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Written Submission from the Nuclear Transparency Project

Mémoire du Project de transparence nucléaire

In the matter of the

À l'égard d'

Ontario Power Generation Inc.

Ontario Power Generation Inc.

Application to renew power reactor operating licence for the Darlington Nuclear Generating Station

Demande concernant le renouvellement du permis d'exploitation d'un réacteur de puissance pour la centrale nucléaire de Darlington

Commission Public Hearing
Part-2

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Submitted via email

May 8, 2025

To President Tremblay and Members of the Canadian Nuclear Safety Commission,

Re: Ontario Power Generation's application to renew the Darlington Nuclear Generating Station's licence

We would like to begin by thanking the Commission for the opportunity to intervene in this hearing. We would also like to recognize the efforts of Ontario Power Generation (OPG), Canadian Nuclear Safety Commission (CNSC) staff, Canadian civil society organizations, and Indigenous Nations for their informative publicly available materials and submissions in this matter.

Having reviewed all available materials to date, we cannot overstate our concern over the length of OPG's requested licence term and CNSC staff's support for it. As we have noted in our past submissions during the relicensing hearings for the Point Lepreau Nuclear Generating Station and the McArthur River, Key Lake, and Rabbit Lake operations, we strongly believe that more frequent public relicensing hearings are a cornerstone of transparency in the Canadian nuclear sector. Given our past experiences intervening in relicensing hearings as well as mid-term licence update meetings, **we strongly recommend the return to a five-year licence term for the Darlington Nuclear Generating Facility.**

Our submissions have been divided into two main parts, with some preliminary notes as follows:

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 is comprised of a multi-disciplinary group of experts who work to examine the economic, ecological, and social facets and impacts of Canadian nuclear energy production. We are committed to interdisciplinary, cross-sectoral, and equitable collaborations and dialogue between regulators, industry, Indigenous nations and communities, civil society, members of host and potential host communities, and academics from a variety of disciplines.

About this intervention

NTP's intervention was made possible by CNSC funding through its Participant Funding Program (PFP). These submissions were drafted by NTP founder and coordinator Pippa Feinstein, JD LLM. An appendix to these submissions was prepared by NTP contributor and environmental toxicologist Dr. Shamaila Fraz.

Our shared concerns about the deeply troubling prospect of 30-year licence terms for nuclear facilities has caused both of us to focus our arguments and research on this issue alone. These submissions outline legal and regulatory concerns over a potential 30-year licence term for the DNGS. These submissions also detail the troubling implications of a 30-year licence for both nuclear transparency as well as the civil society organizations involved and interested in nuclear facilities and regulation. The appendix to these submissions canvasses and evaluates potential ecological changes in the vicinity of the Darlington site that may be expected to occur over the next 30 years, identifying several which could have significant implications for specific DNGS licence terms.

A note on Indigenous jurisdiction and the CNSC's regulatory context

NTP recognizes the sovereignty and jurisdiction of the Indigenous nations on whose land the Darlington facility 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 these facilities operate.

OPG's claimed ownership of the Darlington site does not extinguish Indigenous jurisdiction, nor does it prove the paramountcy of Canadian law and regulation of the site. NTP would support a formalized decision-making process in which Indigenous Peoples' authority and jurisdiction is observed (as defined by these rights holders) and believes this would be necessary to determine a just outcome of these matters.

CNSC staff's submissions acknowledge that,

> During engagement completed for this licence renewal application, Hiawatha First Nation and Curve Lake First Nation both raised concerns regarding the length of the licence OPG requested. Specific concerns raised were related to (a) the lack of ability to voice concerns to the Commission directly as part of a decision-making process and self-determination in relation to the project, (b) whether OPG would continue engagement and (c) how proper oversight and engagement would be maintained without regular re-licensing.
>
> With the recommendation of a longer licencing term, CNSC staff acknowledge there is a risk of eroded trust and relationships with Indigenous Nations and communities and the public, the same concern as was seen with the re-licensing of the Point Lepreau Nuclear Power Plant in 2022 and Cameco's McArthur River/Key Lake uranium mine and mill in 2023 where staff supported 20-year terms.[1]

Given CNSC staff's mandate relating both to the public interest as well as reconciliation with Indigenous Peoples, it is astonishing that staff continue to oppose these expressions of concern over the growing length of licence terms. CNSC staff appear to be aware of the damage longer licence terms will have, but are committed to this move regardless. NTP strongly supports the concerns expressed by Curve Lake First Nation and Hiawatha First Nation and our arguments below echo their concerns.

PART ONE
Commissioners, hearings and the *Nuclear Safety and Control Act*

A 30-year licence for the DNGS would be contravene the spirit of the CNSC's enabling legislation. NTP further submits below that a 30-year licence would offload too much oversight responsibility from the Commissioners to CNSC staff, constituting an improper delegation of Commissioners' legislated duties.

Public accountability in the Nuclear Safety and Control Act

Much of the framework of the *Nuclear Safety and Control Act* (*NSCA*) concerns the powers of, and constraints on, the Commission as a corporate body, primarily comprised of Commissioners and a Commission president. According to the Act, it is this central body that is responsible for the regulation and oversight of Canada's nuclear sector.

A good portion of the Act's text concerns the establishment of the Commission, its objects, the conditions of Commission members' organization, tenure, and remuneration, and their decision-making responsibilities.[2] The Act explains the Commission is a court of record with the powers to summon witnesses, examine evidence, and enforce orders.[3] The Commission has the authority to provide and manage international security classifications, directly oversee workers' conditions in certain circumstances, and manage

[1] CNSC staff CMD at p 18.
[2] *Nuclear Safety and Control Act*, RSC 1997, c-9, sections 8-15.
[3] *Ibid* sections 20.

the Commission's own finances (including the provision of participant funding to intervenors).[4]

Commissioners' decision-making powers are comprehensive: they can set out the classes of licenses as well as their contents.[5] However, these powers are also carefully delineated and ultimately also subject to the public interest. The *NSCA* provides that Commissioners are appointed by elected government representatives[6] and in important ways, also accountable to the public whose safety they must ensure.

More specifically, the objects of the Commission are:

> **Section 9 (a)** to regulate the development, production and use of nuclear energy and the production, possession and use of nuclear substances, prescribed equipment and prescribed information in order to
>
> > (i) prevent unreasonable risk, to the environment and to the health and safety of persons, associated with that development, production, possession or use,
> >
> > (ii) prevent unreasonable risk to national security associated with that development, production, possession or use, and
> >
> > (iii) achieve conformity with measures of control and international obligations to which Canada has agreed; and
>
> **(b)** to disseminate objective scientific, technical and regulatory information to the public concerning the activities of the Commission and the effects, on the environment and on the health and safety of persons, of the development, production, possession and use referred to in paragraph (a).

NTP has consistently argued that this duty to disseminate information is a core function of the Commission and a source of its legislative duty to promote transparency. Transparency, in turn, rather than simply an end unto itself, is a necessary condition for accountability. As we have argued before, and as we set out in these submissions below, public relicensing hearings are essential processes for the Commission to meet these responsibilities.

