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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

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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, if the selected reactor technology is fundamentally different from the specific reactor

[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

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[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

[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

[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 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 [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
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.