors traditionally release more tritium in the gas phase than in the aqueous phase.

What is more, Bruce A's four-unit airborne tritium emissions in 2008 were reported by Bruce Power to be 1.15 Peta-Bq – more than double the projected airborne emissions for the new CANDUs offered by AECL.
One is compelled to ask how AECL plans to maintain tritium emissions at or below the maximum projected levels of 0.48 Peta-Bq (airborne) and 1.4 Peta-Bq (waterborne). Our experience with the long-term operation of more than twenty large CANDUs here in Canada shows that current CANDUs are in some cases already above these emission levels.

Years of effort in trying to reduce tritium emissions from existing CANDU reactors have largely been unsuccessful. As a case in point, Darlington's waterborne tritium emissions more than doubled from the levels seen in the late 1990s to the levels reported in the period 2002 - 2007.

It is also noteworthy that OPG recently announced that it failed to meet its overall 2008 tritium emission targets.

Finally, as a cautionary note, there are reasons to believe that airborne tritium emissions are actually higher than currently measured by station monitors because, as AECL has reported, tritiated species tend to plate out on the walls of the sampling lines, thereby producing artificially low readings.

What is also not mentioned in OPG's EIS with regard to projected tritium emissions for an ACR-1000 is the fact that the tritium concentration in the moderator builds up over several years of unit operation as the function:
C (tritium) = 2.5 [1 − exp (− 0.0563 t)] Tera-Bq/kg.

To make matters even worse, waterborne tritium emissions also increase over time because larger leaks tend to form in aging reactor systems such as the steam generators.

Now there is a way to alleviate some of the expected increase in tritium emissions from a heavy water reactor, namely, detritiation. However we are not informed by AECL or OPG if there are plans to detritiate heavy water from new ARCs, should this reactor design be selected.

Certainly, OPG has since 1990 used cryogenic distillation to detritiate heavy water from its CANDU reactors using the Darlington Tritium Removal Facility (TRF). This facility has the capacity to detritiate up to 3000 tonnes of D_2O (heavy water) per year. It has significantly reduced the average tritium content of OPG's inventory of 10,000 tones of D_2O.

Indeed, it has been estimated that without this facility OPG would be emitting an additional 7.4 Peta-Bq of tritium per year to the environment, which is more than three times its actual tritium emission rate. It must be noted, however, that such calculations typically ignore the fact that OPG's TRF is itself a significant source of tritium emissions.

Nevertheless, if the ACR-1000 or CANDU-6 is selected for the Darlington new nuclear build, substantially higher tritium emissions from the Darlington site are to be expected, either from the buildup and escape of moderator tritium in the new reactors, or from substantially increased use of the existing TRF.

Whatever the case, the projected use of detritiation for moderator heavy water in new ACRs needs to be addressed by OPG in its EIS for Darlington new nuclear build.

3.2 Carbon-14

Radioactive carbon-14 (C-14) is produced in both light water and heavy water reactors by neutron activation of N-14 (non-radioactive nitrogen-14) and/or O-17 (non-radioactive oxygen-17). However, among the three reactor designs under consideration by OPG, the highest projected C-14 emissions of 1.1 Tera-Bq correspond to the projected airborne C-14 emissions from the ACR-1000 heavy water reactors.

Unfortunately however, as we saw for the projected tritium emissions, none of the estimated C-14 discharges provided by the three vendors is accompanied by documentation showing the rationale behind the reported values, and the extent of any possible variability in the discharges. Neither is information provided on how events such as start-up, shutdown, maintenance, system leaks, fuel failures, etc, might impact on the reported C-14 discharges.

What is more, as we will show below, C-14 in CANDU reactor waste (such as ion-exchange resin) is a major environmental concern because of the very long, 5730-year, half-life of C-14.

OPG's original fleet of CANDU reactors commissioned in the early 1970s at Pickering NGS, used nitrogen gas (N_2) to fill their annulus gas systems. Most regrettably, prior to 1979, no one at AECL or OHN recognized the possibility that nitrogen could produce vast quantities of C-14 particulate under neutron irradiation.

Indeed, I have seen documents from AECL Chalk River written in 1981 stating that solid C-14 was not present in the annulus gas systems of Pickering reactors, even though I had reported the presence of solid C-14 in deposit removed from Pickering Unit 4 in 1980. (See: "Analysis of Pickering NGS "A" Unit 4 N_2 Annulus Gas Filter Deposit", OHRD Report No. C81-04-K, January 1981).

Unfortunately for AECL's alleged "experts" on this topic, we now know that thousand of Curies of C-14 particulate were produced in all four Pickering Units prior to the large-scale fuel channel replacement operations in the mid-1980s.

Today OPG no longer uses N_2 in its annulus gas systems, but residual N_2

from air enters moderator systems where it is readily converted to C-14 through the N-14 (n,p) C-14 thermal neutron reaction.

The fact that O-17 (oxygen-17) is enriched in heavy water relative to natural, light water, only adds to the C-14 production problems with CANDUs through the O-17 (n,alpha) C-14 reaction.

This certainly makes one wonder why OPG has no gaseous C-14 emission data for Darlington from 1993 to 1998.

While some C-14 is emitted during reactor operation, however, most of the moderator C-14 is collected on ion-exchange (IX) resin columns used for moderator water quality control.

Storage and/or long-term disposal of carbon-14-contaminated resins is already a major problem for OPG because of the potentially high collective radiation dose (63 person-Sieverts per gigawatt of electric power) from the long-lived C-14.

In light of these facts I would ask OPG to provide answers, with supporting experimental data and/or calculations, to the following questions concerning the production and fate of C-14 from four new ACR-1000 reactors at Darlington:

- What is the projected end-of-life C-14 inventory on spent IX resin from these reactors?
- Where and how will the spent resin be stored and at what repository costs?
- What is the expected condition/integrity of these IX resins to 2050 and beyond?
- What are the expected effects of self-irradiation on the retention of C-14 by the resin?
- What is the probability that microbial action could mobilize the C-14?

3.3 Noble Gases

The radioactive noble gas emissions from nuclear reactors are mostly shortlived fission product isotopes of krypton and xenon. However, Ar-41 (argon-41) from the activation of the small amount of non-radioactive argon in air (0.94 %), is invariably present in the gaseous emissions from operating reactors.
The day-to-day amounts and isotopic composition of noble gas emissions from operating reactors are variable and complex because the numerous radioactive species of interest are short-lived, ($t_{1/2} \sim$ 15 min to 12 days), with continually changing activities.

To add to this complexity, some noble gases escape containment directly and enter the environment via the "non-contaminated" stack, while other species find their way into gaseous effluent streams that use activated carbon beds to delay noble gas release.

The monitoring of noble gas emissions from CANDU reactors has been accomplished in many different ways over the years. Problems such as insufficient detector resolution and sensitivity remained unresolved until well into the 1980s. AECL also encountered similar problems at Point Lepreau and Gentilly-2, and has acknowledged that noble gas emissions reported for these reactors "were flawed", at least until 1994.

Even today, however, CANDU reactor operators do not provide a detailed, isotope-specific, breakdown of their noble gas emissions but simply report gross noble gas emission data in "energy-compensated" units of gamma – Bq.MeV.

This approach is based on the assumption that the radiation dose received by a population exposed to a radioactive noble gas mixture is proportional to the average gamma-ray energy per disintegration. But this is true only if the isotopic composition of the gaseous effluent is relatively constant.

And, as we have already seen, that is simply not the case for CANDU reactors.

Large variations in noble gas composition are caused by variable holdup times as well as by routine operational activities such as startup, refueling and shutdown.

Nevertheless, OPG and AECL continue to use such energy-compensated units when reporting noble gas emissions – even though there are internationally accepted standards, such as ISO60761, for gaseous effluent monitoring from nuclear reactors, and most jurisdictions do indeed report noble gas emissions for individual radioisotopes of argon, krypton and xenon in units of Bq.

Another important requirement of noble gas monitoring at a nuclear station is that the measuring instrument should be able to provide on-scale readings under accident conditions so that the station operator is able to provide meaningful release information for off-site emergency planning and actions. OPG does not address this issue in its Darlington EIS.

What we do find in OPG's EIS (TSD No. 27) is an analysis of "a stylized accident radioactive release scenario" in which a scaled source term, assumed to be a small portion of the reactor core inventory, is released from damaged fuel; this postulated release is subsequently used to determine a dose to the public.

However, this approach also assumes that reactor containment is not breached for 24 hours, artificially allowing the short-lived noble gases to decay. I would ask OPG to justify the assumption of a 24-hour delay. Regrettably, OPG's accident "scenario" has little to do with anticipated reactor accidents that have actually been postulated and studied by nuclear agencies around the world; on the contrary, OPG's approach appears to be an exercise in radioactive bean-counting to satisfy emission/dose limits.

OPG's imagined accident "scenario" is not realistic because it considers a radioactive release from only one fuel element or assembly even though the Canadian nuclear industry and its regulators know that power pulse transients and temperature excursions could damage much more than that. Indeed, a recent CNSC risk assessment for CANDU reactors mentions the likelihood of more than one fuel element being damaged:

"Most accidents involve deteriorated cooling conditions, resulting in elevated fuel temperatures which in some events may reach very high values…. In (feeder) stagnation break or flow blockage, several bundles in a single channel are predicted to experience melting".

I would therefore ask OPG to explain how it arrived at “the post-accident gaseous release source term” data in Table 4.4 of its report N-REP-01200-10000 entitled: “Use of Plant Parameters Envelope to Encompass the Reactor Designs Being Considered for the Darlington Site” In particular I would ask OPG to explain (in relation to Table 4.4 in N-REP-01200-10000):

- How it determined, and how it would validate, the noble gas and radio-iodine emissions in Table 4.4?

- How it modeled the gas, vapor and aerosol release, transport and retention in containment for the postulated accident scenario?

- Why a more realistic accident scenario, involving the melting of several fuel bundles, was not considered?

3.4 “Missing” Radioisotopes

There are a number of radioisotopes, known to be produced in nuclear reactors, which are quite difficult to analyze and are therefore not monitored or reported by reactor operators. Nevertheless, these isotopes are of concern for long-term disposal of reactor wastes.

I would therefore ask OPG to provide production, emission and dose estimates for the following unmonitored long-lived isotopes that may be released or found in the waste generated by Darlington new build reactors:

Al-26 (7.3 x 10^5 y)	aluminum-26	730,000 years
Cl-36 (3 x 10^5 y)	chlorine-36	300,000 years
Fe-60 (10^5 y)	iron-60	100,000 years
Cs-135 (2.3 x 10^6 y)	cesium-135	2,300,000 years
I-129 (1.59 x 10^7 y)	iodine-129	15,900,000 years
Zr-93 (9.5 x 10^5 y)	zirconium-93	950,000 years
Nb-92 (3.2 x 10^7 y)	niobium-92	32,000,000 years
Ar-42 (33 y)	argon-42	33 years

3.5 Accumulation of Radioisotopes in the Near-Field Environment

An important issue that is not addressed in OPG’s EIS for Darlington New Build Reactors is the potential for the accumulation of long-lived radioisotopes in the near-field environment around Darlington.

Radioisotopes of particular interest are H-3 (tritium), C-14 and Cs-137 and the near-field environment of concern would be any location within about 10 km of the Darlington NGS site. Within this region radioisotope emissions from the Darlington site accumulate in exposed vegetation, soil and groundwater as the result of natural dry and wet deposition processes.

While it is difficult to accurately measure the rate of accumulation of H-3, C-14 and Cs-137 in the near-field environment around a nuclear facility, such rates may be inferred from several years of data from suitable environmental samples and comparisons to the concentrations of these species in "background" samples. Background concentrations of H-3, C-14 and Cs-137 reveal the occurrence of these radioisotopes from natural and anthropogenic sources such as cosmic rays and nuclear weapons testing.

Nuclear weapons testing, especially in the 1950s and early 1960s, injected considerable amounts of H-3, C-14 and Cs-137 into the earth's atmosphere, much of which found its way into soil and surface waters around the world. Nevertheless, since the Test-Ban Treaty of 1963, the concentrations of these species have been slowly declining so that current environmental levels are quite low and predictable. Representative maximum background concentrations in environmental samples collected around Darlington are:

H-3 in water from the Great Lakes and/or inland lakes and rivers: 4.5 Bq/L
C-14 in soil: 226 Bq/kg-C
Cs-137 in soil: 7.0 Bq/kg

OPG's EIS TSD Volume 15: "Radiation and Radioactivity Environment Existing Environmental Conditions" provides data for these species at various sites around Darlington. The maximum reported values are:

H-3 in water within the study area: 29.2 Bq/L or 6.5 times background
C-14 in soil: 301 Bq/kg-C or 1.3 times background
Cs-137 in soil: 11.5 Bq/kg or 1.6 times background
These data clearly show that radioactive contamination from the existing Darlington site, which has been in operation for only about 15 years, is already spreading into the local environment.

OPG likes to claim that the radioactive emissions from its nuclear facilities are within regulatory limits and therefore pose no threat to the local environment. However, such claims ignore the accumulation of long-lived radioactive species in the environments around OPG's nuclear facilities due to years of exposure to controlled emissions, uncontrolled leaks and accidental spills. Radioactive species such as Cs-137 have a tendency to bioaccumulate in select species of flora and fauna such as berries, fungi and fish.

What is more, there is evidence that radioactive emissions tend to increase as a nuclear facility ages because more and more radioactive material such as irradiated fuel is stored on-site and radioactive circuits such as annulus gas systems tend to develop leaks and/or require more frequent purging.

Thus it is to be expected that an ever expanding and deleterious radioactive "footprint" will grow around Darlington NGS over the predicted 50-plus years of operation of new nuclear reactors at this site.

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DURHAM NUCLEAR AWARENESS,
SLOVENIAN HOME ASSOCIATION &
THE CANADIAN ENVIRONMENTAL LAW ASSOCIATION

Comments on Ontario Power Generations' Review of the Environmental Impact Statement and Plant Parameter Envelope for the Darlington New Nuclear Project in the Context of the Proposed BWRX-300 Reactor

Prepared by:
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Expert Review by:
M.V. Ramana, Professor and Simons Chair in Disarmament, Global and Human Security

March 20, 2023

I. INTRODUCTION

Durham Nuclear Awareness (DNA) and Slovenian Home Association (SHA) together with the Canadian Environmental Law Association (CELA) and the expert review by Dr. M.V. Ramana,[1] submit this written report in response to the Canadian Nuclear Safety Commission's (CNSC) Notice of Participant Funding dated October 24, 2022 to review the environmental impact statement and plant parameter envelope for Ontario Power Generation's Darlington New Nuclear Project.[2]

DNA, SHA, and CELA's (herein, "the intervenors") report is the result of a review of two Ontario Power Generation (OPG) documents which have been made available to the public: *Use of Plant Parameters Envelope to Encompass the Reactor Designs being Considered for the Darlington Site* and *Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300*. In addition to reviewing the documents submitted by OPG, this report considers the CNSC's jurisdiction pursuant to the *Nuclear Safety and Control Act* (NSCA), which requires that in making a licensing decision, the CNSC ensure the adequate protection of the environmental and human health. In meeting this objective, per section 24(4) of the NSCA, the intervenors' findings and concerns are itemized below. Our recommendations, including suggested licence and licence condition revisions are summarized in **Appendix A.**

II. INTEREST AND EXPERTISE OF THE INTERVENORS

i. Durham Nuclear Awareness

Durham Nuclear Awareness (DNA) is a citizens' group with a longstanding interest in the Darlington Nuclear Generating Station. DNA was first organized in 1986 in the wake of the Chernobyl disaster and born out of a need for people in Durham Region to come together, learn & empower themselves.

As a volunteer group of concerned citizens, DNA dedicates themselves to raising public awareness about nuclear issues facing Durham Region, and fostering greater public involvement in the nuclear decision-making process. DNA has appeared on numerous occasions before the CNSC and has a lengthy history lobbying for critical public health and safety measures, including improved emergency planning and baseline health studies, and setting standards for tritium in

[1] M.V. Ramana is the Simons Chair in Disarmament, Global and Human Security and Professor at the School of Public Policy and Global Affairs, University of British Columbia, Vancouver, Canada.

[2] Canadian Nuclear Safety Commission, "Notice of Participant Funding" (24 October 2022), *PFP funding opportunities* (website), online: https://nuclearsafety.gc.ca/eng/the-commission/participant-funding-program/opportunities/participant-funding-review-environmental-impact-statement-plant-parameter-envelope-darlington.cfm

drinking water. DNA continues to advocate for upgrades to nuclear emergency plans to ensure the protection of communities in the event of a nuclear accident.

ii. Slovenian Home Association

SHA is a non-profit cultural organization dedicated to the preservation of Slovenian culture, language, heritage and identity in Canada. Many Slovenians reside in the vicinity of the Pickering and Darlington nuclear plants and are concerned about the proposed plans to expand nuclear power generation within the region, particularly with OPG proposing novel reactor technology at the Darlington site. Much of these concerns stem from emergency planning for nuclear accidents.

SHA members are not aware of what to do in case of a nuclear alert from the Province of Ontario. Some questions posed to SHA by its members include: *Should they be prepared to evacuate or stay at home? Where is their closest evacuation center? How to protect themselves by staying at home?* Despite emergency planning being a heavy concern for its members, SHA not been made aware of any public information meetings where the details of the actions taken by the citizens, in case of a nuclear alert, were discussed. SHA would welcome an opportunity to distribute emergency preparedness instructions to its members and to organize and host a preparedness workshop on the topic of emergency preparedness.

iii. Canadian Environmental Law Association

CELA is a non-profit, public interest law organization. CELA is funded by Legal Aid Ontario as a speciality legal clinic to provide equitable access to justice to those otherwise unable to afford representation for environmental injustices. For nearly 50 years, CELA has used legal tools to advance the public interest, through advocacy and law reform, in order to increase environmental protection and safeguard communities across Canada.

CELA has been involved in number of nuclear facility licensing and regulatory matters before the CNSC including federal environmental assessments. CELA also maintains an extensive library of public legal education materials related to Canada's nuclear sector on its website.[3]

iv. Dr. M.V. Ramana

Expert review of this submission was provided by M. V. Ramana, Professor and Simons Chair in Disarmament, Global and Human Security at the School of Public Policy and Global Affairs (SPPGA), University of British Columbia. M. V. Ramana has extensive knowledge of small modular nuclear reactor designs and expertise in analyzing the multiple risks associated with these

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[3] Canadian Environmental Law Association, online: www.cela.ca

and accompanying adverse environmental effects. His research interests are in the broad areas of international security and energy supply, with a particular focus on topics related to nuclear energy and fissile materials that can be used to make nuclear weapons. He combines technical skills and interdisciplinary methods to address policy relevant questions related to security and energy issues.

III. BACKGROUND

A. Project Summary

When OPG entered the environmental assessment process to construct a new nuclear power plant at its Darlington site, there had not been a specific technology selected. In order to continue with the assessment at that time, a bounding approach was adopted, and a Plant Parameter Envelope (PPE)—a concept used in the United States—was implemented to consider various reactor designs in the assessment of environmental effects. This is the first and only nuclear project in Canada to rely on a PPE for a licencing application, and to the Intervenors' knowledge, is not being used in other jurisdictions when preparing nuclear power generation site licences.[4]

In the original licence application from 2009,[5] federal environmental assessment and the CNSC's deliberations at that time considered three water cooled designs: two pressurized (light) water reactor designs, and one pressurized heavy water reactor design.

In October 2020, OPG announced that "it is advancing engineering and design work with three grid-scale Small Modular Reactor (SMR) developers: GE Hitachi, Terrestrial Energy and X-Energy" for the Darlington nuclear site.[6]

In 2011, the Joint Review Panel overseeing the Environmental Assessment of the New Nuclear Power Plant Project released its Environmental Assessment Report. The first recommendation within the report stated:

> The Panel understands that prior to construction, the Canadian Nuclear Safety Commission will determine whether this environmental assessment is applicable to the reactor technology selected by the Government of Ontario for the Project. Nevertheless, <u>if the selected reactor technology is fundamentally different from the specific reactor</u>

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[4] The Intervenors submit that the nuclear licencing regime in the United States is more prescriptive than that of Canada. As a result, the use of a PPE within a Canadian nuclear project's licence application is supplanting from a different context, and therefore doesn't translate.

[5] *Use of Plant Parameters Envelope to Encompass the Reactor Designs Being Considering for the Darlington Site*, by Ontario Power Generation (2009).

[6] *Feasibility of Small Modular Reactor Development and Deployment in Canada.*, by SaskPower, Energie NB Power & Ontario Power Generation (2021), online (pdf): https://www.opg.com/documents/feasibility-of-smr-development-and-deployment-in-canada-pdf/, at 24.

> technologies bounded by the plant parameter envelope, the Panel recommends that a new environmental assessment be conducted [emphasis added].[7]

The PPE was designed to predict the adverse effects for a select group of reactor technologies.[8] To determine whether the selected reactor technology is "fundamentally different" from the specific reactor technologies bounded by the PPE, the Joint Review Panel explained that "the selection of a reactor technology that is not one of the four designs considered will require careful review to confirm the continued applicability of the assumptions and conclusions of this environmental assessment."[9]

Now that OPG has selected the GE BWRX-300 reactor technology for the proposed reactor at the Darlington site, this technology must be compared to the bounding parameters of the PPE and the findings within the EIS from 2009.

B. Scope of Review

For the purpose of determining whether the proposed BWRX-300 reactor technology fits within the parameters of the 2009 Environmental Impact Statement (EIS) and the Plant Parameter Envelope (PPE), the Intervenors reviewed a number of documents released by OPG and the CNSC, including, but not limited to:

- Project Description for the Site Preparation, Construction and Operation of the Darlington B Nuclear Generating Station Environmental Assessment (2007)
- The 2009 EIS;
- Use of Plant Parameters Envelope to Encompass the Reactor Designs Being Considered for the Darlington Site (2009);
- The Joint Review Panel's Environmental Assessment Report (2011);
- The BWRX-300 Preliminary Safety Assessment Report (2022);
- The EIS Review Report (2022)
- The Use of PPE to Encompass Reactor Designs being considered for the Darlington Site (2022);
- The Darlington New Nuclear Project Licence to Construct Application Plan (2022);
- Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300 (2022);
- The executive summary of the Canadian Nuclear Safety Commission's Combined phases 1 and 2 pre-licensing vendor design review for the BWRX-300.

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[7] *Joint Review Panel Environmental Assessment Report: Darlington New Nuclear Power Plant Project*, by Joint Review Panel, Environmental Assessment (2011), at iv, *emphasis added.* [**EA Report**].
[8] *Ibid*, at 45.
[9] *Ibid.*

In addition to these documents, the Intervenors considered federal and provincial legislation, various CNSC REGDOCs and CMDs, international nuclear standards documents, and academic studies regarding nuclear power and small modular reactors.

IV. PRELIMINARY MATTERS & PROCEDURAL CONCERNS

Transparency and disclosure of documents of critical value should be a priority in licencing stages

In many prior submissions to the CNSC for the Darlington site, the Intervenors have requested the CNSC direct the public release of studies and accident modelling.[10] We again bring this concern to the attention of the Commission in regard to the ongoing public non-disclosure to the public of the Provincial Nuclear Emergency Response Plan (PNERP) Technical Study from the Office of the Fire Marshall and Emergency Management (OFMEM).

While CELA has obtained a copy on request, CELA has repeatedly requested that the CNSC direct CNSC staff to obtain the PNERP Technical Study from the OFMEM and make it publicly available.[11] Presently, for members of the public to obtain a copy of the PNERP Technical Study, they must submit a request through the OFMEM website or contact the CNSC for a copy. There is no indication for how long it will take for either entity to respond such a request. Because the CNSC has been given permission by the OFMEM to share the Technical Study with anyone who requests it, the CNSC should make this report publicly available on the CNSC website.

The importance of this study to public health and safety cannot be underestimated. As the CNSC has previously stated, the PNERP Technical Study examines "the planning basis for the Pickering, Darlington, Bruce Power and Fermi 2 areas through robust modelling" and once released, "Ontario licensees plan to revise their training programs for new emergency response staff accordingly."[12] Previous correspondence from OFMEM has indicated that the impact on drinking water supply in the event of a nuclear accident was part of the technical study.[13] Now that OPG has selected a specific SMR technology to be situated at the Darlington site, it is crucial for the CNSC to consider

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[10] *See for instance:* DNA, *DNA Request for Ruling* (2015); DNA, *DNA Submission for the Application to Renew OPG's licence for the Darlington Nuclear Generating Station (CMD 15-H8.29)* (2015) at p 6 citing September 21, 2015 letter to Ms. Theresa McClenaghan, Canadian Environmental Law Association from CNSC Commission Secretary Marc Leblanc [**DNA 2015]**

[11] *See* Sara Libman, *Submission by the Canadian Environmental Law Association to the Canadian Nuclear Safety Commission Regarding the Regulatory Oversight Report for Canadian Nuclear Power Generating Sites: 2021* (CELA, 2022), Requested Action no. 5, online (pdf): https://cela.ca/wp-content/uploads/2022/09/1493-Submission-to-CNSC-ROR-NPGS-2022.pdf.

[12] CNSC, Transcript November 6, 2019, online (pdf): http://www.suretenucleaire.gc.ca/eng/the-commission/pdf/2019-11- 06-Meeting-Final-e.pdf (last visited May 2021), at p 137

[13] CNSC, Transcript November 8, 2018, online (pdf): http://www.nuclearsafety.gc.ca/eng/the-commission/pdf/2018-11- 08-Meeting-e.pdf (last visited May 2021).

how the choice of the BWRX-300 reactor design impacts the findings in the PNERP Technical Study related to drinking water supply, as the information about these technology was not available during the preparation of the PNERP Technical Study. The PNERP Technical Study provides a specific discussion surrounding the offsite dose consequence results for the Design Basis Accidents (DBA), Beyond Design Basis Accident (BDBA) and Severe BDBA scenarios modelled from the DNGS vacuum building.[14] How the BWRX-300 reactors would impact the original findings of offsite dose consequences for DBA, BDBA and Severe DBA from the Darlington site needs to be determined.

In prior licensing hearings, many public interest intervenors including DNA and CELA have sought clarification from the CNSC setting out the plans and arrangement made to protect drinking water supplies as required by the PNERP.[15] We remain of the view that as all of Ontario's nuclear reactors are located on the Great Lakes - which supplies the drinking water to 40 million Canadians and Americans - it is not only necessary to protect drinking water supplies, but require contingency planning in the event of an accident. With the PNERP Technical Study not being easily accessible for members of the public, there is no publicly available study of drinking water and contingency planning in the event of an accident. Without such a study, it is not possible to reliably evaluate new nuclear proposals.

In a similar vein, the Intervenors raise the issue of ease of access for reviewing documents related to the review of OPG's application of the EIS and PPE to the BWRX-300 reactors. When reading through the *Preliminary Safety Analysis Report*, there are references and pinpoints to documents that are not quickly available to read. In order to access these referenced documents, an individual needs to either reach out to OPG or the CNSC for access. While the Intervenors have been provided with participant funding to compensate for the time needed to review and comment on materials, a member of the public who simply wishes to submit a comment on the www.letstalknuclearsafety.ca website may not have the luxury of time to compile a list of documents they would like to read, contact either OPG or the CNSC and the wait to receive the documents to see if they are relevant for their comment. There is also no indication as to how long an information request would take to be fulfilled, and whether the documents will be shared at all; the Intervenors had requested a number of documents from OPG and the CNSC prior to the deadline to submit a written comment, and at the time of this report's submission, the request has not even been acknowledged. The Intervenors submit that this further diminishes the capacity for members of the public to meaningfully engage with the materials provided for these public commenting periods.

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[14] ENERCON, "Technical Study Report on the Provincial Nuclear Emergency Response Plan (PNERP)", Emergency Management Ontario, (March 7, 2019), at p. 41

[15] Ontario, "Provincial Nuclear Emergency Response Plan (PNERP), Master Plan" (2017), online (pdf): https://files.ontario.ca/books/solgen-emo-pnerp-master-plan-2017-en-2022-01-06.pdf, at ch 2.2.5(f).

To increase transparency, the Intervenors submit that OPG should be required to make all non-confidential documents readily available for public viewing, either via hyperlinks within documents, or through an archived database on their website. Information must be shared with the public in a timely manner.

Recommendation No. 1: As the PNERP Technical Study has been released by the province of Ontario to the CNSC, we request licensing documents be revised to directly respond to its findings.

Recommendation No. 2: Because the CNSC has been given permission by the OFMEM to share the PNERP Technical Study with anyone who requests it, the CNSC should make this report publicly available on the CNSC website.

Recommendation No. 3: The CNSC should review the PNERP Technical Study and as part of the review of the EIS and the PPE within the context of the proposed BWRX-300 reactor technology, demonstrate the sufficiency of contingency planning for the protection of drinking water, such as Lake Ontario, in the event of an emergency.

Recommendation No. 4: To increase transparency, the Intervenors submit that OPG should be required to make all non-confidential documents readily available for public viewing, either via hyperlinks within documents, or through an archived database on their website. Information must be shared with the public in a timely manner.

V. ACTION REQUESTED OF THE COMMISSION

The Intervenors submit OPG's proposed deployment of up to four GEH BWRX-300 small modular reactors (SMRs) for the Darlington New Nuclear Project (DNNP or Darlington site) does not fit within the parameters of the Environmental Impact Statement (EIS) or the Plant Parameter Envelope (PPE). The following shortfalls will be discussed in greater detail throughout this report:

A. The BWRX-300 reactor is 'fundamentally different' from the variety of technologies captured within the EIS and PPE approved under for the federal environmental assessment (EA) of this project;

B. OPG's two documents, *Use of Plant Parameters Envelope to Encompass the Reactor Designs being Considered for the Darlington Site* (*Use of PPE 2022*)[16] and *Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular*

[16] *Use of Plant Parameters Envelope to Encompass the Reactor Designs being Considered for the Darlington Site*, by Ontario Power Generation (October 2022), online: https://www.opg.com/powering-ontario/our-generation/nuclear/darlington-nuclear/darlington-new-nuclear/#documents [***Use of PPE 2022***]

Reactor BWRX-300 (*EIS Review Report*)[17], fail to adequately address the significant changes in our understanding of the likelihood, types, and consequences of nuclear accidents which have occurred since their 2009 licence application, EIS and EA and thus, these documents are no longer current nor validly reflect present circumstances or current knowledge.

We request that a new environmental assessment be conducted for the BWRX-300 reactor(s) due to the above reasons.

In the alternative that the CNSC deems the BWRX-300 reactor design to be consistent with the parameters of the PPE and EIS (which the Intervenors submit it is fundamentally different), we submit that a before a licence to construct (LTC) process commences, the aforementioned issues must be resolved in order to bring the selected reactor technology within the approved parameters of the EIS and PPE.

A. The BWRX-300 reactor is 'fundamentally different' from the variety of technologies captured within the EIS and PPE

This concern of the intervenors results from having reviewed the long list of documents mentioned above as well as other relevant and available supporting materials. We have also reviewed the 2009 Environmental Impact Statement (EIS), and the 2012 environmental assessment (EA) completed by a Joint Review Panel (JRP) under Canada's previous environmental assessment legislation, *Canadian Environmental Assessment Act*.[18]

A thorough review of these documents indicate that the selected technology, BWRX-300 reactor, is fundamentally different from various forms of technology previously considered to shape the EIS and the PPE for this project site. The proposed BWRX-300 reactor is significantly different from various forms of technology previously considered to shape the EIS and PPE for this Project site. Significant changes to the reactor design means that the applicability of the assumptions and conclusions developed in the PPE are not transferable to the BWRX-300 reactor technology. As a result of significant differences in the reactor design, waste management requirements, and unique safety concerns, which are discussed below, the BWRX-300 does not fit within the parameters of the PPE or EIS and thus warrants a new environmental assessment specific to the selected technology

[17] Ontario Power Generation, *Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300*, by Ontario Power Generation (October 2022), online: https://www.opg.com/powering-ontario/our-generation/nuclear/darlington-nuclear/darlington-new-nuclear/#documents [***EIS Review Report***]

[18] *Canadian Environmental Assessment Act*, SC 1992, c 37 [CEAA 1992]

i. Reactor Design

The Intervenors submit that the BWRX-300 reactor technology proposed by OPG is significantly different from the technologies considered by the existing PPE and the EIS.

Table 1 in the 2009 document *Use of Plant Parameters Envelope to Encompass the Reactor Designs Being Considered for the Darlington Site* includes a number of parameters, including 9.33, 9.3.4, 9.5.2, and 10.1.2, that deal with the potential events that could be of greatest environmental consequence: design basis and severe (beyond design basis) accidents.[19] These deal with the airborne and liquid releases of radioactivity to the environment during accidents. Calculation of these parameters would require a full consideration of all potential accidents, and these will be very different from the potential accidents to be considered in the case of AP1000, EPR, and ACR-100. This becomes clear when looking through the list of the emergency cooling systems of the four different reactor designs in *EIS Review Report*: the BWRX-300 is the only one that uses a Passive Isolation Condenser System (ICS).[20]

Unlike CANDU designs and the EPR that include some kind of an emergency core cooling system, whose reliability is well understood, there are significant uncertainties about passive safety systems like the ICS. In 2016, France's Institut de radioprotection et de sûreté nucléaire published an extensive report explaining why passive safety systems have unique challenges, for example with regard to "producing conclusive probabilistic safety assessments (PSAs), in particular due to the difficulty of assigning failure probabilities to passive safety systems under all conditions covered by PSAs, and the lack of operational feedback on the reliability of such systems under accident conditions".[21]

In the case of ICS, the system relies on "motor operated valves" that have to start operating "during transients, for instance, upon high reactor pressure or low reactor water level".[22] There are various other possible routes to the failure of the safety system, including due to causes like excessive fouling of pipes and insufficient water in the pool. Such failure modes simply do not exist in the case of the EPR design or various CANDU designs.

Further, in its pre-licensing vendor design review, the Canadian Nuclear Safety Commission (CNSC) listed a number of "technical areas that need further development in order for GEH to

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[19] Ontario Power Generation, "Use of Plant Parameters Envelope to Encompass the Reactor Designs Being Considered for the Darlington Site" (2009) at pp. 36-38.

[20] *EIS Review Report*, *supra* note 17, at 11.

[21] IRSN, *Considerations on the performance and reliability of passive safety systems for nuclear reactor*s, (2016), online: http://www.irsn.fr/EN/newsroom/News/Pages/20160107_Considerations-on-the-performance-and-reliability-of-passive-safety-systems-for-nuclear-reactors.aspx (last visited Feb 4, 2016), at 5.

[22] Burgazzi, Luciano, "Passive System Reliability Analysis: A Study on the Isolation Condenser" (2002) 139:1 Nuclear Technology 3–9, at 5.

better demonstrate adherence to CNSC requirements."[23] Specifically, the CNSC identified "severe accident analysis and the corresponding engineered features credited for mitigation" as needing further detail, and not demonstrably meeting "the requirement for 2 separate, independent and diverse means of reactor shutdown, or else an alternative approach, with justification".[24] Because these have not been demonstrated, and there is inadequate detail available about the BWRX-300 (more on this below), it is not clear how OPG could have carried out a safety assessment and come up with reliable numbers for parameters related to design basis and beyond design basis accidents.

So far, the BWRX-300 design has not been licensed by the Canadian Nuclear Safety Commission (CNSC) or any other nuclear safety regulatory authority. In the absence of regulatory approval, there is not even a minimal guarantee that this design will perform safely. Further, a separate concern is that GE-Hitachi might choose to revise the BWRX-300 design in the future. There is historical precedent for such a concern. The BWRX-300 is based on GE-Hitachi's Economical Simplified Boiling Water Reactor (ESBWR) design, which was submitted for licensing to the U.S. Nuclear Regulatory Commission in 2005.[25] That design was changed nine times; the NRC finally approved revision 10 from 2014.[26] Therefore, there is reason to be concerned that the BWRX-300 design might be revised.

All these factors give us reason to question the claim about the compatibility of the BWRX-300 with the other large reactors in *The Use of PPE to Encompass Reactor Designs being considered for the Darlington Site* document of 2022[27].

Recommendation No. 5: OPG should carry out a full-fledged severe accident analysis taking into account the challenges of estimating the reliability of the Passive Isolation Condenser System in order to show how the BWRX-300 design will adhere to CNSC requirements.

Recommendation No. 6: OPG must address how it intends to ensure the proposed reactors twill meet the requirement for 2 separate, independent and diverse means of reactor shutdown.

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[23] CNSC, "Executive Summary: Combined phases 1 and 2 pre-licensing vendor design review –General Electric Hitachi Nuclear Energy" (March 15, 2023), online: https://nuclearsafety.gc.ca/eng/reactors/power-plants/pre-licensing-vendor-design-review/geh-nuclear-energy-executive-summary.cfm

[24] *Ibid.*

[25] Office of Nuclear Reactor Regulation, "Acceptance of The General Electric Company Application for Final Design Approval and Standard Design Certification for The Economic Simplified Boiling Water Reactor (ESBWR) Design," United States Nuclear Regulatory Commission (December 1, 2005), online (pdf): https://www.nrc.gov/docs/ML0532/ML053200311.pdf.

[26] United States Nuclear Regulatory Commission, "GE-Hitachi Design Control Document Tier, Revision 10." nrc.gov (April 14, 2014), online: https://www.nrc.gov/docs/ML1410/ML14104A929.html

[27] *Use of PPE 2022, supra* note 16.

ii. Waste Management

Our understanding of the risks involving spent fuel and potential accidents involving such fuel has evolved significantly since the understanding captured in the 2009 PPE and EIS.

Since the 2011 Fukushima disaster, nuclear safety analysts have come to appreciate how risky it is to accumulate spent nuclear fuel from nuclear power plant operation and store it in a cooling pond at the reactor site. At Fukushima, spent fuel in the dense-packed pool of the Unit 4 reactor was in danger of overheating and caching fire. The radioactivity source term from such a potential fire was much greater than from just one of the reactors. Had this fire broken out and had the wind been blowing toward Tokyo, 35 million people might have required relocation.[28]

This understanding of the risks associated with dense packing of nuclear fuel is absent in the 2009 PPE and thus requires a more careful and fulsome analysis of the potential environmental and public health impact associated with any reactors built in Darlington. At the same time, the situation with any plans for permanent disposal of spent fuel remains the same as it was in 2009: there is still no geological repository operating in Canada, and thus there is no option but on-site storage of spent fuel and radioactive waste from nuclear power plants.

Recommendation No. 7: OPG should conduct a thorough assessment of the hazards associated with spent fuel fires at the Darlington nuclear power plant.

iii. Accidents and Malevolent Acts

Upon reviewing the *EIS Review Report* and the *Use of PPE 2022*, there is insufficient information to determine whether the BWRX-300 technology aligns with the parameters of safeguarding against malfunctions, accidents, and malevolent acts. With an absence of information regarding the BWRX-300 model's approach to mitigating accidents and malevolent acts, it is not possible to confirm that this proposed technology adheres to the conclusions within the PPE and the EIS regarding the significance of adverse environmental effects.

<u>Accidents</u>

While the *Preliminary Safety Analysis Report* indicates that a malevolent large aircraft crash is analyzed in the Security Annex, large civil aircraft accidents have been screened out due to the

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[28] Richard Stone, "Near Miss at Fukushima is a warning for U.S." (2016) 352:6289 Science 1039–1040, at 1039; Committee on Lessons Learned from the Fukushima Nuclear Accident for Improving Safety and Security of U.S. Nuclear Plants, *Lessons Learned from the Fukushima Nuclear Accident for Improving Safety and Security of U.S. Nuclear Plants: Phase 2* (2016), online: http://www.nap.edu/catalog/21874 (last visited May 28, 2016); Frank N von Hippel & Michael Schoeppner, "Reducing the Danger from Fires in Spent Fuel Pools" 24:3 Sci Glob Secur 141–173, at 141.

Quantitative criteria indicating a low frequency of events (frequency of <1.0E-7/yr).[29] The Intervenors submit that the low frequency of commercial aircraft accidents should not be a reason to screen out the risk, as the CNSC requires licensees to respect the precautionary principle.[30] This means that lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation.[31] The Intervenors submit that a low frequency of events does not eliminate the uncertainty of the hazard. The *Preliminary Safety Analysis Report* notes that the reactor building is designed to withstand large aircraft impact,[32] but it is unclear whether waste storage facilities are designed to withstand such an impact as well. The Intervenors request that OPG analyze the hazards associated with and impacts due to a commercial aircraft accident, no matter how unlikely such an accident might be deemed.