In contrast to the detailed provisions relating to Commissioners and their powers and responsibilities, only one section of the Act relates to CNSC staff specifically,

> **Section 16 (1)** The Commission may, notwithstanding any other Act of Parliament, appoint and employ such professional, scientific, technical or other officers or employees as it considers necessary for the purposes of this Act and may establish the terms and conditions of their employment and, in consultation with the Treasury Board, fix their remuneration.

Significantly, CNSC staff are not given the powers of a court of record. Their responsibilities are not as explicitly delineated, though they clearly do not shoulder the same powers or authorities. Because they are not intended to exercise the same powers as Commissioners, they are not answerable to the public in the same proscribed way. Rather, the Act makes it clear that Commission staff's role is to inform and advise

[4] *Ibid* section 21.
[5] *Ibid* sections 23 and 24.
[6] *Ibid* section 10.

Commissioners on primarily technical and scientific issues and implement Commissioners' ultimate decisions.

This interpretation of the important distinctions between Commissioners and Commission staff is further supported by the Act's more detailed sections relating to the duties of inspectors and designated officers.[7] The decision-making authority wielded by inspectors and designated officers are both subject to specific duties to the public (and licensees). The enumerated duties and constraints accompany their respective spheres of authority. In this way, the *NSCA* consistently contains checks and balances on all delegated power.

As we will discuss more in these submissions below, longer licence terms would effectively circumvent the Act's intent, allowing CNSC staff to exercise powers not expressly given to them by the Act. The prospect of 30 years without formal mechanisms for Commissioners' or public involvement in licensing issues for the DNGS would contravene the spirit of the NSCA's legislative regime.

The Nuclear Safety and Control Act and relicensing hearings

While the Act affords Commissioners with some discretion relating to the establishment of their own bylaws and procedural aspects of Commission hearings and meetings, this power is not absolute. A clear thread that runs through the entire Act is that duties to the public are also met via certain procedural safeguards.

As CNSC staff note in their submissions, Section 24 of the *NSCA* contains the legal test for determining whether a licence can be issued. This provision is as follows:

> **Section 24 (4)** No licence shall be issued, renewed, amended or replaced — and no authorization to transfer one given — unless, in the opinion of the Commission, the applicant or, in the case of an application for an authorization to transfer the licence, the transferee
>
> > **(a)** is qualified to carry on the activity that the licence will authorize the licensee to carry on; and
> >
> > **(b)** will, in carrying on that activity, 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.

However, it must be read alongside other provisions of the Act that require such determinations to be made in publicly accessible hearings:

> **Section 40 (5)** The Commission shall, subject to any by-laws made under section 15 and any regulations made under section 44, hold a public hearing with respect to
>
> > **(a)** the proposed exercise by the Commission, or by a panel established under section 22, of the power under subsection 24(2) to issue, renew, suspend, amend, revoke or replace a licence; and

[7] *Ibid* sections 30-39.

(b) any other matter within its jurisdiction under this Act, if the Commission is satisfied that it would be in the public interest to do so.[8]

This provision indicates that relicensing a facility is an important matter that requires direct Commissioner determinations and all the procedural safeguards for intervenors in a public forum. The second part of this provision confirms that public relicensing hearings are a matter of public interest before providing that this public interest may extend to additional circumstances.[9]

As licences are an important trigger for these provisions relating to mandatory public hearings (i.e. their issuance, renewal, suspension, amendment, revocation), the length of licence terms effectively determines the practical significance of this portion of the Act. An average licence term of two to five years, which was what was originally instituted, underscored the importance of Commissioners' and intervenors' frequent and proactive oversight of nuclear facilities and their licence terms. A move to grant 30-year licence terms would drastically limit the scope of these provisions of the Act, and by extension the roles of both Commissioners and intervenors in Canadian nuclear regulatory processes.

PART TWO
The importance of Commission hearings in context

While NTP has always pushed for improvements to hearing processes, current relicensing hearings still provide several practical and profound benefits that other intervention opportunities cannot match. Further, when thinking about relicensing hearings, it is important to go beyond the Commission's enabling legislation, and examine some broader contextual factors including: Canadian nuclear regulation's historical legacy of secrecy; contemporary pushes to expand Canadian nuclear infrastructure; and how Canadian nuclear regulation compares to regulatory regimes in other jurisdictions.

Unique benefits of relicensing hearings

Licensing and relicensing hearings are the only funded opportunities to learn about and comment on specific facilities' operations and licence terms. No other intervention opportunity facilities the same potential for in-depth examinations of a single facilities.

Nuclear generating stations are some of the largest and most complex nuclear facilities regulated by the CNSC. Over time, NTP contributors have increasingly learned how wide-ranging routine operations can be at these facilities. The DNGS is comprised of several different facilities and responsible for several different activities – including the tritium removal facility, medical radioisotope production, and energy generation – each with their

[8] *Ibid* section 40(5). CNSC Bylaws similarly provide for the Commission to hold meetings at "any time and place the convenor determines" including in public. See: *Canadian Nuclear Safety Commission Bylaws*, SOR 200-212, sections 5-6.
[9] See: *Ibid* section 40 more generally.

own environmental, economic, and social facets and impacts. DNGS outputs in each of these areas are also huge. Navigating publicly available data on this facility has taken NTP contributors years, and we continue to learn more with each new intervention. Relicensing hearings have provided the most meaningful opportunities to understand the intricacies of the Darlington site and how its licence terms shape the many aspects of its operations.[10]

Through interventions invited during formal Commission hearings, decision-makers can be exposed to, and learn from, more perspectives and diverse expertise than might otherwise be available from CNSC staff and project proponents' submissions alone. The CNSC's own Participant Funding Program underscores this principle, supporting members of the public and civil society organizations in providing value-added information to assist Commissioners in their deliberations. Consideration of a wider variety of perspectives, viewpoints, and expert opinions can in turn lead to more responsive and comprehensive decisions by Commissioners.

Just as importantly, public hearings offer valuable opportunities for intervenors to learn from one another's interventions. This in turn can allow intervenors to deepen their own knowledge over time and support the provision of additional insights at future proceedings. This is true for technical aspects of nuclear facilities' operations. It is also true for other types of interest. For example, Indigenous intervenors provide important insights that teach us about the lands and waters affected by nuclear infrastructure as well as implications of nuclear facilities and their regulations on Indigenous and Treaty laws. In this way, interventions from Indigenous rights holders teach us what our own responsibilities are to the Indigenous territories and people affected by nuclear development. For these and other reasons, NTP always thanks all intervenors for their contributions to the hearings we follow and intervene in – over time, their knowledge shapes ours as well.

Timeframes are generally longer and funding is higher for licence-related hearings, compared to any other type of public intervention before CNSC Commissioners.[11] These longer timeframes are a procedural benefit that allows intervenors to deepen their knowledge of specific facilities. Longer licence terms, and by extension less frequent licence renewal hearings, will have an adverse impact of intervenors' ability to maintain and grow their knowledge of specific nuclear sites. In fact, Commissioners, civil society organizations, and the public can maintain and build their institutional knowledge and capacity over time with more frequent hearings.

Hearing timeframes and funding amounts should also be in some way commensurate to licence terms. On a five-year licence cycle, providing 6-12 months for public interventions

[10] For the Darlington site, we did this primarily via our interventions in the Darlington Waste Management Facility relicensing hearing and hearings for the Darlington New Build project, further reinforcing the importance of facility-specific hearings.

[11] While hearings to consider environmental assessments (EAs) can also provide for loner intervention timeframes and higher funding amounts, EAs are generally only conducted once or twice in a project's lifespan.

into of facilities during a hearing may be reasonable. However, 6-12 months for a relicensing hearing every 30 years is extremely inadequate, leaving that opportunity effectively meaningless. The same is true for funding through the Participant Funding Program. Currently, funding can cover a few days to a few weeks' worth of work for public intervenors. Such work hours would be insufficient to get caught up to date on the intricacies of 30 years-worth of facility operations, let alone projecting what another 30 years of operations may look like. Here it is important to note that CNSC staff have not made any commitment to providing longer intervention timeframes or higher funding amounts for less frequent relicensing hearings.

Finally, such infrequent relicensing hearings would mean that if a member of the public or civil society organization misses one opportunity to participate in a relicensing hearing, they may never get another opportunity. This could effectively deny people the chance of ever commenting during a facility-specific proceeding should that hearing coincide with sick leave or parental leave, or a particularly busy period of overwork. The inequitable implications of this are obviously inconsistent with the public interest.

Hearings and the legacy of secrecy in the nuclear sector

The nuclear energy sector, due to its proximity to and associations with nuclear weapons, has historically been characterized as very opaque and secretive. Further, much of early Canadian nuclear regulation was also born from the shadow of the Cold War, in which secrecy and suspicion of the public was paramount. It took decades of advocacy by members of the public and civil society organizations to demand more transparency and institutionalized opportunities for public engagement. More frequent CNSC engagement with Indigenous communities only began to occur over the last five to seven years.

When exercising its considerable powers, the Commission should always consider the need to rectify rather than perpetuate the secrecy and inaccessibility that characterized much of its history. The approval of a 30-year licence term for the DNGS would be a significant institutional move in the wrong direction.

CNSC staff in their CMD discuss ways in which Canadian nuclear regulation matured when the Atomic Energy and Control Board became the Canadian Nuclear Safety Commission.[12] One important legislative development at this time was making the new Commission a court of record. In this way, the character of current hearings and their procedural safeguards for intervenors was a fundamental development for the new CNSC.[13]

As such, funded public interventions in licensing and relicensing processes have been a crucial and hard-won element of the CNSC's development, and an essential component of its regulatory maturity. Unilaterally undoing these regulatory developments and

[12] See: section 2.8 of CNSC staff CMD for this matter.
[13] See legislative notes for Bill C-23, *An Act to establish the Canadian Nuclear Safety Commission and to make* consequential amendments to other Acts, 2nd Sess, 35th Parl, 1996-7, online: https://www.parl.ca/documentviewer/en/35-2/bill/C-23/third-reading/page-11.

returning to a form of regulation that deprives the public of the unique benefits of more regular hearings would comprise a significant blow to the generations of public advocates who devoted so much of themselves to make public engagement in Canadian nuclear regulation more meaningful.

Finally, since CNSC staff first began to support the move to increase licence lengths beyond five years, the majority of civil society organizations (and all environmental non-governmental organizations) have opposed this.[14] Thus, despite any assurances by OPG or CNSC staff to the contrary, the move to longer licence terms cannot be said to benefit or be endorsed by civil society.

Hearings and Canada's proposed nuclear expansion

We are at a moment in which new nuclear projects are being approved by the CNSC for the first time in at least three decades. The current push for new nuclear facilities includes: the Darlington Nuclear New Build modular reactors which were recently approved by CNSC Commissioners; a proposal for new reactors to be constructed at the Bruce Nuclear Generating Station; a proposal to build a new micro-nuclear reactor at Chalk River Laboratories; and four new MONARK reactors proposed for construction in Peace River, bringing nuclear energy reactors to Alberta for the first time. Additionally new uranium mining operations are being proposed, namely the Wheeler River and Rook 1 proposals.

NTP is deeply concerned about the ethical implications of any significant increase in nuclear infrastructure coinciding with a decrease in meaningful avenues for meaningful public engagement. If Canada wants to be a global leader in nuclear energy technologies, it should similarly seek to be a leader in transparent, equitable, and robust public engagement in the nuclear sector. This relates to arguments directly below concerning the international landscape for nuclear regulation.

Hearings and their international context

CNSC staff assert that longer licence terms are consistent with international practices. Their CMD provides a table with licence lengths and Periodic Safety Review frequencies for France, South Korea, the United Sates and United Kingdom.[15] OPG also asserts "[t]he concept of a 30+ year licence is common in the international community. Several nuclear power generating stations around the world have 30+ years to indefinite licence terms" referring to this as "accepted industry practice".[16]

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[14] See: NTP submissions for Point Lepreau Nuclear Generating Station relicensing hearing at p 2. For an overview of concerns over less frequent licence hearings, see for example: Lake Ontario Waterkeeper and Ottawa Riverkeeper, Written Submission in the Matter of SRB Technologies, 15-H5.2. For concerns relating to licenses and democratic process, see for example: Greenpeace Canada, Oral Presentation In the Matter of Bruce Power Inc. – Bruce A and B Nuclear Generating Station, CMD 18- H4.99, p 2.
[15] CNSC staff CMD for this matter at p 14.
[16] OPG CMD for this matter at p 18.

NTP submits, rather, that Canadian nuclear regulators should not be engaged in a race to the bottom. NTP's international contributors' and several other colleagues abroad often express admiration when they learn of opportunities for regular funded interventions for licence renewals before the CNSC. It is true that these opportunities do not exist (or are much less frequent) in many other jurisdictions. Further, while NTP has (and will continue) to push for improvements in the current regime for public interventions, we remain grateful for these current opportunities. Canadian regulators should maintain the higher standards other national regulators can aspire to.

At the same time, as discussed in part one above, Canadian legislators clearly envisioned a model of regulation whereby CNSC Commissioners would oversee the nuclear sector via regular public hearings. Their broad authority is tempered and balanced by duties to ensure transparency and public engagement. While CNSC staff compare licence lengths between multiple jurisdictions, there is no accompanying consideration of the respective legislative regimes governing nuclear regulation in these jurisdictions: their objects may be different from those of the CNSC and their purposes as defined by elected officials may be similarly distinct. If other countries' nuclear regulatory bodies do not have similar legislative regimes or objectives to the CNSC, their licence lengths are less relevant.

Further, as NTP submitted in our intervention during the Point Lepreau Nuclear Generating Station: CNSC staff's international benchmarking regarding licence lengths does not include any analysis of the comparative rigour of other jurisdictions' licensing proceedings. Nor do CNSC staff canvass whether any regulatory alternatives for public engagement may accompany or otherwise supplement licensing processes in those countries. As such, the significance and usefulness of CNSC comparisons remains limited. Further, NTP continues to submit that licence periods for nuclear facilities should be reflective of the needs of local communities and civil society as well as the rights and interests of Indigenous Peoples and nations – regardless of what may occur in other jurisdictions. NTP asserts, where widespread concern accompanies requests for longer licenses, the CNSC as a public regulator has a duty to respond and protect these necessary public processes.[17] CNSC staff have yet to take any of these comments into account in their current push for longer licence terms.