Multi-Unit Reactor Accidents

During the licence renewal hearing in 2021, the Intervenors recommended that the potential for and effects of a multi-unit reactor accident is among the detailed review which must be updated in light of SMRs being proposed for the Darlington site.[33] Engineers and other technical experts rely primarily on the use of multiple protective systems, all of which would have to fail before a radioactive release could occur. This approach is known as "defense-in-depth," and it is often advertised as an assurance of nuclear safety. However, as demonstrated by the 2011 accidents at the Fukushima Daiichi nuclear plant, there are occasions when multiple safety systems do fail at the same time - and these occur far more frequently than technical analysts seem to assume.[34] Indeed, one of the reactors that underwent an explosion at Fukushima was a 460MW reactor – a size not dissimilar to the proposed 300MW BWRX-300 reactor.

Fukushima revealed the dangers of building multiple reactors in a single location; accidents at one reactor increases the likelihood of accidents at nearby reactors, and therefore complicating emergency actions. The Intervenors maintain that it would be prudent to assume that a large release could well include early releases from several sources simultaneously.

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[29] *Ontario Power Generation Inc. Darlington New Nuclear Project: BWRX-300 Preliminary Safety Analysis Report*, by Ontario Power Generation, Revision 0 (2022), at 2-21. [**Preliminary Safety Analysis Report**]

[30] CNSC RegDoc-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures,* Version 1.2 at s 2.1.

[31] CNSC, *Glossary of CNSC Terminology,* REGDOC-3.6.

[32] *Preliminary Safety Analysis Report*, *supra* note 29 at 15-132.

[33] Kerrie Blaise & M.V. Ramana, "Comments on Ontario Power Generations Nuclear Power Reactor Site Preparation Licence for the Darlington Site", CELA (3 May 2021), online (pdf): https://cela.ca/cela-and-durham-nuclear-awareness-written-intervention-to-cnsc-for-opgs-site-licence-renewal-at-darlington/, at 11 [2021 Site Licence Renewal Submission]

[34] M. V. Ramana, "Beyond Our Imagination: Fukushima and the Problem of Assessing Risk" (19 April 2011), *Bulletin of the Atomic Scientists*, online: https://thebulletin.org/2011/04/beyond-our-imagination-fukushima-and-the-problem-of-assessing-risk/

While the *Preliminary Safety Analysis Report* provides a discussion of the defence-in-depth approach for the BWRX-300 reactors, it does not clarify how the Darlington Nuclear Generating Station (DNGS)—the existing CANDU reactors at the Darlington site—fit into the analysis. As mentioned within the *EIS Review Report*, the DNGS is currently being refurbished, and dismantling will not occur until approximately 2055.[35] With the timeline, the DNGS would still be in operations during the deployment of the BWRX-300 reactors. As a result of proximity, a nuclear accident at the DNGS would have an impact on the BWRX-300 reactors, and vice versa.

Therefore, emergency measures need to be accordingly modified and the size of zone that might have to be evacuated should be expanded. The concept of a multi-unit accident at the Darlington site extends beyond the four proposed BWRX-300 reactors because of the pre-existing nuclear power station at the Darlington site, and this must be reflected in OPG's emergency planning.

Malevolent Acts

The recent war in Ukraine emphasizes the risk that conflict and malevolent acts pose to nuclear power generating sites, as no nuclear power plant in the world has been designed to operate under wartime conditions.[36] While the likelihood of the Darlington site being subjected to militarized conflict is admittedly extremely low, that was the case with the Tsunami inundating the Fukushima Daiichi nuclear plant. The subsequent events showed a lack of preparedness for rare accidents. The lesson is that the threats of military activities and malevolent acts should not be ignored in the analysis of the BWRX-300 technology. Upon reviewing the *Preliminary Safety Analysis Report*, the Intervenors have identified a number of concerns with the mitigation of malevolent acts.

For instance, when screening site specific hazards, large military aircraft have been screened out on the grounds that because large bombers, large cargo planes, fuel tankers, or heavily armed jet fighters do not fly in the vicinity of the Bowmanville airspace, a large military aircraft accident cannot occur at or close enough to the site to affect BWRX-300.[37] The Intervenors submit that while it is highly unlikely that a large military aircraft would be within the airspace near the Darlington site, the possibility of the hazard impacts should not be omitted, especially now that we are living in an era in which military conflict is resulting in military occupation of nuclear power generation sites. The Intervenors request that that OPG revisit hazards of a large military aircraft accident in proximity to the BWRX-300 reactors.

In terms of assessing the hazards associated with drones, OPG notes that "the impact of drones hitting the BWRX-300 Structures Systems and Components (SSCs) is bounded by small aircraft

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[35] *EIS Review Report*, *supra* note 17 at 90.
[36] *The World Nuclear Industry Status Report*, by M Schneider & A Froggat, WNISR (October 2022), online (pdf): https://www.worldnuclearreport.org/IMG/pdf/wnisr2022-lr.pdf, at 27.
[37] *Preliminary Safety Analysis Report*, *supra* note 29 at 2-21.

crash,"[38] and refers to the United States Nuclear Regulatory Commission's review of impact of drones on U.S. Nuclear Power Plants, which states:

> The technical analysis concluded that U.S. nuclear power plants do not have any risk-significant vulnerabilities that could be exploited by adversaries using commercially available drones to result in radiological sabotage, theft, or diversion of special nuclear material (essentially the reactor fuel).[39]

Based on this analysis, OPG decided that drones are screened out of the external hazards assessment. Considering the wide variety drone types, the malevolent use of drones may extend beyond crashing into reactor's structures, and may involve drones that are not commercially available (i.e., military equipment). Therefore, it is important that OPG conducts a hazard assessment of malevolent drone use on SMRs like the BWRX-300 reactor model, even if the likelihood of such an event occurring is low.

Recommendation No. 8: The Intervenors submit that the low frequency of commercial aircraft accidents should not be a reason to screen out the risk. OPG must analyze the hazards associated with and impacts due to a commercial aircraft hitting the reactor building, or the waste management facilities, or any of other facilities and buildings located on the Darlington site.

Recommendation No. 9: The potential for and effects of a multi-unit accident must take into consideration the relationship between the existing reactors of the Darlington Nuclear Generating Station and the proposed BWRX-300 reactors.

Recommendation No. 10: OPG needs to revisit the hazard assessment of a large military aircraft accident in proximity to the BWRX-300 reactors.

Recommendation No. 11: OPG should conduct a hazard assessment of malevolent drone use on SMRs like the BWRX-300 reactor design, even if the likelihood of such an event occurring is low.

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[38] *Ibid* at 15-133.

[39] *Ibid*. Note: the technical analysis itself is classified, and so the details of this study are not available to the public in order to understand its applicability to SMRs like the BWRX-300 reactors. See: U.S.NRC, "Drones and Nuclear Power Plant Security" (4 November 2020), online: https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-drone-pwr-plant-security.html#analysis.

iv. Decommissioning Phase

The EIS Guidelines for the DNNP required that the EIS include a preliminary decommissioning plan, and that the EIS should specifically identify the following:

> The preferred decommissioning strategy, including a justification of why this is the preferred strategy. It must also include end-state objectives, the major decontamination, disassembly and remediation steps; the approximate quantities and types of waste generated; and an overview of the principal hazards and protection strategies envisioned for decommissioning.[40]

The decommissioning of a nuclear reactor is a complex process, involving the reactor's shut-down, deactivation, and its decontamination.[41] Without a specific technology being selected at the time the EIS was prepared, the discussion of decommissioning was broad and only offered a high-level overview of the potential decommissioning plans. With the selection of the BWRX-300 reactor technology, it was expected that OPG would provide more detail on the preferred decommissioning strategy however, the *EIS Review Report* does not provide such details on a more tailored decommission phase for the DNNP site.

In the *EIS Review Report*, OPG states "as the decommissioning strategy for the BWRX-300 has not been established, it is assumed that the overall approach and principles to be applied for decommissioning of the BWRX-300 reactors are consistent with those described in the EIS."[42]

OPG's claims that the BWRX-300 reactors' effects are anticipated to be similar as considered in the EIS.[43] Without a preliminary decommissioning plan for the BWRX-300 reactors available for review, the Intervenors submit that it is not possible to determine whether the decommissioning of these proposed reactors will actually fit within the parameters of the EIS. With the fundamentally different elements of reactor design and waste management requirements for the proposed BWRX-300 reactors, more information is required to understand the preferred decommissioning strategy for the selected technology.

For example, the BWRX-300 reactor requires a substantially deeper foundation than the reactors assessed in the EIS, as the BWRX-300 foundation embedment is 38m below grade compared to a

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[40] Ontario Power Generation, *Environmental Impact Statement: New Nuclear - Darlington Environmental Assessment*, by SENES Consultants Limited & MMM Group Limited (2009), at p. 12-1. [**2009 EIS**]

[41] Kerrie Blaise & Shawn-Patrick Stensil, "Chapter 9: The Evolution of Decommissioning Planning: Tracing the Requirements to Consider Radioactive Wastes and Social Risk of Nuclear Power Plants" in *Nucl Non-prolif Int Law* (ASSER PRESS, 2021), at 228.

[42] *EIS Review Report, supra* note 17, at 42.

[43] *Ibid.*

maximum of 13.5m[44] below grade for all of the reactors considered in the EIS. One of the concerns with decommissioning land-based SMRs is the decommissioning of underground elements, as "…decommissioning of underground designs may lead to increased magnitude and profile of effects to soil quality depending on the method of decommissioning (e.g. complete removal vs. decommissioning in situ)."[45] The *EIS Review Report* does not analyze how the greater foundation depth of 38m would impact the decommissioning a BWRX-300 reactor in comparison to the technologies previously considered within the EIS.

According to the *EIS Review Report*, "the phases of decommissioning described in the EIS are Preparation for Safe Storage, Safe Storage and Monitoring (if required), and Dismantling, Disposal, and Site Restoration."[46] Despite OPG having selected a type of reactor technology, the *EIS Review Report* falls silent on whether monitoring is a required phase of decommissioning for the BWRX-300 reactors. The Intervenors submit that without a decommissioning plan designed specifically for a BWRX-300 reactor, it is not possible to determine whether the technology selected by OPG is in compliance with the EIS. We request that the CNSC require OPG to outline a non-theoretical decommissioning plan for the BWRX-300 reactors before any further assessments occur for the DNNP site.

Recommendation No. 12: Without a decommissioning plan designed specifically for a BWRX-300 reactor, it is not possible to determine whether the technology selected by OPG is in compliance with the EIS. We request that the CNSC require OPG to outline a detailed and non-theoretical decommissioning plan for the BWRX-300 reactors before any further assessments occur for the DNNP site.

B. OPG's review of the EIS and PPE in the context of the BWRX-300 reactor fails to adequately address the significant changes which have occurred since 2009

The intervenors submit that the *Use of PPE 2022* and the *EIS Review Report* both fail to adequately address the many significant changes which have occurred since the 2009 licence application and EIS and the 2012 EA, such that these documents are no longer current and fail to reflect present circumstances. Over the course of the last decade, there has been significant changes across the province requiring a new analysis of how BWRX-300 reactors would interact with public awareness, land use planning and site suitability, emergency planning, and climate change.

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[44] *Ibid* at 10.

[45] International Atomic Energy Agency, "Considerations for Environmental Impact Assessment for Small Modular Reactors", IAEA-TECDOC-1915 (2020), at 14.

[46] *Ibid*.

i. Public Awareness

Since 2009, the population within the Greater Toronto Area has rapidly grown. The population growth rate from 2016 to 2021 for the distant suburb of Toronto (areas located 30 minutes or more from downtown Toronto) was +9.4%.[47] As the population and population density in the Greater Toronto Area continues to grow, including in population and density in close proximity to multiple nuclear facilities, public awareness is critical to effectively responding to accidents. However, most citizens in the Greater Toronto Area are not aware that they live within the Ingestion Planning Zone – extending 50km from nuclear facilities - of not one but two very large nuclear generating stations. Even fewer are aware that Durham Region is now slated to host Canada's first grid-scale SMRs. If an accident similar to the Fukushima disaster were to occur here – a serious multi-unit accident involving a large radiation release – evacuation will become necessary.

Despite the history of nuclear operations in Durham Region, most people do not know:

1. Who is responsible for nuclear emergency plans in Ontario/Durham Region? This became evident on January 12, 2020, when thousands of Ontarians were awoken by an alert from the Province of Ontario indicating that an incident was reported at the Pickering nuclear power plant. Following the alert, the public was unsure who to look to for authoritative messaging. Indeed, there was a dizzying number of government departments and agencies involved.

   As an independent review by Global Public Affairs found,[48] most CNSC staff explained that the January 12 incident tested the CNSC because there was no existing communications protocol for non-nuclear emergencies and that no previous training or exercise had focused on what to do in the event of a false alert.[49] Further, while staff agreed that the false alarm event served as an important learning opportunity, serious concerns were raised regarding staff resources, noting that CNSC would be hard-pressed to fully staff a 24/7 emergency communications group for a sustained period.[50]

2. What information sources should citizens rely on should an emergency occur? Related, if the emergency coincides with a power outage (whether induced or pre-existing due to weather, for instance) how confident is the CNSC that citizens will promptly be informed of necessary, potentially lifesaving information?

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[47] Statistics Canada, "Map 1: Urban spread is continuing in the census metropolitan area of Toronto while its downtown is growing more rapidly before"(9 February 2022), online: https://www150.statcan.gc.ca/n1/daily-quotidien/220209/mc-b001-eng.htm.

[48] *Global Public Affairs Independent Review of the Canadian Nuclear Safety Commission's Response to the January 12, 2020 Pickering False Alarm and CNSC Management Response*, by CNSC, CMD 20-M11, online (pdf): https://www.nuclearsafety.gc.ca/eng/the-commission/meetings/cmd/pdf/CMD20/CMD20-M11-A.pdf.

[49] *Ibid*, at 12.

[50] *Ibid,* at 20.

3. What does sheltering-in-place mean? Which homes are more suitable for sheltering in place? Most are not familiar with the concept of sheltering in place let alone aware that the International Atomic Energy Agency (IAEA) and according to guidelines from the International Commission for Radiological Protection (ICRP), many North American homes are not suitable for "sheltering."

4. How do citizens re-unite with their family members? Who is responsible for making an evacuation plan and where are evacuation centres located? Do schools, colleges, day care centres, senior homes and hospitals have evacuation plans in place?

5. What to do citizens do if they do not own a vehicle or are incapable of driving them due to age or ill health?

DNA and CELA had previously posed these questions to the CNSC in their 2021 licencing renewal submissions to convey the fact that until answers to these questions becomes public knowledge, there is not the requisite level of public awareness regarding emergency response to proceed with licensing the Darlington site for new nuclear. We submit that these public preparedness issues remain a concern in the community. Despite laudable public pronouncements from the IAEA, ICRP and the CNSC about the need for clear communications to the public about emergencies ahead of time, most citizens are completely unprepared.[51] The materials provided by OPG relating to the selection of the BWRX-300 technology do not provide particulars on improving public awareness about emergency preparedness. DNA, SHA and CELA submit that these questions are very relevant to the discussion of BWRX-300 reactors proposed for the Darlington site, as public awareness is essential to effective emergency planning in the event of a severe accident at one or more of the proposed reactors. The Intervenors further submit that emergency preparedness instructions must be assessed in light of the types of accidents and releases that this particular technology may have.

Recommendation No. 13: As a condition of siting new nuclear, the CNSC should require ongoing public education and clear communication about emergency preparedness and protective actions.

Recommendation No. 14: Emergency preparedness instructions must be assessed in light of the types of accidents and releases that the BWRX-300 reactor technology may have.

ii. Land Use Planning & Site Suitability

The assessment of site suitability for new nuclear power is an important and distinct decision stage which requires thorough review of the potential impacts of operations and accidents on the surrounding environment and population. Since 2009, the Greater Toronto Area has seen

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[51] *DNA 2015*, *supra* note 10, at 9.

substantial growth in total population, population density, while also seeing a substantial change in how the Province of Ontario is using the Greenbelt in response to this growth in population. These contemporary changes have a significant role in assessing site suitability at the Darlington site for up to four SMRs. The CNSC must apply its jurisdiction and expert judgment to the question of suitability of a site in relation to OPG's selection of the BWRX-300 reactor technology.

The *Nuclear Safety and Control Act* (NSCA) requires the CNSC to limit risk to Canadian Society.[52] As seen with past nuclear accidents, such as Fukushima, societal disruption is a key effect of nuclear accidents. It is apparent that the siting of nuclear power stations in highly populated areas increases the potential societal disruption in the event of accident. Therefore, the CNSC has a clear responsibility under the NSCA to assess the potential for a site to exacerbate social disruption in the event of a nuclear accident. When re-evaluating site suitability upon the disclosure of new information, such as the selection of the BWRX-300 reactor technology, changes and developments in land use surrounding the project site must be assessed.

The JRP's *Joint Review Panel Environmental Assessment Report* (EA Report) provides the Panel's recommendations for the DNNP resulting from the 2011 Environmental Assessment process. Based on this Report, land use planning within Durham Region is central to issue of constructing and operating new nuclear plants at the Darlington site. For instance, Recommendation #43 recommended that the CNSC "…engage appropriate stakeholders, including OPG, Emergency Management Ontario, municipal governments and the Government of Ontario to develop a policy for land use around nuclear generating stations"; and Recommendation #59 recommended that "the Municipality of Clarington manage development within the vicinity of the Project site to ensure there is no deterioration in the capacity to evacuate members of the public for the protection of human health and safety."[53]

The *EA Report* was released twelve years ago, and in the time that has passed since the JRP provided these recommendations related to land use and development changes in the region encompassing the DNNP site, there has been considerable growth and development occurring across Durham Region and the rest of the Greater Toronto Area.

DNA and CELA have previously expressed concerns to the CNSC that the continued urbanization and population growth surrounding the Darlington site makes it increasingly unsuitable for the continued operation of a nuclear station.[54] These concerns extend to the proposed construction of

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[52] *Nuclear Safety and Control Act*, SC 1997, c 9. **[NSCA]**
[53] *EA Report, supra* note 7, at 105 and 127.
[54] See for instance: *Blaise & Ramana*, *supra* note 33.
The issue of land use planning and population density has long been a concern with responsible nuclear plant planning. *See*: Kenneth Pearlman & Nancy Waite, "Controlling Land Use and Population Growth Near Nuclear Power Plants" (1984) 27:1/3 Wash U J Urb Contemp L., online (pdf): https://journals.library.wustl.edu/urbanlaw/article/7941/galley/24774/view/.

up to four BWRX-300 reactors at the Darlington site, and it is essential that the CNSC consider population growth projections in line with the project lifespan of the four reactors proposed by OPG, which are projected to operate during the span of 2029-2095.[55]

According to the *EIS Review Report*, OPG has been actively monitoring land use within 10 km of the DNNP site since 2011, including the review of planning and development applications. OPG noted that new development is occurring within urban areas (Oshawa, Courtice, Bowmanville, and Newcastle), and that "this pattern of growth and development is consistent with the latest provincial plans, which, representing the most noteworthy changes in land use at a policy level, seek to focus urban growth within existing urban areas, while maintaining limited development within the Greenbelt and Oak Ridges Moraine."[56]

OPG's determination that growth within the region is maintaining limited development within the Greenbelt and Oak Ridges Moraine is not accurate to the rapidly changing development landscape within Ontario. On December 8, 2022, *Bill 39, Better Municipal Governance Act, 2022* reached Royal Assent. Schedule 2 of this act repeals the *Duffins Rouge Agricultural Preserve Act*, *2005.*[57] Through repealing this Act, the Greenbelt becomes more fragmented, and is opened up to development within Durham Region.[58]

The Intervenors submit that due to the rapidly changing Greenbelt landscape in the region encompassing the DNNP site, the population growth within the region may not align with the projections of the Ontario's Growth Plans. The Intervenors request that the CNSC require OPG to address how planned and unplanned density growth within Durham Region is considered for emergency planning for the DNNP site.

Intervenors further submit that the *EIS Review Report* fails to go into sufficient detail about how construction, operation, and decommission phases of the proposed technology would comply with Ontario's Growth Plans and Ontario's Provincial Policy Statement (PPS). The CNSC has a responsibility to determine whether the siting of BWRX-300 reactors remains appropriate in light of the external factors of population growth and density, as these factors have a direct correlation with the requirement to properly protect the public in an accident.[59] The CNSC's obligation to

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[55] *EA Report*, *supra* note 7, at 18.
[56] *Ibid,* at 36-37.
[57] Legislative Assembly of Ontario, *Better Municipal Governance Act, 2022*, 39.
[58] Theresa McClenaghan & Zoe St Pierre, "Submission on Bill 39, Repeal of the Duffins Rouge Agricultural Preserve Act" (30 November 2022) online: https://cela.ca/submission-on-bill-39-repeal-of-the-duffins-rouge-agricultural-preserve-act/
[59] *For example,* Paragraph 3(1.1)(b) of the *General Nuclear Safety and Control Regulations* states the CNSC may require any other information that is necessary to enable it to determine whether the applicant will make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

protect the health and safety of the public is highly relevant with OPG proposed a new technology for the Darlington site that is not already utilized at the site.

The Intervenors request that the CNSC confirm whether CNSC staff have reviewed the PPS to ensure land use compatibility in the vicinity of major facilities, which includes energy generation facilities. The intervenors submit specific regard should be given to population density and growth around nuclear generating stations and impacts of new and additional nuclear on the implementation of emergency measures and existing plans. The Intervenors submit that the smaller physical footprint and energy output of four BWRX-300 reactors (in comparison to the models considered in the EIS and PPE) does not exclude this technology from being re-assessed from a site suitability perspective.

Recommendation No. 15: The CNSC must exercise its jurisdiction and fulfill the federal constitutional jurisdiction over nuclear site approval. Any siting decision must ensure the protection of the public and environment for the intended lifespan of the new nuclear development. This decision must also account for changes in land use, population density, climate and environmental factors. No amount of subsequent regulatory action short of license termination can adequately protect the public if an unsuitable site is selected.

Recommendation No. 16: With recent legislative changes in Ontario opening up sections of the Greenbelt to development, the CNSC should require OPG to address how unplanned density growth within Durham Region is considered for emergency planning for the DNNP site.

Recommendation No. 17: The CNSC should direct CNSC staff to review the current and planned provincial land use directions under the *Places to Grow Act* and other indications of provincial intent to continue increasing density in this area; to ensure land use compatibility in the vicinity of major facilities, which includes energy generation facilities. Specific regard should be given to population density and growth around nuclear generating stations and impacts of new and additional nuclear on the implementation of emergency measures.

iii. Emergency Planning

Land use planning and site suitability are interconnected with appropriate emergency preparedness when the CNSC is fulfilling its obligations to limit harm to Canadian society. The JRP's *EA Report* emphasized the important role of emergency planning in recommendation #46, which states:

> Given that <u>a severe accident may have consequences beyond the three and 10-kilometre zones evaluated by OPG</u>, the Panel recommends that the Government of Ontario, on an ongoing basis, review the emergency planning zones and the emergency preparedness and

> response measures, as defined in the Provincial Nuclear Emergency Response Plan (PNERP), to protect human health and safety [Emphasis added].[60]

Despite the JRP noting that a severe accident may have consequences beyond the three and 10 km zones evaluated by OPG, to date, OPG has only been monitoring the land use in the 10 km surrounding the Darlington site.[61] The Intervenors submit that this narrow scope of land use monitoring is inadequate for evaluating the appropriate emergency preparedness plans for the BWRX-300 reactors.

Since the EIS was prepared and the EA was concluded, there has been substantial growth in Ontario, which means that mere compliance with the emergency preparedness at the time of the EIS's drafting is insufficient to reflect the health and safety concerns of the present and future population in the Greater Toronto Area.

According to the *Preliminary Safety Analysis Report*, the revised Darlington Evacuation Time Estimate, which OPG has made available to off-site planning authorities, relies on the 2016 National Census Data with per-decade population projections out to 2088, as well as current and forecasted infrastructure.[62] Additionally, OPG noted in this report that "in the first quarter of 2023, OPG will issue an updated Darlington Site Evacuation Time Estimate based on 2021 national census data and will subsequently be shared with stakeholders."[63] The Intervenors submit that this information should have been made available to the stakeholders prior to the submission deadline for commenting on the *EIS Review Report* and *Use of PPE 2022*. With the proposed BWRX-300 reactors projected to be in operations in 2095, having updated population projections are essential in determining whether OPG is preparing adequate emergency plans and accurate Site Evacuation Time Estimates.

The Intervenors submit that before a determination can be made as to whether the BWRX-300 reactor fits within the parameters of the EIS and PPE, the updated Darlington Site Evacuation Time Estimate and emergency planning models based on the 2021 Census data must be made available.

The population growth that has occurred in the region since the EA requires a modernized, robust emergency planning approach for the BWRX-300 reactors proposed for the DNNP site. The Fukushima Daiichi nuclear plant accident in 2011 serves as sombre reminder that a lack of emergency preparedness for a large scale accident will increase the severity of tragedy surrounding such events. With the Fukushima disaster, there were areas as far away as 50 km from the site had

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[60] *EA Report*, *supra* note 7, at 106, *emphasis added.*

[61] *EIS Review Report, supra* note 17, at 36-37.

[62] *Preliminary Safety Analysis Report, supra* note 29, at 2-172.

[63] *Ibid.*

to be evacuated due to high radiation levels, despite the initial evacuation limit of a 20 km radius mandated in the evacuation orders.[64]

In the original EIS, OPG discussed the Evacuation time estimate for the Emergency Planning Zone around the Darlington site. OPG noted that "this zone includes two evacuation regions of 3-km and 10-km radii from the DN site, each of which is further divided into Protective Zones."[65] As the aftermath of Fukushima revealed, planning to evacuate people based on concentric circles ranging from a radii of 5-30km is too rigid and inadequate for protecting the public during a serious nuclear disaster.[66] The Intervenors submit that OPG must provide more information on how emergency planning for BWRX-300 deployment will encompass a larger range of the population in the event of a severe nuclear incident.

During the 2021 licencing renewal application hearing for the Darlington site, DNA and CELA submitted that that section 15 of the proposed Licence Conditions Handbook, which currently lists a series of site specific environmental conditions, be amended to include documentation showing how OPG will ensure that it controls the use and occupation of land within 20 km of the site to maintain safety margins for the fifth level of defence in depth by preventing the intensification and development of residential dwellings. This includes conformance to revised Growth Plans and Ontario's PPS. This action is in furtherance of the Government of Ontario's establishment of a 20 km Contingency Zone in its 2017 PNERP to address the potential of a severe accident.

The Intervenors submit that OPG must ensure that it controls the use and occupation of land within 20 km of the site to maintain safety margins for the fifth level of defence in depth by preventing the intensification and development of residential dwellings to comply with the establishment of a 20 km Contingency Zone in accordance with PNERP.

Another key element within emergency planning is being prepared for the worst possible outcome. One of the factors which contributed to the Fukushima disaster were the shortcomings in safety culture. According to the International Atomic Energy Agency (IAEA):

> A major factor that contributed to the accident was the widespread assumption in Japan that its nuclear power plants were so safe that an accident of this magnitude was simply unthinkable. This assumption was accepted by nuclear power plant operators and was not

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[64] *Lessons from Fukushima*, by Greenpeace (February 2012), online (pdf): https://www.greenpeace.org/usa/research/lessons-from-fukushima/, at 18 [**Greenpeace**].

[65] *2009 EIS, supra* note 40, at 7-48.

[66] *Greenpeace, supra* note 64, at 15.

> challenged by regulators or by the Government. As a result, Japan was not sufficiently prepared for a severe nuclear accident in March 2011.[67]

With this assumption that the plant could cope with anything, whether it be a technology issue or environmental event, there was a lack of regard for an extremely rare event—i.e., a 9.0 magnitude earthquake and tsunami would impact the plant on such a large scale. Both the EIS and the *EIS Review Report* appear to be silent on the impacts of multiple events simultaneously impacting the Darlington site, e.g., an extreme weather event occurring during a nuclear event at the operating CANDU units at the Darlington Nuclear Generating Station. With OPG determining within the *EIS Review Report* that "no residual adverse effects are anticipated from any malfunctions and accidents related to BWRX-300 deployment,"[68] the Intervenors are concerned that the lessons from Fukushima remain unlearned and worst-case scenarios are not being considered for emergency planning. The Intervenors submit that the CNSC and OPG must ensure that the authorities in charge of emergency planning are sufficiently prepared for a severe nuclear accident.

Recommendation No. 18: Before a determination can be made as to whether the BWRX-300 reactor fits within the parameters of the EIS and PPE, the updated Darlington Site Evacuation Time Estimate and emergency planning models based on the 2021 Census data must be made available.

Recommendation No. 19: OPG must provide more information on how emergency planning for BWRX-300 deployment will encompass a larger range of the population in the event of a severe nuclear incident.

Recommendation No. 20: OPG must ensure that it controls the use and occupation of land within 20 km of the site to maintain safety margins for the fifth level of defence in depth by preventing the intensification and development of residential dwellings to comply with the establishment of a 20 km Contingency Zone in accordance with PNERP.

Recommendation No. 21: The CNSC and OPG must ensure that emergency planning authorities are sufficiently prepared for a severe nuclear accident.

iv. Climate Change

In the *EIS Review Report*, OPG concludes that BWRX-300 deployment does not change the original EIS's determination that there are no medium or high risk interactions between the climate change parameters and the Project due to mitigations incorporated in the Project design.[69] Since

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[67] Laura Gil, "Fukushima Daiichi: The Accident", (IAEA) *A Decade of Progress after Fukushima Daiichi: Building on the lessons learned to further strengthen nuclear safety*, (March 2021), online (pdf): https://www.iaea.org/sites/default/files/bulletindecadeafterfukushima.pdf, at 15.

[68] *EIS Review Report, supra* note 17, at 87.

[69] *EIS Review Report, supra* note 17, at 82.

the EIS was prepared, there has been much more information surrounding the impacts of climate change.

The frequency of extreme-weather events in the last decade increases the likelihood of direct and indirect effects on nuclear facilities, and one of the risks posed is a facility shutting down due to a lack of cooling capacity.[70] With rising temperatures, an increase in water temperatures pose a two-fold risk for nuclear cooling capacity: insufficient temperature for cooling purposes, and increase in algal blooms. With the BWRX-300 reactor's design using once through lake water cooling, the qualities of the water cooling the reactor are crucial. Water being drawn for cooling purposes needs to be a suitable temperature to fulfill its cooling duties inside the reactor, and algae can create blockages at water intake pipes and thus prevent adequate water supply to the reactor for cooling purposes. Without sufficient cooling, a reactor's "fuel can overheat, become damaged, and eventually melt, releasing highly radioactive materials into the environment."[71]

The dangers of climate change are already being observed at Ontario nuclear power generating sites: the weighing down of the fish diversion barrier in Lake Ontario by the Pickering nuclear power plant was attributed to algae loading and the rapid water temperature changes related to lake conditions.[72] This also was the explanation provided for increased fish impingement during a recent CNSC's regulatory oversight review for nuclear power plants.[73] Significant amounts of algae have also clogged cooling water intakes causing Pickering's reactors to go temporarily offline.[74] One concern with the impacts of climate change relevant to SMRs is increasing water temperatures, as the BWRX-300 would depend on Lake Ontario's water for cooling the reactor.

The *Preliminary Safety Analysis Report* briefly touches upon lake water temperature, and refers to the use of statistical summary of ambient water temperatures near Darlington Nuclear for date ranges of 1984-1996, 2011 and 2012.[75] The Intervenors submit that this data is outdated, and that data on ambient water temperature needs to updated in a timely fashion in order to understand temperature trends for a long term range. A detailed climate analysis needs relevant data, and

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[70] Ali Ahmad, Andrei Covatariu & MV Ramana, "A stormy future? Financial impact of climate change-related disruptions on nuclear power plant owners" (2023) 81:101484 Util Policy April 2023., at 3.

[71] *"Advanced" isn't always better: Assessing the Safety, Security, and Environmental Impacts of Non-Light Water Nuclear Reactors*, by Edwin Lyman (Union of Concerned Scientists), March 2021, at 24.

[72] Algal blooms causing reactor shutdowns is not a recent phenomenon in Ontario, with both Pickering and Darlington sites being shut down by algal blooms, which has cost millions of dollars in lost power generation caused by shut downs, as reported back in 2007. *See:* Tyler Hamilton, "Algae prompt reactor shutdown", *Tor Star,* (10 August 2007), online: https://www.thestar.com/business/2007/08/10/algae_prompt_reactor_shutdown.html

[73] Kerrie Blaise, *Submission by the Canadian Environmental Law Association to the Canadian Nuclear Safety Commission Regarding the Regulatory Oversight Report for Canadian Nuclear Power Generating Sites: 2019* (CELA, 2020), online (pdf): https://cela.ca/wp-content/uploads/2020/12/CELA-to-CNSC-ROR-NPGS-with-Appendices.pdf

[74] *Ibid.*

[75] *Preliminary Safety Analysis Report, supra* note 29, at 2-59.

without it, it cannot be determined as to whether the BWRX-300 reactors will be able to operate sufficiently if Lake Ontario's ambient temperature is substantially higher in the future. The Intervenors request that OPG provide updated information on ambient water temperature trends for Lake Ontario and compare that with the allowed range of inlet temperatures for the BWRX-300 reactor design.

With algae already being an issue at the Pickering nuclear plant, it is an important risk to evaluate the resultant risks to the proposed nuclear plant too. The *Preliminary Safety Analysis Report*, acknowledges that substantial clumps of algae have the potential to cause blockages or restriction issues at water supply system intakes.[76] In terms of managing algae, OPG notes that "…the Pumphouse/forebay structure is designed to prevent clogging by algae and exceptional quantities of fish and to stop them from entering the cooling systems."[77] It is unclear however, whether the effectiveness of the intake tunnel and lakebed intake structure, and travelling water screens take into account increased volume of algal blooms associated with an increase in lake water temperature. Additionally, OPG's materials do not explain what would be the consequences if these mechanisms fail and algae entering the water supply system intake. The Intervenors request additional studies be conducted on the impacts of an increase in algal blooms due to climate change impacts on Lake Ontario. The modelling for managing aquatic species' interactions with water intake equipment needs to be adapted for the worst case-scenario due to climate change.

Recommendation No. 22: OPG should provide updated information on ambient water temperature trends for Lake Ontario and compare that with the allowed range of inlet temperatures for the BWRX-300 reactor design.

Recommendation No. 23: Additional studies should be conducted on the impacts of an increase in algal blooms due to climate change impacts on Lake Ontario. The modelling for managing aquatic species' interactions with water intake equipment needs to be adapted for the worst case-scenario due to climate change.

VI. CONCLUSION

For the foregoing reasons provided in this report, DNA, SHA, and CELA submit:

(1) The BWRX-300 reactor technology is fundamentally different from the bounding parameters within the Environmental Impact Statement and the Plant Parameters Envelope for the Darlington New Nuclear Project, and therefore a new environmental assessment specific to the BWRX-300 technology is required.

[76] *Ibid* at 2-49.
[77] *Ibid* at 3-77.

(2) In the alternative, before moving on from this pre-licencing stage to commence the licence to construct process, OPG must produce a substantial amount of information and updated data which was missing in order to complete an assessment of the bounding parameters for the selected technology. Any new resources produced by OPG should be subjected to a public review and commenting process.

Sincerely,

On behalf of

CANADIAN ENVIRONMENTAL LAW ASSOCIATION
DURHAM NUCLEAR AWARENESS
SLOVENIAN HOMEOWNERS ASSOCIATION

Sara Libman

Sara Libman
Legal Counsel

APPENDIX A - SUMMARY OF RECOMMENDATIONS

Recommendation No. 1: As the PNERP Technical Study has been released by the province of Ontario to the CNSC, we request licensing documents be revised to directly respond to its findings.

Recommendation No. 2: Because the CNSC has been given permission by the OFMEM to share the PNERP Technical Study with anyone who requests it, the CNSC should make this report publicly available on the CNSC website.

Recommendation No. 3: The CNSC should review the PNERP Technical Study and as part of the review of the EIS and the PPE within the context of the proposed BWRX-300 reactor technology, demonstrate the sufficiency of contingency planning for the protection of drinking water, such as Lake Ontario, in the event of an emergency.

Recommendation No. 4: To increase transparency, the Intervenors submit that OPG should be required to make all non-confidential documents readily available for public viewing, either via hyperlinks within documents, or through an archived database on their website. Information must be shared with the public in a timely manner.

Recommendation No. 5: OPG should carry out a full-fledged severe accident analysis taking into account the challenges of estimating the reliability of the Passive Isolation Condenser System in order to show how the BWRX-300 design will adhere to CNSC requirements.

Recommendation No. 6: OPG must address how it intends to ensure the proposed reactors twill meet the requirement for 2 separate, independent and diverse means of reactor shutdown.

Recommendation No. 7: OPG should conduct a thorough assessment of the hazards associated with spent fuel fires at the Darlington nuclear power plant.

Recommendation No. 8: The Intervenors submit that the low frequency of commercial aircraft accidents should not be a reason to screen out the risk. OPG must analyze the hazards associated with and impacts due to a commercial aircraft hitting the reactor building, or the waste management facilities, or any of other facilities and buildings located on the Darlington site.

Recommendation No. 9: The potential for and effects of a multi-unit accident must take into consideration the relationship between the existing reactors of the Darlington Nuclear Generating Station and the proposed BWRX-300 reactors.

Recommendation No. 10: OPG needs to revisit the hazard assessment of a large military aircraft accident in proximity to the BWRX-300 reactors.

Recommendation No. 11: OPG should conduct a hazard assessment of malevolent drone use on SMRs like the BWRX-300 reactor design, even if the likelihood of such an event occurring is low.

Recommendation No. 12: Without a decommissioning plan designed specifically for a BWRX-300 reactor, it is not possible to determine whether the technology selected by OPG is in compliance with the EIS. We request that the CNSC require OPG to outline a detailed and non-theoretical decommissioning plan for the BWRX-300 reactors before any further assessments occur for the DNNP site.

Recommendation No. 13: As a condition of siting new nuclear, the CNSC should require ongoing public education and clear communication about emergency preparedness and protective actions.

Recommendation No. 14: Emergency preparedness instructions must be assessed in light of the types of accidents and releases that the BWRX-300 reactor technology may have.

Recommendation No. 15: The CNSC must exercise its jurisdiction and fulfill the federal constitutional jurisdiction over nuclear site approval. Any siting decision must ensure the protection of the public and environment for the intended lifespan of the new nuclear development. This decision must also account for changes in land use, population density, climate and environmental factors. No amount of subsequent regulatory action short of license termination can adequately protect the public if an unsuitable site is selected.

Recommendation No. 16: With recent legislative changes in Ontario opening up sections of the Greenbelt to development, the CNSC should require OPG to address how unplanned density growth within Durham Region is considered for emergency planning for the DNNP site.

Recommendation No. 17: The CNSC should direct CNSC staff to review the current and planned provincial land use directions under the *Places to Grow Act* and other indications of provincial intent to continue increasing density in this area; to ensure land use compatibility in the vicinity of major facilities, which includes energy generation facilities. Specific regard should be given to population density and growth around nuclear generating stations and impacts of new and additional nuclear on the implementation of emergency measures.

Recommendation No. 18: Before a determination can be made as to whether the BWRX-300 reactor fits within the parameters of the EIS and PPE, the updated Darlington Site Evacuation Time Estimate and emergency planning models based on the 2021 Census data must be made available.

Recommendation No. 19: OPG must provide more information on how emergency planning for BWRX-300 deployment will encompass a larger range of the population in the event of a severe nuclear incident.

Recommendation No. 20: OPG must ensure that it controls the use and occupation of land within 20 km of the site to maintain safety margins for the fifth level of defence in depth by preventing the intensification and development of residential dwellings to comply with the establishment of a 20 km Contingency Zone in accordance with PNERP.

Recommendation No. 21: The CNSC and OPG must ensure that emergency planning authorities are sufficiently prepared for a severe nuclear accident.

Recommendation No. 22: OPG should provide updated information on ambient water temperature trends for Lake Ontario and compare that with the allowed range of inlet temperatures for the BWRX-300 reactor design.

Recommendation No. 23: Additional studies should be conducted on the impacts of an increase in algal blooms due to climate change impacts on Lake Ontario. The modelling for managing aquatic species' interactions with water intake equipment needs to be adapted for the worst case-scenario due to climate change.

March 20, 2023

Caroline Ducros (PhD)
Director General
Directorate of Advanced Reactor Technologies (DART)
Canadian Nuclear Safety Commission
613-862-9017

Delivered by Email (dnnp-npnd@cnsc-ccsn.gc.ca)

Dear Dr. Ducros,

RE: Hiawatha FN's partial review of Ontario Power Generation's Updated Plant Parameter Envelope and Environmental Impact Statement Review reports

On behalf of our Consultation Department at Hiawatha First Nation (HFN), we are writing to submit to you Hiawatha FN's **partial** review of Ontario Power Generation's Updated Plant Parameter Envelope and Environmental Impact Statement Review reports. Hiawatha FN has accepted the review and recommendations from 4 Directions of Conservation Consulting Services. Please refer to details in Appendix A for details. That said, there are other thoughts that have not yet been documented and therefore cannot be shared in time for the deadline of March 20, 2023.