Hearings and their ecological context

In requiring the Commissioners to ensure that nuclear facilities protect the environment, the *NSCA* requires sensitivity to ecosystems in which nuclear infrastructure is embedded. Traditionally, allowable environmental releases were determined primarily with reference to modelled radioactive doses to human receptors. However, more recent changes to REGDOC 2.9.2 de-emphasize this human-centred focus and instead account for non-human ecological receptors including water quality, aquatic life, and non-human terrestrial biota.[18]

[17] NTP submissions for Point Lepreau Nuclear Generating Station relicensing hearing, at pp 4-5.
[18] REGDOC 2.9.2: Environmental Protection; controlling releases to the environment, online: https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-9-2/.

30 years is a long time for people, but a much longer time for many non-human species who have shorter lifespans than we do. Further, the ecosystem in which the Darlington site is situated is in considerable flux, affected by multiple environmental stressors as well as the many uncertainties climate change has begun to bring. Dr. Fraz canvassed some of these changes over the last 30 years, including:

- The significant decline of Diporeia, Oligochaeta, and Sphaeriidae (three benthic invertebrate species important for the local food web in Lake Ontario) due to invasive species; and
- The decline of Lake whitefish, Slimy sculpin, American eel, and Lake sturgeon (which is a species that is particularly vulnerable to climate change)[19]

Climate change is accelerating faster than predicted, and expected to change the physical, chemical and biological make up of Lake Ontario.[20] Ecological conditions in and around the Darlington site over the next 30 years will be very difficult to predict.

Dr. Fraz in her expert report for this intervention also highlighted some significant ecological changes that have been documented at the Darlington site in the last decade alone. In particular, ten years ago:

- Lake Sturgeon present along the Darlington shoreline had no federal *Species at Risk Act* (*SARA*) status. Now it is considered a *SARA* special concern species and considered threatened by Ontario authorities;[21]
- American eel (also identified as being present in the vicinity of the DNGS) was a Committee on the Status of Endangered Wildlife in Canada (COSEWIC) species of special concern. Now, it considered endangered by COSEWIC and a threatened species according to Ontario authorities;[22]
- Two species of bat (little Brown myotis and Northern myotis) were not found to be present at the Darlington site, whereas they are now. Both species are considered endangered by federal and provincial authorities;[23] and
- Long-eared owls, were identified at the Darlington site but do not appear to be there anymore. While Green herons and Barn swallows (a threatened species) were not present at the site ten years ago but are present there now (for the Barn swallows they are documented to have begun to nest at breed at the Darlington site). [24]

Dr. Fraz further explains that species with threatened or endangered status can be particularly vulnerable to the effects of climate change. These changes have direct implications for OPG's requested licence terms and length.

All of these ecological changes to species movements and populations in and around the Darlington site will require frequent adaptive management by OPG. Their licence and

[19] See: Table 1, Dr. Shamaila Fraz, Review Prepared for NTP Regarding OPG's Application to Relicense the DNGS for 30 Years, Appendix A to these submissions.
[20] *Ibid* at p 1.
[21] *Ibid* at p 5.
[22] *Ibid.*
[23] *Ibid* at p 8.
[24] *Ibid* at pp 8-9.

Licence Condition Handbook (LCH) provisions will likely have to be amended, along with their biodiversity and environmental monitoring plans and activities. A 30-year licence will effectively prevent Commissioners and the public from learning about and commenting on these amendments – as only relicensing hearings would have the timeframes and single-facility focus required to examine this issue over time.

In addition to the effects on species, weather changes may affect lake temperatures and cause lake stratification, which could also lead to oxygen depletion and dead zones deeper in Lake Ontario.[25] Such a change may require new approaches to regulating Darlington's thermal discharges into the lake from its once-through cooling system. However, with fewer relicensing hearings, Commissioners and members of the public are not guaranteed the time required to review any related changes to Darlington's licence or LCH.

PART THREE
Comparing relicensing hearings with other intervention avenues

Both OPG and CNSC staff list a variety of other avenues for public engagement alternatives to more frequent licence renewal hearings. Our submissions below argue that none of these avenues should be considered adequate alternatives to full hearings, either on their own or viewed together.

Licence amendment hearings

Licence amendments are not always subject to full public hearings. Also, where hearings are held, they are often only in writing. Hearings in writing miss the valuable two-way dialogue that can occur during oral submissions at hearings, and thus fail to provide the same quality and depth of exchanges or learning opportunities as in-person hearings.

Further, many licence amendment hearings do not offer participant funding. For example, NTP wanted to intervene in OPG's last submission of its updated consolidated financial guarantee. However, no funding was offered, effectively preventing NTP from hiring the third-party experts it required to provide comments on technical financial aspects of OPG's application. After much advocacy, the CNSC finally made some funding available, however by then NTP contributors only had one week to review materials and draft submissions, with no time for information requests.[26]

More recently, Cameco Corporation has updated its financial guarantees for its Cigar Lake and McArthur River operations. Cameco is also applying to amend its licence for

[25] *Ibid* at p 3.
[26] See: CNSC announcement of funding to NTP for an intervention on OPG's consolidated financial guarantee, online: https://www.cnsc-ccsn.gc.ca/eng/the-commission/participant-funding-program/opportunities/nuclear-transparency-project-opg/.

the Cigar Lake with a new site map. This licence amendment is subject to a hearing in writing only, with no funding made available to intervenors.[27]

For these reasons, licence amendment hearings cannot be considered an adequate alternative to full licence renewal hearings.

Mid-term licence updates

NTP has now intervened in three mid-term licence update meetings: one for the Bruce Nuclear Generating Station which was its own proceeding with specifically-designated participant funding; and two were tacked onto routine Regulatory Oversight Report meetings, one for Canadian Nuclear Laboratories and the other for the Pickering Nuclear Generating Station. In our experience, licensee CMDs in all these proceedings were not are not nearly as detailed as relicensing applications. This meant we had to rely more on information requests of the proponents. While the Bruce nuclear meeting's timeframes allowed for this, the RORs' timeframes did not. The result was an unequal and seemingly arbitrary procedure for mid-term update meetings.

From these past experiences, it also remains unclear whether and to what extent Commissioners can require amendments to licence terms during these mid-term licence update meetings. While we understand this is possible, we are not aware of this ever happening in practice.

Finally, we had originally conceded in our submission for Cameco's licence renewal applications for McArthur River, Key Lake, and Rabbit Lake operations that a ten-year licence with mid-term licence update at the five-year mark might be sufficient for public engagement. However, our experiences to date have forced us to revisit this position. Mid-term licence update meetings cannot be considered to be an adequate alternative to licence renewal hearings due to the poorer quality of their CMDs, the unpredictability of their procedures, and the uncertainty surrounding possible meeting outcomes. As a result, we are requesting a return to a five-year licence term for the DNGS and would recommend the same for all other CNSC-regulated facilities.

Regulatory Oversight Reports

RORs have a fundamentally different purpose than relicensing hearings. ROR meetings are meant for canvassing multiple facilities; facilitating comparisons between these facilities; and promoting an understanding and evaluation of general categories of licensee. When participant funding is provided to intervenors, it specifically required them to review the ROR documents. While intervenors may want to follow up on concerns or interests relating to specific licensees, they would have to do so on their own without guaranteed access to participant funding for that work.

[27] CNSC, Hearing notice, online: https://api.cnsc-ccsn.gc.ca/dms/digital-medias/CMD25-H104-Notice-eng.pdf/object.

It is also important note, as we have done in our last two submissions relating to the ROR for nuclear generating facilities, that this ROR has the least amount of information (and data) compared to all other RORs. While we appreciate that the size and complexity of nuclear generating stations must make this a particularly challenging ROR for CNSC staff to prepare, more disclosure and analysis should be prepared for the public than is currently provided.[28] This particular deficit makes the ROR for nuclear generating facilities an especially poor substitute for relicensing hearings for nuclear generating facilities.

Finally, timeframes for licence renewal hearings are considerably longer than those for RORs. Participant funding amounts are similarly higher for licence renewal hearings than they are for most ROR meetings. While CNSC staff offer ROR meetings as alternatives to relicensing hearings, they have not proposed greater funding amounts or timeframes for RORs to make up for less frequent hearings.

CNSC-ENGO Forum

CNSC staff meet quarterly with a group of Environmental Non-governmental Organizations to discuss matters of broad regulatory interest. NTP is a member of this Forum and Ms. Feinstein served as its Co-chair until this past year. However, it cannot be considered to be an adequate replacement for more frequent relicensing hearings as its Terms of Reference prevent facility-specific discussions:

> **Section 2.2.** To maintain a separate line of engagement distinct from the narrower project- or policy-specific opportunities for ENGOs to intervene before the Commission on specific project licences, regulatory oversight reports, or reviews of draft regulatory documents or regulations.[29]

The Forum's purpose is instead to focus on larger structural and procedural aspects of Canadian nuclear regulation.

Further, the Forum is not immediately open to general public and rather has specific membership criteria and corresponding commitments.[30]

Public Information and Disclosure Protocols and REGDOC 3.2.1

The CNSC only requires one-way communications (from licensees to the public) in Public Information and Disclosure Protocols. As such, it cannot produce the same benefits of the two-way communication possible during in-person relicensing hearings.

Further, no funding is provided to civil society organizations or members of the public to review nuclear operators' data or reports outside of funded intervention opportunities.

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[28] See: NTP submissions re: Canadian Nuclear Safety Commission Staff's Regulatory Oversight Report on Nuclear Generating Facilities in Canada: 2023, at p 2.
[29] Forum between the Canadian Nuclear Safety Commission and Canadian Environmental Non-Governmental Organizations, Terms of Reference, online: https://www.cnsc-ccsn.gc.ca/eng/resources/engoforum/terms-of-reference/.
[30] *Ibid* at section 6.

Additionally, even if the public were to review proactive disclosure, their analysis would not be seen by Commissioners without a formal intervention opportunity.

CNSC staff have assured that "[s]hould OPG be granted a 30-year license by Commission, an updated PIDP from OPG would be required to address the long-term communications objectives and explain how the program will be updated throughout the licensing period."[31] However, no further details about these potential amendments appear to be publicly available at this time. No such previsions seem to have been included in CNSC staff's currently proposed licence and LCH for the DNGS. Nor is any information available concerning whether there would be any specifically-designated process for the public to review updated provisions in OPG's PIPD for the DNGS.

CNSC staff also cite event initial reports as an opportunity for public engagement in the absence of more frequent licence renewal hearings. Here, NTP submits that these event reports are also examples of only one-way communication from licensees to the public. Further, for a number of years, we have been recommending specific improvements for how the public should be informed of reportable events. More specifically, we have requested that publicly available event reports include:

a. The date, time, and duration of the event;
b. Location of the event;
c. Any measured releases to the environment on- and/or off-site. Here, concentration and/or activity (preferably in sieverts or grays in addition to becquerels) and volumes should be provided. If no measurements are taken, reasons for this should be provided along with estimated release concentrations and volumes;
d. Relevant licence limits, i.e. facility-specific action levels, derived release limits as well as applicable regulatory environmental standards or release limits; and
e. A description of any mitigation and follow-up monitoring efforts, including any available monitoring data.[32]

Finally, several important licensee reports are made available on 5-year bases. These include Environmental Risk Assessments, Probabilistic Safety Assessments, Preliminary Decommissioning Plans and financial guarantees. Were licence renewal hearings coordinated with the release of these reports every five years, it would provide a practical forum for supported public and Commissioner review of these reports.

PART FOUR
Hearings and regulating publicly accessible nuclear data

In the same way that demographic and ecological changes in the vicinity of the DNGS will likely be significant but difficult to predict over the next 30 years, significant developments in proactive machine-readable data disclosure are likely but impossible to predict. Over the next 30 years, DNGS licence amendments will likely be required to

[31] CNSC staff CMD for this matter at p 97.
[32] This recommendation is taken from our submissions relating to recently proposed amendments to REGDOC 3.2.1 and our most recent submissions for the 2023 ROR for nuclear generating facilities.

account for developments in proactive data sharing. However, it remains unclear whether such changes would be subject to funded in-person and stand-alone hearings.

Public access to nuclear data

Over the last decade, the policy landscape for data and information sharing has dramatically changed. The Open Government data portal has become an extensive source of information and data supporting government transparency and accountability.[33] A new federal Disaggregated Data Action Plan has promised to focus on breaking down datasets with a view to differentiating diverse populations of people over distinct geographic areas.[34] Last year, the International Atomic Energy Agency (IAEA) launched a new open data platform.[35] The CNSC has also initiated several initiatives in line with this trend, making use of the Open Government data portal to upload regulatory documents and annual radionuclide loadings from nuclear facilities.

Over the next 30 years, public access to nuclear-related data may be one of the most significant emerging regulatory issues for the CNSC. Data pipeline automation will allow for the release of larger volumes of data. Community science may grow to become a significant source of nuclear-related data, Licensees and regulators may facilitate or demand more categories of data to be released (including employment demographic data, stormwater, ambient air, and surface water data).

OPG has already developed an interactive online application ("apps") for sharing machine-readable groundwater data from the DNGS. NTP has urged the CNSC to begin to develop a consistent approach to regulating or otherwise standardizing licensees' apps to ensure the data is clearly explained and high-quality.[36]

As a significant emerging regulatory issue, more specific provisions for CNSC oversight may have to be reflected in the DNGS licence in the future. However, there is no current discussion in any CMDs for this matter relating to whether any such changes might be subject to funded in-person and stand-alone hearings. Regardless, 30 years would be too long to exclude the public from licence reviews in this area. More frequent hearings, ideally every five years, would allow licensees, CNSC staff, Commissioners, the public, and Indigenous rightsholders to address this issue, learn from one another, and thus more equitably, responsively, and comprehensively determine how individual licenses could address issues relating to the collection and proactive disclosure of nuclear data.

[33] See: Government of Canada, "About Open Government"", online: https://www.canada.ca/en/government/system/government-wide-reporting-spending-operations/trust-transparency/about-open-government.html.
[34] Statistics Canada, Disaggregated Data Action Plan, online: https://www.statcan.gc.ca/en/trust/modernization/disaggregated-data.
[35] See: https://www.iaea.org/newscenter/news/iaea-launches-open-data-platform.
[36] See: NTP submissions relating to recently proposed amendments to CNSC REGDOC 3.2.1.