Hiawatha FN's Core Consultation and Land Resource Development office was established to address the Crown's (Federal and Provincial Governments) "Duty to Consult." This is in response to the Supreme Court of Canada decision relating to the Crown's "Duty to Consult" aboriginal communities regarding proposed land development when their treaty and traditional lands are impacted.

Our mandate is to engage with governments and private sector proponents on land and resource matters that may affect the Treaty and inherent rights of our First Nation. Hiawatha First Nation's traditional territory has been affected by numerous and various developments, which have impacted our traditional territory, way of life, and sustainability of Hiawatha. Our traditional ways are derived from the land. Hiawatha is not opposed to development. We would like to be reassured that wildlife, habitat, air, and water tributaries would be adequately protected from contamination for 7 generations without upsetting the balanced eco-system/relationship we have with our Mother Shka-ki-mi-kwe (Mother Earth).

Our values grow from the culture from which we are born into and live with and our beliefs and attitudes emerge from our values. As Mississaugi people from the Mississauga Nation, we try to live a healthy way of life "Mino Bimaadiziwin" through the teachings passed down from ancestors. These teachings include Seven Grandfathers teaching that was given to us by the Creator. This story has been passed down many generations. These foundational teachings include; wisdom, love, respect, bravery, honesty, humility, and truth.

All of the above combined create a balance of spiritual, emotional, physical and mental being. They are the cornerstones of our belief system and the formula for maintaining the delicate balance between Shka-ki-mi-kwe (Mother Earth) and all her inhabitants. We have a strong connection to Shka-ki-mi-kwe and only use what is necessary from her. We believe that all things are connected and are taught that if we look after our Mother she will look after us. With all decisions made we always consider the effects our choices will make on the next seven generations just as our ancestors have done for us. We often turn to our Elders who hold great knowledge of Shka-ki-mi-kwe that no one else possesses. Their knowledge is held in their hearts and minds to be passed by oral tradition for the next generations.

We thank the CNSC for providing participant funding; it has helped in our ability to conduct these reviews and will help in participating at the upcoming virtual meeting on April 4.

Sincerely,

Sean Davison
Lands & Resource Consultation
Consultation and Land Resource Development Office
Hiawatha First Nation

Francis Chua
Support to Hiawatha First Nation

cc:
Chief Laurie Carr, Hiawatha First Nation
Trisha Shearer, Director of Operations, Hiawatha First Nation
Mandy McGonigle, Archaeology, Hiawatha First Nation
Gary Pritchard, CEO & Indigenous Conservation Ecologist, 4 Directions of Conservation Consulting Services

Appendix A:

4 Directions of Conservation Consulting Services review of Ontario Power Generation's Updated Plant Parameter Envelope and Environmental Impact Statement Review reports

431 Hiawatha Line, Hiawatha, ON K9J 0E6 • Telephone (705) 295-4421 • Fax (705) 295-7177

March 17, 2023

Attn: **Consultation Department**
Hiawatha First Nation
431 Hiawatha Line
Hiawatha, ON. K9J 0E6
P: (705) 295-4421

RE: Darlington New Nuclear Project Environmental Impact Statement Review Report for SMR BWRX-300 Review

4 Directions File No: 23-033

4 Directions of Conservation Consulting Services (4 Directions) is pleased to present our review and recommendations regarding documents prepared by Calian Group Ltd. These documents were presented to Hiawatha First Nation (HFN) from Ontario Power Group (OPG) under their Duty to Consult and Accommodate. 4 Directions' review of the report, *Darlington New Nuclear Project Environmental Impact Statement Review Report for SMR BWRX-300 Review,* is broken down into two main sections. Relevant statements, questions, and concerns are identified in the following document under their respective headings:

- Concerns Regarding Michi Saagiig Inherent and Treaty Rights
- Concerns Regarding the Environment

Although it should be noted that 4 Directions acknowledges that the two above-mentioned topics are inextricably linked, the review has been organized under these section headings for clarity purposes. After these sections, 4 Directions provides a brief summary of identified recommendations for OPG, followed by closing remarks.

Background

OPG's report, titled *Darlington New Nuclear Project Environmental Impact Statement Review Report for SMR BWRX-300 Review* was reviewed under the provided context:

"The DNNP, is a proposed new nuclear power plant on the north shore of Lake Ontario in the Municipality of Clarington, within the Regional Municipality of Durham. More precisely, the DNNP is located on the existing Darlington Nuclear (DN) site of Ontario Power Generation (OPG), about 70 km east of Toronto.

The DNNP was subject to an environmental assessment (EA) under the Canadian Environmental Assessment Act (CEAA). The scope for the assessment included the site preparation, construction, operation, and decommissioning of up to four new nuclear power reactors to produce up to 4,800 megawatts of electrical generating capacity.

When the EIS was conducted in 2006 to 2009, no specific reactor technology was selected, rather, the EIS considered a Plant Parameter Envelope (PPE) that encompasses limiting design parameters from the reactor technologies under consideration for the DNNP at that time, as the basis for the EA. It was identified that the PPE may need to be modified when the specific reactor technology is selected.

For the DNNP, a federal joint review panel (JRP) conducted a review of the EA and considered the licence application to prepare the site for the Project. The JRP concluded that "the Project is not likely to cause significant adverse environmental effects, provided the mitigation measures proposed and commitments made by OPG during the review, and the JRP's recommendations are implemented." In May 2012, the Government of Canada (GOC) accepted the JRP's conclusions for the DNNP as well as the JRP's recommendations, in accordance with the GOC response, for the DNNP. Following that, the Canadian Nuclear Safety Commission (CNSC) issued a 10-year Power Reactor Site Preparation Licence (PRSL 18.00/2022) for the DNNP. The JRP's recommendations that the GOC assigned to OPG and commitments that OPG made during the EA process were consolidated in the Darlington New Nuclear Project Commitment Report NK054-REP-01210-00078-R007 [1].

Following OPG's application to renew the PRSL in 2020, the CNSC renewed the PRSL for another 10 years in 2021. For this licence renewal application, OPG had not initiated any licensed activities nor had OPG selected a reactor technology for DNNP, and the Project scope remained unchanged from that assessed in 2012. CNSC staff confirmed during the PRSL renewal public hearing that the EA accepted by the JRP and the GOC is still valid. There is no expiry on an EA decision as long as the scope of that project remains within the scope of the original EA. One of the commitments listed in the DNNP Commitment report is D-P-12.1(a) - Comprehensive Environmental Impact Statement Review stated that "Once the specific technology is selected and design information is available, OPG will comprehensively review the EIS to ensure that the results of the EIS remain valid. If this review indicates either a gap or a condition not bounded by the EIS, OPG will initiate corrective actions as necessary. This may include mitigation options."

In December 2021, OPG selected the BWRX-300 for deployment at the DNNP site. OPG has been working with the vendor, GE Hitachi Nuclear Energy (GEH), to progress the design of the BWRX-300 and develop the required documents to support a Licence to Construct (LTC) Application. To fulfill the above commitment, OPG has conducted an EIS Review for the selected BWRX-300 which is the purpose of this EIS Review document.

As the EIS used the PPE as the basis for the environmental assessment, the commitment on PPE as listed in D-C-3.1 Preliminary Safety Analysis and Design [1] as stated below also needs to be considered in the EIS review: "After the Licence to Prepare Site is issued the vendor will demonstrate to OPG's satisfaction that the design of the facility fits within the values used in the Plant Parameter Envelope. If the Nuclear Facility is not bounded by the Plant Parameter Envelope, the Envelope will be updated and appropriate assessment of the impacts will be undertaken or the design modified, as required."

The GEH BWRX-300 reactor is a SMR using boiling water reactor (BWR) technology. The electrical power output for each reactor is about 300 MWe and its design life is 60 years. The BWRX-300 is a smaller reactor when compared to those evaluated for the PPE in the 2009 EIS as well as with the currently operating reactors at the DN site, both in electrical production and in physical size. BWR technology was considered during the development of the PPE for the EIS; however, insufficient information was submitted by the vendor in time for inclusion in developing the PPE. The JRP indicated in its EA report that "should the Government of Ontario decide to include boiling water-type reactors in its procurement process, the plant parameter envelope would be updated accordingly."

(Executive Summary, DNNP EIS Review Report for SMR BWRX-300).

1.0 Concerns Regarding Michi Saagiig Rights

1.1.1.1 Statement

The proposed project is situated within the Gunshot Treaty. Given this, Michi Saagiig Inherent and Treaty Rights, including harvesting rights and sovereignty over water-related matters, must be upheld throughout all project works (Curve Lake First Nation, 2013; Chiefs of Ontario, 2008).

1.1.1.2 Question

Why is there no mention of the Gunshot Treaty within the land acknowledgment and in the report? How are Michi Saagiig Inherent and Treaty Rights upheld throughout the provided report?

1.1.1.3 Recommendation

The Gunshot Treaty should be included in the report and Michi Saagiig Inherent and Treaty Rights incorporated throughout the report and in the project.

2.0 Concerns Regarding the Environment

2.1 Cultural Keystone Species

2.1.1.1 Statement

There is no mention of the Cultural Keystone Species of the Michi Saagiig in any description of the biotic communities mentioned in the document. Cultural Keystone Species are protected under the Michi Saagig Treaty Rights. Any species considered a cultural keystone species is therefore protected under the Williams Treaty. Additionally, any alterations to the habitat that elicit negative effects on these species is infringing upon the Michi Saagiig Treaty Rights.

2.1.1.2 Question

Why were Cultural Keystone Species of the Michi Saagiig not included or mentioned within the document?

2.1.1.3 Recommendation

Observations of Cultural Keystone Species should be included in the EIS and subsequent monitoring to ensure that these species and their habitats are protected. Support in this action can be provided through continued consultation and engagement with First Nations communities.

2.2 Other Environmental Concerns

2.2.1 Quotation

"The EIS identified the Deepwater Sculpin, Lake Sturgeon, Atlantic Salmon, and American Eel as fish species at risk. Since the EIS concluded that the nearshore area does not contain critical habitat for any of these species, (EIS p. 4-45) and significant interactions with the existing DNGS have not been detected in monitoring studies to date (although entrainment of some Deepwater Sculpin has recently been identified), there is no further concern for these species."

Page 43

2.2.1.1 Statement

The species listed in this quote include Cultural Keystone Species to the Michi Saagiig

2.2.1.2 Recommendation

While the EIS does not identify a risk to these species, they should be prioritized in any monitoring of the aquatic community to ensure that there is no adverse effect on any Culturally Significant species in this community.

2.2.2 Quotation

"*The assessment of changes to the hydrology was completed [17], and it determined there will be negligible hydrological change to the wetlands and ponds. For noise and dust, the studies are being completed. If the evaluation shows adverse effects on aquatic receptors, OPG will implement mitigation measures to ensure that there are no significant residual adverse environmental effects.*"

Page 44

2.2.2.1 Statement

Wetlands are incredibly important to Michi Saagiig culture and way of life and are protected by Treaty Rights. Any impacts to a wetland as part of this project are an infringement on these constitutionally protected rights. Furthermore, under the 2008 Water Declaration: "First Nations in Ontario have our own territories that includes the waters, which include the rain waters, waterfalls, rivers, streams, creeks, lakes, mountain springs, swamp springs, bedrock water veins, snow, oceans, icebergs, and the seas". The Michi Saagiig have rights and responsibilities to these wetlands and ponds on their territory.

2.2.2.2 Recommendation

Proponents should provide more clarity on the negligible changes expected to occur in wetlands and ponds and demonstrate how they will continue to monitor wetlands and ponds to ensure they are protected during and after the project.

2.2.3 Quotation

"*These interactions include removal of bat habitat as well as potential interactions between the Project and bat species and bat habitats that may be retained on the DNNP site*."

Page 44

2.2.3.1 Statement

As indicated in the EIS, four bat species identified on the DNNP site are listed as endangered (Little Brown Myotis, Northern Myotis, Eastern Small-footed Myotis, and Tri-colored Bat). It is important that these species and their habitat are protected from any adverse effects related to this project.

2.2.3.2 Recommendation

4 Directions has written a response to the Darlington New Nuclear Project AAF and CPAF on behalf of Curve Lake First Nation that speaks to the need for monitoring the effect of dust and noise on the bat populations and the invertebrate community, specifically aerial insectivore prey for bats. The suggestions given in that document related to monitoring should be incorporated into this project.

2.2.4 Quotation

"The assessment of changes to the hydrology was completed [17], and it determined there will be negligible hydrological change to amphibian and reptile habitat."

Page 45

2.2.4.1 Statement

Many amphibians and reptiles are Culturally Significant species and are protected under Michi Saagiig treaty rights. The Michi Saagiig also have rights and responsibilities to the wetland and ponds on their territory.

2.2.4.2 Recommendation

The proponents need to clarify how they will be monitoring amphibian and reptile communities and habitat to ensure this project does not infringe on Michi Saagiig Inherent and Treaty rights. Wetland community surveys should be done prior to, and after construction to ensure the protection of wetland habitat and any Cultural Keystone Species making use of this habitat

2.2.5 Quotation

"However, periodic and short-term disruption to wildlife travel along the east-west wildlife corridor are expected during the Site Preparation and Construction phase of the Project."

Page 45

2.2.5.1 Statement

Many Culturally significant species could be using this corridor and disruptions to their movement patterns can be disruptive to their overall health. This work may also affect harvesting and hunting in the area, particularly if it disrupts wildlife movement.

2.2.5.2 Questions

Have the proponents considered how this distruption may infringe on Michi Saagiig inherent and treaty rights?

Has there been considerations for how workers will interact with any Michi Saagiig they may encounter practicing these rights during the project?

2.2.5.3 Recommendation

The proponents should clarify the process they are taking to reduce disruption and other associated harm to wildlife (e.g vehicle mortality). Proponents should clarify how this work will not infringe on Michi Saagiig Inherent and Treaty Rights.

2.2.6 Quotation

"The net loss of approximately 24 to 34 ha of on-site habitat currently used as butterfly stopover area migration."

Page 55

2.2.6.1 Statement

There is no mention of Monarch butterflies (*Danaus plexippus*) in this area, do they use this habitat? Monarch butterflies are listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC. 2021). There is also no mention of milkweed (*Asclepias spp*.), a species critical in the monarch lifecycle. Have surveys for milkweed been carried out? Does OPG have a plan in place to restore lost habitat or lost milkweed plants which are essential components in the monarch life cycle?

2.2.6.2 Recommendation

Proponents should clarify how they will monitor the area, including an assessment of milkweed plants, especially in areas that will be affected by project activities. Proponents should also specify how they will restore this habitat and work with HFN to develop this restoration protocol.

2.2.7 Quotation

"Decrease in populations of breeding birds on the DN Site. Migrant songbirds and their habitat, winter raptor feeding and roosting"

Table 6, Page 56

2.2.7.1 Statement

Many birds, especially raptors, are Culturally Significant species to the Michi Saagiig. The full effects of this habitat loss should be known, specificially which birds might be affected and how, and a plan to restore habitat should be in place.

2.2.7.2 Recommendation

The proponents should clarify how they will monitor the bird communities, including the identification of any Cultural Keystone Species, that may be affected by project activities. Proponents should also specify how they will restore this habitat after the project and work with HFN to develop these restoration plans.

Summary of Recommendations

- The Gunshot Treaty should be included in the report and Michi Saagiig Inherent and Treaty Rights incorporated throughout the report and in the project.
- Cultural Keystone Species should be included in all environment assessments and monitoring aspects of this project.
- Proponents should provide more clarity on the negligible changes expected to occur in wetlands and ponds and demonstrate how they will continue to monitor wetlands and ponds to ensure they are protected during and after the project.
- The proponents need to clarify how they will be monitoring amphibian and reptile communities and habitat to ensure this project does not infringe on Michi Saagiig Inherent and Treaty rights. Wetland community surveys should be done prior to, and after construction to ensure the protection of wetland habitat and any Cultural Keystone Species making use of this habitat.
- The proponents should clarify the process they are taking to reduce disruption and other associated harm to wildlife (e.g vehicle mortality). Proponents should clarify how this work will not infringe on Michi Saagiig Inherent and Treaty Rights.
- Proponents should clarify how they will monitor butterfly habitat, including an assessment of milkweed plants, especially in areas that will be affected by project activities. Proponents should also specify how they will restore this habitat and work with HFN to develop this restoration protocol.
- Incorporate the Recommendations from the 4 Directions response to the DNNP AAR and CPAF related to bat and invertebrate monitoring into future monitoring related to this project.
- The proponents should clarify how they will monitor the bird communities, including the identification of any Cultural Keystone Species, that may be affected by project activities. Proponents should also specify how they will restore this habitat after the project and work with HFN to develop these restoration plans.

Closing Remarks

4 Directions staff are generally satisfied with the information provided within the DNNP EIS Review Report for SMR BWRX-300. As noted in the summary of recommendations, 4 Directions encourages OPG to provide further clarity regarding how Indigenous Inherent and Treaty rights are upheld throughout the construction of the SMR and the post-construction monitoring for this project.

We trust that this information aids in your engagement process and the next steps forward. If you have any questions, please do not hesitate to contact us.

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Comment Submission: OPG's Darlington New Nuclear Project (DNNP)

Updated Plant Parameter Envelope Report & Environmental Impact Statement Review Report

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To the attention of:

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Re: OPG's DNNP Updated Plant Parameter Envelope Report and Environmental Impact Statement Review Report

Thank you for the opportunity to comment on the Updated Plant Parameter Envelope (PPE) Report and Environmental Impact Statement (EIS) Review Report for the Darlington New Nuclear Project. Comments and questions on behalf of the Mississaugas of Scugog Island First Nation (MSIFN) are below, with detailed comments on each report found on subsequent pages.

Table 1. Comments on the Updated Plant Parameter Envelope (PPE) Report

Page	Reference Text	Comment/Question
5	*"Where the BWRX-300 fell outside Revision 3 of the PPE, the design was either adjusted until it fit within the PPE, or where it could be demonstrated that the PPE value can be adjusted without introduction of unreasonable risk to the public, environment, or workers, the PPE is being revised to Revision 5 to document a new bounding envelope in these areas [R-13] [R-15]."*	• What PPE values were adjusted? Adjusting the parameters is contradictory to the intent of designing the PPE based on reactor designs considered. The BWRX-300 design did not fit within the values used in the PPE or it would not have to be adjusted.
6	*"GE-Hitachi chose not to participate in the RFP process"*	• If GE-Hitachi chose not to participate in the RFP process and the bounding limits for the PPE were designed for the ACR-1000, EPR, and AP-1000, how can the PPE properly capture the values for the BWRX-300 (made by GE-Hitachi) if they were not part of the RFP process?
6	*"The PPE was then sent to the vendors to confirm that their design(s) was (were) bounded by it. Verification was received from AECL [R-2] and Areva [R-3]."*	• Did OPG not receive verification that BWRX-300 design is bounded by the PPE?

Page	Reference Text	Comment/Question
6	*"Between 2019 and 2021 OPG worked through a technology selection and due diligence process and in December 2021 selected the BWRX-300 as the technology to be deployed at the DNNP site"*	• Why did the due diligence process result in the selection of the BWRX-300 if that specific technology wasn't studied in the design of the PPE?
67	*"The PPE incorporates values from the BWRX-300 technology selected by OPG"*	• Does it incorporate all values from the BWRX-300? If not, what values are outstanding?
7 (Apdx. A)	*Appendix A: OPG's Plant Parameters Envelope Development Approach*	• The BWRX-300 wasn't incorporated into the design of the PPE until the revisions at the very end of the process. This seems contradictory to the purpose of designing a PPE specific for the technology that is selected to be used.
6	*"In December 2021 selected the BWRX-300 as the technology to be deployed at the DNNP site"*	• When did GE Hitachi decide to participate in the process? How long did they participate in the PPE development prior to being selected as the technology to be deployed at the DNNP site?
13	*"Revision 3 of the PPE, the distinction between VDS and RCS parameters is no longer highlighted"*	• It is important for the distinctions to be made between the Vendor Design Specific (VDS) parameters and the Reactor Class Specific parameters because the vendor that was chosen did not participate in the design of the PPE and therefore, those parameters that are VDS would not apply? • While it is understood that the values of the composite PPE are presumed to capture the values of the BWRX-300 design, it would be prudent to demonstrate a comparison between the designs that were used to create the PPE and the design technology that was chosen. Where does the BWRX-300 differ?
Table 1	*Table 1 does not include parameters that relate to design features that are no longer of interest to OPG*	• What made these parameters no longer important or of interest to OPG?
15	*"Four units of the following reactor designs could be built at the Darlington site: the AP-1000, the ACR-1000 and the EC6."*	• Why is the BWRX-300 not included in this list? How many of the BWRX reactors can be built at the Darlington site?

Page	Reference Text	Comment/Question
143	*"The BWRX-300 uses a deeply embedded reactor building 38 meters below DNNP plant grade".*	• P.62 speaks to the site water level, measuring the maximum flood and maximum ground water. If the BWRX is below grade 38 metres, how will these parameters change? • P. 61 speaks to earthquakes and the ground acceleration for which the plant is designed. The BWRX was not included in the list of limiting reactors. How will the BWRX design be compromised given that it is deeper below grade than the other reactors?
143	*"A distinct feature of this reactor design is that water is circulated within the core by natural circulation."*	• It is our understanding that water interacts with the radioactive bundles in the BWRX-300 design. Has the PPE considered the effects on humans and the environment if the radioactive water interacts with the environment? It is our understanding that the interaction of water with the nuclear bundles is fairly unique to this design.

Table 2. Comments on the Environmental Impact Statement (EIS) Review Report

Page	Reference Text	Comment/Question
4	*"There is no expiry on an EA decision as long as the scope of that project remains within the scope of the original EA."*	• It is understood that the DNNP Project is subject to the Ontario Environmental Assessment Act, which typically has an expiry date for most projects. Please explain why there is no expiry date on the EA decision for DNNP, as well as how OPG justifies the project remaining within the original scope from 2011. The natural environment on the DNNP site as well as the surrounding land use has changed significantly over the last decade and must be taken into consideration.
7	*"OPG recognizes that while the assessment of environmental effects from DNNP has been satisfied from the Western scientific perspective, it may not fully address the impact of the DNNP on Indigenous inherent and treaty rights as they are understood today. OPG endeavors to continue to work with Indigenous nations and communities having a historical relationship with the site to appropriately identify the impacts of the Project on them and to achieve feasible mitigation measures and/or accommodation."*	• It should be noted that MSIFN submitted comments to OPG and the ERO regarding OPG's Endangered Species Act (ESA) Permit for the DNNP project site preparation. MSIFN raised concerns regarding the lack of guarantee for long-term protection of the SAR habitat on site. MSIFN requested that a conservation easement or restrictive covenant be placed on the created SAR habitat to ensure it is not destroyed during further site prep for reactors 2-4. MSIFN also suggested an off-site ecological restoration fund as an alternative, but OPG was unwilling to accommodate either request. • MSIFN considers these requests to be feasible, therefore it is not fair to say that "OPG endeavors to achieve feasible mitigation measures and/or accommodation".
16	*"More specifically, the PPE was developed based on the limiting parameters for four different types of reactors that were considered at that time, and it was identified that the PPE may need to be modified when the specific reactor technology was selected."*	• Please explain the reasoning behind creating the PPE before selecting a specific reactor technology. This does not seem like the best method to ensuring the chosen reactor is environmentally and physically compatible with the DNNP site. Why did OPG take this selection approach?
20	*"Nevertheless, if the selected reactor technology is fundamentally different from the specific reactor technologies bounded by the Plant Parameter Envelope, the Panel recommends that a new environmental assessment be conducted."*	• As mentioned, the selected BWRXT reactor was not one of the reactors considered in the original EIS or PPE. Although OPG states that the BWRXT reactor is not fundamentally different than those previously considered, MSIFN is aware that this will be North America's first SMR. Does this not justify a new EA to ensure the technology fully conforms with the current environmental conditions and parameters?

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Page	Reference Text	Comment/Question
21	*"The GOC response therefore directed the CNSC (as a Responsible Authority) to determine if the selected technology is "fundamentally different" than the technologies specified in the EIS and if a new EA is required for the selected technology."*	• To clarify, the Government of Canada delegated this determination to the CNSC? What dictates what is "fundamentally different" between SMR technologies, and how did the CNSC come to this decision?
23	*"Up to 5%. Light (normal) water is used as coolant and moderator."*	• How much water is used in this process, and is it lake water? What happens to the water once it has been used as a coolant/moderator?
31	*"Construction of Intake and Discharge Structures (e.g., offshore submerged intake and discharge structures for the once-through lake water cooling)"*	• We would like more information about the construction of the intake and discharge structures offshore, including their size and location in Lake Ontario as well as anticipated environmental effects/mitigations.
31	*"Marine and Shoreline Works (e.g., shoreline protection and some minor lake bottom dredging)"*	• MSIFN was under the impression that limited shoreline work would be required under the new PPE/EIS due to the smaller footprint of the project. Please elaborate on details of the dredging so that we can better assess impacts to the environment.
32	*"Dismantling, demolition, and site restoration (removal of all contaminated SSCs and restoration of the site to be available for other OPG uses)"*	• Please explain what "other OPG uses" could be for the DNNP site. The site is on the shores of Lake Ontario with multiple natural heritage features and includes a wildlife corridor running through it. Should end-of-life plans not include restoring the site to as it was before, i.e. significant ecological lands with SAR habitat?
33	*"In the BWRX-300 the heated reactor coolant turns directly into steam."*	• In past discussions with OPG/CNSC staff regarding the BWRXT technology, we were told there is no "spent water" and that the process occurs in a continuous loop. Can this concept be further elaborated on? Does the process not generate wastewater?
38	*"The BWRX-300 reactor has a footprint of 19 ha. The site area for one reactor will be prepared for construction at the outset of the Project, with the additional preparation of the whole site undertaken if the deployment of four reactors proceeds."*	• Later site preparation activities are likely to destroy the newly created SAR habitat on site as the remaining reactors are constructed and the Project footprint grows. Please explain how OPG plans to maintain protection of the natural features created to satisfy their ESA permit as the project proceeds.

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Page	Reference Text	Comment/Question
39	*"The water intake and the discharge pipes will be sized for four reactors. The BWRX-300 deployment will utilize either typical underground mining techniques involving blasting and excavation or by boring using a purpose-built tunnel boring machine and/or other modern construction techniques."*	• What are the environmental risks and mitigation measures of blasting and excavation vs. boring via tunnel machine. Which is less impactful to the environment? MSIFN requests to be kept updated on the construction of the intake and discharge pipes offshore.
39	*"The BWRX-300 deployment will not expand the DNGS switchyard (Bowmanville Switching Station) as described in the EIS but will establish a new one, adjacent to the reactor buildings."*	• Why was the decision made to create a new switchyard instead of the original plans to expand the previously existing DNGS switchyard? Does this increase the project footprint?
42	*"A decommissioning strategy for BWRX-300 has not been established. A deferred dismantling strategy has been assumed."*	• It is disappointing that OPG has not created a decommissioning plan or even a preliminary strategy for the BWRXT reactors/DNNP site. OPG's own website states "It is imperative that Preliminary Decommissioning Plans (PDP) are put into place for OPG's generating facilities." • It is irresponsible to begin a project of this size without a decommissioning strategy, this is a requirement for most major projects on Crown land. Please provide MSIFN with the decommissioning strategy for the BWRXT-300 as soon as it becomes available. It is recommended that a strategy be implemented before any further site-prep is conducted.
42	*"The delay in commencement of the DNNP of several years does not, on its own, have an adverse effect on the environment. However, over time some environmental conditions at the DNNP site have changed.*	• As stated in the EIS report, commencement of the project is occurring approximately 12 years later than the original date. What was the cause of such a significant delay? • In terms of environmental conditions on site, it should be noted that the project delay also allowed significant ecological lands and SAR habitat to thrive and grow, which now must be destroyed.
45	*"The solid waste volumetric activity (Bq/m3) generated by the operation of the BWRX-300 is higher than what was assessed in the EIS"*	• It is concerning that the solid waste anticipated to be generated by the BWRXT technology is even higher than initially reported in the EIS. There is still no long-term plan for the safe management and storage of nuclear waste in Ontario, and MSIFN must live with the risk of temporarily storing this excess waste in their Treaty Territory, at the

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		DWMF, without ever providing their consent. This should be considered before construction of the remaining reactors.
49	*"Since the completion of the EIS, two fish species, Lake Sturgeon and American Eel have become listed provincially as endangered under Ontario's Endangered Species Act (ESA)."*	• Will OPG be creating any beneficial actions or offsetting as they are likely to impact these two SAR species? Will DFO Authorizations be required?
49	*"Bank Swallow - Despite the average change between years for the survey area being relatively minor, there has been a notable decreasing trend (-30%) in the burrow counts since the inception of the program."*	• Is OPG not planning to impact the bank where the remaining swallows live as part of site prep? Given that bank swallow burrow counts have already been decreasing on site, is OPG able to relocate the SAR habitat or create habitat elsewhere for the species?
57	*"The EIS identified the Deepwater Sculpin, Lake Sturgeon, Atlantic Salmon and American Eel as fish species at risk. Since the EIS concluded that the nearshore area does not contain critical habitat for any of these species, and significant interactions with the existing DNGS have not been detected in monitoring studies to date (although entrainment of some Deepwater Sculpin has recently been identified), there is no further concern for these species. Nevertheless, fish protection measures will be taken if needed at the intake structure, especially for Deepwater Sculpin, so as to have no significant effects."*	• Please explain how there is no further concern for the fish species if entrainment of Deepwater Sculpin has been identified recently on site? What does OPG mean by "fish protection measures will be taken if needed at the intake structures"? MSIFN requests that fish protection measures be taken at the intake structures regardless of prevalence of SAR or other factors.
59	*"The construction of the first BWRX-300 would provide an opportunity to retain the Bank Swallow nesting habitat along the Lake Ontario shoreline as the bluff would be remaining in place.* *If the DNNP site is built out to include additional BWRX-300 reactors, additional shoreline protection would be implemented to stabilize the shoreline, and the result would likely be that this would make the nesting habitat unsuitable for Bank Swallows to inhabit."*	• See previous comment re. Bank Swallow. • The plan is for 4 reactors to be constructed on site, and various site preparations are being undertaken that fit this scope (i.e. water intake structures are being built to handle 4 reactors). Why does the EIS suggest that this may not happen, and that the SAR habitat may be retained? It seems highly unlikely that the bank swallow habitat will remain if the project proceeds as planned.

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Page	Reference Text	Comment/Question
59	*"Regarding the disruption of landscape connectivity affecting wildlife travelling along the east- west corridor, the DN site annual biodiversity monitoring since 1997 has led to the observation that wildlife are present and have been around for a long period, despite the roads and other disturbances on site. However, periodic and short-term disruption to wildlife travel along the east-west wildlife corridor are expected during the Site Preparation and Construction phase of the Project. This is consistent with the assessment in the EIS."*	• It is unreasonable to conclude that because the east-west wildlife corridor has survived past fragmentation that wildlife will still be present during/after DNNP project construction. Cumulative effects of multiple activities on site over a long period of time could permanently impact the corridor disrupting connectivity and the surrounding ecosystem. • OPG should look into retaining part of the site for the wildlife corridor, and keeping some of it fenced off to allow migration throughout the site preparation and construction period.
60	*"A comparison of emissions from the BWRX-300 reactor and the reactors assessed in the EIS, found that tritium, carbon-14, particulates, and noble gases emissions from the BWRX-300 are less than these emissions for the reactors assessed in the EIS. In contrast, the emissions of iodine are higher for the BWRX-300 than the values assumed in the EIS."*	• MSIFN notes that Iodine emissions from the BWRX-300 will be higher than anticipated in the EIS. Please explain the impacts of higher levels of radioactive iodine emissions in the atmosphere to humans and the environment.
62	*"This is particularly true in light of the Williams Treaties First Nations (WTFN) 2018 settlement agreement with the Governments of Canada and Ontario. While OPG is not privy to the contents of the settlement agreement, OPG recognizes the importance of furthering our knowledge and understanding, in ongoing meaningful engagement with the WTFN. OPG will continue to work with Indigenous Nations and communities to appropriately identify the rights impacted by the Project, and to work toward mitigation measures and/or accommodation. These commitments are reinforced by OPG's dedication to reconciliation and to renewing its relationships with Indigenous peoples."*	• As per above comments, MSIFN has raised concerns regarding the lack of guarantee for long-term protection of the SAR habitat on site in previous consultations. OPG was unwilling to accommodate either of our requests. • Although OPG may be unaware of the exact contents of the WTFN settlement agreement (2018), they do have relationships with many of the seven Treaty Nations including MSIFN. Through these relationships, OPG is aware that protection of the environment and living relatives is of high priority. When identifying rights impacted by the project and working toward accommodations, OPG should consider what they are hearing directly from impacted First Nations.

Page	Reference Text	Comment/Question
66	*"An assessment of the effects on the biota in the wetlands which may remain on the DNNP site will be required. Mitigative measures are available to eliminate or reduce residual adverse effects to a non-significant level."*	• Please update MSIFN on the status of the wetlands on site and whether they will remain throughout the project. If they will remain, please inform us of the results of the effects assessment. If not, what will OPG do to compensate for the loss?
81	*"The Project will not result in a residual adverse effect on Aquatic Habitat because of the mitigation measures that will be implemented (notably, the Fish Habitat Compensation Plan)."*	• Please share the Fish Habitat Compensation Plan with MSIFN for review.
82	*"Once-through-cooling porous veneer intake has been designed specifically for reducing entrainment and impingement of fish. The intake incorporates design features based on fish behavioral principles and is also located offshore at depths which are less productive than inshore locations. The expected losses will be low relative to Lake Ontario populations."*	• Does OPG have an approximate number for expected fish losses through impingement and entrainment? This would allow us to understand the comparison between expected losses and Lake Ontario fish populations.
97	*"The Project is not likely to cause significant adverse environmental effects, provided the mitigation measures proposed and commitments made by OPG during the review, and the JRP's recommendations are implemented."*	• Based on the EIS and PPE, as well as the ESA Permit required for site preparation, it is not fair to say that the DNNP project will not cause significant adverse environmental effects. The mitigation measures suggested thus far do not outweigh the negative impacts of the project, and OPG is not willing to commit to protecting SAR habitat on the site long-term. Further, this conclusion is not reasonable given the lack of decommissioning plan.
104	*"The EIS considered the cumulative effect of the DNNP and other projects that would coincide with DNNP that could affect the same aquatic environment, with the predominant relevant effect of the DNNP being impingement losses of fish for the once-through cooling system."*	• Another relevant effect of DNNP would be the increase in water temperature via outflow into Lake Ontario. Thermal effects of the DNNP project should be considered alongside climate change already increasing surface water temperatures as a cumulative effect on the lake ecosystem.

Sincerely,

MSIFN Consultation Office

consultation@scugogfirstnation.com

Northwatch Comments on OPG's EIS Review Report and PPE Update Report – Darlington New Nuclear

March 20, 2023

Introduction

Ontario Power Generation is intending to construct four of the GE-Hitachi BWRX-300 boiling water reactors at the site of the Darlington Nuclear Generation Station on the north shore of Lake Ontario, 70 kilometres east of Toronto.

The BWRX – 300e is a small modular reactor designed by GE Hitachi. It is cooled and moderated by low-pressure, light-water with the distinctive safety feature of natural cooling of the core without reliance on electrical pumps to circulate water and remove decay-heat in the event of reactor shutdown (for a minimum of seven days without power or intervention by operators).

The fuel is UO2, enriched to an average of 3.4% 235-U.

It is a tenth-generation version of the U.S. NRC-licensed, 1,520 MWe ESBWR. As such, many of the components, e.g., fuel and moderator/coolant, have already been in use for decades, providing considerable operational experience and knowledge of materials properties and their response to intense radiation fields. However, the BWRX-300 reactor has not yet been constructed or operated anywhere, and it is unclear where this reactor lands on the continuum from idea to concept to design to deliverable. With the current plethora of SMR vendors or would-be vendors, it if difficult to differentiate between reactors with realistic designs and those which are simply power-point productions.

While the earlier versions of this reactor type have been employed elsewhere, the only commercial reactors that have operated in Canada have been the heavy-water CANDU reactors, which use a different fuel, have a different operating system, and generate reactor fuel wastes which are very different in characteristics and in dimensions. As such, the selection of the BWRX-300 is a significant departure for Ontario Power Generation and for Canada more generally.

Ontario Power Generation announced the selection of the 300-megawatt (MWe) BWRX-300 reactor in December 2021. According to OPG, their preliminary schedule is to complete construction of the first reactor by 2028 with commercial operation in 2029.

On October 20th 2022 Northwatch received an email notification from the Canadian Nuclear Safety Commission that the CNSC would be holding “webinars on the upcoming licensing review of the Darlington New Nuclear Project”. This was first notice received from CNSC with respect to the CNSC review of OPG’s application to construct additional reactors at the Darlington Nuclear Generating Station. The email indicated:

> *Ontario Power Generation (OPG) is proposing to construct a small modular reactor of up to 300 megawatt electric as early as 2028 in the Municipality of Clarington, Ontario. In December 2021, OPG announced its selection of GE Hitachi's BWRX-300 technology. OPG currently holds a site preparation licence and intends to submit an application for a licence to construct in October 2022.*[1]

The email included a link to a web page that further described the purpose of the webinar as being to familiarize the public with the project and its activities; discuss the CNSC's licensing process; discuss OPG's licence application; and provide information on participant funding to review two reports: Use of Plant Parameters Envelope to Encompass the Reactor Designs Being Considered for the Darlington Site and Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300[2]

On October 24th 2022 Northwatch received an email notification from the Canadian Nuclear Safety Commission that again described that "*Ontario Power Generation (OPG) is proposing to construct a small modular reactor as early as 2028 in the Municipality of Clarington, Ontario. OPG currently holds a site preparation licence for the project and intends to submit an application this month to the CNSC for a licence to construct* and that funding is available to assist Indigenous Nations and communities, members of the public and stakeholders in reviewing two OPG documents related to the Darlington New Nuclear Project, namely the "*Use of Plant Parameters Envelope to Encompass the Reactor Designs Being Considered for the Darlington Site*" and "*Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300*" and to support the participation in workshops and/or meetings with CNSC staff regarding OPG's Darlington New Nuclear Project and the submission of comments to the CNSC. No dates or descriptions for the workshops and/or meetings were provided at that time.

The notice also stated that a "second stage of funding, to be announced at a later date, will assist with participation in the remainder of the regulatory process, including the review of Commission member documents and documents related to OPG's application for a licence to construct, and participation at the Commission hearing."[3]

CNSC staff describe the purpose of the current consultation as being "to enable the Canadian Nuclear Safety Commission (CNSC) to gather feedback early in the licensing process for

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[1] Email subject line "Webinars on the upcoming licensing review of Ontario Power Generation's Darlington New Nuclear Project", dated Thu, 20 Oct 2022 10:02:45 -0400, received from cnsc.info.ccsn@cnsc-ccsn.gc.ca

[2] https://www.nuclearsafety.gc.ca/eng/stay-connected/get-involved/meet-the-nuclear-regulator/darlington-webinar.cfm

[3] Email subject line "Funding available to review documents for Darlington New Nuclear Project", dated Mon, 24 Oct 2022 11:52:54 -0400, from cnsc.info.ccsn@cnsc-ccsn.gc.ca

Ontario Power Generation's (OPG) Darlington New Nuclear Project (DNNP). Feedback received during this stage will help the CNSC to better understand this project."[4]

Northwatch's Interest

Northwatch is a public interest organization concerned with environmental protection and social development in northeastern Ontario. Founded in 1988 to provide a representative regional voice in environmental decision-making and to address regional concerns with respect to energy, waste, mining and forestry related activities and initiatives, we have a long term and consistent interest in the nuclear chain, and its serial effects and potential effects with respect to northeastern Ontario, including issues related to uranium mining and refining, nuclear power generation, and various nuclear waste management initiatives and proposals as they may relate or have the potential to affect the lands, waters and/or people of northern Ontario.

Northwatch has a dual mandate that includes public interest research, education and advocacy to promote environmental awareness and protection of the environment, and the support and promotion of public participation in environment-related decision-making.