APPENDIX A

Review Prepared for NTP Regarding OPG's Application to Relicense the DNGS for 30 Years

Prepared by Dr. Shamaila Fraz, biologist and environmental toxicologist

Project-environment interactions could change significantly in the upcoming 30 years and these interactions would be **confounded, complicated and exacerbated** due to Climate change, as discussed below with the support of published scientific literary evidence. Several reports predict climate change interaction with the Great Lakes like: Canada's Changing Climate Report (Bush et al., 2019); Climate Change Trends and Impact in The Great Lakes Basin by Ontario Climate Consortium, and Toronto and Region Conservation Authority (Lam, S., and Dokoska, K. 2022); Laurentian Great Lakes Basin Climate Change Adaptation by the US National Oceanic and Atmospheric Administration Great Lakes Programs (Nelson et al., 2011); and Climate Change Research Report by Ontario Ministry of Natural Resources on Ontario's Aquatic Ecosystems. These reports show that Climate change would alter physical, chemical and biological factors of the Lake Ontario ecosystem (Dove-Thompson et al., 2011).

These unpredictable ecological changes will make it more challenging to track potential environmental impacts of routine operations at the Darlington Nuclear Generating Station. It would also be extremely difficult for a licence to proactively account for these changes over a future 30-year period.

1. Climate Change is Rapid and Accelerating

Climate systems are changing faster than ever, with significant shifts often occurring within a decade or less. The hazard of Climate change has increased over time, and a study that focussed on examining the effects of climate change on species at risk in Canada produced a 10.3 years estimate, and found the hazard/risk of extinction posed by climate change has increased for at risk species from 11.7 to 49.5%. With this acceleration, Climate change would be the second most significant anthropogenic hazard (Woo-Durand et al., 2020).

According to an ECCC report (Bush et al., 2019), climate volatility in Canada is particularly elevated:

"*It is virtually certain that Canada's climate has warmed and that it will warm further in the future. Both the observed and projected increases in mean temperature in Canada are about twice the corresponding increases in the global mean temperature, regardless of emission scenario*" and "*Both past and future warming in Canada is, on average, about double the magnitude of global warming*".

Key climate indicators like temperature, precipitation, ice cover, and extreme weather events can shift dramatically in just a few years. The number of days with surface water temperature greater than 4^0C for Lake Ontario is projected to increase between 17-19 days or 36-44 days during the periods of 2011-2040 and 2041-2070 respectively (Dove-Thompson et al., 2011). Reduction in ice cover would mean degradation/loss of physical conditions for winter spawning fish that use ice cover as shield for egg incubation in shallow waters. Warming water could mean habitat loss for cold and cool water species (Collingsworth et al., 2017).

Lake Ontario more specifically is one of the two Great Lakes that are predicted to experience: the greatest increases in over-lake precipitation *("refers to precipitation that falls on the lake's surface, which may vary from year to year"*); increases in evaporation from the lake surface; significant variations in lake water levels (more frequent extreme highs and lows); significant declines in the length of the ice season between December-May; and warming surface water temperatures (Lam, S., and Dokoska, K. 2022). Extremely high and low water levels could also change the chemical habitat of fish, affecting contaminants and nutrient loads.

2. Communication of Adaptive Management with Concerned Groups would be Delayed

Warmer water would decrease the cooling efficiency of the once through cooling water system at Darlington, leading to higher discharge water temperatures, presumably higher chances of discharge water thermal criteria exceedances and increased thermal stress on aquatic biota. Anticipated higher frequencies of droughts may lead to lower lake water levels which may adversely impact Darlington's water intake. Water withdrawal in such conditions could also lead to additional stress on aquatic habitat (Lam, S., and Dokoska, K. 2022; Nelson et al., 2011). These conditions would demand regular and

frequent sharing of site-specific adaptive management strategies with data to show/support their effectiveness. Public access to models of recent realistic data (with uncertainty estimates) would be important to ensure transparency in any forecasts of future conditions.

3. Communication of Project Interactions with Changes in the Lake's Hydrology, Chemistry and Biology would be Delayed

With short winters and early spring warming, lake stratification would occur earlier in spring, it may last for a longer period of time, and stratification may start at shallower depths. This would prevent the natural and gradual mixing of water, one would expect in normal weather conditions. It could also cause oxygen depletion at greater depths with the formation of "dead zones" leading to the death of fish and other organisms. Hence, physical and chemical habitat of fish would change.

The geographical range boundaries of species in Lake Ontario is expected to change which would alter the mixture of species and community composition (Nelson et al., 2011). Lake Ontario would suffer from "significant loss of cold bottom water volume" which would lead to reduced available habitat and decline in Cold water species (lake trout, brook trout and whitefish) and cool water species (northern pike, walleye), along with northward expansion of warm water species (bluegill and smallmouth bass), and greater habitat suitability for invasive species like (e.g., carp, round goby, quagga mussel, and zebra mussel (Lam, S., and Dokoska, . 2022). Harmful algal blooms would increase in frequency or intensity due to frequent intense storms bringing nutrient and contaminant loaded runoff. With low water levels, contaminants bound in sediments may dissociate, resuspend, reach toxic levels in the deeper water, or accumulate in the aquatic food chain (Lam, S., and Dokoska, K. 2022; Nelson et al., 2011; Dove-Thompson et al., 2011). Hence, there could be significant biological changes in the Lake Ontario ecosystem.

4. Effects of Shorter-Term Climate Patterns on the Project interactions could be Missed

Important climate cycles like the North Atlantic Oscillation or El Niño/La Niña occur every 2–7 years and influence the Lake Ontario basin. These cycles influence shorter-term ecological changes in weather patterns. Such events also require regular and frequent public access to site specific ecological information such as environmental risk assessment reports, environmental monitoring data and/or reports, and reports that model recent realistic data with uncertainty estimates and forecasts of the future. 30 years would capture multiple weather cycles and pose too long a timeframe to understand each of them and their potential impacts on Darlington operations and licence terms.

5. Communication of Biodiversity Changes to Concerned Groups would be Delayed

Stakeholder Involvement is an essential component of the ecosystem-based approach in the ecological risk assessment (ERA) as it provides an opportunity for community inputs to guide management decisions. Like discussions relating to chemical and thermal pollution above, and lake water conditions, potential changes relating to species diversity at the Darlington nuclear site will similarly be the subject of significant and unpredictable change.

Lake Ontario's biodiversity is changing as indicated in a report by the Ontario Ministry of Natural Resources and Forestry (OMNRF) (Brinker et al., 2018). Here, a Climate change vulnerability assessment was conducted that spanned around 10 major taxonomic groups: amphibians, birds, bryophytes (mosses and liverworts), fishes, insects and spiders, lichens, mammals, molluscs, reptiles, and vascular plants. Out of 158 species from Lake Ontario Basin assessed, 52 % (78 species) were found to be extremely, highly, or moderately vulnerable to Climate change (Brinker et al., 2018).

5.1. Changes in Aquatic Biodiversity

Factors driving change in aquatic biodiversity could be: 1) changes in the availability of suitable thermal habitat which would result in altered abundance and range boundary shifts for native fish leading to changes in predator prey-interactions; 2) northward latitudinal shift of aquatic macroinvertebrates, change in community composition and abundance of benthic invertebrates; 3) altered timing of spring and summer phytoplankton bloom; 4) decoupling between

the timing of ecological cues for life cycle processes of native fish like spawning, egg incubation, larval emergence and dispersal and juvenile growth which would affect survival of fish early life stages and recruitment; 5) thermal habitat shifts could also increase chances of the establishment of invasive species like Asian carp (Dove.-Thompson et al., 2011; Koops 2015; Asch et al., 2019; Collingsworth et al., 2017; Brinker et al., 2018). All these factors can lead to changes in fish community structure. According to Casselman (2002), with a predicted increase of 1.1-6.4^{0}C by 2100, numerous aquatic fish communities of Ontario would be dominated by warm water fish.

The anticipated rate and extent of natural changes in Lake Ontario ecosystem is further explained in Table 1 which was prepared and included below and provides an account of historical change, the current status, and future predictions of selected groups/species taken from the list provided in the Darlington site's Environmental Risk Assessment, (2020). The table notes the generation time and maximum life expectancy of species because the effects of climate change may be detected sooner in short-lived than in long-lived species. This also relates directly to the prospect of a 30-year licence which would cover many more generations of change for a variety of non-human ecosystem components.

This table shows that a change in aquatic biodiversity would lead to changes in the list of fish VECs for the Darlington site, as has already happened over the last decade or so. For example, Lake Sturgeon was a VEC in previous ERAs but not in the DNGS ECo ERA, (2020). Similarly, Lake Sturgeon was indicated as "*SARA*: no status" species in the Darlington New Build Environmental Assessment (2009 EIS) but its SARA status has changed now to "special concern" and it has a "threatened" species status in Ontario (https://www.dfo-mpo.gc.ca/). Another example relates to American eel, which was indicated a COSEWIC: Special Concern species in 2009 (2009 EIS) but has changed to a COSEWIC: Endangered species now and it has "threatened" species status in Ontario.

Table 1: An account of historical change, current status and future predictions of selected groups/species

Species/community	Driving factor	Historical change or Current status	Expected change	References
Benthic invertebrate community	Selected VEC; Exposed to waterborne effluent through sediment (DNGS ECo ERA, 2020)	Between 1960-1980 Diporeia, Tubificidae, and Sphaeriidae dominated Lake Ontario benthos. With zebrafish invasion in 1990, Diporeia, and other taxa including Amphipoda, Oligochaeta, Hirudinea, Gastropoda, and Trichoptera increased in densities in the 1990s. In early 2000 the decline of Diporeia, Sphaeriidae, and Oligochaeta occurred with significant increase in quagga mussels.. The benthic invertebrate community is now dominated by the Quagga Mussel and oligocheates. (Burlakova et al., 2018; 2022)	The spatial and temporal changes in benthic invertebrate communities' abundance and structure is predicted to change with changes in food web (Koops 2015) .	Burlakova et al., 2022 Burlakova et al., 2018 Koops 2015 DNGS ECo ERA, 2020
Deep water sculpin	Loss of cold bottom water volume and available habitat in shallow Great Lakes like Lake Ontario (Lam et al., 2022) Generation time = 4-5 years Not a VEC; Entrained species in the 2015/2016 entrainment study (DNGS ECo ERA, 2020)	SARA species of special concern (2020ECo ERA) Highly abundant fish before a sharp decline in early 1900s. The species started reappearing in trawl sampling in 2005. The species is recovering in Lake Ontario (Weidel et al., 2016) Note: Biomass of slimy sculpin is also declining in Lake Ontario between 1970-2016 (Robinson et al., 2020)	Presumable loss of spawning and nursery habitat. Changes in the abundance of Lake trout and burbot, predator-prey interactions, deep water benthic food web dynamics and competition with non native species like round goby Changes in energy transfer and adaptive capacity of Lake Ontario ecosystem (Robinson et al., 2020)	Robinson et al., 2020 Weidel et al., 2016 Lam et al., 2022 DNGS ECo ERA, 2020
Whitefish	Loss of cold bottom water volume and available habitat in shallow Great Lakes like Lake Ontario (Lam et al., 2022)	A decline in growth and recruitment of Lake whitefish evident as decrease in early-life-stages and juvenile began during the early 2000s	Expected loss of spawning and nursery habitat Annual recruitment could be affected since warm waters may increase natural mortality and early hatching of Lake Whitefish larvae, which could	Ebener et al., 2021 Lim et al., 2018 Pankhurst and Munday 2011 Lim et al., (2018

	Generation time = 5.4 (3.4 - 9.4) years (https://www.fishbase.se/) RWF is a VEC (DNGS ECo ERA, 2020)		potentially create a mismatch with zooplankton production. Changes in air and water temperature, ice cover, and currents would also affect survival, dispersal, and growth of early life stages of lake white fish. (Ebener et al., 2021) Delayed ovulation and spawning in reproductive adults (Pankhurst and Munday 2011) Lim et al., (2018) have shown that fluctuating or elevated temperatures can alter development rate, hatch dynamics, and growth, and increase mortality is round white fish embryos".	DNGS ECo ERA, 2020
American eel	Freshwater habitat deterioration, fragmentation, and cumulative stressors are associated with decline (Cosewic 2012) Generation time = 4.5-14 (https://www.fishbase.se/) Life expectancy = 22-30 years (Cosewic 2012; (Drouineau et al., 2018) Not a VEC; Occasionally impinged specie; Highly valued by Indigenous peoples (DNGS ECo ERA, 2020)	Listed as Endangered in Ontario. Listed as Threatened by COSEWIC (DNGS ECo ERA, 2020) A 65% decline has been reported since 2008 in maturing eels from Lake Ontario and St. Lawrence River area. Significant decline has been noted since 1980 (Cosewic 2012) Greater than 99% decline in recruitment and standing stock in Lake Ontario in last 32 years (approx. 2 eel generations) (Cairns et al., 2013)	Recovery cannot be predicted because American eel are sensitive to all 5 components of climate change and have limited adaptive capacity (Drouineau et al., 2018) Recovery efforts are underway following an ecosystem based approach.	Drouineau et al., 2018 Cosewic 2012 Cairns et al., 2013 DNGS ECo ERA, 2020
Lake Trout	Loss of suitable thermal habitat in shallow Great Lakes like Lake Ontario (Biswas et al., 2017) Selected VEC; Potentially spawns in the area, Exposed to thermal stressor (DNGS ECo ERA, 2020)	Lake trout were extirpated from Lake Ontario in the 1950s and the current population mainly composed of hatchery reared Lake trout released by management efforts (LOTC 2022)	Declines in native trout populations due to range expansions of nonnative fishes, Lake trout would experience shrinking range and small mouth bass and northern pike may benefit. ((Brenden et al., 2011;Kovach et al., 2019) Changes in growth, phenology, demography, and distribution would occur (Kovach et al., 2019)	Kovach et al., 2019 LOTC 2022 Biswas et al., 2017 Dove-Thompson et al., 2011 Brenden et al., 2011 DNGS ECo ERA, 2020