Northwatch is interested in Ontario Power Generation's proposed approach to nuclear waste management and containment over various time frames. Northwatch's issues and concerns relate to the generation and management of the nuclear wastes that will result from Ontario Power Generation's operations. The wastes of concern include those wastes which will result from continued and future reactor operation, including and particularly – in this case – the novel wastes from the BWRX-300 reactors which Ontario Power Generation has selected for construction, operation and decommissioning at the Darlington Nuclear Generating Station.

Given Ontario Power Generation's established practice of transferring radioactive wastes from the Darlington NGS to the Western Waste Management Facility on the eastern shore of Lake Huron, and given the OPG-controlled Nuclear Waste Management Organization's current investigation of the Revell Lake area between Ignace and Dryden in Kenora District in northern Ontario as a potential burial location for high level nuclear (irradiated) fuel waste and potentially other radioactive wastes - including wastes generated through the construction, operation and decommissioning of so-called "small modular reactors" – all licensing stages related to the development of new reactors at the DNN are of direct interest to Northwatch.

[4] As found at https://www.letstalknuclearsafety.ca/dnnp-pre-licensing-consultation 19 March 2023

Project Licensing History for the Darlington New Nuclear Project

In 2007 Ontario Power Generation (OPG) considered nine reactor designs under offer or development by six different six vendors: the EC6 and ACR-1000 from AECL, the EPR from Areva, the ABWR and ESBWR from GE Hitachi, the OPR1000 and APR1400 from KHNP, the US-APWR from Mitsubishi, and the AP-1000 from Westinghouse.

In March 2008, Infrastructure Ontario (IO) issued a competitive Request for Proposal (RFP) for a new nuclear power station in Ontario and four vendors were invited to participate in the RFP process: AECL (the ACR-1000), Areva (the EPR), GE-Hitachi (the ESBWR) and Westinghouse (the AP1000). GE-Hitachi chose not to participate in the process.

In September 2009 Ontario Power Generation submitted an Application for a Licence to Prepare a Site (LTPS) and an Environmental Impact Statement (EIS) for the Darlington New Nuclear Project (DNNP). In response to an August 2010 information request from the Joint Review Panel reviewing OPG's EIS, OPG provided information to the JRP about the Enhanced CANDU 6 (EC6) heavy water reactor, in consultation with the EC6 vendor, AECL.

The Joint Review Panel carried out an environmental assessment review and hearing in the absence of a selected reactor design or the detailed information that would - presumably – have been under consideration in an actual environmental assessment of an identified reactor design.

The JRP released its report on August 25, 2011 and presented 67 recommendations in its report, including recommendation 1: "*The Panel understands that prior to construction, the Canadian Nuclear Safety Commission will determine whether this environmental assessment is applicable to the reactor technology selected by the Government of Ontario for the Project. Nevertheless, if the selected reactor technology is fundamentally different from the specific reactor technologies bounded by the plant parameter envelope, the Panel recommends that a new environmental assessment be conducted*."

In 2013 the Government of Ontario deferred the procurement of large new nuclear reactors at the Darlington site.

Between 2019 and 2021 OPG reviewed several different concepts or conceptual designs for various "small modular reactor technologies, and in December 2021 announced that it had selected the BWRX-300 as the technology to be deployed at the DNNP site.

Prior to their December 2021 announcement of their selected reactor design, OPG had sought and received a renewal of their site preparation license for the Darlington New Nuclear Project.

Northwatch intervened in that license review process and objected to the license being renewed at that time for a number of reasons, including the absence of a selected reactor design, despite the imminence of OPG's selection decision and announcement.

In their *Application to Renew the DNN Site Preparation License*, Ontario Power Generation OPG acknowledged that the basis for their existing licence included the safety analysis that was performed during the last application period, and that detailed assessment reports in support of the original application were submitted to the CNSC[5]; Northwatch had noted that these assessments were done when Ontario Power Generation was considering a completely different set of potential designs. At no point did the 2020 / 2021 documentation indicate that assessments have been undertaken with consideration of the three new under-development reactor designs that were under review by OPG at that time, including the now-selected BWRX-300.

Northwatch argued during the site licence review that the information necessary for the Commission to make its decision for a licence to prepare a site for nuclear reactor operations included descriptions of those reactors and their spatial requirements and factors which would affect the site configuration. Key site configuration factors include the spatial requirements of not only the reactors, but also of their associated infrastructure including heat transport systems, fuel handling and storage, and waste handling and storage. Neither OPG's license application of the Commission Member Documents for the site preparation licence review included that information

While it was – and remains – Northwatch's assessment that it was erroneous for the 2009 environmental assessment to be carried out without a reactor design having been selected and a detailed description made available (this absence in effect made the EA a project review without a project), that was equally or even more the case in the application for site preparation license renewal.

During the site preparation licence renewal review, it was CNSC's position that "when OPG submits documentation regarding technology selection CNSC staff will review and confirm whether OPG has clearly demonstrated that reactor technology selected remains within the bounds of the JRP EA report and complies with CNSC regulatory requirements outlined in REGDOC 1.1.1"[6] while it was Northwatch's position that that this assessment should have been done prior to the review of OPG's application to renew the license to prepare the site. The CNSC staff CMD expressed their position as follows:

[5] Application to Renew the DNN Site Preparation License. Ref. 2021-H-04, Pg 90
[6] CNSC Staff CMD: 21-H4, 8 March 2021, Pg 43

If OPG submits an application for a licence to construct that includes any changes to the predicted environmental effects from any revised design and/or baseline information, CNSC staff will conduct an environmental review determination to assess whether the proposed project is outside the bounds of the scope, predictions and conclusions of the previous EA. If CNSC staff determine that, the proposed project is outside the bounds of the previous EA scope, predictions and conclusions a further review will be required. CNSC staff would then determine what type of environmental review would be required.

Northwatch contended at the time that (in the context of CNSC decision-making) such a decision should rest with the Commission. We continue to hold that view in the context of CNSC decision-making, but with the knowledge of OPG's selected reactor design and having reviewed the EIS Review Report, we have concluded that while the CNSC or OPG could voluntarily initiate an environmental assessment process, the decision on the applicability of the previous EA to the current project more reasonably would rest with the federal Minister of the Environment, and that it is within the Minister's purview to delegate the BWRX-300 reactor project for a federal assessment, should CNSC fail to require one.

During the review of OPG's licence to prepare the Darlington expanded site Northwatch proposed that a complete project description was required, and that OPG should provide such a description. Such a project description would provide the CNSC and those interested and engaged in this review process the basis for determining if a new environmental assessment should be conducted. OPG has not done that.

There is not a full project description included in either of the two documents to which CNSC is proposing that this consultation be scoped, i.e. the *Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300* report and the *Use of Plant Parameters Envelope to Encompass the Reactor Designs being considered for the Darlington Site* report. There is also not a complete project description included in the Application to Construct which OPG filed in October 2022.

Scope and Approach of Current CNSC Consultation

CNSC staff have devised what Northwatch believes to be a unique (to date) approach to the review of the licence to construct a nuclear power reactor in the case of OPG's project to constrct up to four BWRX-300 reactors at the Darlington site.

As announced by CNSC staff, the scope of this consultation is limited to "*solely on the 2 OPG documents that address JRP recommendation 1: "The Panel understands that prior to construction, the Canadian Nuclear Safety Commission will determine whether this environmental assessment is applicable to the reactor technology selected by the Government of*

Ontario for the Project. Nevertheless, if the selected reactor technology is fundamentally different from the specific reactor technologies bounded by the plant parameter envelope, the Panel recommends that a new environmental assessment be conducted."

The CNSC web page further states that "*feedback that is out of scope, such as comments related to energy mix, financing of small modular reactors, and construction of the proposed facility, will not be considered during this consultation period. Out-of-scope comments will however not be deleted*."[7]

During the review of OPG's application to renew their license to prepare the site Northwatch made the following request:

> **21-H4 REQUEST:** The Commission require OPG to provide a complete project description following selection of their preferred reactor design prior to re-filing their application to renew the site preparation licence, to provide the Commission with an information base to consider whether the previous EA was for the same project as which OPG is not proposing to undertake.

Having now reviewed the *Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300* report and the *Use of Plant Parameters Envelope to Encompass the Reactor Designs being considered for the Darlington Site* report and having considered the comments we received from our expert advisers who had also reviewed these reports, we maintain this assessment: As a next step in this review, Ontario Power Generation should be required prepare and make public a completed project description.

The fundamental question posted by the JRP Recommendation 1 is whether or not a new environmental assessment must be undertaken. In order to make that determination, the CNSC must have an adequate description of the project, including reactor construction, operation and decommissioning and ancillary structures and activities, including waste and waste management over various time scales. That project description is not available. If the decision at this point is a "yes / no" decision on whether a new environmental assessment is required, the default position is most definitely a "yes", given there is not sufficient information available about the project to determine that the previous environmental assessment is applicable.

[7] As found at https://www.letstalknuclearsafety.ca/dnnp-pre-licensing-consultation

Fatal Flaws

Northwatch characterizes the issues identified in this section as “fatal flaws” because they are fatal to the supposition that the 2009 EIS is sufficient and that the 2022 EIS Review Report and the PPE (both flawed in themselves) are sufficient substitutions for a full environmental assessment.

Northwatch has identified three fatal flaws, set out below, but we do not assert that this is a comprehensive list and fully anticipate that other commenters may add to this list.

OPG’s Review Documents to Not Address Radioactive Waste

The generation of radioactive wastes by the proposed construction and operation of four boiling water reactors is a significant issue, as is the long term challenge of the care and containment of these wastes, including irradiated fuel wastes, which must be isolated from the environment into perpetuity. Beyond very brief mentions, the EIS Review Report and the PPE report did not address radioactive waste concerns.

For example:

- in outlining the “review” approach it is stated that “the EIS review examined fundamental elements of the EIS” and lists seven areas, but radioactive waste and its generation and management is not included.
- Figure 5 in Section 3.2 on Conceptual Plant Layout does not identify the location of the various radioactive waste storage facilities; these are listed on page 17 but their locations are not identified and there are no or inadequate descriptions provided
- the EIS Review Report blithely references the Nuclear Waste Management Organization (NWMO) created under the auspices of the federal Nuclear Fuel Waste Act (NFWA) as being charged with development of a long-term management approach for used fuel, but overlooks that the NWMO has been in a siting process for 13 years in which it describes to potential “host” communities a transportation, packaging and repository system which is completely designed for CANDU fuel; in a 2022 technical report the NWMO acknowledged the potential construction of a non-CANDU fueled reactor in Ontario, but to date has excluded the potential shift to include a fuel waste which higher levels of activity and very different characteristics and dimensions from its interface with potentially impacted communities

The Project Lacks Consistent Definition

Across the documents considered in this review, the most fundamental question about the project is not answered consistently, that question being about how many reactors will be constructed as part of this “project” and the application for a license to construct.

The Canadian Nuclear Safety Commission contends that Ontario Power Generation (OPG) is proposing to construct a small modular reactor (as in one reactor)[8] or that OPG's DNNP is a project for the construction and operation of up to four new nuclear reactors, or that OPG has submitted an application to the CNSC for a licence to construct.[9]

Ontario Power Generation Inc. is similarly inconsistent, in the Licence to Construct application stating that they are applying for a Canadian Nuclear Safety Commission (CNSC) Licence to Construct (LTC) the first of up to four nuclear power reactors on the Darlington New Nuclear site, and in the EIS review report stating that the activities in the licence application includes the construction and the fuel-out commissioning of a single BWRX-300 reactor on the DNNP site in one section, and stating that the completion of construction of the fourth reactors is 2035.[10]

The documents do not provide sufficient information

While CNSC staff have scoped this comment to exclude Ontario Power Generation's application to construct additional reactors at the Darlington site, Northwatch has completed a preliminary review and can firmly include the LTC application on the list of documents which do not provide a satisfactory description of the project, including with respect to radioactive wastes and their generation and management. As is noted elsewhere in this submission, OPG has simply not provided the documentation and supporting references necessary to this review.

Northwatch Findings in Current Review

Northwatch undertook a review of OPG's documents with respect to the Use of Plant Parameters Envelope to Encompass the Reactor Designs being Considered for the Darlington Site, and the Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300, and several related documents. Northwatch's review focused on those aspects of the PPE and the EA Review Report related to the fuel and the fuel waste.

Northwatch was assisted by two technical experts, namely Arnie Gunderson (Fairewinds Energy Education) who supported our review of the plant parameters envelope as revised by Ontario Power Generation, and Professor Rodney C. Ewing (Stanford University[11]) who supported our review of the address of radioactive waste in the review documents.

The conclusions of the two expert reviews and of Northwatch's own review were consistent: there was not information included in the documents to carry out a sufficient review.

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[8] https://www.nuclearsafety.gc.ca/eng/stay-connected/get-involved/meet-the-nuclear-regulator/darlington-webinar.cfm

[9] https://www.letstalknuclearsafety.ca/dnnp-pre-licensing-consultation

[10] Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300, NK054-REP-07730-00055 R000, October 5, 2022

[11] https://cisac.fsi.stanford.edu/people/rodney_c_ewing

These conclusions support – in fact, informed – Northwatch's contention that a full project description is required in order to determine if a new environmental assessment must be undertaken.

What follows are Northwatch's specific comments on each of the two reports; these comments are a blend of those provided by our expert reviewers and those generated through Northwatch's own review. There were no conflicts between the observations and comments of the various reviewers; had there been, those conflicts or variations would have been noted, with comment sources identified. That stated, this submission has not been reviewed by those who provided technical assistance (due to time constraints) and any errors in technical details or technical interpretation can be assigned to Northwatch, rather than to our technical experts.

Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300[12]

In October 2022 Ontario Power Generation released an Environmental Impact Statement Review Report for the deployment of up to four BWRX-300 small modular reactors (SMR) for the Darlington New Nuclear Project (DNNP), formerly referred to as the New Nuclear Darlington (NND) Project, produced by their consultants Calian Nuclear. Two OPG reviewers were identified, but the personnel involved in producing the report or their areas or expertise were not.

As stated in the report, the focus of the EIS Review was "to ensure that the conclusion of the EIS remains valid for the deployment of the BWRX-300 at the DNNP site".

The EIS Review covered the two components: the Plant Parameter Envelope (PPE), and the Environmental Impact Statement (EIS). And, as noted in the report "positive environmental effects are also identified and explained."

The report self-describes as having "examined the fundamental elements of the EIS and compared to those resulting from the deployment of four BWRX-300 reactors at the DNNP site to confirm the EIS conclusion remains valid." It states that "in comparison to the environmental conditions described in the EIS, prevailing conditions are largely similar, but have not been static over the years. For example, since 2009, several bat species now inhabit areas of the DNNP site. Durham Region and its area municipalities have also continued to change due to population growth, urbanization, and economic development" and that "the BWRX-300 deployment is expected to involve works and activities that are essentially the same as those evaluated in the

[12] Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300, NK054-REP-07730-00055 R000, October 5, 2022

EIS. Compared to the reactors considered in the EIS, the BWRX- 300 reactors are smaller in physical size and electrical power. As a result, the effects of the BWRX-300 deployment on the environment are generally less than those examined in the EIS. In addition, there are opportunities with the BWRX-300 deployment to retain some terrestrial habitats on the DNNP site."

In general and persistently, the writers of the EIS Review report promote the idea that the comparatively smaller size of the BWRX-300 reactors can be extrapolated to mean that the impacts, outcomes, outputs and effect of this project will also be "smaller".

This is a nonsensical thesis, similar to a thesis that a three inch ball will hurt less when it is hurled at a person than would a twelve inch ball. It is not the size that matters as much as the composition and "operation" (throwing) of that ball. Similarly, a smaller reactor is not necessarily a safer reactor, and the radioactive wastes generated a smaller reactor cannot be expected to be less radioactive to less requiring of long-term management and containment. It may be the case, but it unlikely to be the case, and the review would be better served by actual information in the form of a detailed project description than this type of unsupported conjecture.

Our review of the EIS Review Report generated numerous questions and comments, including the following which are listed and identified by the section they occurred, or where the issue or question first arose:

- While section 3.1 provided a reasonable summary of the of the general characteristics of the reactor, this section of the report – or other sections – did not provide an indication of burn-up; it is important to know the expected burn-up in order to anticipate composition and properties of the spent fuel and this information is not provided
- Table 1 identifies a very significant difference between the BWRX-300 and any other reactor designs considered in the 2009 EIS, that being that the reactor structure will penetrate 38 metres below ground level; this very important difference is given minimal treatment, and there is not enough information provided to fully evaluate, or to have confidence that OPG or their consultants have adequately evaluated the potential environmental consequences, including but limited to migration of radio-contaminants from the sub-surface structure to surrounding groundwater and potentially reporting to surface water; for example, there is no description of how monitoring will be undertaken or what mitigation measures might be employed; noted that there is a very brief (but inadequate) description in Section 4.1.2 and again in 5.2.2 where the potential for an effect on groundwater flow was identified as not having been considered in the 2009 EIS but this statement is not followed by any substantive discussion

- Figure 5 in Section 3.2 on Conceptual Plant Layout does not identify the location of the various radioactive waste storage facilities; these are listed on page 17 but their locations are not identified and there are no or inadequate descriptions provided
- Section 3.4 indicates that irradiated fuel and low and intermediate level waste will be stored on the site, but the report does not include a detailed *description of liquid, radioactive waste management systems, although a generic descriptions is found in later sections of the report.*
- Section 3.6 states that "There is no change to the description of waste management practices in Ontario. The process in this section applies to the BWRX-300 deployment; L&ILW will also be produced, and will be processed on-site, and shipped to an off- site OPG licensed facility"; while that may very well be the case, the very general statements offer little basis for review and are not a substitute for a detailed description and discussion of radioactive wastes
- The statement in Table 3 in Section 3.6 that "There is no change in the description of waste management practices" is misleading at best; while little information is provided in these documents about the fuel or the waste or their characteristics it is known that the wastes will have different characteristics (for example, a different burnup rate) and different dimensions than CANDU waste, which is the subject of all waste management practices in Ontario at present; so the document may parse the situation to say there is "no change to the description" of waste management practices, but that could only be the case if the 'description' was of management practices other than for the current and past wastes generated by OPG reactors; this parsing characterizes the problem with the approach CNSC as adopted, wherein the comparison is being made to an inadequate report about theoretical reactors from over a decade ago, rather than describing the currently proposed reactor in sufficient detail, including the associated and ancillary activities, including and particularly waste generation and management
- Table 4 similarly makes the assertion that "the description of the on-site dry storage facility in the EIS is applicable to the BWRX0-300 deployment; this statement is unsupported by an actual detailed description of the on-site dry storage facility, and would require comparison to a detailed description of dry storage facilities for the 2009 fleet of conceptual reactors; at minimum, a comparison of the BWRX-300 "Radioactive Waste Management Plan"(scheduled for release in Q1 2023) to the 2009 Nuclear Waste TSD would be required, although at this point we cannot be confident that the BWRX-300 "Radioactive Waste Management Plan"(scheduled for release in Q1 2023) will contain sufficient detail and information about dry storage facilities
- The report states in Section 3.7 that "*The volume of L&ILW and used fuel generated from the BWRX-300 deployment over the 60 years of operation is estimated to be less than for the*

larger reactors assessed in the EIS"; this statement is not consistent with the findings set out in the expert paper [*Nuclear waste from small modular reactors*][13] (Krall et al.,2022); this is a key point – do the report authors have actual information to support this questionable statement

- The BWRX-300 deployment will transport the L&ILW off-site to an OPG licensed facility. The description of the on-site dry storage facility in the EIS is applicable to the BWRX-300 deployment. *Again, not much can be said about such statements without more documentation.*
- *Section 3.7 states that "Management of spent fuel for BWRX-300 will also use an on-site dry storage facility", but no additional information is provided, such as: how long will the dry cask storage be in operation? What will be the state of the fuel after this period? Are there provisions for repackaging defect fuel assemblies?*
- *Section* 4.13 discussed three parameters associated with airborne and waterborne releases of radioactive contaminants that result in doses to the public were outside of the parameters assessed in the EIS, and notes that "The three parameters associated with airborne and waterborne radioactive releases required a separate study to assess their effect and compare it with what was assessed in the EIS…."; Northwatch requested the Reference [14] A. "Amendola and R. Parker, "DN Dose Calculations for Gap Analysis," on February 23 and received it on March 10th, but this arrival date – regrettably - left insufficient time for our experts' review; the referenced documents are not available online and there can be a significant time lag between making the request and receiving the document, in those instances where the document is provided and this is problematic in all reviews, including in this instance
- Section 4.1.4 "Solid Waste and Spent Fuel" states that a) solid waste volumetric activity (Bq/m3) generated by the operation of the BWRX-300 is higher than what was assessed in the EIS but that there will be equipment changes in response and b) the weight of the cask used to transport the BWRX-300 spent fuel on site (113 tonnes) is heavier than the cask assessed in the EIS, but the roads will be upgraded in response , and then indicates that "there is no impact on the EIS conclusions as a result of these mitigation measures"; insufficient details is included about the waste and the waste containers, but this is far to simplistic a response to be credible; this is another example of why a full examination of the project through a full environmental assessment is required

[13] Nuclear waste from small modular reactors, Lindsay M. Krall, Allison M. Macfarlane and Rodney C. Ewing, Edited by Eric J. Schelter, University of Pennsylvania, Philadelphia, PA; received June 26, 2021; accepted March 17, 2022 by Editorial Board Member Peter J. Rossky May 31, 2022, as posted at https://www.pnas.org/doi/10.1073/pnas.2111833119

- Table 5 includes a note that "the radionuclides in gaseous effluents, liquid effluents, and solid waste are the same as in the EIS, but their proportions have changed" but there is no reference for a supporting document; it would be useful to have the data on how their proportions have changed.
- Section 5.2.8 makes assertions with respect to the volumes of L&ILW and used fuel to be generated from the BWRX-300 being lower and the land area required for used fuel dry storage being smaller than what was assessed in the 2009 EIS but provides no actual information about the fuel, the various wastes, or the dry storage systems; the document should include supporting data, or at least live links to documents which include the supporting data
- Section 5.2.13 "Operation and Maintenance Phase" includes statements that the BWRX-300 used fuel pool is smaller than what was assessed in the EIS but that the change in capacity is accounted for through the availability to move used fuel earlier and that it is planned that used fuel storage facilities will be available once the BWRX-300 starts operation and that dose consequence due to higher activity will be managed through appropriate cask and shielding design; these statements are not referenced, and no supporting information is provided; several questions arise, include: why will used fuel be moved earlier and how much earlier and to where? Which casks are being referred to in the statement that the higher activity will be managed through cask and shielding design? i.e. interim dry storage, transportation or perpetual care casks?
- Section 5.3.6 "Radiation and Radioactivity Environment" makes an important statement about Radiation and Radioactivity Environment being considered a pathway to effects in other environmental components, but provides no supporting documentation
- Section 5.3.6 "Radiation and Radioactivity Environment" also states that "A comparison of emissions from the BWRX-300 reactor and the reactors assessed in the EIS, found that tritium, carbon-14, particulates, and noble gases emissions from the BWRX-300 are less than these emissions for the reactors assessed in the EIS. In contrast, the emissions of iodine are higher for the BWRX-300 than the values assumed in the EIS"; again, no supporting information is provided, and equally troubling is the absence of any discussion of the consequences of higher levels of iodine emissions
- Section 5.7.2 "Radiological and Transportation Malfunctions and Accidents" describes the BWRX-300 radiological waste as containing different proportions of radionuclides than the waste that was assessed in 2009 EIS, and notes that the mass of fuel placed in the spent fuel transfer cask is different than what had been assessed in the EIS; this section states that the assessment of radiological malfunctions and accidents involving radioactive waste and used nuclear fuel was reanalyzed for the BWRX-300 "using the same scenario as was examined in

the EIS" and then goes on to say that the reassessment lead to the same conclusion, but it does not provide any of the supporting data, discussion of documentation; for this and for the other re-evaluations of accidents (e.g. transportation accidents, damage to spent fuel) further information is required; also, in evaluating the probability and consequences of accidents all four of the proposed BWRX-300 reactors should be considered as a system, and this cannot be determined based on the very limited information provided; one of the lessons at Fukushima was that there can be disadvantages to having reactors connected by the same supporting systems and it is not clear from these documents if the systems for each reactor unit are independent or combined; more detail is required in order to assess or review critical assertions on exposure to the public.

Use of Plant Parameters Envelope to Encompass the Reactor Designs Being Considered for the Darlington Site[14]

As stated in the 2009 EIS, "A PPE is a set of design parameters that delimit the bounding framework for key features of the Project. A fully developed PPE represents the limiting values for the common elements of the different design options being considered and serves as a conservative surrogate for actual reactor design information that varies among the options."[15]

In Section 1.0 of the 2022 PPE report[16] OPG introduces the concept of the PPE as an approach to resolve issues before a reactor design had been chosen. Later in the same paragraph OPG states that "high level design information is required for the environmental assessment that precedes the licensing decision for a License to Prepare the site".

In summary, OPG explains that the purpose of the PPE is to act as a surrogate in the absence of a selected reactor design, for the purpose of supporting an application for a license to prepare a site.

As of last year, a reactor design been selected, the GE-Hitachi BWRX-300. Also as of last year, the licence to prepare the site has been renewed. Therefore, there is no longer a need for a surrogate for a reactor design during a site preparation licence review. Nor is there a need for a substitute for a reactor design, when a reactor has been selected and presumably the reactor

[14] Use of Plant Parameters Envelope to Encompass the Reactor Designs being considered for the Darlington Site, N-REP-01200-10000 R005, October 4, 2022

[15] Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300, NK054-REP-07730-00055 R000, October 5, 2022, page 6

[16] Use of Plant Parameters Envelope to Encompass the Reactor Designs being considered for the Darlington Site, N-REP-01200-10000 R005, October 4, 2022

design is already well-know to OPG (otherwise, on what basis did they make their reactor design selection?)

A PPE review and the EIS Review report may have served some purpose during the review process for the license to prepare a site, which was carried out in 2021 and 2022. However, that work was not undertaken by OPG during that license review process and was not required by CNSC. Northwatch sees little point in the exercise at this juncture.

That being the case, Northwatch did – despite the lack of utility for this exercise – carry out a review of the PPE.

In general, Northwatch and our technical advisors found that the PPE update was poorly done and lacked sufficient content to support a meaningful review.

What seems to be the key message in the PPE report is as stated in Section 6.2 in the EIS Review Report:

> *"Overall, given that the BWRX-300 is smaller in size and requires less footprint, it is expected that effects on the environment within the EA Study Areas would be less than those assessed in the EIS. Therefore, the determinations regarding the significance of residual adverse effects made in the EIS remain valid. The DNNP, considering the mitigation measures identified, will not result in significant adverse environmental effects, including effects from accidents, malfunctions and malevolent acts, effects of the environment on the Project, and cumulative effects.*

This suggestion that size and footprint are the determinants of risk and / potential consequences or adverse impacts of an operation or activity is unsupported, as has been noted elsewhere in this submission.

While the PPE process may be an accepted regulatory process from the regulators' or licensees' perspective, it has the effect of obscuring the actual basis for the determination of safety for an actual reactor system.

However, from a waste management prospective the use of bounding values for different classes of reactor could potentially provide a means by which actual waste generation (L- , IL- and HL-waste) values could be calculated, although that certainly does not appear to have been done in the case of this PPE, or is not documented as having been done. Northwatch would be interested in seeing OPG compare waste generation parameters to the BWRX-200 to a) BWRs in the GWe range, and b) conventional CANDU reactors following procedures similar to those used by Krall et al (2022).

In summary, even if a PPE approach were appropriate, the selected reactgor is fundamentally different from those considered in the 2009 EIS. In that csase, the PPE considered three water-cooled designs, tow pressurized water reactor designs, and one pressurized heavy water design.

No boiling water reactor design was considered. We note again that GE-Hitachi had been invited to submit design details, but had opted out.

Finally, and perhaps most importantly, GE-Hitachi and OPG have not made public the design details for the BWRX-300, and CNSC has not disclosed the information considered in their Vendor Design Review exercise. Relying on an "updated" PPE is not a valid substitution for making this information available and the basis for the review process.

Conclusions

As outlined earlier in this submission, having reviewed the *Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300* report and the *Use of Plant Parameters Envelope to Encompass the Reactor Designs being considered for the Darlington Site* report and having considered the comments we received from our expert advisers who had also reviewed these reports, Northwatch's conclusion is that Ontario Power Generation must be required prepare and make public a completed project description.

The fundamental question posted by the JRP Recommendation 1 was whether or not a new environmental assessment must be undertaken. In order to make that determination, the CNSC must have an adequate description of the project, including reactor construction, operation and decommissioning and ancillary structures and activities, including waste and waste management over various time scales. That project description is not available.

In the alternative, OPG could forego that preparatory step of preparing a detailed project description and move straight to the task of preparing a full impact statement and supporting documents. However, under the federal process the standard approach is to preparate a project description which is then used as the basis for production of tailored guidelines for the preparation of the impact assessment, so a greater efficiency would likely be achieved by following the standard course and preparing a full project description as the next step.

For return correspondence contact Northwatch at nortwatch@nortwatch.org nuclear transparency project

Website: www.nucleartransparency.ca
Email: info@nucleartransparency.ca

Submitted by email

March 20, 2023

To President Velshi and Members of the Canadian Nuclear Safety Commission,

Re: Comments relating to Ontario Power Generation's 2022 Environmental Impact Statement and Plant Parameters Envelope documents for the Darlington New Nuclear Project

We would like to begin by thanking the Commission for this opportunity to provide comments on the Environmental Impact Statement Review Report (EIS) and Updated Plant Parameter Envelope Report (PPE) for Ontario Power Generation's (OPG) Darlington New Nuclear Project (DNNP) proposal. We would also like to recognize the efforts of Canadian Nuclear Safety Commission (CNSC) staff, multiple Canadian civil society organizations, members of the public, and Indigenous Nations for their informative publicly available materials and submissions on this matter. Finally, we thank Ontario Power Generation (OPG) for their time in preparing preliminary responses to several of our information requests to date.

These comments have been made possible by CNSC funding through its Participant Funding Program (PFP). These submissions were drafted by NTP founder and coordinator Pippa Feinstein. Hydrogeologist Dr. Ekaterina Markelova and environmental toxicologist Dr. Shamaila Fraz are also in the process of reviewing OPG materials for this intervention.

Our submissions have been divided into five parts on the following pages:

About NTP

The Nuclear Transparency Project (NTP) is a Canadian-registered not-for-profit organization dedicated to supporting open, informed, and equitable public discourse on nuclear technologies. NTP advocates for robust public access to data and other types of information and helps to produce accessible analysis of publicly available information, all with a view to supporting greater transparency in the Canadian nuclear sector.

NTP engages with a multi-disciplinary group of experts to address economic, ecological, and social facets of the Canadian nuclear sector, producing public reports, academic articles, and other publicly accessible resources as well as intervening in regulatory decision-making processes. The organization seeks to support youth and early career scholars, especially those from underrepresented communities and groups. NTP also recognizes a responsibility to model the transparency and accountability practices for which it advocates. It is committed to interdisciplinary, cross-sectoral, and equitable collaborations and dialogue between regulators, industry, civil society, members of host and potential host communities, as well as academics and professionals from Science, Technology, Engineering, and Mathematics (STEM) fields, the social sciences, and humanities.

About the current opportunity for public comments

The Ontario provincial government directed OPG to propose new nuclear reactors to be built at the Darlington site in 2006. OPG proceeded to prepare an EIS for three potential reactor models: AECL's ACR-1000, Areva's US_EPR, and Westinghouse's AP-1000. Once the process began, OPG was requested to add another type of reactor to their assessment: the EC6. An environmental assessment (EA) of OPG's EIS was conducted by a Joint Review Panel (JRP) under the *Canadian Environmental Assessment Act, 1992.* The JRP issued a report recommending that the project proceed, provided a series of 67 recommendations were implemented mitigating potential adverse effects of any new build project at Darlington.

OPG and the JRP sought to evaluate all four models in the same process by using what they called a 'bounding approach' in which the general characterizations of the potential adverse environmental impacts associated with all four reactors were identified and assessed together. This bounded approach resulted in a fairly broad EIS and EA, with many particulars (including those relating to environmental emissions, waste management, and other issues) being left to determine in more detail once a reactor model for the Darlington site was chosen at a later date. The JRP noted in their final report, however, that if a 'fundamentally different' reactor design was selected for the Darlington new build project, it would require a new EA.

In early October, 2022, OPG submitted an updated EIS and PPE for the DNNP. In these documents, OPG introduced its chosen technology for its new build project: the BWRX-300 modular reactor, a reactor technology that was not considered in the initial EIS for new reactors at the Darlington site. OPG argues that the potential environmental impacts of this new BWRX-300 modular reactor technology are mostly within the parameters of the 'bounding approach" used in the original EIS in 2006. As such, it argues no new EA is required under the current *Impact Assessment Act* for the construction of up to four new modular BWRX-300 reactors at the Darlington site.

The CNSC scoped the current public comment opportunity narrowly, asking for submissions relating to whether the proposed BWRX-300 modular reactor should be considered a "fundamentally different" reactor to the four others reactor types studied between 2006 and 2011. In preparing submissions, the CNSC directed members of the public to only consult two documents: the 2022 EIS and PPE prepared by OPG.[1]

No definition of "fundamental difference" has been developed. The main criteria provided to help members of the public comment on whether this threshold for a new EA has been met are the 198 plant parameters used to 'bound' the assessment of the initial four reactor designs. By OPG's own estimate: 60 of the 198 parameters are not applicable to the BWRX-300 design; nine BWRX-300 features are outside the 198 parameters; the remaining 129 parameters capture predicted BWRX-300 impacts.[2]

Concerns over the current focus on the "fundamental difference" threshold

After reviewing the EIS and PPE, it became apparent that there was not enough information in either document to get a comprehensive sense of the potential adverse environmental impacts of the BWRX-300 modular reactor. There was also insufficient information to develop a clear understanding of how the BWRX-300 modular reactors would interact more generally with the local environment. For example, neither the EIS nor the PPE contain detailed information or data relating to:

- The source, volumes, or discharge points for all identified contaminants to air, surface water, groundwater, and stormwater;
- Exact treatment or mitigative efforts to address potential contaminants in liquid effluent, contaminant releases to air, groundwater or in stormwater; or
- Additional environmental monitoring that will be required, should the BWRX-300 modular reactor be approved, to ensure against any significant adverse environmental effects.

In fact, many of the potential environmental effects identified by OPG are still being examined and modeled to determine their significance and necessary mitigation measures: approximately 30% of the potential residual effects of the BWRX-300 reactor are still being studied,[3] approximately 15% of the studies to determine the significance of residual adverse effects of the BWRX-300 are still being studied.[4]

[1] Canadian Nuclear Safety Commission, "Darlington New Nuclear Project (DNNP) pre-licensing consultation", online: https://www.letstalknuclearsafety.ca/dnnp-pre-licensing-consultation
[2] Ontario Power Generation, "Environmental Impact Statement Review Report – DNNP", online: https://www.letstalknuclearsafety.ca/33710/widgets/138079/documents/95811, pp 29-30.
[3] Ontario Power Generation, "Environmental Impact Statement Review Report – DNNP", Table 6.
[4] Ontario Power Generation, "Environmental Impact Statement Review Report – DNNP", Table 7.

Further, there are several times in the EIS where OPG predicts that the BWRX-300 impacts on the local environment will be less that those identified in the original EIS due to a relatively "smaller environmental footprint" of the BWRX-300 design. For example:

- OPG asserts the aquatic environment will be more protected by BWRX-300 than the other reactors in the initial EIS because it's flow rate is relatively smaller.[5] However, no assessment is provided to characterize the BWRX-300 flow rate and its impact on aquatic biota in more detail;
- OPG asserts terrestrial effects of the BWRX-300 reactors will similarly be less than those identified for other reactors in the initial EIS since the surface area taken up by the reactors will be less for the BWRX-300 (19 hectares per reactor compared with the average 35 hectares for other reactors examined in the original EIS).[6] The relative differences in disruption during construction of the BWRX-300 reactors versus other EIS reactors is under examined, and there is no evaluation of the likelihood that any saved surface area from smaller reactors would constitute significant gains in species habitat;
- Further, arguments relating to the "smaller footprint" for the BWRX-300 ignore the deeper foundations required for the BWRX-300 (38m compared to all other reactors in the initial EIS that had a foundation depth of around 13.5m deep).[7] The excavation work required for the BWRX-300 will alter the water table at the site, though the ways in which it may do so, and for exactly how long, are not discussed sufficiently in the 2022 EIS report;
- OPG asserts BWRX-300 will generate smaller volumes of waste than the reactor models examined in the initial EIS, and argues this factor indicates a smaller environmental impact.[8] However, these wastes have higher radioactivity levels, than other CANDU wastes at the Darlington site. It is unclear from the 2022 EIS and PPE how this higher activity is taken into consideration when evaluating impacts and management requirements for spent fuel from the BWRX-300 reactors.

We are in the process of reviewing OPG supporting documents to get a better sense of the predicted environmental effects of the BWRX-300 and their potential significance. We were not able to make a confident determination from information in the 2022 EIS and PPE alone as to whether BWRX-300 reactors are fundamentally different from the other reactors assessed in the original EIS. We argue it would be irresponsible to say with any authority or confidence that the BWRX-300 fits reasonably within the original plant parameter envelope, with reference to the 2022 EIS and PPE alone.

<u>Concerns relating to transparency in public communications</u>

Transparency is a crucial precondition for accountability. It is required of regulators and companies in different ways, and for different purposes. In the nuclear sector,

[5] Ontario Power Generation, "Environmental Impact Statement Review Report – DNNP", p 90.

[6] Ontario Power Generation, "Environmental Impact Statement Review Report – DNNP", p 91.

[7] Ontario Power Generation, "Environmental Impact Statement Review Report – DNNP", p 10.

[8] Ontario Power Generation, "Environmental Impact Statement Review Report – DNNP", p 25 and 27.

transparency is demonstrated by an accessible regulator that ensures its work and the reasoning behind its decisions are clearly communicated to the public. It is also demonstrated by licensees who share information about the real and potential impacts their facilities can have on the environment, human health, the economy, and society more broadly. Regulators have an important role in ensuring licensees provide this information. Regulators are also responsible for ensuring they and the public have the necessary information on which to make informed decisions about what real and potential impacts are reasonable or acceptable, and which are not.

In this intervention, NTP identified two main areas in which transparency can be better safeguarded by both the CNSC as regulators, as well as OPG as a licensee. The first relates to need for clearer communications of the DNNP's context and the current EIS and PPE documents prepared in 2022. The second relates to ongoing information gaps that prevent NTP from being able to provide fulsome analysis of the BWRX-300 modular reactor. OPG is proposing to continue the EIS process initiated in 2006, however little note is made to the existing record on which OPG hopes to continue to build.

Each of these two areas will be discussed below in more detail in turn.

1) Public communications relating to project context

Since the original EIS was prepared, it was considered in an Environmental Assessment that resulted in a series of additional information requests of OPG, and a final EA report in 2011 that specified the project could only proceed if the following studies were undertaken and resulted in findings that any identified environmental impacts could be mitigated to ensure against them becoming 'significant'. These studies included:

- A comprehensive soil characterization program (EA recommendation 2);
- A follow-up and adaptive management program for air contaminants including Acrolein, NO_2, SO_2, SPM, PM_2, and PM_{12} (EA recommendation 8);
- A detailed acoustic assessment, noise monitoring, and a noise complaint mechanism (EA recommendation 9);
- A detailed geotechnical investigation prior to site preparation activities (including site-wide information on soil physical properties, determining mechanical and dynamic properties of overburden material, mapping geological structures to deepen understanding of "site geological structure model", and other measures, EA recommendation 10);
- Collecting water and sediment quality data for future embayment area produced as a result of shoreline modifications close to the outlet of Darlington Creek (EA recommendation 12);
- Collecting and assessing water quality data for shoreline and off-shoreline locations in the study area in advance of any in-water works (EA recommendation 13);
- Evaluating site layout opportunities to minimize effects on terrestrial and aquatic environments (EA recommendation 20);

- Developing a follow-up program for insects, amphibians and reptiles, mammal species and communities to verify the effectiveness of mitigation efforts (EA recommendation 22);
- Sampling to confirm the presence of Least Bittern before site preparation activities begin (EA recommendation 25);
- The geotechnical and seismic hazard elements of a geotechnical investigation be performed (with varying activities required before site preparation, construction, and operation phases of a new build project, EA recommendation 38);
- Expanding the scope of groundwater monitoring for flows that may arise as a consequence of grading changes during site preparation and construction phases (EA recommendation 19);
- Determining the compensation for any loss of ponds and for preventing runoff of sediment and other contaminants into Coot's Pond during site preparation and construction (EA recommendation 21);
- A detailed assessment of predicted effluent releases from the project including effluent quantity, concentration, points of release and a description of effluent treatment, demonstrating how the chosen technology will achieve best available treatment techniques economically achievable, and determine whether further mitigation is necessary (EA recommendation 14);
- Establishing toxicity testing criteria and methodologies (including testing frequency) for confirming that stormwater discharges will comply with the *Fisheries Act* (EA recommendation 16);
- Assessments of ingress and transport of contaminants in groundwater at all project phases (taking into account effects of any future dewatering and expansion activities at nearby St. Mary's Cement Quarry, EA recommendation 17);
- A comprehensive assessment of the management of hazardous substance releases and required management practices for hazardous chemicals on site (EA recommendation 26);
- A surface water risk assessment, once a reactor technology is chosen, characterizing the surface combined thermal and contaminant plume, and the physical displacement effects of altered lake currents as a "hazardous pulse exposure" to fish whose larvae drift through area (EA recommendation 35);
- Conducting a hazard algae assessment (EA recommendation 40);
- Making provisions for on-site storage of all used fuel and low and intermediate-level wastes for the duration of the project, should permanent storage elsewhere not be found or approved (EA recommendations 52 and 53);
- Conducting additional fish impingement and entrainment monitoring and looking into cost-effective mitigation such as live return systems and acoustic deterrents (EA recommendations 30 and 32); and
- Ensuring advanced thermal plume modelling is conducted that takes climate change impacts into account (EA recommendation 34).[9]

[9] For acceptance by Governor in Council, see: "Government of Canada's Response to the Joint Review Panel Report for the Proposed Darlington New Nuclear Power Plant Project in Clarington Ontario, online: https://www.ceaa.gc.ca/archives/evaluations/29525/document-html-eng_did=55542.html.

Neither the 2022 EIS nor PPE systematically address any of these studies or their progress. As such, it remains unclear to what extent this ongoing work has been conducted. It remains unclear whether the studies themselves have been included in the supporting documents referred to in the EIS. We are still in the process of verifying the extent to which they are referenced in the supporting materials OPG shared with us over the last week.

The 2011 EA report was judicially reviewed by the Federal Court upon an application by several participants in that EA process. Justice Russell for the court found there to be insufficient information on the public record relating to hazardous substance emissions from a future new build, radioactive waste management practices, and the effects of a severe common cause accident.[10] To date in our review, we have assessed the first two issues in the 2022 EIS and PPE and similarly find significant information gaps.

This Federal Court decision was then appealed by OPG, the CNSC, and Attorney General. The Federal Court decision was ultimately overturned by the Federal Court of Appeal's majority, however, the dissenting judgment of Rennie JA agreed with the initial decision by Russell J that there was not enough information on the EA public record relating to hazardous emissions from the proposed new nuclear project.[11]

These cases show that the extent and sufficiency of the evidentiary record in this case has been long-contested. The comprehensiveness of the evidentiary record should be the top priority in any evaluation of the proposed BWRX-300 modular reactors.

2) Lack of access to data and detailed information to support EIS and PPE

As discussed above, both the EIS and PPE are highly context-dependant documents, part of a process initiated in 2009 that was subject to two court rulings (though ultimately affirmed). This full context and the supporting documents referenced in OPG's EIS and PPE should have been made available alongside the 2022 EIS and PPE documents themselves – both on the CNSC consultation website as well as OPG's own website.

The follow-up studies required by the EA report of the JRP should also have been explicitly discussed by OPG in their application and shared online with the public along with the current EIS and PPE documents. This is still something that can be done now, as intervenors like ourselves continue to study this proposal and prepare for any further environmental review or application by OPG for a licence to construct new reactors at the Darlington site.

[10] *Ontario Power Generation Inc. v. Greenpeace Canada,* 2014 FC 463, online: https://www.canlii.org/en/ca/fct/doc/2014/2014fc463/2014fc463.pdf, para 228.

[11] *Ontario Power Generation Inc. v. Greenpeace Canada,* 2015 FCA 186, online: https://www.canlii.org/en/ca/fca/doc/2015/2015fca186/2015fca186.html?searchUrlHash=AAAAAQAmZmVkZXJhbCBjb3VydCBvZiBhcHBlbCBjbnNjIGdyZWVucGVhY2UAAAAAAQ&resultIndex=2, paras 49-51.

Finally, projects like these underscore the importance of proactive routine environmental performance disclosures, so that members of the public can ground their reviews of the proposed project in larger understandings of the Darlington site and how existing nuclear facilities engage with the local ecosystem in which they are embedded.

Concerns with the current CNSC review process

1) Indigenous jurisdiction and the CNSC's regulatory context

NTP recognizes the sovereignty and jurisdiction of the Indigenous Nations on whose land the Darlington site sits. We support their interventions in this matter and recognize them as relevant decision-makers when determining allowable activities by nuclear industry in their territories. NTP also recognizes the applicability of Indigenous laws as part of these Nations' governance systems of their homelands on which any approved new modular nuclear reactors would operate.

OPG's claimed ownership of this site does not extinguish Indigenous jurisdiction, nor does it prove the paramountcy of Canadian law and regulation of the site. A formalized process by which Indigenous Peoples' authority and jurisdiction is observed is necessary to determine a just outcome of these matters and should be defined by these rights holders.

2) Excluding other factors in determinations about EAs

In addition to the question of the BWRX-300's "fundamental difference" to other reactor technologies, or not, there are other public interest arguments for a new EA. Since the completion of the EA for the DNNP, federal environmental assessment legislation has changed twice. New species at risk have been listed and are present in the vicinity of the Darlington site. Further, the underlying need for these projects, and changes in energy demand forecasts and energy mixes since 2006 have been significant – as have public decision-making processes in the province relating to these types of determinations. EIS revisions (between 2010 and 2022) were dormant for 12 years, and the initial EIS is now 14-17 years old.

Were a new EA required, it would not necessarily require all new assessments, and as such would not unnecessarily duplicate work that has already been done. Rather, it would provide for a consolidated record of all past studies, and ensure they are supplemented with additional work required by the current federal standards demanded of significant industrial project proposals.

APPENDIX A: NTP information requests and responses to date

<u>Information request timelines</u>

March 2, 2023: NTP information requests sent to OPG – Environment, Health, and Safety

March 13, 2023: Response received from OPG – Environment, Health, and Safety indicating no updates yet available relating to outstanding DWMF information requests

March 13, 2023: Response received from OPG – New Nuclear Growth with four of the requested reports

March 17, 2023: Response received from OPG – New Nuclear Growth with further two of the requested reports as well as preliminary responses to the second category of NTP's information requests

March 20, 2023: Response received from OPG – New Nuclear Growth with final requested report

March 20, 2023: NTP sent confirmation of reports and responses received, requested rationales for redacted portions of three of the reports nuclear transparency project

Website: www.nucleartransparency.ca
Email: info@nucleartransparency.ca

Submitted by email

March 2, 2023

To Mr. McCalla,

Re: Information requests to assist the Nuclear Transparency Project's intervention in the Canadian Nuclear Safety Commission review of OPG's Darlington New Nuclear Project

The Nuclear Transparency Project (NTP) has been funded by the Canadian Nuclear Safety Commission (CNSC) to prepare an intervention in the upcoming hearing to consider Ontario Power Generation's (OPG) proposed Darlington New Nuclear Project (DNNP). NTP is submitting the following information requests in order to better understand OPG's licensing application and supporting documents (namely the Environmental Impact Statement (EIS) and Plant Parameters Envelope (PPE) from October 2022).

Our information requests are divided into three categories: the first contains a list of requested studies; the second requests information that is not included in the 2022 EIS or PPE documents (though we recognize this information may be in the additional documents we are requesting); and the final category seeks clarification on specific portions of the 2022 EIS and PPE documents. We have also attached as an appendix to this document a table with outstanding information requests from December 6, 2022 which we sent as part of our intervention in the Darlington Waste Management Facility relicensing process. We still hope to receive responses to those questions as they will assist with our preparations for this current intervention.

Our deadline for providing written comments to the CNSC on the EIS and PPE is March 20, 2023. As such, we request a preliminary response to our queries from OPG by March 13, 2023. We hope by that time you will be able to provide: 1) access to the requested reports (the first category of requests below); and 2) a timeline by which OPG expects to provide responses to the information requests in this document (including its appendix).

With appreciation for your time and assistance,

Pippa Feinstein, JD LLM
Coordinator, NTP

Information requests specific to the Darlington New Nuclear Project

CATEGORY 1 – NTP's list of requested supplementary documents

In order to better understand OPG's EIS and PPE documents, we request electronic copies of the reports listed below. We understand there are several versions of some of these reports, some of which appear available online. For these reports, we have included links to the copies we have been able to find and request confirmation that these are the most recent versions and/or the versions of these reports being relied on for OPG's licensing application.

- Calian Nuclear, "Darlington New Nuclear Project Supporting Document for Comprehensive Review of EIS for BWRX-300";
- WSP Golder, "Hydrology Memo to Assess Water Balance of Surface Water Features for the Darlington New Nuclear Project";
- WSP Golder, "Groundwater Modelling to Assess Effects from Construction-Related Dewatering for Darlington New Nuclear Project";
- OPG, "Darlington New Nuclear Project Commitments Report"
  - (is this the most recent version and/or the version of this report being relied on for OPG's licensing application: https://archive.opg.com/pdf_archive/Nuclear%20Licencing%20Documents/Darlington%20New%20Nuclear/Commitments_Report.pdf);
- OPG, "DNNP Site Evaluation Update Summary Report";
- OPG, "BWRX-300 Darlington New Nuclear Project Preliminary Safety Analysis Report"
  - (is this the most recent version and/or the version of this report being relied on for OPG's licensing application: https://www.opg.com/documents/dnnp-bwrx-300-preliminary-safety-analysis-report-pdf/; and
- Any draft environmental assessment follow-up monitoring program for BWRX-300 modular reactors, should they be approved for construction at the Darlington Nuclear site.

CATEGORY 2 – Additional information

There are six broad areas in which we require more information than is contained in either the 2022 EIS or PPE documents. These have been summarized in the enumerated list below. Some of this information may be contained in the reports we requested above. If this is the case, please let us know. If the requested information below is contained in reports we have not yet requested, please provide those additional reports for our reference.

1. Constituents of Potential Concern specific to the BWRX-300 modular reactor design:
   a. Descriptions and analysis of the specific content and types of radionuclides in gaseous effluents, liquid effluents, and solid wastes from the proposed

BWRX-300 modular reactor design. We are interested in descriptions that include analysis of applicable radionuclides that include their respective half-lives and chemical, biological, and environmental properties and pharmacokinetic profiles. Further, an explanation of exactly how they may vary from the radionuclides released by the reactor designs specified in the 2009 EIS would also be of special interest;

b. Descriptions and analysis of non-radiological substances in gaseous effluents, liquid effluents, and solid wastes from the proposed BWRX-300 modular reactor design. An explanation of exactly how they may vary from the non-radiological substances released by the reactor designs specified in the 2009 EIS would also be of special interest (other than or in addition to the chemicals from blowdown ponds for cooling or hydrazine which the 2022 EIS notes are not applicable for BWRX-300 modular reactors);
c. Any cumulative analysis of radiological and non-radiological atmospheric or liquid effluent releases from a BWRX-300 modular reactor to the local environment.

2. Comparisons of wastes and waste management practices between BWXR-300 modular reactors and those for Darlington's current reactors and reactor technologies contained in the 2009 EIS:
   a. Analysis comparing the classification of wastes (e.g. ILW or HLW) from BWRX-300 modular reactors and the current CANDU reactors operating at the Darlington site
   b. A comprehensive comparison between waste management activities required for the BWRX-300 modular reactors compared with those currently employed at the Darlington site for its existing CANDU reactors.
   c. A description of any differences in requirements for long-term waste storage between BWRX-300 used fuel and used fuel from existing CANDU reactors at the Darlington site and reactors considered in the 2009 EIS;
   d. Safety analysis of the potential impacts to human and environmental health of the higher level of activity in BWRX-300 wastes, including potential impacts relating to BWRX-300 wastes being moved from fuel bays earlier (in time) than would be the case for other reactor technologies considered in the 2009 EIS;
   e. An assessment of potential effects on groundwater or soil biota in routine waste management operations for BWRX-300 modular reactors. Further, any analysis of potential impacts on groundwater or soil biota in case of any natural accidents relating to waste management activities.

3. Construction of BWRX-300 embedded foundations:
   a. Analysis of potential environmental impacts of required mining, excavating, grading, and/or blasting activities for the 38m embedment of BWRX-300 modular reactors. A comparison of groundwater impacts of the installation of BWRX-300 modular reactors with the installation of the other reactor designs specified in the 2009 EIS is of particular interest;

   b. A comprehensive description of the composition, handling/treatment, and disposal of liquid effluent during BWRX-300 construction and installation; and
   c. Implications for stormwater management during BWRX-300 construction and installation.

4. Comparisons of cooling water designs between BWRX-300 modular reactors and those for Darlington's current reactors and reactor technologies contained in the 2009 EIS:
   a. Analysis comparing the pros and cons of having completely separated reactor coolant water and feedwater versus common reactor coolant water and feedwater, including probable environmental impacts of each design.

5. Environmental monitoring plans for the Darlington Nuclear site and potential BWRX-300 modular reactors:
   a. A description (with a map) of how many new groundwater wells will be installed and each well's location around any constructed modular BWRX-30 reactors. This should include a discussion and supporting analysis of whether the BWRX-300 units will have their own groundwater monitoring program, or whether (and how) they will be integrated with the existing groundwater monitoring plan for the Darlington site;
   b. A description (with a map) of the stormwater infrastructure that will be constructed around (or be restructured to accommodate) any installation of the modular BWRX-300 reactors. This should include how stormwater runoff from the BWRX-300 site would be monitored, and collected and channeled into drainage systems of retention ponds. It should also explain how stormwater whether any treatment methods would be applied, and if so what these methods would be.
   c. A more fulsome description of potential surface water impacts by modular BWRX-300 reactors and exactly how these effects will be monitored and mitigated. This description should go beyond the assessment of water temperature already included in EIS materials.
      i. This should also include references to studies mentioned in the EIS which were undertaken to assess impacts of changes in hydrology or surface water to specific terrestrial elements such as amphibians and reptiles, and their habitat (e.g. EIS section 5.3.4). We also request electronic copies of these studies themselves;
   d. A description of how other existing environmental monitoring plans for both radionuclides and non-radionuclides in liquid effluent, gaseous releases to air, and aquatic and terrestrial species would be integrated with measures specific to monitoring impacts of the modular BWRX-300 reactors.
      i. Note: It appears as though gaseous releases of iodine are greater for the BWRX-300 than other reactor technologies assessed in the 2009 EIS. How is this specific issue being addressed (e.g. mitigated) in OPG's plans for a BWXR-300 modular reactor?

6. What measures would be undertaken to mitigate fish impingement and entrainment in BWRX-300 intakes? EIS Table 7 (p68) notes a "Once-through-cooling porous veneer intake has been designed specifically for reducing entrainment and impingement of fish. The intake incorporates design features based on fish behavioural principles and is also located offshore at depths which are less productive than inshore locations. The expected losses will be low relative to Lake Ontario populations". Is this true for the BWRX-300 design as well, and where could we find BWRX-300-specific evaluations of the potential for fish impingement and entrainment? If this information is available in studies, we request electronic copies of them. Further:
    a. To what extent, to date, has the Department of Fisheries and Oceans and possibly Environment and Climate Change Canada assessed the BWRX-300 design for compliance (including via permit) with the *Fisheries Act*?
    b. EIS Table 7 (p67) notes mitigative efforts in the Fish Habitat Compensation Plan to ensure a minor residual adverse effect. Where could more information be found on these measures, and can we access an electronic copy of this plan?

7. The EIS asserts impacts on terrestrial and aquatic VECs posed by the BWRX-300 modular reactor design would be less significant than those posed by reactor designs considered in the 2009 EIS. Can you provide specific information or data used to support these claims (either from a more detailed EIS support document, data collected from mitigative measures, or proposed or in-place monitoring plans that assess effects on VECs)?

CATEGORY 3 – Clarifying 2022 EIS and PPE reports

We request additional clarity on the following portions of the 2022 EIS document:

8. Table 3 "Comparison of how energy is produced" (pp19, 20, 22): according to what criteria were BWRX-300 and 2009 EIS reactors designated to be "similar" in design despite the fact that "In the BWRX-300, the reactor coolant water and the feedwater are the same" while "In the EIS (Environmental Impact Statement), the reactor coolant water and the feedwater do not mix".

9. Table 4 "Project works and activities" (p24): "mobilization and preparatory works" appear to be defined as largely "clearing, grubbing, services and utilities, and on-site roads and related infrastructure". On this basis, the 19 ha area on which the BWRX-300 would be built was considered to constitute a "smaller footprint" than other reactor technologies considered in the 2009 EIS. Why was the deeper foundation embedment and related preparatory activities below ground, not included in the analysis of the construction footprint of the BWRX-300 in this table?

10. Table 6 "Summary of residual adverse effects and relevant VECs": certain cells in this table are highlighted in pink with a note that "pink shades indicate that there is

potential for a Residual Adverse Effect from BWRX-300 deployment that is different than that described in the EIS OR was not considered in the EIS". However, all the columns in the shade of pink then conclude: "Residual adverse effect not considered in the EIS". Can OPG provide more clarity on the rationale behind these decisions?

   a. Use of the qualifying words "potential" and "some" relating to environmental effects are imprecise and indicate some uncertainty. Will further clarity and verification happen in a future follow-up monitoring program, or before then?
   b. Relating to potential effects on habitat and species conservation associated with the deployment of modular BWRX-300 reactors, could you provide some clarity around which effects were anticipated to be less significant and which were not considered in the EIS?

11. Section 5.3.14 (p64) notes a decline in bank swallow burrows since 2008. How would future monitoring differentiate between this ongoing decline and impacts specific to the installation of BWRX-300 modular reactors?
    a. Further, if the loss of nesting habitat exceeds the 1000 burrow threshold, how could the potential contribution of BWRX-300 reactor operations to this trend be defined?
    b. What plans have been developed to mitigate decreasing groundwater flow to the bluffs that would disrupt bank swallow habitat?

12. EIS Table 7 (p81) notes "Five (5) residual adverse effects have been identified that require additional studies. These residual adverse effects were not considered in the EIS and are anticipated to be not significant. 1. On-site Aquatic Habitat (ponds, intermittent tributaries to Darlington Creek and to Lake Ontario, Darlington Creek, 2. VECs in the Cultural Meadow and Thicket Ecosystem,3. Wetland and Woodland Ecosystems, Rare Plant Species, Amphibians and Reptiles, Insects – Dragonflies and Damselflies, Mammal communities and species, 4. Bank swallows, 5. Bats". Since these conditions were not considered in the EIS, what is the status of the assessments? Are these studies a part of the environmental assessment follow up monitoring program and will these assessments be completed before any BWRX-300 licensing hearing before the CNSC?

13. EIS Table 4 (p25) notes, "For BWRX-300, the water intake and the discharge pipes will be sized for four reactors. The discharge pipe includes a series of diffusers from which the water is discharged to promote rapid thermal mixing in the lake". This statement raises the question of heat rejection to lake water, but a more detailed discussion of this aspect is not in the EIS. If the reliance of BWRX-300 on once-through cooling water for both primary and secondary cooling alter the overall need of water from lake, what could the impacts of rapid thermal mixing of discharge water be, and what are the advantages of choosing a design that would not use atmosphere as the ultimate heat sink? Further what will the actual size of BWRX-300 discharge pipes be? We understand they have been designed with the capacity to function for 4 modular reactors at the Darlington site.

We request additional clarity on the following portions of the 2022 PPE document:

14. B1.1, Table 1 points 1.2.1 and 1.4.1: what climate change model (if any) is being used to predict probable maximum precipitation (PMP)? What are the worst-case scenarios being used and how will the PMP accommodate heavy rainfall or potential flash flood events?

15. B1.3, Table 3, points 1.2.2: Can more analysis be provided to support how valid and conservative anticipated maximum estimates of snow and ice loads are for the root of the building housing the BWRX-300 modular reactor(s)?

16. B1.3, Table 3, points 1.4.1 and 1.4.2: Can OPG clarify what is meant by the comment, "This is a design assumption, rather than a site characteristic" relating to maximum groundwater and maximum flood descriptions?

17. B1.3, Table 3, points 4.1., 14.1.1, and 14.1.3: it is noted at these points that wet bulb (WB) temperature is not a limiting temperature. Is this explained by the phrase elsewhere that "Wet bulb temperature values are not normally collected as part of standard meteorological monitoring at the Darlington station and thus do not exist specifically for the Darlington site"? If so, why is this explanation not included in points 4.1., 14.1.1, and 14.1.3?

18. B1.4, Table 4: for all PPE parameters for which the "where used" column notes either the N/A or "not used in EIS or Site Evaluation Studies", can OPG explain the rationale for this designation? How is the exclusion of these PPE parameters justified, e.g. on the basis of redundancy, non-requirement by the CNSC or other technical reasons like prorated values? Further, how are these exclusions consistent with the criteria described in section B3.2 "Limiting factors to environmental impact"?
    a. For this same table, there are a few places in column 2 where it notes that values of PPE parameters are prorated (Y), but in column 4 exactly the same values are provided for both the single unit and the prorated value (e.g., see points 7.3.1, 9.3.2, 12.3.3). How can these same values be explained?
    b. In column 5 of the same table "where used", can you clarify if the prorated values of the PPE parameters were used for EIS and SES wherever applicable (e.g., see points 2.4.15, 2.5.15, 2.6.2, 9.5.1, 9.5.3, 10.3.1, 10.3.2, 13.4, 16.1.1 and more).
    c. Several places (e.g., see points 9.3.1, 9.3.2, 11.2.3, 12.4.3, 16.1.3, 16.1.4 and 18.4) note in the last column that "this PPE value was considered but not used in the assessment". Can you provide rationales that support this choice?

19. B1.3, Table 3 "Site parameters and Darlington characteristic values, composite table": why is there no information on the BWRX-300 modular reactor design in

this table? In the absence of BWRX-300-specific data, how can the data in this table be used for a safety assessment of the BWRX-300 design?

   a. From the table it can be noted that if a reactor's design technology is to be rated based on the number of citations as a "limiting reactor" the descending order would be EC6 < EPR < ACR-1000= AP-1000. When selecting a certain design technology, how are "limiting reactor" citations handled? How would the BWRX-300 design compare with these other four designs in the absence of information or data to ascertain the limiting reactor for several PPE parameters?

20. B1.4, Table 4 "Consolidated PPE Parameters, their values, where used, and how used": the BWRX-300 modular reactor is cited least frequently as the "limiting reactor" for 5 PPE parameters (1.1.2, 7.1.1, 7.1.3, 9.4.2 and 17.1.2). Do fewer citations indicate non-availability of data? If so, how does this affect the comparison of the BWRX-300 modular reactor design with other designs in the EIS or SESs?

APPENDIX 1: Outstanding information requests from the Darlington Waste Management Facility (DWMF) relicensing process

	Questions sent December 6, 2022	**OPG Responses, received January 17, 2023**
1.	Copy of OPG's Design Manual (this was mentioned during our meeting as the best source for calculations and methodologies OPG uses to implement CSA standards N288.1 and 288.4 at the Darlington site)	[NTP awaiting response]
2.	The best source of information (i.e. a report or other type of assessment or plan) on which OPG relies to measure shoreline conditions at the Darlington site, especially lake water levels	[NTP awaiting response]
3.	The 2021 or 2022 risk assessment used to determine groundwater monitoring frequency for wells at the Darlington site	[NTP awaiting response]
4.	A map of stormwater management infrastructure at the Darlington site	[NTP awaiting response]

	(indicating catchments and identifying connections to on-site ponds)	
5.	Does OPG perform Standard Deviation (SD) analysis (i.e. plotting or calculating SD) of its tritium monitoring data?	OPG: Currently, the trend analysis methodology employed by OPG is commensurate with the objectives of the groundwater monitoring program, the complexity of the site, the level of risk posed to receptors, and the quantity and quality of monitoring data available. Areas of the DN Site where groundwater quality is or may be influenced by the activities at site are monitored by comparing measured concentrations of the parameters of interest to their background concentrations. Parameter concentrations vs. time are plotted in graphs and are examined for any significant increase and deviation in trends.
6.	Does OPG perform Regression Analysis (RA) of its groundwater monitoring data in order to identify temporal trends over time?	OPG: Refer to answer for question 5.
7.	Does OPG perform statistical analysis to calculate Normalized Mean (NM) values for its groundwater monitoring data to capture spatial variation in sample values at the Darlington site?	OPG: Refer to answer for question 5.
8.	Does OPG conduct generic monitoring of geochemical parameters in groundwater below or around the Darlington site? In particular, are any of the following routinely sampled for: a. pH b. Eh c. T	OPG: pH, temperature, electrical conductivity, oxidation-reduction potential, dissolved oxygen, and/or turbidity are monitored in-situ during the purging of groundwater in all monitoring wells, if possible. The monitoring frequency of these field parameters differs depending on the

	d. Dissolved Oxygen e. Electric Conductivity f. Total Dissolved Solids If any of these parameters are monitored, what is their frequency? Are measurements made in-situ?	monitoring wells and are based on the sampling schedule of each individual monitoring well.
9.	Does OPG monitor for any of the following major constituents in groundwater below or around the Darlington site? Namely: a. Na b. K c. Ca d. Mg e. Si f. Li g. Sr h. Cl i. SO4 j. Br k. HCO3 If any of these parameters are monitored, what is their frequency?	OPG: The listed parameters were not included in the previous groundwater monitoring program as they were not identified as parameters of interest in the Risk Assessment Report and the Conceptual Site Model.
10.	How often does the collection and processing of condensate for the reactor building occur? Does it occur on a regular cycle? Reference for this question: DN fig 2.6 (pp.17, 2021 EMP report), *"The increases in emissions observed in 2016 and 2017 are primarily attributed to the processing and discharge of condensate from reactor building air conditioning units (ACUs) through the active liquid waste system".*	[NTP awaiting response]
11.	Were any engineering solutions implemented to minimize the frequency of leaks of refrigerant?	[NTP awaiting response]

	Reference for this question: *Release of Ozone depleting substances (pp.21, 2021 EMP report),* Leaks of the of refrigerant R134a on Jan. 28, Aug. 26 and Oct. 11 which may be a concern.	
12.	Relating to the above, the EMP report mentions "There was no observed or presumed adverse environmental impact as a result of the spill". How was this observation or assumption made? Were event reports for these instances sent to the CNSC and/or provincial MECP? (This is unclear from the 2021 event reports posted to OPG's website.)	[NTP awaiting response]
13.	Relating to hydrazine: Are there any supplemental studies you could point us to that evaluate/monitor the chronic effects of the release of hydrazine on White sucker or Brown bull head (especially early developmental stages of these fish)? Are the potential or measured effects on terrestrial plants and animals monitored/ studied?	[NTP awaiting response]
14.	Relating to ammonia: Are there any supplemental studies to evaluate/monitor the chronic/long term effects of the release of ammonia on White sucker or Brown bull head (especially early developmental stages of these fish) or other fish species of ecological relevance?	[NTP awaiting response]
15.	For *Table D4- Darlington EMP-Fruits and Vegetables – (pp. 81, 2021 EMP report)* certain receptor locations (R19, R27, and R335) have comparably higher levels of HTO and C14 than the other sites (DF9 and F18). R27 appears to have higher levels in all the 3 EMPs (2019, 2020, and 2021) and same is the case with R275	[NTP awaiting response]

	(EMP 2019, and 2020). Do these sites have higher background levels of HTO and C14? It is unclear from the report alone. Further, in *Table D8- Annual Average Drinking Water and Lake Water Concentrations –EMP reports 2019, 2020, 2021:* The receptor well-R2 appears to have high background levels of Tritium (23.8- 27.7 Bq/L)? Is this is the case? And a follow-up question: if “R” indicates a receptor location, what does “D” stand for?	
16.	Relating to #15 the above, can OPG comment on the potential for receptor locations to appear more contaminated than test sites and how this might be taken into account in monitoring activities?	OPG: On-site perimeter monitoring wells are sampled on a regular basis. Sampling frequency will be increased when an abnormal level of parameters is detected in receptor locations to confirm if there is truly an increase in parameter concentrations.
17.	Does the variation in contamination of milk measured around nuclear sites call for more frequent supplemental studies or can these year-to-year variations be incorporated satisfactorily by the probabilistic models? Reference for this question: *Section 3.3.3.2- Milk and Animal Feed (pp. 33, 2021 EMP report): “The annual average HTO and C-14 in milk measurements around the nuclear sites vary from year to year due to changes in prevailing winds, emissions, humidity, cow’s diet, feed sources, and water sources”.*	[NTP awaiting response]
18.	Can you clarify whether the values for HTO in eggs reflect actual low levels that are hard to detect with monitoring equipment or whether they are meant to express high uncertainty?	[NTP awaiting response]

	Reference for this question: *Tables D-7, Annual Average Concentrations in Eggs, and Poultry – 2019 (EMP reports 2019,2020 and 2021):* The HTO in eggs is increasing slightly. It is hard to know whether there is a challenge detecting the small amounts or whether there is high uncertainty as the values are more than LC but less then LD.	
19.	*Table A7:* The 2020 DNGS ERA mentions excessive concentrations of lead were found in the radioactive liquid waste (RLW), and it is mentioned that this would have no impact on the lead concentration in the condenser cooling water and initial mixing zone. Can OPG confirm that same is true for excessive concentrations of Lithium in the RLW?	[NTP awaiting response]
20.	Are there plans for monitoring both total Ammonia (N) and total unionized ammonia in light of Environmental Study levels? Reference for this question: *Table A-10: Ecological Screening Criteria for Surface Water COPCs.* According to CCME CWQG the acceptable limit of total Ammonia (N) and total unionized ammonia are 0.044 and 0.019 mg/L (Selected Ecological Screening Criteria) and the 95th Percentile Background, 2019 Environmental Study levels were 0.01 and 0.2 mg/L.	[NTP awaiting response]
21.	Can you clarify or provide more evidence to support assumptions of people's movements when calculating exposure averages? Reference *Table 3-26 and 3-27 (DNGS ERA-2020): "for hydrazine the risk*	[NTP awaiting response]

	exceeds the associated target value. Incremental Lifetime Cancer Risks> 1E-06, HQ > 0.2. This is estimated for adult urban resident receptors at Oshawa/Courtice, Bowmanville and for campers in Table 3-26 and for sport fisher and campers in Table 3-27. However, the statement *“since people tend to average their exposure by spending time in various locations, the maximum is not considered representative of long-term exposure and results should be interpreted based on the UCLM”* gives a notion that these values are an overestimation of risk.	
22.	In Table A-15 of the DNGS-ERA 2020, the units are noted as “micrograms/s”. Is this indicating micrograms per second or does the "s" stand for something else?	[NTP awaiting response]

Information requests from Nuclear Transparency Project (NTP) specific to the Darlington New Nuclear Project

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Document Requested	OPG Response
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WSP Golder, "Hydrology Memo to Assess Water Balance of Surface Water Features for the Darlington New Nuclear Project"	Document provided in attachment
WSP Golder, "Groundwater Modelling to Assess Effects from Construction-Related Dewatering for Darlington New Nuclear Project"	Document provided in attachment
OPG, "Darlington New Nuclear Project Commitments Report" (is this the most recent version and/or the version of this report being relied on for OPG's licensing application: https://archive.opg.com/pdf_archive/Nuclear%20Licencing%20Documents/Darlington%20New%20Nuclear/Commitments_Report.pdf);	Provided in email from Jesara Mar 13, 2023
OPG, "DNNP Site Evaluation Update Summary Report"	Document provided in attachment
OPG, "BWRX-300 Darlington New Nuclear Project Preliminary Safety Analysis Report" (is this the most recent version and/or the version of this report being relied on for OPG's licensing application: https://www.opg.com/documents/dnnp-bwrx-300-preliminary-safety-analysis-report-pdf/; and	Provided in email from Jesara Mar 13, 2023
Any draft environmental assessment follow-up monitoring program for BWRX-300 modular reactors, should they be approved for construction at the Darlington Nuclear site.	Provided in email from Jesara Mar 13, 2023

CATEGORY 2 – Additional information

There are six broad areas in which we require more information than is contained in either the 2022 EIS or PPE documents. These have been summarized in the enumerated list below. Some of this information may be contained in the reports we requested above. If this is the case, please let us know. If the requested information below is contained in reports we have not yet requested, please provide those additional reports for our reference.

1. Constituents of Potential Concern specific to the BWRX-300 modular reactor design:	**OPG Response**
a. Descriptions and analysis of the specific content and types of radionuclides in gaseous effluents, liquid effluents, and solid wastes from the proposed BWRX-300 modular reactor design. We are interested in descriptions that include analysis of applicable radionuclides that include their respective half-lives and chemical, biological, and environmental properties and pharmacokinetic profiles. Further, an explanation of exactly how they may vary from the radionuclides released by the reactor designs specified in the 2009 EIS would also be of special interest;	This information is provided in the following: • A discussion of gaseous airborne releases (Section 20.13 of the PSAR and Table 20.13). • A discussion of liquid effluent releases (Section 20.14 of the PSAR and Table 20.14-1). • A comparison of airborne releases, and liquid releases between the BWRX-300 and the bounding scenario reactors assessed in the EIS (Section 5.5.7 of the EIS Review Supporting Document.) • A similar comparison for solid radioactive waste (Table 5-25 of the EIS Review Supporting Document). • The effects of radioactive releases to the atmosphere and surface water (Section 5.5.7 of the EIS Review Supporting Document).
b. Descriptions and analysis of non-radiological substances in gaseous effluents, liquid effluents, and solid wastes from the proposed BWRX-300 modular reactor design. An explanation of exactly how they may vary from the non-radiological substances released by the reactor designs specified in the 2009 EIS would also be of special interest (other than or in addition to the chemicals from blowdown ponds for cooling or hydrazine which the 2022 EIS notes are not applicable for BWRX-300 modular reactors);	Information on non-radiological releases from the deployment of the BWRX-300 are provided in Section 20.8.4 and Table 2.4-1 of the PSAR. The effects of non-radiological releases to air and water on non-human biota is provided in Section 5.5.14.4 of the EIS Review Supporting Document.
c. Any cumulative analysis of radiological and non-radiological atmospheric or liquid effluent releases from a BWRX-300 modular reactor to the local environment.	Chapter 5.8 of the EIS Review Supporting Document describes the assessment of cumulative environmental effects. Sections 5.8.1 to 5.8.5 summarize the cumulative effects of BWRX-300 deployment in comparison with those assessed in the 2009 EIS.

2. Comparisons of wastes and waste management practices between BWXR-300 modular reactors and those for Darlington's current reactors and reactor technologies contained in the 2009 EIS:	**OPG Response**
a. Analysis comparing the classification of wastes (e.g. ILW or HLW) from BWRX-300 modular reactors and the current CANDU reactors operating at the Darlington site	The waste classification for the BWRX-300 will follow CSA N292.0, which is the same as the CANDU reactor at the Darlington site.
b. A comprehensive comparison between waste management activities required for the BWRX-300 modular reactors	The BWRX-300 used fuel will follow the same basic waste management activities as are employed at the existing Darlington site: following a period of wet storage in the used fuel

compared with those currently employed at the Darlington site for its existing CANDU reactors.	pool, the used fuel is transferred to dry storage containers and placed in appropriate storage facilities. The L&ILW will be processed on-site and stored or otherwise managed in appropriate facilities either on-site or shipped to OPG licensed off-site facilities. OPG's Nuclear Sustainability Services – Western Waste Management Facility currently receives and manages such waste from existing OPG nuclear generating stations.
c. A description of any differences in requirements for long-term waste storage between BWRX-300 used fuel and used fuel from existing CANDU reactors at the Darlington site and reactors considered in the 2009 EIS;	The general requirements for used fuel storage of BWRX-300 and CANDU are the same. Due to differences between the fuel of the BWRX-300 and the fuel from the existing CANDU reactors, different dry storage containers will be needed for the BWRX-300 fuel. These canisters will have the same function as the existing CANDU dry storage containers to safely contain the fuel and will be chosen from the various dry storage containers for boiling water reactor fuel used worldwide. For long-term storage, the BWRX-300 fuel can be stored consistent with what is described in the 2009 EIS (i.e., in waste storage buildings or outdoors on concrete pads). OPG is working with NWMO to ensure the plans for a DGR incorporate the design of the GNF2 fuel from the BWRX-300.
d. Safety analysis of the potential impacts to human and environmental health of the higher level of activity in BWRX-300 wastes, including potential impacts relating to BWRX-300 wastes being moved from fuel bays earlier (in time) than would be the case for other reactor technologies considered in the 2009 EIS;	When compared to the assessment from the 2009 EIS, the solid waste generated by the operation of the BWRX-300 has less radioactivity annually (Bq/year), the same principal radionuclides, and less annual volume. Section 5.7.3 of the EIS Review Supporting Document provides a discussion on postulated radiological and transportation malfunctions and accidents involving solid waste. The effect of the activity in BWRX-300 wastes is assessed in Section 5.7.3.1 of the EIS Review Supporting Document, and supports the conclusion there are no significant adverse effects. For used fuel, the dose consequences due to higher activity will be managed through appropriate cask selection and shielding design.
e. An assessment of potential effects on groundwater or soil biota in routine waste management operations for BWRX-300 modular reactors. Further, any analysis of potential impacts on groundwater or soil biota in case of any natural accidents relating to waste management activities.	As stated in the 2009 EIS construction-related waste will be sent to appropriately licensed off site waste management facilities for disposal or recycling (section 2.5.11, 2009 EIS). The generation of non-radioactive (i.e., conventional) wastes will be minimized to the extent practicable through re-use and recycling programs. All residual waste (i.e., that remaining after diversion programs) will be collected regularly by licensed contractors and transferred to appropriately licensed off-site disposal facilities and no waste disposal facilities will be established on the DN site (section 2.6.13, 2009 EIS). The management of construction waste and conventional waste is not predicted to interact with the ground water environment or non-human biota. Nuclear waste and used fuel transportation, processing and storage postulated accidents are discussed in section 5.7.3.1 of the EIS Review Supporting Document.

3. **Construction of BWRX-300 embedded foundations:**	**OPG Response**
a. Analysis of potential environmental impacts of required mining, excavating, grading, and/or blasting activities for the 38m embedment of BWRX-300 modular reactors. A comparison of groundwater impacts of the installation of BWRX-300 modular reactors with the installation of the other reactor designs specified in the 2009 EIS is of particular interest;	The requested analysis is provided in Section 5.5.6 of the EIS Review Supporting Document.
b. A comprehensive description of the composition, handling/treatment, and disposal of liquid effluent during BWRX-300 construction and installation; and	Refer to Section 5.3 Surface Water Environment of the EIS (NK-054-REP-07730-00029). Management of conventional releases in liquid effluent during construction will be addressed through compliance with applicable regulatory requirements and a Ministry of Environment, Conservation and Parks (MECP) Environment Compliance Approval, as applicable. The project will be in compliance with testing, monitoring, and discharge limits as well as volume.
c. Implications for stormwater management during BWRX-300 construction and installation.	Refer to Section 2.5.9 Management of Stormwater in the EIS (NK-054-REP-07730-00029) for this information. Management of storm water will be in compliance with applicable regulatory requirements and a Ministry of Environment, Conservation and Parks (MECP) Environment Compliance Approval, as applicable.

4. **Comparisons of cooling water designs between BWRX-300 modular reactors and those for Darlington's current reactors and reactor technologies contained in the 2009 EIS:**	**OPG Response**
a. Analysis comparing the pros and cons of having completely separated reactor coolant water and feedwater versus common reactor coolant water and feedwater, including probable environmental impacts of each design.	The EIS Review Report (NK054-REP-07730-00055, has confirmed the environmental impacts of the BWRX-300 are bounded by the approved EIS. The boiling water reactor design has a single coolant loop for the reactor and turbine. This simplification eliminates the need for a steam generator, results in less components to maintain, and generally results in higher thermal efficiency. With primary coolant entering the turbine, shielding and associated radiological monitoring and controls are required in the turbine area of the facility when the unit is operating. Turbine maintenance during outages also requires radiological considerations. The probable environmental impacts of the BWRX-300 design are outlined in the EIS Review Report, and as mentioned above, bounded by the approved EIS.

5. **Environmental monitoring plans for the Darlington Nuclear site and potential BWRX-300 modular reactors:**	**OPG Response**
a. A description (with a map) of how many new groundwater wells will be installed and each well's location around any constructed modular BWRX-30 reactors. This should include a discussion and supporting analysis of whether the BWRX-300 units will have their own groundwater monitoring program, or whether (and how) they will be integrated with the existing groundwater monitoring plan for the Darlington site;	The DNNP Environmental Monitoring and Environmental Assessment Follow up (EMEAF) Program includes a groundwater monitoring component. The EMEAF details the monitoring or assessment activities to be undertaken to confirm the predictions of environmental effects identified in the environmental assessment and to determine the effectiveness of mitigation measures. The follow-up groundwater monitoring program applies to the groundwater monitoring wells network within the DNNP site boundary and remains compliant with CSA N288.7.
b. A description (with a map) of the stormwater infrastructure that will be constructed around (or be restructured to accommodate) any installation of the modular BWRX-300 reactors. This should include how stormwater runoff from the BWRX-300 site would be monitored and collected and channeled into drainage systems of retention ponds. It should also explain how stormwater whether any treatment methods would be applied, and if so what these methods would be.	The stormwater infrastructure design is in progress. Stormwater management will be addressed through compliance with applicable regulatory requirements and a Ministry of Environment, Conservation and Parks (MECP) Environment Compliance Approval, as applicable. OPG has conducted a Flood Hazard assessment of the BWRX-300 site. The results of this assessment are summarized in Chapter 2 Section 2.5 Hydrology in the Preliminary Safety Analysis Report (PSAR).
c. A more fulsome description of potential surface water impacts by modular BWRX-300 reactors and exactly how these effects will be monitored and mitigated. This description should go beyond the assessment of water temperature already included in EIS materials. i. This should also include references to studies mentioned in the EIS which were undertaken to assess impacts of changes in hydrology or surface water to specific terrestrial elements such as amphibians and reptiles, and their habitat (e.g. EIS section 5.3.4). We also request electronic copies of these studies themselves;	Potential surface water impacts resulting from the BWRX-300 deployment are detailed in Section 5.5.3 of the EIS Supporting Document. Potential effects to the terrestrial environment resulting from hydrological changes are detailed in Section 5.5.5 of the EIS Supporting Document. OPG has an Environmental Monitoring and Environmental Assessment Follow up (EMEAF) Program that details the monitoring or assessment activities to be undertaken to confirm the predictions of environmental effects.
d. A description of how other existing environmental monitoring plans for both radionuclides and non-radionuclides in liquid effluent, gaseous releases to air, and aquatic and terrestrial species would be integrated with measures specific to monitoring impacts of the modular BWRX-300 reactors. i. Note: It appears as though gaseous releases of iodine are greater for the BWRX-300 than other reactor technologies assessed in the 2009 EIS. How is this specific issue being addressed (e.g. mitigated) in OPG's plans for a BWXR-300 modular reactor?	OPG has an Environmental Monitoring and Environmental Assessment Follow up (EMEAF) Program that details the monitoring or assessment activities to be undertaken to confirm the predictions of environmental effects. The total emissions to the atmosphere from the BWRX-300 are lower than reactor technologies considered in the EIS. Although the assessment of atmospheric emissions of iodine are slightly higher in the report, the dose from iodine is low. It should also be noted that the Iodine values were calculated using Industry Standards (NEDO-10871) that assume a conservative number of fuel failures in the reactor.

	OPG Response
6. What measures would be undertaken to mitigate fish impingement and entrainment in BWRX-300 intakes? EIS Table 7 (p68) notes a "Once-through-cooling porous veneer intake has been designed specifically for reducing entrainment and impingement of fish. The intake incorporates design features based on fish behavioural principles and is also located offshore at depths which are less productive than inshore locations. The expected losses will be low relative to Lake Ontario populations". Is this true for the BWRX-300 design as well, and where could we find BWRX-300-specific evaluations of the potential for fish impingement and entrainment? If this information is available in studies, we request electronic copies of them. Further:	The requirements for the once-through cooling system and its ability to mitigate fish impingement and entrainment is independent of the reactor technology. OPG has updated the impingement and entrainment analysis for the BWRX-300 and has confirmed it is within the conclusions of the approved EIS as described in the EIS Review Report (NK054-REP-07730-00055)
a. To what extent, to date, has the Department of Fisheries and Oceans and possibly Environment and Climate Change Canada assessed the BWRX-300 design for compliance (including via permit) with the Fisheries Act?	The design of the once through cooling system is in progress. Applicable regulatory requirements will be complied with and addressed through applicable permits, including engagement with Fisheries and Oceans Canada and Environment and Climate Change Canada.
b. EIS Table 7 (p67) notes mitigative efforts in the Fish Habitat Compensation Plan to ensure a minor residual adverse effect. Where could more information be found on these measures, and can we access an electronic copy of this plan?	The Fish Habitat Compensation Plan is dependent on the once through cooling system design and shoreline protection. When the design is finalized the compensation plan will be developed to support the Fisheries Act Authorization application to the Department of Fisheries and Oceans (DFO).

	OPG Response
7. The EIS asserts impacts on terrestrial and aquatic VECs posed by the BWRX-300 modular reactor design would be less significant than those posed by reactor designs considered in the 2009 EIS. Can you provide specific information or data used to support these claims (either from a more detailed EIS support document, data collected from mitigative measures, or proposed or in-place monitoring plans that assess effects on VECs)?	Detailed descriptions of the potential impacts on terrestrial and aquatic VECS are found in Sections 5.5.5, 5.5.5 and 5.9 of the EIS Supporting Document. Terrestrial and aquatic VECs are included in the DNNP Environmental Monitoring and Environmental Assessment Follow up (EMEAF) plan to confirm the predictions of environmental effects identified in the environmental assessment and to determine the effectiveness of mitigation measures.

CATEGORY 3 – Clarifying 2022 EIS and PPE reports

We request additional clarity on the following portions of the 2022 EIS document:	OPG Response
8. Table 3 “Comparison of how energy is produced” (pp19, 20, 22): according to what criteria were BWRX-300 and 2009 EIS reactors designated to be “similar” in design despite the fact that “In the BWRX-300, the reactor coolant water and the feedwater are the same” while “In the EIS (Environmental Impact Statement), the reactor coolant water and the feedwater do not mix”.	The single or separate cooling loop does not impact any EIS conclusions. Furthermore, as shown in Section 4.0 of the EIS Review, the vast majority of BWRX-300 design parameters are within the original PPE values. The effects of those BWRX-300 parameters that fall outside of their respective PPE values were assessed and their effects remain consistent with the conclusions of the EIS.
9. Table 4 “Project works and activities” (p24): “mobilization and preparatory works” appear to be defined as largely “clearing, grubbing, services and utilities, and on-site roads and related infrastructure”. On this basis, the 19 ha area on which the BWRX-300 would be built was considered to constitute a “smaller footprint” than other reactor technologies considered in the 2009 EIS. Why was the deeper foundation embedment and related preparatory activities below ground, not included in the analysis of the construction footprint of the BWRX-300 in this table?	The footprint refers to the surface area of the facility. The deeper foundation embedment has been assessed separately in Section 4.1.2 of the EIS Review.
10. Table 6 “Summary of residual adverse effects and relevant VECs”: certain cells in this table are highlighted in pink with a note that “pink shades indicate that there is potential for a Residual Adverse Effect from BWRX-300 deployment that is different than that described in the EIS OR was not considered in the EIS”. However, all the columns in the shade of pink then conclude: “Residual adverse effect not considered in the EIS”. Can OPG provide more clarity on the rationale behind these decisions? a. Use of the qualifying words “potential” and “some” relating to environmental effects are imprecise and indicate some uncertainty. Will further clarity and verification happen in a future follow-up monitoring program, or before then? b. Relating to potential effects on habitat and species conservation associated with the deployment of modular BWRX-300 reactors, could you provide some clarity around which effects were anticipated to be less significant and which were not considered in the EIS?	The reactors considered in the EIS required a much larger footprint, hence the removal of all terrestrial habitats on the DNNP site were assumed in the EIS and their residual adverse effect did not need to be considered at that time. The BWRX-300 requires a smaller footprint, as such opportunities to preserve some terrestrial habitats exist but need to be explored to confirm the feasibilities of such reservation and the potential residual adverse effect. Where it was noted that further study was required to assess effects to habitats that may be retained due to the smaller scale of the DNNP, these studies have been completed since the completion of the EIS review report and are reflected in the EIS Review Supporting Document NK054-REP-07730-00058.
11. Section 5.3.14 (p64) notes a decline in bank swallow burrows since 2008. How would future monitoring differentiate between this ongoing decline and impacts specific to the installation of BWRX-300 modular reactors? a. Further, if the loss of nesting habitat exceeds the 1000 burrow threshold, how could the potential contribution of BWRX-300 reactor operations to this trend be defined?	As noted in the question, the decline of bank swallow burrows is well documented. Natural forces, such as groundwater and erosion, constantly erode the face of shoreline embankments and effect habitat contained within them. (EIS section 8.4.3 (NK054-REP-07730-00029). The DNNP environmental monitoring and EA follow-up program details the monitoring to verify predictions of the environmental effects identified in the environmental assessment, and to determine the effectiveness of mitigation measures. This includes monitoring for

b. What plans have been developed to mitigate decreasing groundwater flow to the bluffs that would disrupt bank swallow habitat?	effects on bank swallows. This EIS Review concluded that the EA follow-up and monitoring programs remain suitable for BWRX-300 deployment. OPG continues to monitor the Bank Swallow colonies on an annual basis at both the Bank Swallow Evaluation Area which includes the Darlington site, as well as a reference location at Bond Head bluffs. As bank Swallows and their habitat are protected under the provincial Endangered Species Act, measures to mitigate impacts to Bank Swallows from the Project will be addressed through an Endangered Species Act (ESA) permit issued by the Ministry of Environment, Conservation, and Parks, as applicable. Any effect on groundwater during the construction is expected to be temporary.
12. EIS Table 7 (p81) notes “Five (5) residual adverse effects have been identified that require additional studies. These residual adverse effects were not considered in the EIS and are anticipated to be not significant. 1. On-site Aquatic Habitat (ponds, intermittent tributaries to Darlington Creek and to Lake Ontario, Darlington Creek, 2. VECs in the Cultural Meadow and Thicket Ecosystem,3. Wetland and Woodland Ecosystems, Rare Plant Species, Amphibians and Reptiles, Insects – Dragonflies and Damselflies, Mammal communities and species, 4. Bank swallows, 5. Bats”. Since these conditions were not considered in the EIS, what is the status of the assessments? Are these studies a part of the environmental assessment follow up monitoring program and will these assessments be completed before any BWRX-300 licensing hearing before the CNSC?	Additional studies on groundwater, hydrology, noise, dust, and vibration (from blasting) were completed following the submission of the EIS Review Report. The results of the studies are provided in the EIS Review Supporting Document and confirm that any residual effects do not alter the conclusion of the EIS.
13. EIS Table 4 (p25) notes, “For BWRX-300, the water intake and the discharge pipes will be sized for four reactors. The discharge pipe includes a series of diffusers from which the water is discharged to promote rapid thermal mixing in the lake”. This statement raises the question of heat rejection to lake water, but a more detailed discussion of this aspect is not in the EIS. If the reliance of BWRX-300 on once-through cooling water for both primary and secondary cooling alter the overall need of water from lake, what could the impacts of rapid thermal mixing of discharge water be, and what are the advantages of choosing a design that would not use atmosphere as the ultimate heat sink? Further what will the actual size of BWRX-300 discharge pipes be? We understand they have been designed with the capacity to function for 4 modular reactors at the Darlington site.	The EIS considered both atmosphere (cooling tower) and lake water (once through cooling) as a heat sink. OPG has completed commitment D-C-1.1 to conduct a Best Available Technology Economically Achievable (BATEA) assessment for once through cooling and mechanical draft cooling towers, which concluded a once through cooling system was the BATEA technology. The CNSC accepted that this assessment addressed the Joint Review Panel action and closed the commitment. OPG has updated the thermal plume analysis for the BWRX-300 and has confirmed it is bounded by the approved EIS as mentioned in the EIS Review Report (NK054-REP-07730-00055). The current design of the discharge tunnel is approximately 6m in diameter. The diffusers are approximately 60cm in diameter.

We request additional clarity on the following portions of the 2022 PPE document:	OPG Response
14. B1.1, Table 1 points 1.2.1 and 1.4.1: what climate change model (if any) is being used to predict probable maximum precipitation (PMP)? What are the worst-case scenarios being used and how will the PMP accommodate heavy rainfall or potential flash flood events?	The PMP value in the PPE is taken from Table A.4 in Appendix A of the Lakes and Rivers Improvement Act Technical Guidelines (OMNR, 2004). The values provided in Lakes and Rivers Improvement Act Technical Guidelines do not incorporate any climate change modelling to OPG's knowledge. However, the value for PMP selected for the DNNP site is considered by OPG to be conservative even when accounting for potential effects of climate change. As part of commitment D-C-7 (see NK054-REP-01210-00078, DNNP Commitments Report), OPG has undertaken a systematic approach to assess the resiliency of the proposed facility against the effects of climate change. OPG has assessed projected future conditions for the site, to the extent practical, using regional downscaled multi-model ensembles constructed from several global climate models (GCMs). OPG has assessed data from these models for two Representative Concentration Pathway (RCP) scenarios, RCP4.5 and RCP8.5. The results of these assessments have shown that the predicted extreme rainfall amounts for a 12-hour period are projected to be well below the OPG PMP identified in the PPE for both RCP4.5 and RCP8.5. OPG has used the PMP value along with other data to conduct a Flood Hazard assessment of the facility for a variety of extreme and combination of extreme events. The results of these assessments are summarized in Chapter 2 Section 2.5 Hydrology in the Preliminary Safety Analysis Report (PSAR).
15. B1.3, Table 3, points 1.2.2: Can more analysis be provided to support how valid and conservative anticipated maximum estimates of snow and ice loads are for the root of the building housing the BWRX-300 modular reactor(s)?	Table 3 parameter 1.2.2, snow and ice load, shows the limiting value (3 kPa), limiting reactor (EC6) and the Darlington site characteristic (2.2 kPa from the NBCC). The BWRX-300 is not the limiting reactor for this parameter. The BWRX-300 will follow the appropriate codes and standards for roof design for the applicable site snow load.
16. B1.3, Table 3, points 1.4.1 and 1.4.2: Can OPG clarify what is meant by the comment, "This is a design assumption, rather than a site characteristic" relating to maximum groundwater and maximum flood descriptions?	The phrase is noting that the parameters are a simplifying assumption rather than a specific modeled site characteristic. In the example, 1.4.2 'maximum groundwater' is simplified to a conservative limiting value of –1m from plant grade.
17. B1.3, Table 3, points 4.1., 14.1.1, and 14.1.3: it is noted at these points that wet bulb (WB) temperature is not a limiting temperature. Is this explained by the phrase elsewhere that "Wet bulb temperature values are not normally collected as part of standard meteorological monitoring at the Darlington station and thus do not exist specifically for the Darlington site"? If so, why is this explanation not included in points 4.1., 14.1.1, and 14.1.3?	The quoted statement (from parameter 2.1.2) is noting the source of the wet bulb temperature used for that site characteristic. The note for other parameters, which are dry bulb temperatures, is noting that the wet bulb is not limiting to the shown dry bulb value.
18. B1.4, Table 4: for all PPE parameters for which the "where used" column notes either the N/A or "not used in EIS or Site Evaluation Studies", can OPG explain the rationale for this	The PPE was developed consistent with the Nuclear Energy Institute (NEI) guidance on a PPE. The initial version of the PPE was also developed in parallel with the Environmental Impact Statement (EIS) and Site Evaluation (SE) work.

designation? How is the exclusion of these PPE parameters justified, e.g. on the basis of redundancy, non-requirement by the CNSC or other technical reasons like prorated values? Further, how are these exclusions consistent with the criteria described in section B3.2 “Limiting factors to environmental impact”? a. For this same table, there are a few places in column 2 where it notes that values of PPE parameters are prorated (Y), but in column 4 exactly the same values are provided for both the single unit and the prorated value (e.g., see points 7.3.1, 9.3.2, 12.3.3). How can these same values be explained? b. In column 5 of the same table “where used”, can you clarify if the prorated values of the PPE parameters were used for EIS and SES wherever applicable (e.g., see points 2.4.15, 2.5.15, 2.6.2, 9.5.1, 9.5.3, 10.3.1, 10.3.2, 13.4, 16.1.1 and more). c. Several places (e.g., see points 9.3.1, 9.3.2, 11.2.3, 12.4.3, 16.1.3, 16.1.4 and 18.4) note in the last column that “this PPE value was considered but not used in the assessment”. Can you provide rationales that support this choice?	Upon review of the completed EIS, SE and supporting documents, it was confirmed that several parameters were not used in these documents and had no impact on the environmental effects and conclusions. It was decided to note these parameters as “Not used in EIS or Site Evaluations studies” but maintain them in the PPE. Section B3.2 illustrates some types of parameters which are limiting factors to Environmental Impact. Answers to bullets as follows: a. For several parameters it would be contrary to the applicable regulations to prorate the parameter. For example, parameter 9.3.2 is a CNSC dose limit and would be applicable to the licensed facility. b. All prorated values were used in the EIS and SE as noted in the “where used” and “how used” columns. c. When conducting the review mentioned above, several parameters were mentioned in the EIS but not used in the assessment of environmental effects. This note was used for parameters that met this criteria.
19. B1.3, Table 3 “Site parameters and Darlington characteristic values, composite table”: why is there no information on the BWRX-300 modular reactor design in this table? In the absence of BWRX-300-specific data, how can the data in this table be used for a safety assessment of the BWRX-300 design? a. From the table it can be noted that if a reactor’s design technology is to be rated based on the number of citations as a “limiting reactor” the descending order would be EC6 < EPR < ACR-1000= AP-1000. When selecting a certain design technology, how are “limiting reactor” citations handled? How would the BWRX-300 design compare with these other four designs in the absence of information or data to ascertain the limiting reactor for several PPE parameters?	Each parameter is defined as a minimum or maximum value. The parameter value and limiting reactor is assigned based on the maximum or minimum value for all reactor technologies under consideration. The other reactor technologies will be bounded by that limiting reactor. The BWRX-300 does not appear in Table 3 as a limiting reactor, as it was not the bounding value for any of the site characteristics presented in this table.
20. B1.4, Table 4 “Consolidated PPE Parameters, their values, where used, and how used”: the BWRX-300 modular reactor is cited least frequently as the “limiting reactor” for 5 PPE parameters (1.1.2, 7.1.1, 7.1.3, 9.4.2 and 17.1.2). Do fewer citations indicate non-availability of data? If so, how does this affect the comparison of the BWRX-300 modular reactor design with other designs in the EIS or SESs?	Any parameter where the BWRX-300 was the limiting technology was updated to reflect the new value and the limiting reactor updated to the BWRX-300.

Radiation Safety Institute of Canada
Institut de radioprotection du Canada

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Review of the Environmental Impact Statement and Plant Parameter Envelope for Ontario Power Generation's Darlington New Nuclear project

for

Canadian Nuclear Safety Commission
(Reference Form number: *PFP 2022 DNNP-02*)

by

Radiation Safety Institute of Canada

Radiation Safety Institute of Canada
Institut de radioprotection du Canada

Report Date: 19 March 2023

Submitted to:

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Contents

1 Introduction

1.1 About the Radiation Safety Institute of Canada

Founded in 1980, the Radiation Safety Institute of Canada (RSIC) is an independent, national organization dedicated to promoting and advancing radiation safety in the workplace, in the environment, and in the community. Our commitment to the principle of “good science in plain language” ® underpins everything we do. The Radiation Safety Institute of Canada is incorporated under federal statute as a not-for-profit corporation and is also a registered charity (number: 106861511RR001).

The Radiation Safety Institute of Canada offers a broad range of educational, technical, and scientific services to businesses, government organizations, healthcare providers, communities, and individuals across Canada and around the world. The Institute is known for the high quality and scientific integrity of its work, and the practical and helpful assistance of its staff. The Institute’s independent information service receives hundreds of calls and e-mails every year, for information and assistance on workplace radiation questions.

1.2 Purpose of this Submission

The *Radiation Safety Institute of Canada* (RSIC) applied for funding through CNSC’s Participant Funding Program (PFP). RSIC agreed to participate in the CNSC’s proceedings, while completing two objectives: (1) review Ontario Power Generation’s plant parameter envelope (PPE), environmental impact statement (EIS), and related documentation, and conduct analysis and (2) submit a written report to the CNSC (Canadian Nuclear Safety Commission) summarizing comments from the review of the EIS and PPE. The deadline for submission of the written report is 20 March 2023.

1.3 Safety Considerations

Small Modular Reactors (SMRs) are a type of nuclear power technology that is smaller in size compared to traditional large-scale nuclear reactors. They may offer several potential benefits such as increased safety, modularity, and flexibility. However, like any nuclear technology, safety is a crucial consideration in the deployment of SMRs.

Radiation safety in SMRs should be ensured through a combination of design features, program requirements, operational procedures, and regulatory oversight. SMRs use passive safety systems that rely on natural phenomena such as gravity, convection, and radiation to maintain safe conditions in the event of an emergency, reducing the need for active interventions such as pumps or valves.

However, the deployment of SMRs requires thorough testing and evaluation to ensure their safety and performance. As any nuclear technology, Small Modular Reactors (SMRs) have certain safety concerns that need to be considered. Some of the key safety concerns with SMRs may include:

- Cybersecurity: SMRs rely on complex digital systems to control their operation, which could make them vulnerable to cyber-attacks. Ensuring the cybersecurity of these systems is crucial to prevent unauthorized access and potential malfunctions.
- Fuel handling and storage: SMRs use enriched nuclear fuel to generate power, which can be highly radioactive and pose a risk if not handled and stored properly. Ensuring the safe handling, transport, storage, and use of enriched nuclear fuel is a key safety concern in the deployment of SMRs.
- Accident scenarios: While SMRs have design features that aim to increase safety, it is still important to consider potential accident scenarios and evaluate the potential consequences of such events.
- Emergency planning and response: in the event of an emergency, SMRs require a well-prepared and coordinated response to minimize the impact of the event. Ensuring that adequate emergency plans and response capabilities are in place is a key safety concern.
- Regulatory oversight: the deployment of SMRs is regulated in Canada by the Canadian Nuclear Safety Commission, which plays a crucial role in ensuring their safety and performance. Ensuring that the regulatory framework is robust and effective is key.

It is important to note that these safety concerns are not unique to SMRs, and similar considerations apply to traditional large-scale nuclear reactors, but the novel design features of SMRs do require additional attention to these issues to ensure their safe deployment and operation. RSIC is continuously looking for ways to add value to the safety conversation in this area.

1.4 Project Background

OPG provides information on their intentions with respect to the new nuclear power plant installation, a Small Modular Reactor (SMR) at:

https://www.opg.com/powering-ontario/our-generation/nuclear/darlington-nuclear/darlington-new-nuclear/

"*Darlington New Nuclear Project is leading the way in the advancement of Small Modular Reactor (SMR) technology in Canada – the future of nuclear power generation. SMRs, like existing nuclear reactors, are designed to provide reliable, low-carbon electricity, but with a much smaller land footprint. Low-carbon energy from SMRs is a key pillar in OPG's Climate Change Plan which will assist OPG's efforts to become a net-zero carbon company by 2040 and Ontario's aim to become a net-zero economy by 2050. OPG and our partners are working* *together to deploy Canada's first grid-scale, 300-MW SMR at the Darlington site. The preliminary schedule is to complete the construction of the reactor by 2028 with commercial operation in 2029. The Darlington site is the only site in Canada currently licensed for a new nuclear build with an accepted environmental assessment and Site Preparation Licence.*"

The CNSC has offered an opportunity for interested stakeholders to bring information to the Commission regarding the PPE and EIS. RSIC has responded to this opportunity through this review of the PPE and EIS documents.

2 Review of Plant Parameters Envelope (PPE) Document

It is important to note that the PPE document in question was not *originally specifically* prepared for the proposed SMR project at the Darlington site. OPG and its partners initially developed a "Plant Parameters Envelope" (PPE) in 2008. The PPE was developed to provide input to an Environmental Assessment (EA) for the Darlington New Nuclear Project (DNNP), as described in the Project Description for the Site Preparation, Construction and Operation of the Darlington New Nuclear Generating Station. The proposed 2008 development involved the construction and operation of four nuclear reactor units supplying up to 4,800 Megawatts (MWe). At the time of the original submission, the consideration did not envision Small Modular Reactor technology deployment at the site.

The above note is important as the goal of the initial project has altered – originally, the intent was to supply a significant amount of baseload power to Ontario's power grid, via the installation of full-scale power reactors. However, it appears that the project's objective has since shifted towards exploring whether Small Modular Reactors (SMRs) can serve as a valuable source of power for Canada."

The original PPE was developed to assist in evaluating the safety and environmental effects of the multiple reactor designs being considered for the site at that time. PPEs have been previously used in the United States to assist in obtaining regulatory approval for site preparation before a final reactor design was determined. In the case at hand, the SMR final reactor design has been chosen (i.e., the BWRX-300), but this was not one of the original reactor designs considered within the PPE, so the 2008 PPE had to be revised to ensure that there would be no additional excessive siting or environmental issues caused by choosing a reactor outside the original scope. An environmental impact statement (EIS) document was then revised based on the addition of the BWRX-300 characteristics to the PPE.

The Institute was provided with the document titled the "*Use of Plant Parameters Envelope to Encompass the Reactor Designs being considered for the Darlington Site*," document N-REP-

01200-10000 R005, dated 4 October 2022. The PPE provides a "bounding envelope" of plant design and site parameter values used in licence applications and in environmental assessments. It should place upper bounds on any potential adverse interactions between the operation of nuclear power plants and the environment. As noted in this document's revision summary, the document was updated to include BWRX-300 plant parameters which were not bounded by the previous revision of the PPE, which had considered a different set of potential reactors being sited. Thus, the PPE should bound not only the original reactor technologies but also the selected reactor (i.e., the BWRX-300).

The original PPE was based on inputs from the reactor vendors that were considered earlier. The values in the PPE were generated, and verified using a Quality Assurance Program compliant with CSA N286.2-00 "*Design Quality Assurance for Nuclear Power Plants*." The limiting values for each of the 198 parameters of interest were then tabulated. Once the SMR BWRX-300 was selected as the reactor of choice, that PPE was reviewed to make sure that all parameters of the BWRX-300 fell within the original bounding envelope. Upon review, it was found that nine of the parameter boundaries needed to be adjusted based on the characteristics of the BWRX-300. It is important to note that while only 9 of the 198 parameters were found to be limited by the BWRX-300, several of these could be of significant public concern.

The process of selecting 198 parameters to bound all possible environmental impacts of a group of reactors, including the radiation dose to humans, is a complex task. It is difficult to determine whether all 198 parameters cover all key aspects of an environmental assessment, or whether there are large groups of highly correlated parameters that have little independent effect on the assessment. Additionally, the significance of each parameter needs to be reviewed.

While the plant parameters envelope provided a useful framework for evaluating the suitability of the originally anticipated reactors, it may not be as relevant for the newly selected reactor. It is important to keep in perspective that the original PPE was initially used to compare multiple full-size power reactors. Now that a different reactor from the ones that were originally anticipated has, in fact, been selected, its utility may be limited. The selection of a Small Modular Reactor (SMR) should commensurate reduced issues for site preparation and installation. Continuing to follow the original PPE analysis while planning to install a Small Modular Reactor (SMR) may not be the most efficient approach, but it is the most conservative. This is because the expense associated with worst-case limiting parameters for full-scale power reactors may not be necessary or relevant for SMRs, which typically have lower electrical generating capacities. Therefore, it may be more appropriate to conduct a tailored and focused analysis specific to the SMR, rather than maintaining the same level of analysis as for full-scale reactors. By doing so, it would be possible to identify and prioritize the factors that are most relevant for the SMR, while avoiding unnecessary expenses and ensuring that the analysis is appropriately tailored to the application at hand.

Additionally, the PPE approach utilized in the document is based on a U.S. methodology. It is noted that at least five "NUREG" documents were referred to within the document (i.e., publications prepared by US Nuclear Regulatory Commission Staff). It would have been preferable to refer to documents that apply directly to the Canadian regulatory environment, but as this is the first preliminary assessment for an SMR there is no Canadian example to point to. It is important that the adoption of any methodology be based on a sound rationale that is applicable to the Canadian context. This approach should help ensure that the regulatory framework in Canada is well-defined and effective in overseeing the implementation of Small Modular Reactors (SMRs). If SMRs are to become an important part of Canada's solution to producing low carbon electricity, and if Canada is to take a leadership role in all things SMR, especially where safety is concerned, it does make sense for the Canadian SMR proponents and for the Canadian regulatory agency to continue moving towards developing assessment methods devised for the Canadian regulatory environment.

Further connection to the US operational environment and safety consideration is extended through the practice of using traditional units instead of SI units. The use of traditional units (such as mrem, curie, feet, mph, and lbs) in the document makes alignment with the Canadian standards and the international safety standards, such as those set by the International Atomic Energy Agency (IAEA), less straightforward. Note that the "Vendor data" provided included "*comparison against equivalent parameter values accepted by the U.S. NRC (Nuclear Regulatory Commission)*." It is unclear whether the CNSC accepted the "equivalent parameter values" based on the acceptance by the US Nuclear Regulatory Commission (NRC) or through independent evaluation. If these are available, it would be helpful to have these conclusions shared. For the purpose of the PPE document in question, it is important to have consistency, clarity, and transparency on the unit of measurement used. While it is preferable to use SI units, where traditional units are used, it is advisable to provide conversions to SI units to ensure consistency and comparability with international, as well as Canadian standards. This approach would minimize the possibility of human error introduction, where it is easy to confuse different unit measures which may result in a factor of ten difference in the final calculations. One good example of this approach would be the primary PPE table, where non-SI units are used (mph, lbs, etc.) SI unit conversions should be provided.

Other queries/comments to the PPE document that require clarification:

- Item 2.1.4 "Maximum ambient temperature (0% exceedance) is presently cited at 39.0 C. Given the variability of weather patterns and the potential for extreme heat events, has the impact of temperatures above 39.0°C on the system been considered?"
- There is inconsistency in the units used for land area measurement in the document. Specifically, hectares are used in section 2.7.1, while both m^2 and acres are used in section 3.3.1. Additionally, the values provided in the actual "acreage" section (17.2) are in hectares, which further adds to the confusion. It is recommended that uniformity in the units be used for land area throughout the document to avoid any ambiguity.
- In Table 4.1: Airborne Source Term Single Reactor, it appears that the BWRX-300 is projected to release higher quantities of certain individual isotopes when compared to other reactors that were previously considered. Notably, a greater amount of radioiodine appears to be released from this reactor compared to others.
- It is recommended that consistency be maintained in the units of measurement to prevent potential errors in the future. Section 17.1.2 provides the value in "tonnes," while section 18.1.2 provides the value in "metric tons."
- Sections 9.3.1, 10.1.1, and 10.1.2 make reference to CNSC G-129, which has been superseded by REGDOC 2.7.1 as of July 2021. While it is understood that G-129 requirements are a part of REGDOC 2.7.1, it is recommended that current regulatory documents be referenced throughout. This ensures consistency and communicates an understanding of and adherence to current safety regulatory requirements.

3 Review of Environmental Impact Statement (EIS)

The Institute undertook a detailed review of a 100-page document titled the "*Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300*", document NK054-REP-07730-00055 R000, which had been prepared by Calian Nuclear with their associated consulting team and was submitted to Ontario Power Generation Inc in October 2022. The Environmental Impact Statement (EIS) should be considered with the Plant Parameter Envelope reviewed above because the latter served as the environmental assessment's foundation. As a result, many of the concerns highlighted in the PPE review are also pertinent to the Environmental Impact Assessment.

As stated in the EIS document, the original environmental assessment was conducted from 2006 to 2009 and it evaluated a different set of possible nuclear reactors to be sited, along with up to four nuclear power reactors that could produce up to 4800 MWe of electrical generating capacity. The current EIS, however, evaluates the impact of deploying up to four BWRX-300 small modular reactors (SMRs) with a maximum electrical generating capacity of about 1200 megawatts. The EIS stipulates that dose to the public or environmental receptor is well below the regulatory limits. Keeping that in mind, it is of note that the environmental impact of deploying SMRs in some cases could be similar to, or even greater than, that of larger reactors, particularly in the case of radioiodine release, despite the lower energy output. While the Institute refrains from commenting on the economic factors of the decision-making process, it is essential to clarify this distinction for the Canadian public to understand.

Furthermore, the present EIS document highlights that the BWRX-300 is categorized in the same Light Water Reactor (LWR) family as the Pressurized Water Reactor (PWR) that was evaluated in the original EIS. Based on the information provided, it appears that the document contends that, while generating significantly less electricity, the BWRX-300 could be considered "not fundamentally different" from reactor designs previously considered. This assertion is a stretch, given that SMR vendors, including those of the BWRX-300, have taken significant measures to distinguish their designs from conventional power reactors such as the four that were initially considered in the PPE.

The SMR proposed for the site is a boiling light water reactor. A boiling water SMR is a type of nuclear reactor that uses water as both a coolant and a neutron moderator and operates on the principle of boiling water to produce steam that drives a turbine to generate electricity. The BWRX-300 considered for the Darlington site is an example of a boiling water SMR. It has to be noted that none of the four original designs were boiling light water reactors.

In a pressurized water reactor, the steam turbine is located outside of the nuclear system. To detect any leaks of radioactive water early, an activity meter is installed to monitor the outlet steam of the steam generator. In contrast, boiling water reactors pass radioactive water through the steam turbine, resulting in the turbine being designated as part of the radiologically controlled area of the nuclear power station. This design can lead to contamination of the turbine due to short-lived activation products, which is a known drawback of the boiling water reactor. And so, the proposed SMR's emergency cooling system differs from the previously considered designs.

It is also worth noting that compared to the four original nuclear reactor designs, the BWRX-300 requires deeper foundations extending up to 38 meters below ground level.

Section 3.5 of the document lists a proposed project timeline. It is noted "The conceptual timeline for the BWRX-300 deployment is presented in Table 2 with an anticipated start in Q3/Q4 2022, approximately 12 years later than the original date". This project timeline indicates "site preparation" starting in 2022. Based on the upcoming hearing, it is our understanding that the timeline needs to be adjusted.

The BWRX-300 parameters not bounded by the original PPE are discussed in the EIS document.

Table 5 from the EIS is repeated below for information.

Summary of PPE Parameters Bounded by BWRX-300 Characteristics

PPE Line item	Description	Original PPE value	BWRX-300 value	Impacts to EIS conclusions
7.1.1	Maximum Short-term Rate of Water Withdrawal for Fire protection	39.4 L/s	127 L/s	None
7.1.3	Quantity of Water Stored in Fire Protection System	3.78E+06 L	4.00E+06 L	None
1.1.2	Foundation Embedment	13.5 m	38 m	None
9.4.2	Elevation (Normal Operation)	48.8 m	35 m	None
9.5.1	**Gaseous Radioactive Emissions (Normal)**	**See note**	**See note**	**None**
10.3.1	**Liquid Radioactive Emissions (Normal)**	**See note**	**See note**	**None**
11.2.1	**Solid Radwaste Volumetric Activity**	**See note**	**See note**	**None**
17.1.2	Spent Fuel Cask Weight	100 tonnes	113 tonnes	None
1.7.2	Importance Factor for Wind Load	1.15	1.0	None

Note: the radionuclides in gaseous effluents, liquid effluents, and solid waste are the same as in the EIS, but their proportion has changed.

The table presented in both the PPE and EIS documents indicates that the BWRX-300 has higher levels of releases for certain isotopes compared to the other reactors evaluated, even though the overall dose from the four proposed SMRs is stated to be less than that already included in the EIS. It would be helpful to obtain details on how the dose was calculated or provide a summary of dose of the radionuclide groups.

For example, the Institute invites further elaboration on why the BWRX-300, despite generating less electricity than the other reactors assessed, is expected to have higher annual airborne releases of radioiodine and a higher solid waste component of radioiodine release, as indicated in the PPE and EIS documentation. This is particularly relevant to public concern, given the need to distribute iodine pills in the event of an accidental release. A more in-depth discussion of all the airborne and liquid effluent source terms would have been beneficial.

Another important factor to consider for the placement of the BWRX-300 is the foundation embedment depth, which is now required to be 38 m instead of the previous 13.5 m. This implies the need to excavate deep into the bedrock in the area, which while it is feasible compared to the foundation depth of some high-rise buildings, represents a significant deviation from the previous requirement.

Finally, the water requirements for the fire protection systems are significantly increased versus the previously considered units. These requirements need to be assiduously maintained. This is a critical safety issue because fire protection is a key aspect of nuclear power plant safety. In the event of a fire, the plant's fire protection systems must be capable of suppressing the fire to prevent damage to the reactor and containment systems. If the water requirements for the fire protection systems are not met, or if the systems are not properly maintained, the risk of a fire and its potential consequences can increase significantly. Therefore, it is important to ensure that the fire protection systems of a nuclear power plant, including the water requirements, are properly maintained and monitored to ensure the safety of the plant and the surrounding community.

The EIS document reviewed by the Institute asserts that the deployment of four BWRX-300 units at the planned site is not likely to cause significant adverse environmental effects if mitigation measures are implemented as planned. The Institute highlights the crucial role of mitigation measures in minimizing negative impacts and ensuring safe deployment of these nuclear reactors. It is essential to prioritize and implement these measures effectively to maintain a safe and environmentally responsible operation.

4 Conclusion

The Institute team reviewed Plan Parameters Envelope (PPE) and Environmental Impact Assessment (EIS). It should be noted that the review was limited to what was made available to the Institute. For example, background documents giving the actual methods and calculations used to derive the potential maximum annual radiation dose to members of the public due to siting a BWRX-300 were not part of the Institute's review.

Based on the available information from the PPE and EIS, the siting of four BWRX-300 SMR units at the Darlington site does not appear to pose any additional critical safety concerns compared to the previously planned four reactors for this site, provided all the planned mitigation procedures are implemented.

According to the PPE, the site is suitable for much larger and more complex full-scale nuclear power plants. With the note that the BWRX-300 releases a slightly higher amount of radioiodine into the environment in comparison to the larger potential reactor units, the dose to the public is stated to be within the regulatory limits.

5 References

N-REP-01200-10000 R005 *Use of Plant Parameters Envelope to Encompass the Reactor Designs being considered for the Darlington Site* October 4, 2022

NK054-REP-07730-00055 R000 *Darlington New Nuclear Project Environmental Impact Statement Review Report for Small Modular Reactor BWRX-300* October 5, 2022

REGDOC-1.1.1, Version 1.2 Site Evaluation and Site Preparation for New Reactor Facilities

REGDOC-1.1.2, Licence Application Guide: Licence to Construct a Nuclear Power Plant

REGDOC-1.1.3, Licence Application Guide: Licence to Operate a Nuclear Power Plant

REGDOC-1.1.5, Supplemental Information for Small Modular Reactor Proponents

REGDOC-3.5.1, Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills

Written Submissions of the Saugeen Ojibway Nation –
Darlington New Nuclear Power Project pre-licensing consultation

April 3, 2023

Introduction

The purpose of this document is to provide written submissions on behalf of the Saugeen Ojibway Nation (SON) to the Canadian Nuclear Safety Commission (CSNC) as part of the Darlington New Nuclear Project (DNNP) pre-licensing consultation process.

The SON is comprised of the Anishinaabe People of the Chippewas of Nawash Unceded First Nation and Chippewas of Saugeen First Nation. The SON's Territory (or Anishinaabekiing) encompasses much of the Saugeen (Bruce) Peninsula, extending down south of Goderich and east of Collingwood. The waters surrounding these lands and the lakebed of Lake Huron from the shore to the international boundary with the United States and to halfway across Georgian Bay are also part of the SON's Territory.

The SON's ancestors have used and occupied Anishinaabekiing since time immemorial and its People continue to do so today. The SON's Territory consists of everything integral to life—the lands, rivers, lakes, winds, plants, people, animals, and fish. Anishinaabekiing has sustained the SON People physically and spiritually for countless generations and must continue to do so far into the future.

The development of the nuclear industry in the SON's Territory has played a major role in shaping the land and the SON People's place within it.[1] Without consultation, the SON became host to the world's largest operating nuclear facility, a now decommissioned nuclear reactor, the vast majority of Ontario's low and intermediate-level waste (L&ILW), and 40 percent of Canada's spent fuel.

The SON's Territory is currently being considered as one of two potential sites for Canada's deep geological repository (DGR). As such, the SON is being asked to accept all of Canada's 5.5 million bundles of spent fuel from existing facilities for permanent disposal. As the Nuclear Waste Management Organization (NWMO) is now recommending to the federal Minister of Natural Resources that ILW be co-located with the spent fuel, the scope of this project may expand significantly.[2]

The launching of a small modular reactor (SMR) industry in Canada would radically impact plans for radioactive waste management, storage, and disposal moving forward. No longer would the NWMO only be required to plan for the waste produced by Canada's aging fleet of CANDU reactors—all of which will be decommissioned within then next three or four decades—the introduction of SMRs would create an entirely new and endless stream of spent fuel and L&ILW. The potential implications of this development and how it may

[1] The history and current reality of the nuclear industry in SON Territory has been described in previous SON submissions relating to the licensing of the Western Waste Management Facility and the Joint Review Panel for Ontario Power Generation's deep geological repository for Low and Intermediate Level Wastes proposal.
[2] Nuclear Waste Management Organization, "Draft Integrated Strategy for Radioactive Waste" (August 25, 2022), online at: <radwasteplanning.ca/>.

impact the SON's Territory and People has not been the subject of any consultation or substantive discussion with the SON by the Crown or its agents. It is clear, however, that the pressure on the SON to accept this new waste will be enormous. As a result, the SON has a deep and unique interest in the licensing process of this first proposed commercial SMR at Darlington as well as Canada's larger aspirations to launch a new SMR industry.

<u>Background</u>

In October 2022, Ontario Power Generation (OPG) submitted its DNNP Application for a Licence to Construct a Reactor Facility to the CNSC. The first phase of the application process is to determine whether the Environmental Impact Statement (EIS) and subsequent Environmental Assessment (EA) conducted by a federally appointed joint review panel adequately considered the impacts of the chosen reactor design: the GE Hitachi BWRX-300. The EA, which was conducted over a decade ago, was based on bounded technologies in a Plant Parameter Envelope (PPE). As the BWRX-300 was not among the four reactor technologies assessed in that process, the CNSC must determine whether the EA findings are still valid.

OPG states that the EA adequately addresses possible impacts because the BWRX-300 belongs to the same Light Water Reactor family as the Pressurized Water Reactor that was included in the EIS. As with the Pressurized Water Reactor, the BWRX-300 requires lightly enriched uranium (U-235 enrichment up to 5 percent) and light water as the coolant and moderator. Because OPG has opted for an SMR instead of a full-sized reactor, it argues that virtually all predicted negative impacts from the project will be diminished due to the reduced scale of the project. OPG concludes that no further impact assessment is required.

The SON submits that the conversion of this project to an SMR does not signal a reduction of impacts. Rather, the DNNP represents the launching of a new era in nuclear development that could have widespread and lasting impacts. The original EA fails to capture the implications of this project as the first commercial SMR in the country. Canada, through policy initiatives and the provision of funding to support an SMR industry, is actively launching a new era in nuclear development. Now is the moment to undertake a credible, comprehensive, and public assessment of the potential impacts. For this reason, SON will request this project be designated under the *Impact Assessment Act* (IAA) for a strategic and a regional assessment. SON will also be seeking clarity into whether and to what extent Canada's policy and programs directed at promoting SMRs have been subjected to, or considered for, a Strategic Environmental Assessment (SEA) per the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals.[3]

[3] Privy Council Office and the Canadian Environmental Assessment Agency, "The Cabinet directive on the environmental assessment of policy, plan and program proposals: guidelines for implementing the Cabinet directive", (2010), online at: https://www.canada.ca/en/impact-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html.

Comments and Recommendations

SON staff and subject-matter experts have completed a review and analysis of the project. The following comments will focus on concerns regarding the existing regulatory and policy framework under which this and future SMRs will be considered.

Promotion of a Nuclear Renaissance

Government and industry have expressed exceptional enthusiasm about the promise of SMRs and the future of nuclear energy as an important part of the solution to reduce carbon emissions. SMRs are understood to be key to the widespread deployment of nuclear reactors across the country and into remote communities because they can be manufactured offsite and transported to a final destination. Also, because of their modular design, they can be expanded upon to meet increased energy demands.

The Government of Canada has made it clear that it intends to support and promote the development of a new SMR industry and economy. In October 2022—the same month OPG submitted its DNNP licence to the CNSC—the Minister of Natural Resources presented Canada's National Statement on Nuclear Energy in Washington, D.C. Minister Wilkinson explained that Canada intends to be an early adopter of SMRs and the government's investment of billions of dollars to support their development and deployment "underlines the accelerating momentum in nuclear energy and highlights Canada's desire to play a leadership role in this area."[4]

This announcement aligns with various other federal and provincial efforts to promote SMRs, such as Canada's SMR Roadmap, SMR Action Plan, and the Memorandum of Understanding on the cooperation of the development and deployment of SMRs between Ontario, New Brunswick, Saskatchewan, and Alberta.

"Streamlining" SMR Regulations

Both industry and government have sought to ensure that SMRs benefit from "streamlined" regulatory review, ostensibly to allow for cheaper and faster deployment. The consequence, however, will be to insulate SMRs and their deployment from full and appropriate regulatory scrutiny. The SMR Regulatory Readiness Working Group (RRWG), established as part of Canada's SMR Action Plan, highlighted the need to ensure that the federal government's new and improved IAA exempts SMRs from the "Project List" that triggers an impact assessment. The RRWG warned that:

[4] Natural Resources Canada, "Canada's National Statement on Nuclear Energy" (October 26, 2022), online at: <www.canada.ca/en/natural-resources-canada/news/2022/10/canadas-national-statement-on-nuclear-energy--the-honourable-jonathan-wilkinson-minister-of-natural-resources--the-international-atomic-energy-agen.html>.

the pending Bill C-69 legislation poses a risk to the future of SMR deployment in Canada, particularly for the small off-grid applications. The RRWG concludes that including SMR in the "Project List" for consideration under the pending Impact Assessment Act could result in undue timelines and costs for SMR project approval, which are likely to be an impediment to SMR deployment.[5]

Ultimately, these efforts to have SMRs exempted bore fruit: SMRs with a thermal capacity of 200 MWth or less are exempted from the "Project List."[6] Nine of the 11 vendor design reviews being conducted by CNSC fall under this threshold. Also exempted are new storage facilities for irradiated nuclear fuel or nuclear waste associated with these SMRs.[7]

Perhaps even more troubling from the SON's perspective is the exemption of new reactors with the combined thermal capacity of up to 900 MWth if located within the licensed boundaries of an existing Class IA facility.[8] This exemption sets the stage for projects like the DNNP, which sits within the bounds of the existing Darlington nuclear facility. It also sets the stage for future nuclear development on the SON's Territory at the Bruce Power site.

The SON submits that regulatory oversight should be increased rather than diminished when a proponent is proposing to place SMRs next to existing CANDU reactors. Such proximity raises important considerations that should be addressed, such as how the modular units would share support systems between themselves as well as with existing CANDU reactors. Compounding environmental effects require careful and integrated assessments. As identified during the Fukushima nuclear disaster, having many units at a single site can have unexpected consequences, such as common mode failures impacting the operations and safety of neighbouring plants.

Establishing lower thresholds for triggering impact assessments on sites already subjected to nuclear development is a red flag for environmental and distributive justice. That the regulations are specifically designed to encourage the perpetuation of nuclear development at existing sites threatens to exacerbate the injustices faced by the SON and other similarly placed Indigenous groups.

We already see the consequences of this weaker environmental and impact review regime with respect to other proposed demonstration SMRs in Canada, including the Advanced Reactor Concepts sodium-cooled fast reactor (ARC-100) in Point Lepreau, New Brunswick. Although concerned citizens, community groups, and First Nations requested that the

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[5] Regulatory Readiness Working Group, "Canadian SMR Roadmap: Regulatory Readiness Working Group, Final Report" (August 1, 2018), online at: <smrroadmap.ca/wp-content/uploads/2018/12/Regulatory-Readiness-WG.pdf?x64773>.
[6] *Physical Activities Regulations*, SOR/2019-285, s 27(b).
[7] *Ibid*, s 28.
[8] *Ibid*, s 27(a).

Minister of Environment and Climate Change Canada designate this project for an impact assessment, he refused on the basis that the project would be subject to existing nuclear licencing and provincial/federal environmental regulatory processes.[9] This logic undermines the importance of a coordinated impact assessment as a public planning and decision-making tool to determine the positive and negative effects of a project. It also undermines the public—and the SON's—trust in the assessment process.

BWRX-300 Environmental Assessment Concerns

With respect to the BWRX-300 design itself as it relates to OPG's EIS, a couple issues were not well addressed in the EIS and warrant additional review. First, the EIS does not appear to have assessed the impacts of the transportation of new waste to the Western Waste Management Facility (WWMF). Merely relying on history and current transportation routes to the only radioactive waste storage facility does not constitute an assessment. Alternatives are not addressed.

Second, the EIS does not adequate analyze the impacts of these new sources of waste. It does not take into account the impacts of expanding the different waste generation from the SMR at DNNP. The WWMF is identified as the preferred recipient for radioactive waste, yet there is no assessment of the impact of the increased amounts in both radioactivity and volume on the environment (or on the operating license) of the WWMF.

New Fuel Source

Basic but crucial questions regarding SMR fuel, such as where it will come from, remain unanswered. Despite having some of the largest uranium deposits in the world and a major uranium mining and milling industry, Canada does not have the capacity to produce the lightly enriched uranium required by SMRs. This issue was recognized in SMR Roadmap in which Canada explained that SMRs

> will use a grade of low-enriched uranium fuel, and fuel types that are different from the natural uranium fuel bundles currently used in Canadian nuclear reactors. While fuel for demonstration projects may be able to be sourced from the United States, both China and Russia are positioned to lead the commercial SMR fuel supply market.[10]

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[9] Government of Canada, "Minister's Response – Small Modular Reactor Demonstration Project" (December 22, 2022), online at: <iaac-aeic.gc.ca/050/evaluations/document/145836?culture=en-CA>. The other demonstration SMR being proposed at the Point Lepreau site (Moltex SMR) will trigger an impact assessment. This is because the project includes a fuel reprocessing facility to recycle spent fuel on site, not because of the SMR itself.

[10] Canadian Small Modular Reactor Roadmap Steering Committee, "A Call to Action: A Canadian Roadmap for Small Modular Reactors" (2018) at 23-24, online at: <smrroadmap.ca/wp-content/uploads/2018/11/SMRroadmap_EN_nov6_Web-1.pdf?x64773>.

Since the release of the roadmap in 2018, the world has changed. The United States and Europe themselves are scrambling to try to find alternatives to Russian and Chinese uranium for their light water reactors. How the fuel will be obtained and through what channels it will be transported are questions that must be addressed in an intentional, public, and transparent manner.

Quite apart from geopolitical concerns, there are also nuclear criticality safety concerns related to the use of lightly enriched uranium as the nuclear fuel. That lightly enriched uranium can go critical in normal water—unlike CANDU fuel—means that CNSC will have to ensure more safety controls are in place. That some of these controls include the use of neutron absorber (poison) in the rack design and borated water are cause for concern from a human safety and environmental protection point of view. These safety concerns will impact the entire fuel cycle from production, to transportation, to storage and disposal. These criticality issues and concerns are far different from the past rhetoric about the added safety for CANDU reactors because of the use of natural uranium as the fuel.

Waste Management

The greatest cause for concern for the SON is the question of waste management, storage, and disposal. Because of the compartmentalization of the assessment process, the proponents of SMRs have not been required to meaningfully answer the question of what happens to the waste.

OPG explains that the various waste disposal paths that may be deployed under a future DNNP operating licence depend on the characterization of the waste, but that answering these questions is not required as part of the licence to construct application. Nevertheless, OPG suggests that solid radioactive waste will likely be "shipped to a licenced off-site facility for incineration, decontamination, volume minimization, and/or storage," and "[r]adioactive liquid chemicals are likely to be incinerated or solidified and stored at an OPG licensed facility."[11]

Shipping "off-site" to be stored in an "OPG licensed facility" means shipping it to the SON's Territory. Unless OPG has some as yet undisclosed plans to develop another centralized processing and storage facility, all this waste is destined for the WWMF—the only central storage facility for OPG's L&ILW—which is situated in the heart of SON's Territory.

The SON's Territory is intensely nuclearized. This reality has made it the target for future and permanent waste management and disposal projects. OPG's proposed plan of siting its L&ILW DGR on SON's Territory, adjacent to its current surface storage, was unsurprising, and indeed, inevitable as the most efficient and economical choice. The NWMO's planned

[11] Ontario Power Generation, "Darlington New Nuclear Project: Application for a Licence to Construct a Reactor Facility" (October 2022) at 224.

DGR for spent fuel (and perhaps ILW) is no different. The SON's Territory has been a targeted site for nuclear waste management. And so, as with all prior radioactive waste storage and disposal plans, all paths for future waste disposal point to the SON's Territory.

In the original DNNP EIS from 2009, the SON were not identified as having rights and interests that could be impacted by the project and therefore were not considered. As such, even though the SON will likely be asked to host the waste produced by this project forever, they were not mentioned once in the 1168-page EIS report. This reality demonstrates how damaging the compartmentalization of assessment processes is and there is a real need for strategic and regional assessments regarding the DNNP and SMRs more generally. Because the waste disposal issue is to be addressed by NWMO rather than the project proponents, the scope of review for SMRs is artificially narrowed. Deferred impacts are not considered. The affected Indigenous Nations are not consulted.

The bare references and hopeful assumptions regarding how the DNNP's waste will be managed is consistent with the normal pattern. The ARC-100 SMR's proposal is the same. Nine potentially affected Indigenous groups are identified as having rights and interests that could be impacted by the project—the SON are not among them. In reviewing the designation request for ARC-100, the Impact Assessment Agency noted that "the Proponent anticipates that spent fuel would be transported to a deep geological repository for long-term management."[12] The corresponding footnote, however, recognizes that:

> [t]here is no existing deep geological repository in Canada. […] Should a site be selected and a facility approved, it may be deemed suitable for the future disposal of the Proponent's used fuel from this Project (if approved), depending on waste acceptance criteria that have yet to be established and evaluated."[13]

That the NWMO has been issued a mandate to solve the nuclear waste problem does not guarantee that it will manage to do so. The NWMO does not have a site selected for a DGR project, let alone a DGR project under development. This is a fact that cannot simply be ignored. Nor can it be ignored that the current NWMO DGR project is based on fuel wastes from existing reactors. Dealing with a new and, potentially, endless stream of waste produced from an SMR industry is not part of the original Adaptive Phased Management plan. As such, there are many questions that have not been answered, such as:

- Will the NWMO seek to expand its currently planned DGR project to deal with this new waste?

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[12] Impact Assessment Agency, "Analysis Report: Whether to Designate the Smal Modular Reactor Demonstration Project in New Brunswick pursuant to the Impact Assessment Act" (December 2022), online at: <iaac-aeic.gc.ca/050/evaluations/document/145835>.
[13] *Ibid.*

- Will the introduction of lightly enriched uranium impact the design specifications of the DGR project?
- Will additional DGRs be required to accommodate this new waste stream? If so, where will they be sited? And according to what time frames?
- How can the NWMO be asking the SON, or any other Nation or community, to accept a DGR when the bounds of that project are so poorly defined or understood by the industry itself?

It is unclear whether the NWMO has had the opportunity to investigate these questions deeply. It certainly has not provided publicly accessible analyses that address the issue of new SMR waste streams. Nor does its proposed Integrated Strategy for Radioactive Waste address the issues. It is simply unacceptable to defer the asking and answering of these questions to some future unspecified date. Canada cannot repeat the mistakes of the past by rushing into a new era of nuclear development without having a solution for the resulting waste. The SON have paid heavily for this lack of planning already—it is profoundly unjust to ask them to continue to do so.

Until a decision has been made by the SON membership as to whether they are willing to host the proposed DGR and until the parameters of such a project are determined, the SON will not accept fuel waste from newly approved SMR projects on the SON's Territory. Similarly, the SON will not accept the L&ILW from these projects at the WWMF for interim storage without these larger issues being addressed. Rather, if any future SMR's are approved and licenced for operation, the SON expect the radioactive waste produced by SMRs to remain on site at the facility until an acceptable waste disposal solution has been reached. The CNSC will have a critical role in working with Canada and the necessary federal departments and institutions to ensure that the SON's position is addressed in the assessment process and incorporated in any licenses issues. Government, regulators, and proponents must not assume or make plans on the basis that the SON will continue accepting radioactive waste on its Territory indefinitely, particularly given the SON's long-lasting nuclear legacy issues have not yet been meaningfully addressed or resolved.

Designation of DNNP for a Strategic and a Regional Assessment

The launch of a nuclear renaissance in this country through the development and deployment of SMRs—as marked by the potential licencing of the DNNP—requires a comprehensive and public review. The many seriously and novel issues raised by the development and deployment of SMRs, and the very real and permanent impacts this will have on SON, its Rights, Territory, and People must be understood and meaningfully addressed. This can only be accomplished through a full impact assessment or through a strategic and a regional assessment under the new IAA—legislation specifically designed to provide an enhanced tool for environmental planning. In the IAA's Preamble, Canada "recognizes the importance of regional assessments in understanding the effects of existing or future physical activities and the importance of strategic assessments in assessing federal policies, plans or programs that are relevant to conducting impact assessments".

The SON will request that the DNNP, or the commercial launch of SMR technology that is represented by the DNNP, be designated for a strategic and regional assessment. SON will work directly with various federal authorities, including IAAC and CNSC, in preparing its request to the Minister of Environment and Climate Change.

Aboriginal Rights

The IAA also includes a recognition of Canada's legal obligation, "in the course of exercising its powers and performing its duties and functions in relation to impact, regional and strategic assessments, to ensuring respect for the rights of the Indigenous peoples of Canada recognized and affirmed by section 35 of the *Constitution Act, 1982*, and to foster reconciliation and working in partnership with them".[14]

At present, the DNNP assessment itself, the compartmentalization of impact assessments of SMRs generally, and Canada's promotion of the SMR industry more broadly, all constitute a failure to meet Canada's constitutional obligations towards the SON. Canada is now creating realities that have the potential to create an insurmountable nuclear waste management problem. As the problem grows, so will the pressure to compromise SON's rights for the "public interest". This is a situation that can and must be avoided today.

Moreover, the realities Canada is seeking to create run counter to its recent international and national commitments to Indigenous peoples. In 2016, Canada announced it would be a full supporter of the *United Nations Declaration on the Rights of Indigenous Peoples* (UN Declaration) without qualification. Article 29(2) of the UN Declaration requires that:

> States shall take effective measures to ensure that no storage or disposal of hazardous materials shall take place in the lands or territories of indigenous peoples without their free, prior and informed consent.

In 2021, Canada adopted the *United Nations Declaration on the Rights of Indigenous Peoples Act*,[15] in which it recognized that "the rights and principles affirmed in the Declaration constitute the minimum standards for the survival, dignity and well-being of Indigenous peoples of the world, and must be implemented in Canada".[16] In its recently released UN Declaration Act Action Plan, Canada has made no mention of the commitments found in Article 29(2). Instead, it has included its agenda of promoting the development and

[14] *Impact Assessment Act*, S.C. 2019, c. 28, s.1, preamble.
[15] *United Nations Declaration on the Rights of Indigenous Peoples Act*, S.C. 2021, c. 14. (UN Declaration Act)
[16] *Ibid.* at Preamble.

deployment of the SMR industry.[17] Specifically, in raising the need for alternative energy sources for remote Indigenous communities, Canada identifies SMRs—and only SMRs—as a possible "clean energy alternative".

To fail to mention other clean energy alternatives (such as geothermal, wind, solar, hydro), demonstrates a striking single-minded commitment to the promotion of Canada nuclear industry. It also demonstrates a complete disregard for the implications this could have on the SON. Canada must honour its commitment to ensuring Indigenous peoples have the right of free, prior, and informed consent prior to the storing or disposing of radioactive waste on their Territories by ensuring consent is secured before the launching of the SMR industry, not after.

Conclusion

The question posed by the CNSC in this pre-consultation phase for OPG's Licence to Construct application is too narrow. CNSC asks whether the existing EA adequately addresses the considered impacts of the BWRX-300 reactor technology. Although this question is critical and there does remain work to be done in light of the chosen technology, there are larger, foundational issues that must be addressed. Canada is seeking to rapidly usher in a new chapter in nuclear energy production by providing substantial public funds to industry and reducing regulatory scrutiny of SMR projects. The consequence of these actions is the perpetuation of the negative impacts experience by the SON at the hands of the nuclear industry.

For over 60 years, the SON have been at the heart of the development of the nuclear industry in this country, without consultation or consent. Longstanding legacy issues regarding this history remain unresolved. Understood in this context, it becomes clear that any decision the CNSC makes regarding the DNNP stands to impact the SON's rights, interests, and future in profound and lasting ways. As the first commercial reactor in this country, the DNNP could set a precedent that could deeply affect the SON's Territory and its People's place within it.

At this stage of the review, the SON expect to continue to work with CNSC staff to fully understand the implications of the DNNP project and its potential impacts on SON rights and interests. The SON expects that this engagement and consultation will inform submissions that CNSC staff will ultimately make to the Commission, as well as the submissions the SON will make to the Commission. As part of these discussion, the SON will explore the possibility of joint, or aligned, submissions aimed at accommodating SON

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[17] Government of Canada, "Draft *United Nations Declaration on the Rights of Indigenous Peoples* Action Plan", at s. 44, online at: <https://www.justice.gc.ca/eng/declaration/ap-pa/ah/index.html>.

rights and interests. This could include the option of a joint request that this project be designated under the IAA for a strategic and a regional assessment.

Finally, it bears repeating that until a decision has been made by the SON membership as to whether they are willing to host the proposed DGR, and until the parameters of such a project are determined, the SON will not accept within its Territory wastes from any newly approved SMR projects. Accordingly, the SON will work with all responsible parties to develop a regulatory framework, guidance and plans that will require that radioactive waste produced by SMRs remain on site at the facility until an acceptable waste disposal solution has been reached. The SON expects that CNSC will have a critical role in this work and to ensure that Canada and the responsible federal departments and institutions understand and accommodate the SON's concerns in this regard. Plans to create a renewed nuclear industry cannot be based on the underlying assumption that the SON will unquestioningly accept new waste streams into its Territory. Canada has committed to implementing the UN Declaration—it is time to recognize the implications of this commitment and to honour it.

[redacted]

From: Paul Filteau [redacted]
Sent: Sunday, March 19, 2023 7:35 PM
To: Darlington New Nuclear Project / Nouveau projet nucleaire de Darlington
Subject: Comment on OPG plans to build 4 GE-Hitachi reactors

Categories: PPE/EIS - Added to Comments Tracker, In Process - Nicole

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Please consider that:
Since the reactor design and the wastes are different those considered in the 2009 PPE, a full environmental impact assessment is required.
Also, there should be a process for the public to submit questions about this project and receive answers before comment deadlines.
[redacted]

[redacted]

From: Jack Gibbons [redacted]
Sent: Monday, March 20, 2023 11:12 AM
To: Darlington New Nuclear Project / Nouveau projet nucleaire de Darlington
Cc: Brennain Lloyd; [redacted] 'Gordon Edwards'; [redacted]; 'Ontario Clean Air Alliance'
Subject: Darlington New Nuclear Project pre-licensing consultation

Categories: PPE/EIS - Added to Comments Tracker, In Process - [redacted]

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Dear CNSC,

We are writing to provide you with our comments with respect to OPG's:

1. Updated Plant Parameter Envelope Report; and
2. Environmental Impact Statement Review Report.

We believe that the CNSC needs to determine whether these reports are in compliance with the International Joint Commission's Great Lakes Water Quality Board recommendations that OPG's nuclear waste storage facilities should be: a) "hardened"; and b) located away from shorelines to prevent them from being compromised by flooding and erosion.

We also believe that the CNSC needs to determine if these reports are in compliance with the International Atomic Energy Agency's conclusion that immediate dismantling is the "preferred decommissioning strategy" for nuclear reactors.

Yours truly,

[redacted]

SOCIETY of UNITED PROFESSIONALS
IFPTE 160

March 17, 2023

Re: Darlington New Nuclear Project (DNNP) pre-licensing consultation

The Society of United Professionals represents over 9,000 engineers, scientists, supervisors, and other professionals in Canada's energy and legal sectors. As an organization, we have represented professionals for over 70 years.

The Society represents employees working for a dozen different employers in the electricity sector, including Ontario Power Generation, Bruce Power, Nuclear Waste Management Organization, Hydro One, the Independent Electricity System Operator, the Ontario Energy Board, Toronto Hydro, Kinectrics, and the Electrical Safety Authority.

Our members work in every aspect of the electricity industry. They are involved in generation, transmission and distribution of electricity, management of the electricity system, regulation and enforcement of standards, and management of the electricity market. They are employed as first-line managers and supervisors, professional engineers, scientists, information systems professionals, economists, auditors and accountants, as well as many other professional, administrative, and associated occupations.

The Society's members are knowledge workers who take great pride in exercising their civic, social, and professional responsibilities. As a union, we stand behind our members' professionalism, integrity, and commitment to excellence in all areas, particularly workplace safety, public health, and environmental sustainability.

Advocating for safe and healthy operation of our nuclear workplaces is one of the Society's highest priorities as a union. Our members work inside of, and in close proximity to, nuclear facilities, and they are among the first in harm's way if the highest standards of safe operation, and occupational health and safety are not adhered to. They and their families are residents of Durham and Port Elgin and they are very conscious of the importance of ensuring a safe and healthy environment in their communities.

The Society recognizes that this consultation is only to determine whether the existing environmental assessment for the Darlington new nuclear site is applicable to the reactor technology chosen for the project, the BWRX-300 small modular reactor.

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The Society engaged a third-party expert consultant – Dr. Kirk Atkinson, PhD, Associate Professor in the Faculty of Energy Systems and Nuclear Science and Director of the Centre for Small Modular Reactors at Ontario Tech University – to provide an opinion on the applicability of the existing environmental assessment to the BWRX-300 reactor. Dr. Atkinson's full report has been included with this submission.

Dr. Atkinson concluded that "Given the reduced size and thermal power of the BWRX-300 SMR compared to the DNNP candidate reactor technologies for which the [Plant Parameter Envelope] was originally developed and on which the [Environmental Impact Statement] EIS was based…the 2009 EIS conclusions remain valid" and "there are no obvious findings that challenge the approved [Environmental Assessment]."

The Society, having reviewed Dr. Atkinson's assessment, submits that the existing environmental assessment is applicable to the BWRX-300 reactor technology chosen for the Darlington New Nuclear Project, and as such no new environmental assessment need be conducted.

Sincerely,

M Johnston

Michelle Johnston
President
Society of United Professionals

TECHNICAL CRITIQUE

Darlington New Nuclear Project Plant Parameter Envelope (PPE) Revision 5 and BWRX-300 Environmental Impact Statement Review

Background

In September 2006, Ontario Power Generation (OPG) made a preliminary application to the Canadian Nuclear Safety Commission (CNSC) for a license to prepare the Darlington site for new nuclear build. In accordance with the Canadian Environmental Assessment Act (CEAA), it was determined that an Environmental Assessment (EA) of the Darlington New Nuclear Project (DNNP) was necessary. This EA was undertaken over a three-year period and, in the absence of a selected reactor technology, used a Plant Parameter Envelope (PPE) based on limiting parameters for three reactor types under consideration for analysis. The resulting Environmental Impact Statement (EIS) submitted in September 2009 was subsequently revised on request from the Joint Review Panel (JRP) to include consideration of additional reactor types. Ultimately, after revision of the EIS, the EA was accepted by the JRP in 2011, and in May 2012 the Government of Canada accepted the JRP recommendations and a Power Reactor Site Preparation Licence (PRSL) issued.

In 2013 the Ontario Government deferred new nuclear build at Darlington, a circumstance that persisted until OPG began exploring Small Modular Reactor (SMR) technologies in 2018. In December 2021, OPG selected the GE-Hitachi BWRX-300 SMR for the DNNP and in accordance with commitment D-P-12.1(a) in the Comprehensive Environmental Impact Statement Review:

"Once the specific technology is selected and design information is available, OPG will comprehensively review the EIS to ensure that the results of the EIS remain valid. If this review indicates either a gap or a condition not bounded by the EIS, OPG will initiate corrective actions as necessary. This may include mitigation options."

In late 2022, the PPE was revised (revision 5) to include the BWRX-300 and the EIS was reviewed to ensure its conclusions were unchanged (or found to be insignificant) thereby meaning the original approved EA remained valid.

Scope of critique

To ensure due diligence on behalf of its members, the Society requested that the following documents be reviewed, and strengths, weaknesses, or shortfalls identified with respect to consideration of the BWRX-300:

Use of Plant Parameters Envelope to Encompass the Reactor Designs being considered for the Darlington Site (Document reference: N-REP-01200-10000-R005).

Darlington New Nuclear Project Report for the Review of the Environmental Impact Statement for Small Modular Reactor BWRX-300 (Document reference: NK054-REP-07730-00055-R000).

Critique of Plant Parameter Envelope (PPE) Revision 5

To facilitate quantitative analysis in the EA, the PPE was developed to provide a bounding envelope of (worst case) values for plant design and site characteristics, along with any interactions between the two. The approach followed precedent in the U.S. The PPE considers both individual, vendor-specific limiting values, and assembles them into a composite form that takes the worst value of a given parameter across all technologies under consideration. Clearly any reactor technology that is bounded by the PPE could be deployed at the DNNP. The original PPE considered the possibility of four AP-1000, ACR-1000, or EC6 units, or three EPR units, being built on site, with a maximum output of 4800 MWe. The BWRX-300 was not considered until this revision of the PPE (revision 5).

Whilst the PPE format is solid and most of the limiting values presented therein approved in earlier revisions of the document, a minor observation was made pertaining to revision 5 as read in March 2023:

- In section B.1.3 Table 3. “Site Parameters and Darlington Characteristic Values, Composite Table,” parameter 2.3.1, the condenser/heat exchanger maximum inlet temperature, is set as 25.5°C against a characteristic site value of 24°C, the latter value being based on historic precedent and future projections published in 2008. Given the intended sixty-year operating lifetime of new build units and increasingly frequent extreme temperature events seen globally; whilst the volume of Lake Ontario is very large (compared to the rivers in France for which high temperatures led to the shutdown of reactor units in 2022) and hence should suppress extreme conditions, what would the implications and/or mitigations be for operating units if a temperature of 25.5°C was exceeded at some point in the future? Whilst this is unlikely to be of a significant concern, given the lack of certainty around predicting the consequences of climate change, some additional consideration would not be unwarranted to de-risk potential future concerns.

As the BWRX-300 has an electrical output of 300 MWe and a thermal power of 870 MW, a maximum four-unit deployment (i.e., 1200 MWe / 3480 MWth) will have essentially the same power output as a single unit of a bigger plant (e.g., an AP-1000 produces 1110 MWe / 3415 MWth). Simple scaling therefore shows that site power-related outcomes will in many cases be approximately one quarter those predicted for the reactor deployments described in previous versions of the PPE. The PPE therefore already bounds almost all parameters being considered, the only divergence being through design differences, e.g., as per section B.1.4 Table 4: “Consolidated PPE Parameters, Values, Where Used and How Used” the only parameters where the BWRX-300 provides a limiting value are:

- Parameter 1.1.2, Foundation Embedment, as the BWRX-300 extends to a depth of 38 m below grade due to the reactor containment being sunken into the ground.
- Parameter 7.1.1, Maximum Use of raw water by the Fire Protection System.
- Parameter 7.1.3, Stored Water Volume for the Fire Protection System.

- Parameter 9.4.2, (minimum) Elevation of the Airborne Effluent release point during normal operation, i.e., only 35 m for the BWRX-300.
- Parameter 17.1.2, the Spent Fuel Cask Weight being a mighty 133 tonnes due to the differences in used fuel characteristics, and thereby causing challenges for site access and road infrastructure.

Additionally, whilst to first approximation fission events in low enriched uranium fuel (i.e., the type of fuel used in all candidate reactor technologies for DNNP) will yield similar fission product distributions; variations in enrichment, fuel irradiation times (longer times typically result in higher activities per unit volume of fuel), neutron fluxes and spectra, even between similar reactor types (i.e., light water reactors) will yield differences in the resulting radiological inventories. These differences are captured in the data provided for the following source terms:

- Parameter 9.5.1, Airborne Source Term.
- Parameter 10.3.1, Liquid Effluent Source Term.
- Parameter 11.2.1, Solid Radwaste Activity Levels.

Whilst revision 5 of the PPE lists source term information for each of the DNNP candidate reactor technologies, information provided for the BWRX-300 seemingly being the most complete, the method by which these data were deduced is not made immediately clear. The presumption is that values were calculated, e.g., using a code such as ORIGEN, but the tables do not explicitly state this. It is a minor point given the presented values will not have a significant impact on the bounding assumptions (since the power per BWRX-300 is roughly a quarter that of the larger reactors considered, the total inventory activity per unit will be smaller even at higher fuel burn ups), yet clarification would be warranted.

With recent acknowledgements that along with First-Of-A-Kind (FOAK) SMR deployment at Darlington, new build ‘large’ nuclear is once again under serious consideration in the Province of Ontario, it follows that as Darlington remains the only site currently licensed for new build, there is a small possibility that mixed deployment of reactor types on-site could be proposed (whilst the BWRX-300 is the test case for grid-scale SMRs in Canada, even in a four-unit configuration, the deployment is not maximising power per hectare despite future electricity demands in Ontario and beyond being well recognised).

- The PPE only considers multi-unit deployments of similar reactor technologies. Either consideration should be given in the PPE as to the implications of dissimilar reactor technologies being deployed adjacent to one another, or the possibility should be explicitly excluded.

Critique of BWRX-300 Environmental Impact Statement Review

Led by Calian Nuclear, a consulting team comprising Calian, SLR Consulting, Ecometrix, Independent Environmental Consultants, Golder Associates and Beacon Environmental was assembled in 2022 to review the accepted 2009 Environmental Impact Statement

(EIS) for new nuclear build at Darlington considering OPG's selection of the BWRX-300 SMR for the DNNP. For the approved EA to remain valid, the BWRX-300 technology must remain bounded by the EIS or any deviance from it must not materially change its scope or conclusions. As such, being that the EIS was based on the PPE, analysis having been undertaken previously to ensure the environmental impacts of each bounding parameter were at least tolerable or could be mitigated; the Calian-led team reviewed PPE revision 5 to identify which parameters had changed with respect to the BWRX-300. They found that of the 198 parameters in the PPE, 60 were not applicable due to the design of the BWRX-300 (principally related to the fact that a BWR does not require heat exchangers, and because the condenser employs once-through cooling using lake water rather than employing cooling tower infrastructure), 129 were within bounding limits, and 9 were out of bounds. These nine include the eight described above, along with PPE parameter 1.7.2 pertaining to Importance Factors employed for wind speed analysis during plant design.

- No indication was given in the PPE that suggested parameter 1.7.2, Importance Factors, employed for wind speed analysis during plant design was not bounded adequately in revision 5. Amendment of the PPE may be warranted.

Calian subsequently analysed these nine PPE parameters to prove they did not cause significant residual environmental effects. They concluded that:

- The deeper foundation depth (parameter 1.1.2) would cause negligible impacts on groundwater flow in the longer term (post-construction), whilst construction related activities remained consistent with the 2009 EIS.
- The Importance Factors employed for wind speed analysis (parameter 1.7.2) were based on a newer methodology that gave results (strength targets) consistent with the 2009 EIS.
- The additional water requirements for fire protection (parameters 7.1.1 and 7.1.3) were offset by lower water usage elsewhere within the plant, i.e., net water use is lower than that found by integration over all water-using PPE parameters.
- The 35 m elevation of the Airborne Effluent release point during normal operation (parameter 9.4.2), whilst being beneath the 48.8 m height specified in the 2009 EIS did not result in doses to the public greater than those specified previously.
- The Airborne Source Term (parameter 9.5.1) did not result in doses to the public greater than those specified in the EIS.
- The Liquid Effluent Source Term (parameter 10.3.1) did not result in doses to the public greater than those specified in the EIS.
- Solid Radwaste Activity Levels (parameter 11.2.1), whilst above those specified previously, could be mitigated by improved tooling and hence the EIS conclusions were unchanged.
- The Spent Fuel Cask Weight (parameter 17.1.2), whilst 13 tonnes heavier than specified previously, could be mitigated by roadway reinforcement and hence the EIS conclusions were unchanged.

In short, it was found that accounting for all 138 PPE parameters applicable to its design, selection of the BWRX-300 had no impact on the conclusions found within the 2009 EIS. Moreover, by virtue of its design the BWRX-300 was found to have less environmental impact compared to the other reactor types considered in the EIS. In particular:

- Due to its smaller size and footprint compared to larger plants, construction of the BWRX-300 will provide increased opportunities for habitat retention and lower greenhouse gas (GHG) emissions due to reduced excavation needs.
- The non-requirement for cooling towers will prevent significant negative visual and practical consequences, allowing the deployment to fit better with its surroundings.
- Infilling of on-site ponds may be unnecessary, hence preserving non-human biota.
- The Bank Swallow population, a threatened species in the Province of Ontario, will likely be unaffected by construction of the first BWRX-300 unit.

Whilst almost all residual adverse effects were found to be not significant by inspection, just as they were within the 2009 EIS; five (including new dust pathways and a new bat population), whilst also expected to be not significant were deemed worthy of additional studies to ascertain if there will be a need for additional mitigations to make this so.

Whilst the EIS Review is quite thorough, some inconsistencies or omissions were found:

- Table 4 (Project Works and Activities) alludes to a post-construction workforce of approximately 300 persons for four operating units yet section 5.2.12 suggests this figure is 1,400 persons. This inconsistency should be resolved or clarified.
- Recognising that REGDOC-2.5. 2 has superseded Regulatory Document RD-337; the evaluation of the BWRX-300 PSA described in Section 5.7.3 of the EIS Review indicates that the design satisfies required safety goals, but also makes the pointed acknowledgement that this pertains to the design “as it has progressed to date”. It would have been valuable for the EIS Review to have identified where the BWRX-300 design has not progressed, or where it might yet change significantly enough to impact the conclusions of EIS. If the remaining aspects of design are unlikely to change these conclusions, the review should say so to reduce uncertainty.
- Section 5.7.4 states that as BWRX-300 fuel will be within the range of enrichment (<5%) assessed in the 2009 EIS, an out-of-core criticality accident will not lead to any significant residual adverse effects. Whilst this may well be true, it was rather dismissive of the criticality safety risks generally. Over 60 criticality accidents have occurred worldwide since the advent of the nuclear age (see, for example, the Tokaimura Criticality Accident in 1999 which led to the evacuation of residents and more than a hundred people receiving a >1 mSv dose), each of which was different due to the fuels, facilities, and/or processes involved. Whilst globally there is much experience of how to mitigate criticality safety risks along with well-documented guidelines; due to its widespread use of natural uranium fuel, Canadian industry experience of handling low enriched uranium fuels is lacking. Moreover, given it is a new design, it is plausible that some of the details pertaining to BWRX-300 fuel

management are unavailable at the present time. Whilst potential consequences can likely be comfortably bounded by prior precedent, knowledge, and analogy, more detailed consideration may be warranted if there are known unknowns.

More generally, whilst their potential environmental impacts were likely captured during analysis using parameters 9.5.1 (Airborne Source Term) and 10.3.1 (Liquid Effluent Source Term), it was surprising that there was no explicit mention of the potential for irradiated steam release or the reduced barriers to fission product release due to once-through cooling. It is assumed that the probabilities of such outcomes, and the mitigations in place to prevent them, are captured in documents elsewhere.

Conclusions

Given the reduced size and thermal power of the BWRX-300 SMR compared to the DNNP candidate reactor technologies for which the PPE was originally developed and on which the EIS was based; it is unsurprising to find that aside from the nine exceptions described above, earlier versions of the PPE adequately bound the BWRX-300, and hence the 2009 EIS conclusions remain valid. Furthermore, for the few instances where PPE revision 5 deviated from earlier versions, the EIS Review adequately demonstrated that residual adverse effects were not significant and hence, again, the 2009 EIS conclusions remain valid. Consequently, there are no obvious findings that challenge the approved EA.

This Technical Critique has reviewed both documents in good faith, checking references where necessary to interpret findings therein. Independent validation of findings was not within the scope of work, nor possible with the information provided. Opting for terseness over verbosity, it has not restated the tables and findings verbatim, but has highlighted possible inconsistencies or omissions in both, along with potential points to consider. All in all, the PPE, and EIS (and by extension the EIS Review) are fit-for-purpose but judging from some subtleties in choice of words (within the EIS Review), perhaps the collective understanding of Boiling Water Reactors is less strong than it could be.

Comment on the Darlington New Nuclear Project *Environmental Impact Statement Review Report*

Ole Hendrickson (Ph.D. in Ecology, University of Georgia, 1981)

March 20, 2023

Section 2 (1) of the 1992 version of the *Canadian Environmental Assessment Act* (CEAA 1992), under which new reactor construction at the Darlington New Nuclear Project (DNNP) was assessed during the 2006 to 2009 period, defines environmental effect as

> any change that the project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the *Species at Risk Act* [SARA].

Under section 11.01 (3) of CEAA 1992, the Canadian Nuclear Safety Commission, as the DNNP federal authority, must ensure that an assessment of the environmental effects of this project is conducted and

> must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them.

As noted in the October 2022 *EIS Review Report for Small Modular Reactor BWRX-300*,

> Several species of bats are using the woodlands on the DNNP site for roosting and foraging activities, which represents a baseline condition that was not previously considered… three species (Little Brown Myotis, Northern Myotis, and Tri-colored Bat) are listed as endangered on Schedule 1 of the federal SARA.

Identification of the DNNP's adverse effects on endangered bat species and measures to avoid or lessen these effects are required. These adverse effects and measures to avoid or lessen them are not discussed in the *EIS Review Report*. It cites an *EIS Review Supporting Document* in referring to "removal of bat habitat as well as potential interactions between the Project and bat species." This *Supporting Document* does not appear to be publicly available.

The *EIS Review Report* says "further studies are ongoing to identify and mitigate any potential effects" but provides no details of these studies.

The removal of bat habitat contemplated by the DNNP is not a "potential" effect. If the project were to proceed it would represent a direct, adverse effect that must be mitigated.

Another direct adverse effect on bats would be the increase in ambient noise associated with the DNNP project. The deeper foundations of the BWRX-300 reactors compared to the foundations of the original reactors proposed for the site (38 m rather than 13.5 below grade) would necessitate increased drilling and blasting.

In a study by Allen et al. (2021), "Noise distracts foraging bats," the probability of bats successfully localizing prey dropped three-fold in the authors' increased noise treatments. The authors called this "a dismal outcome for a hunter trying to survive." They concluded that the acoustic environment "likely constrains bat habitat suitability," and that this does "not bode well for the long-term persistence of acoustic predators."

The authors stated that "we must reduce the acoustic footprint of human activity." They added that "Many bats probably avoid noisy areas rather than suffer these foraging costs… but with ever-expanding cities, roadways and energy extraction fields, it is possible that at some point, acoustically oriented predators simply would not be able to flee far enough."

Clearly, further work is needed i) to identify the adverse effects of the DNNP on endangered bat species, and ii) to develop measures to avoid or lessen them.

Bank Swallows are another species at risk that could permanently lose habitat as a result of the DNNP:

> … the site layout for four BWRX-300 reactors will likely require some shoreline protection measures which may cause the bank to become unsuitable for Bank Swallows to inhabit.

For this species as well, habitat loss is clearly an adverse environmental effect. The EIS Review Report indicates that drilling and blasting activities "might" have adverse effects on Bank Swallows as well. It indicates that investigations are under way.

No effective mitigation measures for adverse environmental effects on either bats or Bank Swallows are identified in the *EIS Review Report*.

Under CEAA 1992 it is not sufficient to merely identify adverse impacts. Section 16 (1) requires consideration of measures that would mitigate any significant adverse environmental effects.

Given that mitigation measures have not been identified for species at risk, the conclusion in the *EIS Review Report* that deployment of the BWRX-300 at the DNNP site "is not likely to cause significant residual adverse environmental effect" is invalid.

Results of the previous EIS do not remain valid insofar as impacts on species at risk are concerned.

More detailed studies of impacts and mitigation measures for federally listed bats and Bank Swallows are required before a decision is made on the significance of the adverse environmental effects of the DNNP project.

Reference

Allen, L. C., Hristov, N. I., Rubin, J. J., Lightsey, J. T., & Barber, J. R. (2021). Noise distracts foraging bats. Proceedings of the Royal Society B, 288(1944), 20202689.

[redacted]

From: Evelyn Gigantes <[redacted]>
Sent: Monday, March 20, 2023 7:55 PM
To: Darlington New Nuclear Project / Nouveau projet nucleaire de Darlington
Subject: Licensing of BWRX-300 site preparation

Follow Up Flag: Follow up
Flag Status: Completed

Categories: In Process - [redacted]

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Submission by Evelyn Gigantes, March 29, 2023

This is an amazing and unacceptable process.

OPG decides it wants to develop new nuclear production on the site of the Darlington CANDU station. It works on an Environmental Impact Statement between 2006 and 2009, without identifying a reactor type.

An Environmental Impact Statement for the development of four small reactors at the Darlington site gets acceptance by the CNSC, the Joint Review Panel and the Government of Canada in 2012. There was still no identified reactor type.

The CNSC considers and approves a 10-year Power Reactor Site Preparation License for the unidentified reactor later in 2012. It also renewed that PRSPL in 2021. In December 2021 the OPG decided its first new reactor at Darlington should be a BWRX 300.

This apparently requires only a review of the 2012 Joint Panel Review – "CNSC staff confirmed during the PRSPL renewal public hearing that the EA accepted by the JRP and the GOC* is still valid. There is no expiry on an EA decision as long as the scope of that project remains within the scope of the original EA".

*Government of Canada

But the BWRX -300 is designed to use a fuel that has been enriched up to 5%. The current position of OPG is that a similar reactor, the Pressurized Water Reactor (PWR), which uses similarly-enriched fuel, was included in the group of reactors assessed in the original EIS and deemed acceptable. Therefore, OPG contends, the BWRX- 300 use of enriched fuel should also be deemed acceptable.

The fact is that the development of a BRWX-300 reactor at the Darlington site would be the first BWRX-300 reactor developed anywhere in the world. It is not acceptable that construction of this reactor be authorized by a review that suggests the features or operations of the BWRX -300 are “consistent with” or “similar” to other reactor types reviewed in the original EIS.

This is a sloppy, unimpressive approach to a very serious subject. The BWRX- 300 should be environmentally-evaluated in a full and rigorous way. It would be the first of its kind developed. It would use an enriched fuel for the first time at the Darlington site, and it would produce a new kind of waste at the Darlington site.

It appears the fact that OPG has chosen to develop a BWRX-300 at Darlington has given Estonia the belief that this reactor type has been endorsed as environmentally safe by Canada.

"As the initial construction will start in Canada, Fermi Energia saw the reactor as the most suitable for construction in Estonia out of the three offers received," it said. "Based on the design and construction experience of the Darlington nuclear power plant near Toronto, Ontario, the planning, design and construction of the Estonian nuclear power plant can also be gradually started."*

*World Nuclear News, Feb8, 2023

The “Updated Plant Parameter Report” notes that “the solid waste activity generated by the operation of the BWRX-300 is higher than what was assessed than what was assessed in the EIS. The design of the handling equipment for waste containers will be adapted to manage the higher activity. The weight of the cask to be used to transport spent fuel on the site (113 tonnes) is heavier than the cask assessed in the EIS (100 tonnes). This will mean upgrading the hauling roads to accommodate heavier cask weight. This upgrade is feasible is feasible and does not change the conclusions of the EIS”.

The new fuel clearly generates more potent radionuclides for disposal.

Further: "As the decommissioning strategy for the BWRX-300 has not been established, it is assumed that the overall approach and principles to be applied for decommissioning of the BWRX-300reactors are consistent with those described in the EIS. Therefore their effects are anticipated to be consistent with those described in the EIS. If the decommissioning strategy differs from this assumption, after submission of the PDP, OPG will review the assessment of the effects as part of its licensing commitments."

It is also striking that, in spite of the clear evidence that Climate Change is viciously proceeding, with concomitant acceleration in rising temperature ranges, this material refers to ambient temperatures and storm patterns gathered over unidentified previous years, referring to them casually as appropriate reflections of what is to be expected on the shoreline of Lake Ontario, no matter what warnings are now being generated by people who live and work in the Great Lakes regions, and by scientific experts.

Altogether, this sprawling and uninspired rehash of the documents produced to license site preparation for an earlier grouping of potential Small Modular Reactors is unworthy of an organization such as OPG, and/or the CNSC.

[redacted]

From: Kelly Clune <[redacted]>
Sent: Monday, March 20, 2023 11:17 AM
To: Darlington New Nuclear Project / Nouveau projet nucleaire de Darlington
Cc: Prime Minister/Premier Ministre; Premier of Ontario | Premier ministre de l'Ontario
Subject: OPG's plan to construct 4 new BWRX-300 reactors

Categories: Drafting Response

March 19, 2023

[redacted]

Re: OPG's plan to construct 4 new BWRX-300 reactors

Dear CNSC Members,

OPG has already agreed to collaborate with GE-Hitachi Nuclear Energy, SNC-Lavalin, and Aecon Group to construct four new nuclear reactors at the Darlington Nuclear Site in Clarington, Ontario. Site preparations and related work have apparently already begun.

The fact that this is the case is concerning, since today is the CNSC deadline for public comment into OPG's new plans. This demonstrates that CNSC is not serious about public involvement in the process.

It is irresponsible for CNSC to approve OPG's plan to build more nuclear reactors when the issue of nuclear waste has not yet been resolved.

CNSC needs to require OPG to construct a safe, practical, affordable, and environmentally acceptable long-term solution to store the decades of radioactive nuclear waste that have already accumulated.

GE-Hitachi BWRX-300 reactors would generate an even higher level of nuclear waste than that which results from current CANDU reactors. Therefore, a full environmental impact assessment is necessary, since the original environmental assessment no longer applies.

In addition to a full environmental review of OPG's new nuclear plans, the CNSC must ensure that the public have a wide opportunity to participate, to discuss and debate project proposals prior to public/private contracts being made. The public process must include any questions being fully answered and widely shared before comment deadlines and certainly before contracts are secured. After all, we know that it is ultimately the public that is liable for the health, environmental and financial costs of nuclear projects.

CNSC has allowed OPG to continue, and to expand, nuclear operations without requiring OPG to develop a responsible solution to address nuclear waste. This does not satisfy regulatory requirements or public safety.

CNSC must address these concerns.

Thank you,

[redacted]

[redacted]

From: Let's Talk Nuclear Safety <[redacted]>
Sent: Thursday, February 2, 2023 1:21 PM
To: Consultation / Consultation (CNSC/CCSN)
Subject: New comment added on Comment on the updated Plant Parameter Envelope Updated Report

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Hi CNSC-CCSN

You have received a new comment on the Forum Topic, Comment on the updated Plant Parameter Envelope Updated Report on project Darlington New Nuclear Project (DNNP) pre-licensing consultation on your site,

The CNSC has received the following comment:The Government of Ontario chose BWRX-300 technology over the Canadian EC6. While both are of modular design type, EC6 is a Canadian technology based on enhancing the CANDU-6 name with its International track record. EC6 has passed three phases of safety reviews by the CNSC, " Phase 3 Executive Summary Pre-Project Design Review of Candu Energy Inc. Enhanced CANDU 6 Design, CNSC, June 14. To that end, CNSC has concluded that " EC6® design provided a higher level of assurance that Candu Energy has taken regulatory requirements and expectations into account and further confirmed that there are no fundamental barriers to licensing the EC6® design in Canada".On the other hand, BWRX-300 has never been deployed anywhere in the world nor has it been reviewed by the Canadian Regulator. The decision to select BWRX-300 over EC6 technology, which has passed three rounds of licensing with the Canadian regulator, could have significant implications for public trust in government decision-making. By choosing a new and unproven technology over a proven Canadian one, the government is taking a risk with public safety and the environment, and may be criticized for not choosing the more reliable and established option. For example, if the government would be perceived as being uninterested in supporting local innovation, it could discourage future investment in Canadian technology development. Additionally, if the foreign technology selected is not as cost-effective, safe, efficient, or reliable as advertised, it could result in higher costs for taxpayers and lower energy production, which could have negative economic consequences. Moreover, the deployment of foreign technology could result in a transfer of wealth and expertise out of the country, rather than supporting local businesses and communities. The decision may also have political implications, as there may be public opposition to the government's choice of a foreign technology over a Canadian one. The recent submissions, NK054-REP-07730-00055-R000 and N-REP-01200-10000-R0005, have neglected to address the socioeconomic impact of choosing an unproved foreign technology over an enhanced Canadian technology with a track record. Therefore, the government of Ontario needs to be transparent about its decision-making process and the rationale behind it, if they wish to maintain public trust and support. [redacted]

Added by CNSC-CCSN

Click here to view the comment

This comment is subject to moderation.

[redacted]

From: Let's Talk Nuclear Safety <[redacted]>
Sent: Tuesday, January 31, 2023 7:59 PM
To: Consultation / Consultation (CNSC/CCSN)
Subject: A new question has been added to Questions?

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Hi there,

Just a quick heads up to let you know that a new question has been asked at Darlington New Nuclear Project (DNNP) pre-licensing consultation by abdelbaky.

The question that was asked is:

The Government of Ontario chose BWRX-300 technology over the Canadian EC6. While both are of modular design type, EC6 is a Canadian technology based on enhancing the CANDU-6 name with its International track record. EC6 has passed three phases of safety reviews by the CNSC, " Phase 3 Executive Summary Pre-Project Design Review of Candu Energy Inc. Enhanced CANDU 6 Design, CNSC, June 14. To that end, CNSC has concluded that " EC6® design provided a higher level of assurance that Candu Energy has taken regulatory requirements and expectations into account and further confirmed that there are no fundamental barriers to licensing the EC6® design in Canada". On the other hand, BWRX-300 has never been deployed anywhere in the world nor has it been reviewed by the Canadian Regulator. The decision to select BWRX-300 over EC6 technology, which has passed three rounds of licensing with the Canadian regulator, could have significant implications for public trust in government decision-making. By choosing a new and unproven technology over a proven Canadian one, the government is taking a risk with public safety and the environment, and may be criticized for not choosing the more reliable and established option. For example, if the government would be perceived as being uninterested in supporting local innovation, it could discourage future investment in Canadian technology development. Additionally, if the foreign technology selected is not as cost-effective, safe, efficient, or reliable as advertised, it could result in higher costs for taxpayers and lower energy production, which could have negative economic consequences Moreover, the deployment of foreign technology could result in a transfer of wealth and expertise out of the country, rather than supporting local businesses and communities. The decision may also have political implications, as there may be public opposition to the government's choice of a foreign technology over a Canadian one. The recent submissions, NK054-REP-07730-00055-R000 and N-REP-01200-10000-R0005, have neglected to address the socioeconomic impact of choosing an unproved foreign technology over an enhanced Canadian technology with a track record. Therefore, the government of Ontario needs to be transparent about its decision-making process and the rationale behind it, if they wish to maintain public trust and support. [redacted]

Please DO NOT reply to this email. If you want to provide an answer to this question, sign into your site and respond to the question from within the Q & A tool.

Regards

Bang The Table Team

[redacted]

From: Feliz Casa [redacted]
Sent: Tuesday, January 31, 2023 8:25 PM
To: Consultation / Consultation (CNSC/CCSN)
Subject: Darlington New Nuclear Project (DNNP) pre-licensing consultation

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

The Government of Ontario chose BWRX-300 technology over the Canadian EC6.

While both are of modular design type, EC6 is a Canadian technology based on enhancing the CANDU-6 name with its International track record. EC6 has passed three phases of safety reviews by the CNSC, " Phase 3 Executive Summary Pre-Project Design Review of Candu Energy Inc. Enhanced CANDU 6 Design, CNSC, June 14. To that end, CNSC has concluded that " EC6® design provided a higher level of assurance that Candu Energy has taken regulatory requirements and expectations into account and further confirmed that there are no fundamental barriers to licensing the EC6® design in Canada".

On the other hand, BWRX-300 has never been deployed anywhere in the world nor has it been reviewed by the Canadian Regulator.
The decision to select BWRX-300 over EC6 technology, which has passed three rounds of licensing with the Canadian regulator, could have significant implications for public trust in government decision-making. By choosing a new and unproven technology over a proven Canadian one, the government is taking a risk with public safety and the environment, and may be criticized for not choosing the more reliable and established option.

For example, if the government would be perceived as being uninterested in supporting local innovation, it could discourage future investment in Canadian technology development. Additionally, if the foreign technology selected is not as cost-effective, safe, efficient, or reliable as advertised, it could result in higher costs for taxpayers and lower energy production, which could have negative economic consequences

Moreover, the deployment of foreign technology could result in a transfer of wealth and expertise out of the country, rather than supporting local businesses and communities. The decision may also have political implications, as there may be public opposition to the government's choice of a foreign technology over a Canadian one.

The recent submissions, NK054-REP-07730-00055-R000 and N-REP-01200-10000-R0005, have neglected to address the socioeconomic impact of choosing an unproved foreign technology over an enhanced Canadian technology with a track record. Therefore, the government of Ontario needs to be transparent about its decision-making process and the rationale behind it, if they wish to maintain public trust and support.

[redacted]

[redacted]

From: Let's Talk Nuclear Safety <[redacted]>
Sent: Thursday, February 2, 2023 1:21 PM
To: Consultation / Consultation (CNSC/CCSN)
Subject: Your comment on Darlington New Nuclear Project (DNNP) pre-licensing consultation

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Let's Talk Nuclear Safety

Hi CNSC-CCSN,

Thank you for your comment on **Darlington New Nuclear Project (DNNP) pre-licensing consultation**. Here is the comment for your reference:

The CNSC has received the following comment:

The Government of Ontario chose BWRX-300 technology over the Canadian EC6.

While both are of modular design type, EC6 is a Canadian technology based on enhancing the CANDU-6 name with its International track record. EC6 has passed three phases of safety reviews by the CNSC, " Phase 3 Executive Summary Pre-Project Design Review of Candu Energy Inc. Enhanced CANDU 6 Design, CNSC, June 14. To that end, CNSC has concluded that " EC6® design provided a higher level of assurance that Candu Energy has taken regulatory requirements and expectations into account and further confirmed that there are no fundamental barriers to licensing the EC6® design in Canada".

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for taxpayers and lower energy production, which could have negative economic consequences.

Moreover, the deployment of foreign technology could result in a transfer of wealth and expertise out of the country, rather than supporting local businesses and communities. The decision may also have political implications, as there may be public opposition to the government's choice of a foreign technology over a Canadian one.

The recent submissions, NK054-REP-07730-00055-R000 and N-REP-01200-10000-R0005, have neglected to address the socioeconomic impact of choosing an unproved foreign technology over an enhanced Canadian technology with a track record. Therefore, the government of Ontario needs to be transparent about its decision-making process and the rationale behind it, if they wish to maintain public trust and support.

[redacted]

Thank you,
Canadian Nuclear Safety Commission (CNSC)

**This comment is subject to moderation*

Other projects that might interest you

Nuclear Security Regulations

Consultation has closed.The existing Nuclear Security Regulations (NSR) are an essential part of...

View Project

Discussion Paper DIS-22-02, Proposals to Amend the REGDOC-2.12 Nuclear Security Series

The CNSC regulates the use of nuclear energy and materials to protect the health, safety and...

View Project

REGDOC-2.4.5 Nuclear Fuel Safety

This regulatory document is part of the CNSC’s safety analysis series of regulatory documents,...

View Project

View all projects

March 20, 2023

Senior Tribunal Officer, Secretariat

Canadian Nuclear Safety Commission

[redacted]

[redacted]

Dear Tribunal Officer,

Please accept the comments below in response to the Review of the EIS for the Darlington New Nuclear Project (DNNP). These are my personal comments, made as a private citizen, not on behalf of any organization.

The opportunity to provide input is appreciated, although it is a daunting task.

[redacted]

Comments on the pre-licensing consultation pages for the DNNP

The few responses visible on the discussion page suggest that the pre-licensing consultation process has been ineffective. As a private citizen who tries to follow the nuclear news in Durham, I only recently became aware of this (apparently new?) process, though I see that it launched in December. How it was publicized, to whom, and how frequently, in the Region and communities directly affected? Did the CNSC work with the communications arms of host communities and affected Indigenous nations?

As noted in the response from the Municipality of Clarington, a comprehensive review of the multiple technical documents relevant to this consultation, is almost impossible for municipalities. Typically, it would involve a process for which they have few staff, limited expertise and no supplementary funding. Municipal officials familiar with the original Environmental Assessment (EA) process and JRP approval from 2006 to 2012, have in all likelihood moved on or retired. It is even more intimidating for an individual citizen to review and comment.

As a result, the CNSC will receive very little information about how citizens, either individually, or as represented by their Regional or municipal governments, see the project. I suspect the vast majority of residents in Clarington and Durham have little to no awareness of the 2009 EIS or the proposed SMR project.

Another general point goes to the type of review being done. The introductory web page for the DNNP EIS Review project indicates that no new EA is required if OPG can prove that the current project fits within the PPE of the 2009 EA. This seems to contradict the way CNSC normally operates.

It is my understanding that when nuclear facilities and equipment are built, renewed and relicensed by the CNSC, they are generally expected to meet current standards not old ones. Thus, it makes no sense that a major new project could proceed with a decade-old EA approval without meeting any new requirements covered by the current Impact Assessment Act process. The world has changed in the past 10 to 15 years since the original EA studies were completed. The Fukushima disaster, the urgency to address climate change, cumulative development pressures on the natural environment in the GTHA, the political instability that can threaten nuclear facilities, the UNDRIP and the nuclear industry's approach to decommissioning, are significant contextual events and trends. It is not apparent in this review document that new imperatives and approaches are being taken into consideration at all. Perhaps an entirely new EA should be done, but at minimum more work is needed to position the project as viable and necessary in 2023.

If this consultation was intended to help educate stakeholders and the public about the proposed project and confirm why no new EA is needed, it fails on many fronts. For example, just because the footprint of the SMR units is smaller, does not make it necessarily a wise project to carry out on this site. In fact, some parties might argue that it is not a good fit or optimal use of a site thought capable of generating 4 times as much energy. Are the benefits to the community from this much smaller project worthwhile? Will the property tax revenues directed to the Region and municipalities balance out the local costs and responsibilities of being a host to these much smaller reactors for 100 years? In the context of political strife and war as seen in Ukraine, what are the dangers of being the host to such a facility.

The Plant Parameter Envelope (PPE) comparison and review approach does not address any of these questions.

*Comments on the **Darlington New Nuclear Project Environmental Impact Statement (EIS) Review Report for Small Modular Reactor BWRX-300***

General points about the document:

- The format is extremely repetitive, with subsequent report sections revealing a few new bits of information about the same list of subjects. Would it not be possible to discuss all the information about the impact of the proposed reactors on habitat for bank swallows or bats or butterflies once? Could it not just say there will be no cooling towers in one place and dispense with that issue? If this document is meant to be a vehicle for **public** consultation, then it needs to be readable, not exasperating, for the public.
- Some of the content is confusing and obscure. The document talks about OPG's current application to build one BWRX-300 reactor but then alludes to the construction of a total of four reactors by 2035. Which is it? The constant allusion to a smaller footprint for the project implies that the overall impact of the Small Modular Reactor (SMR) development is significantly smaller than what had been proposed in the 2009 EIS. Without a clear understanding of what was contained in that 2009 document (which is over 1100 pages) how can the reader ascertain whether the impacts per unit of energy produced from this smaller reactor are worth enduring or insignificant. I could not find a definition of "significant adverse effect" in the EIS review report and did not have time to dive into the 2009 document.

SMR Technology

- If this document is intended for public engagement, OPG needs to spend more time explaining in language understandable to the public, how the SMR now being designed will operate. How is it helpful to compare the BWRX 300 to a bunch of old alternative designs that never happened? This may be the single most compelling reason for a new EA. That process was not assessing the suitability of the Darlington location for SMRs which, in OPGs own assessment are intended to be used anywhere. Let's be candid. Building this BWRX-300 at Darlington is an administrative convenience and highly opportunistic, since there was an existing approval.

SMR Project Lifecycle (Sections 3.4 Phases and 3.5 Timeline)

- The document spends a lot of time talking about the smaller geographic footprint of the project but the timeline impact of the project (section 3.5) is still a century long and barely discussed. For the last four decades of the timeline, there is no energy production, and little employment or economic benefit to the community of hosting the 1 (or 4) SMRs.
- Given OPG's sustainability commitments, what new efforts will be made during the SMR construction phase to limit GHG emissions from construction vehicles? Will low carbon concrete and steel be used? Would the reactor design allow for excess heat to be dispersed into a nearby district energy system rather than using the lake? Will administrative and storage buildings be built to a net-zero standard? Will employees be encouraged to take transit or carpool to the site? I doubt any of this was a consideration in the 2009 EIS but times have changed.
- As a taxpayer and an electricity ratepayer, I want to know what the costs and benefits of each stage of the lifecycle are, not just the construction stage, when a number temporary jobs are created. How many jobs exist at each phase? What are the GHG impacts of each phase? What is the net cost to the local taxpayer in each phase?
- How will the company or the federal government support the Regional and local community to participate in all of the hearings and regulatory processes required of a host community? Clearly, from Clarington's response, they do not have the necessary resources to keep up. My recollection is that the Region of Durham, other host communities and CANAC have also highlighted the need for resources to allow meaningful participation in the nuclear regulatory processes.

Impacts on the Environment

- The concept of the environmental baseline used for this project is one that is adjusted to fit the current level of degradation. The big surprise for this project is that left undisturbed, the 2009 baseline environment has in some cases improved…butterflies, bank swallows and bats have taken up residence.
- It was a relief to read that no lake infilling is involved with the SMR development but there will still be a hardened shoreline. After reading multiple sections of the review, it eventually becomes clear that the habitat that supports butterfly migration, bank swallows and the new bat colony are doomed if 4 reactors are built. These seem like significant adverse effects. But nowhere in this review are the proposed "mitigations" described. Has there been any demonstrable success creating artificial bank swallow habitat? Citizens would like to know how effective any of the proposed mitigations will be.

- Re water: at no time is the prospect of large amounts of used nuclear fuel housed within metres of the largest drinking water source in Ontario mentioned as a potential or perceived hazard.
- Re Socio-economic impacts: as noted earlier, what are the property tax and employment impacts at each phase of the project?
- Will Ontario apply the same proxy property tax regime to this new nuclear facility as it applies to others in the province, scooping off dollars that should be flowing to the Region and area municipalities to support local and regional services?
- The notion that an adverse impact is less than noted in the 2009 EIS does not necessarily mean it is now acceptable. The 2023 context should be applied. For example, are we destroying 1000 of the last 100,000 bank swallows in Ontario? Context matters and it may have changed since 2009. Saying that "expected losses are low relative to Ontario populations" is not very reassuring. This seems like an "extinction by a thousand cuts" approach to environmental protection.
- On page 82, in Section 5.6.3 the review states that prior to construction, OPG will prepare a contingency plan for construction, operational and decommissioning phases" that will account for climate uncertainties. This will include conducting "localized climate change modelling or utilize published studies to evaluate the effect of climate change on the project." Any new modelling or information produced should be shared with the local governments to enhance their climate change understanding and efforts.

Malfunctions, Accidents and Malevolent Acts

- The lists do not seem to include:
    - a prolonged loss of power to the SMR facility due to damaged external infrastructure. As we have seen in Ukraine, this is a serious problem.
    - A pandemic that incapacitates a large proportion of specialized staff required to operate and maintain the facilities over extended periods of time.

Decommissioning

- There is no discussion of the decommissioning phase other that to admit that because the BWRX-300 does not yet have a completed design, that a preliminary decommissioning plan is NOT being prepared now. It is assumed that the decommissioning strategy of the 2009 EIS will be applied.
- On p.42, the review states:

> If the decommissioning strategy differs from this assumption, after submission of the PDP, OPG will review the assessment of the effects as part of its licensing commitments.

- In what year would this post-PDP review occur?
- While this approach may fall within the old PPE, it contradicts the characterization of SMRs promoted by the federal government and industry that

these smaller reactor units can be mass produced, installed where and as needed, matched to a project a lifecycle and later removed with no fuss or muss. A plug-and-play experience is promoted. Don't worry about the pesky hangover of nuclear decommissioning.

- The Canadian experience to date shows that a deferred decommissioning approach allows the reactor owners to indefinitely delay dismantling and site restoration. If this OPG SMR is to demonstrate what now could be achieved elsewhere to support limited-time endeavours like mining in remote locations, an accelerated approach to decommissioning should be paramount.
- The lack of attention to the impacts of the entire lifecycle of the BWRX-300 project is characteristic of the ongoing failure in Canada of our energy and resource development regulators to look past the operational phase of a project, to a time when the resource is no longer economically extracted or the energy is no longer needed. Abandoned mines, oil and gas wells, improperly secured tailings dumps and ponds, and history of un- or poorly-regulated emissions and wastes dot our national landscape. These result in costly and ongoing hazards to Canadians.
- Admittedly, nuclear is held to a higher standard than some other resource sector enterprises (perhaps in part due to international agreements). However, the most notable examples of decommissioning in Canada seem to have resulted in "in situ" decommissioning with on-site (or nearby) waste storage facilities. This means that the host community will forever bear the burden of the defunct nuclear activities. It should be made clear to potential host communities that site decommissioning is not completed until the waste is removed, "eventually" which remains undefined.
- One of the key differences in the BWRX-300 from the previous PPE is the depth of excavation at 38 metres, compared to about 13 m.
    - Do previous seismic studies deal with operations at this depth?
    - How does the proponent envision decommissioning equipment installed at this depth? Is the need to dismantle in 60 years a key factor in the SMR design now being prepared?
- Based on past practice in Canada, it seems likely that equipment housed at this depth could well end up being entombed rather than removed. Was that option covered in the 2009 EIS?
- Page 18 indicates that the Decommissioning Phase, estimated to begin in 2095, is when dismantling plans will be developed. Based on presentations I heard at a September 2019 conference in Ottawa on nuclear waste and decommissioning, planning for decommissioning and dismantling during the design phase is now recommended by experts (e.g., presentation by CNL highlighting dismantling experiences at Chalk River). In this way, the wastes needing the most protection can be minimized, targeted and built with safe removal in mind. Decommissioning planning in 2095 seems to contradict that advice.

- What is the anticipated impact of the decommissioning on the site? Can it be restored and naturalized or made suitable for other industrial uses?
- It appears the CNSC is being asked to approve the reactor's construction based on unproven assumptions, with few or no answers to these questions.

Waste Management Issues

- After more than half a century of nuclear operations in Canada, it is clear that the federal government and industry need specific motivation to resolve the issue immediately. Therefore, the CNSC should not approve the **operation** of additional nuclear reactors until clear decisions and commitments about the safe long-term care and containment of the related wastes have been achieved. A "Plan" to deal with them is not sufficient.
- Personally, I agree that nuclear generation is likely necessary to support electrification of our economy to meet Canada's 2050 climate goals. Nuclear generation has a comparatively small environmental footprint over its lifecycle. It is not fast to build, but in combination with conservation, other alternative energy sources, and energy storage, it can help us reduce dependence on fossil fuels in coming decades. However, the federal government and the nuclear sector MUST deal with the nuclear waste issue as an implementation priority. Finding waste solutions must be top priorities to create broad acceptance of ongoing nuclear generation.
- The progress of the Nuclear Waste Management Organization (NWMO) in creating the used fuel Deep Geological Repository (DGR) has been glacial. In addition, as an agent of the nuclear energy utilities, its effort is perceived as tainted and self serving. In any case, the NWMO does not have (nor should they have) the authority needed to conclude the DGR siting question.
- The need to negotiate with Indigenous rights holders and local governments is fundamental to a DGR location decision. The federal government MUST work directly and honestly with the Indigenous rights holders and the existing and potential nuclear host communities to resolve the long-term management of the waste. Multiple solutions for the various categories of waste will be required.

The Conceptual plant layout in the review document (Section 3.2, page 14) shows no new waste storage facilities and yet…

- On page 17 there are two references to the construction of radioactive waste storage facilities including dry storage "e.g., dry storage of used fuel (e.g., at an on-site facility pending eventual transfer to a long-term management facility". How many waste buildings would be anticipated for the full 4 reactor build out and where would they be located?
- In Section 4.1.4, the review notes that used fuel waste handling equipment and containers have to be adapted to the higher radioactivity levels of the SMR fuel and onsite hauling roads will have to be upgraded to support 113 tonne storage

casks. The review notes on page 41 that the solid waste “activity generated by the operation of the BWRX is higher than what was assessed in the EIS.”

- These are the first clear acknowledgements in the report that the used fuel waste is different than that currently being stored at Darlington. Can the CNSC base a decision with a 100-year impact on assurances that NWMO’s planned DGR will be able to accommodate this new type of fuel assembly? And if so, when?
- The review report indicates that, consistent with the previous plans, low and intermediate level waste will be moved to another licensed OPG facility (p.25). In 2009, this statement likely referred to the planned L & ILW Deep Geological Repository then being planned by OPG for Kincardine. The application to build that DGR facility has since been withdrawn by OPG (another contextual change of the past decade) due to lack of support by the Saugeen Ojibway Nation.
- The EIS review acknowledges that the 2009 EIS did not adequately consult Indigenous rights holders about the project. How will OPG now acquire the consent of Williams Treaty First Nations to construct the SMR project, including the new waste facilities at the Darlington site and what will they do if consent is not available?
- From a citizen’s perspective, the lack definition of “interim” waste storage or “eventual” waste removal are extremely problematic. With no time limits, the CNSC essentially has been approving indefinite waste storage at all the nuclear generating sites. Had this been clear to host communities from the outset, would the facilities have been welcomed? It seems unlikely.

[redacted]

From: Let's Talk Nuclear Safety <[redacted]>
Sent: Monday, March 20, 2023 8:38 PM
To: Consultation / Consultation (CNSC/CCSN)
Subject: New comment added on Comment on Environmental Impact Statement Review Report

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Hi CNSC-CCSN

You have received a new comment on the Forum Topic, Comment on Environmental Impact Statement Review Report on project Darlington New Nuclear Project (DNNP) pre-licensing consultation on your site,

• The Environmental Impact Statement is too broad and lacks specific information about the BWRX-300. • Because the BWRX-300 has a different design and will produce novel wastes, the original environmental assessment is not applicable and a full environmental impact assessment must be undertaken. • A process should be developed for the public to send in questions about the Darlington Project and get back answers before the deadline to comment closes.

[redacted]

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[redacted]

From: Let's Talk Nuclear Safety <[redacted]>
Sent: Saturday, February 11, 2023 4:34 PM
To: Consultation / Consultation (CNSC/CCSN)
Subject: New comment added on Comment on Environmental Impact Statement Review Report

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Hi CNSC-CCSN

You have received a new comment on the Forum Topic, Comment on Environmental Impact Statement Review Report on project Darlington New Nuclear Project (DNNP) pre-licensing consultation on your site,

I am also concerned about this. Today the East-West portion of the trail on the east side of Holt Road is closed and is rerouted along the busy Energy Drive. So disappointed as we love this portion of the trail. Hopefully it will be rebuilt in some capacity.

[redacted]

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[redacted]

From: Let's Talk Nuclear Safety <[redacted]>
Sent: Wednesday, December 21, 2022 4:10 PM
To: Consultation / Consultation (CNSC/CCSN)
Subject: New comment added on Comment on Environmental Impact Statement Review Report

Follow Up Flag: Follow up
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EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Hi CNSC-CCSN

You have received a new comment on the Forum Topic, Comment on Environmental Impact Statement Review Report on project Darlington New Nuclear Project (DNNP) pre-licensing consultation on your site,

My concern centres around the Great Lakes, Waterfront Trail (GLWT). Will the current trail routing which traverses around and through and adjacent to the OPG Darlington property be disrupted.Are there plans to reroute the trail during the construction phase of the SMR?Will there be a consultation with the GLWT and Clarington active transportation committee with the goal of keeping the trail passable and unbroken?Thanks[redacted]

[redacted]

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[redacted]

From: Let's Talk Nuclear Safety [redacted]
Sent: Monday, March 20, 2023 7:41 PM
To: Consultation / Consultation (CNSC/CCSN)
Subject: New comment added on Comment on Environmental Impact Statement Review Report

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Hi CNSC-CCSN

You have received a new comment on the Forum Topic, Comment on Environmental Impact Statement Review Report on project Darlington New Nuclear Project (DNNP) pre-licensing consultation on your site,

Why the rush for this new reactor? Let's review the lessons of the last major nuclear accident. This month 12 years ago, three nuclear reactors at the Fukushima plant in Japan suffered catastrophic meltdowns. Ironically, 12 years ago, in the midst of the media blitz about the ongoing triple meltdown in Japan, intervenors were testifying at a federal Environmental Assessment (EA) hearing for up to four new large nuclear reactors to be built by OPG at Darlington. Later, in 2019, the CNSC, legally mandated to protect the public and the environment from radioactive emissions and nuclear accidents, lobbied the government to do away with Impact Assessments for almost all SMRs. Now OPG wants to build a smaller reactor at the Darlington site, and since a new Impact Assessment is not required, CNSC is using the assessment report done 12 years ago as the basis for public interventions, even though the BWRX-300 has no similarity to any of the reactors that were under consideration back then or to any reactors operating in Canada today. The day after Canada's Infrastructure Bank gave OPG a $970 million "low-interest loan" last October to develop the BWRX-300, NRCan Minister Jonathan Wilkinson boasted to a Washington audience that it would be Canada's first commercial SMR. Similarly, the CNSC President and CEO has said publicly that Canada will be the first Western country to approve an SMR built for the electricity grid. The regulator's fawning over the industry's prize SMR and push to get it through the regulatory process inspires mistrust. Why the rush? Let's look at Fukushima. Most people today would say the tsunami caused the catastrophe in Japan. However after six months of hearings into the root cause of the triple meltdowns, a Commission of Investigation in Japan came to a much different conclusion. The Commission's report to the Japanese Parliament (the National Diet) in 2012 concluded that the cause was collusion and lack of governance.The accident "was the result of collusion between the government, the regulators and TEPCO [the nuclear company], and the lack of governance by said parties. They effectively betrayed the nation's right to be safe from nuclear accidents. Therefore, we conclude that the accident was clearly "manmade." We believe that the root causes were the organizational and regulatory systems that supported faulty rationales for decisions and actions…"That finding was further elaborated by the Chairman of the Commission who wrote: "What must be admitted – very painfully – is that this was a disaster 'Made in Japan.' Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity …. nuclear power became an unstoppable force, immune to scrutiny by civil society. Its regulation was entrusted to the same government bureaucracy responsible for its promotion." Has Canada heeded these warnings? Does the CNSC see its role as protecting the public or supporting the nuclear industry? The original environmental assessment does not and should not apply; the reactor design is and the wastes will be different - a full environmental impact assessment is required.

[redacted]

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This comment is subject to moderation.

[redacted]

From: Let’s Talk Nuclear Safety [redacted]
Sent: Friday, March 17, 2023 1:14 PM
To: Consultation / Consultation (CNSC/CCSN)
Subject: New comment added on Comment on Environmental Impact Statement Review Report

Follow Up Flag: Follow up
Flag Status: Completed

EXTERNAL EMAIL – USE CAUTION / COURRIEL EXTERNE – FAITES PREUVE DE PRUDENCE

Hi CNSC-CCSN

You have received a new comment on the Forum Topic, Comment on Environmental Impact Statement Review Report on project Darlington New Nuclear Project (DNNP) pre-licensing consultation on your site,

Senior Tribunal Officer, SecretariatCanadian Nuclear Safety Commission280 Slater Street, P.O. Box 1046, Station BOttawa, Ontario K1P 5S9March 17, 2023Subject: Darlington New Nuclear Project (DNNP) pre-licensing consultationDear Secretariat:I would like to thank the Joint Review Panel for the opportunity to provide this written submission regarding Ontario Power Generation’s (OPG) Darlington New Nuclear Power Plant Project. The Municipality of Clarington, as Host to the Darlington New Nuclear Project, has followed and regularly submitted comments on the DNNP. Our observations and comments generally relate to land use planning, an area in which we possess the required expertise to provide comments and suggestions. We are thankful to both OPG and the CNSC for their past concern for our community and the demonstrated commitment made to mitigate and avoid potential project issues.We have attempted a preliminary review of the Updated Plant Parameter Envelope Report (N-REP-01200-100000 R005) and the Environmental Impact Statement (EIS) Review Report (NK054-REP-07730-00055-R000). Unfortunately, the Municipality of Clarington does not have the internal expertise or resources to provide meaningful input on the technical aspects of the updated reports. A briefing on the ‘new’ DNNP to Clarington staff and Council would be helpful in making informed comments on this and future consultation.More fundamentally, it is challenging for Municipalities to participate in these exercises as we are unable to obtain funding necessary to engage the technical expertise required to fully inform councils about the applications. The Canadian Association of Nuclear Host Communities (CANHC) has typically been able to access participant funding to address members’ needs at the licensing stage, but CANHC itself lacks funding which limits its ability to coordinate such efforts. Clarington is a proud host to the DNGP and we have confidence in the abilities of OPG and the skilled workers that bring safe, reliable and low carbon power to our province. We look forward to the opportunity to learn more about the project through a technical briefing. Regards, [redacted]

[redacted]

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