	.		Poor survival of early life stages due to reduced ice cover, low quality of spawning habitat, mis match with zooplankton emergence and predation of eggs and larvae by slimy sculpin, round goby, rainbow smelt, crayfish, and alewife (LOTC 2022) Decoupling of ecological cues like short winter and early spring would significantly affect life-cycle processes like spawning, survival of early life stages and growth (Dove-Thompson et al., 2011)	
Lake Sturgeon	Not a VEC (DNGS ECo ERA, 2020)	Conservation concern in Great Lakes; Threatened provincially (DNGS ECo ERA, 2020) Regarded as highly vulnerable to climate change (Brinker et al., 2018)	Recovery efforts in effect but habitat degradation and habitat loss are still considered a threat to recovery of this species and successful recovery is dependent on future anthropogenic impacts on habitats (Bruch et al., 2016; Pollock et al., 2015)	Brinker et al., 2018 Bruch et al., 2016; Pollock et al., 2015 DNGS ECo ERA, 2020

5.2 Changes in Terrestrial Biodiversity

The biodiversity change may not be limited to the aquatic ecosystem but it could be accompanied by changes in the terrestrial ecosystem. The major climate change driving factor for terrestrial mammals is habitat loss, with changes in abundance, dispersal and range. This is evident by the fact that two species of bats (Little Brown Myotis and Northern Myotis) that were found to be not present on site in 2009 (2009 EIS) are now present on site and have a federal and provincial conservation status of "Endangered". Since terrestrial mammals with a COSEWIC status are predicted to be highly affected by climate change (Woo-Durand et al., 2020), the list of mammal species to be monitored will likely need to be updated over the course of the proposed 30-year licensing period.

Woo-Durand et al., 2020 reported COSEWIC status birds as another taxon shown to be "most threatened by climate change" due to alteration/loss of migratory, breeding and over-wintering habitats; though birds have dispersal abilities which could contribute to adaptive potential (Brinker et al., 2018). Changes in bird VECs selection have happened between 2009 and 2020 at the DNGS. For example, Long eared owl was a VEC in 2009 EIS but not in the DNGS ECo ERA, (2020); Green Heron was not a VEC in 2009 EIS but is a VEC present on site in the DNGS ECo ERA, (2020); Trumpet Swan

and Barn Swallow were not found to be present on site in 2009 EIS but Trumpet Swan is indicated to be nesting on site, and Barn swallow (a Threatened species) was found to be breeding on site in the DNGS ECo ERA, (2020). As such, the list of bird species to be monitored will likely need to be updated over the course of the proposed 30-year licensing period.

Finally, insects are another taxon which is predicted to shift range boundaries and distribution in response to climate change (Brinker et al., 2018). However, despite being an important component of the ecosystem, this taxon seems to be under represented in the DNGS Eco ERA (2020). For example, Eastern Emberwing was selected as an indicator species in the 2009 EIS to represent Dragonflies and Damselflies, but is not a VEC in the DNGS Eco ERA (2020). Dragonflies are completely excluded from the list of VECs in the DNGS Eco ERA (2020). While the 2009 EIS indicates that "*DN site represents a site where there is extensive habitat for Monarch butterflies, which is a species of Special Concern both federally and provincially*. (p.258, 464 2009 EIS)", Monarch butterflies are not a selected VEC in the DNGS Eco ERA (2020) instead represented by Earthworm. On this last point, it is concerning that an endangered valuable species could be represented by a less valuable and more commonly present species.

6. Communication of Potential Changes of Risk Characterization to Concerned Groups would be Delayed

The DNGS Eco ERA (2020) indicates that in case of facility related exceedances of radioactive or chemical COPCs (contaminants of potential concern) benchmarks, OPG would confirm exposure, monitor effects relevant, and evaluate options for risk management (p. 5.10). 30 years is a long time that could include several changes to identified of COPCs. Risk characterizations of biota on site could also similarly change in the future. This is especially applicable to organisms where the DNGS ECo ERA (2020) indicates a HQ > 1 and "a potential for adverse ecological effects is inferred". For future reference, public access would be helpful to field studies that could clarify adverse effects if a HQ > 1 and refine risks. Specific examples with queries are highlighted here:

- "*Maximum surface water concentrations for the site study area in **Lake Ontario** exceeded the benchmarks for ammonia for fish*" (DNGS ECo ERA 2020 p. 4.120). "Maximum sediment concentrations for Lake Ontario exceeded the sediment benchmark for total Kjeldahl nitrogen for benthic invertebrates". Both the maximum and the UCLM

(upper confidence limit on the arithmetic mean) sediment concentration of phosphorus exceeded the sediment benchmark. (DNGS ECo ERA 2020 p. 4.120). Although it was stated that these elevations are not likely due to the DNGS operations, it remains unclear how is this parameter is predicted to change in the future, given changes in nutrient and contaminant uploading due to Climate change.

- "*Maximum ammonia (un-ionized) concentrations in surface water in **Coot's Pond** exceeded the fish (Northern Redbelly Dace) and turtle/frog benchmarks*" (DNGS ECo ERA 2020 p. 4.122). The two species of turtle found on site i.e., Midland Painted Turtle and Snapping Turtle are Special Concern status species. It remains unclear how the risk characterization would change in the future, especially when habitat loss is predicted to be a major future threat to amphibians and reptiles. (Woo-Durand et al., 2020)
- "*Maximum and UCLM sediment concentrations in **Coot's Pond** exceeded the sediment target benchmarks for total organic carbon, total Kjeldahl nitrogen, cadmium, chromium, copper, iron, manganese, nickel, phosphorus, vanadium, and zinc for benthic invertebrates*" (DNGS ECo ERA 2020 p.4.122). Storm water runoff was regarded as a potential source of these exceedances. The maximum HTO concentration measured in Coot's Pond was 46.8 Bq/L which is higher than the maximum concentration in Lake Ontario. Atmospheric emissions from DN and subsequent deposition to Coot's Pond was considered the likely pathway of transfer. It remains unclear how the risk characterization of these COPCs might change in future with regard to changes in weather patterns and risk assessment if employing a whole ecosystem approach.
- With reference to **Polygon C, D and E** of the site area, it remains unclear, if data to determine strontium benchmarks for birds becomes available in future, how the risk characterization might change.
- "*The HQ for selenium exceeded 1 for Bank Swallow and Yellow Warbler exposed to either maximum or UCLM concentrations The HQ values for zinc exceeded the target of 1 for American Robin, Bank Swallow, Song Sparrow and Yellow Warbler exposed to both maximum and UCLM concentrations. Therefore, risk could not be ruled out from selenium and zinc to terrestrial birds in **Polygon E**.*" (DNGS ECo ERA 2020 p. 4.126). As Bank swallows are an

Endangered species, that use the Polygon E for foraging, it remains unclear how updated risk characterizations might include inputs from the soil characterization study.

- There was no data to determine tin (Sn) benchmarks for soil invertebrates. If data to determine tin toxicity benchmarks for soil invertebrates becomes available in future, it remains unclear how the risk characterization might change in **Polygon E** of the site.
- *"The results of the terrestrial assessment in **Polygon E** (the yard waste and building materials storage area) showed exceedances of the HQ target of 1 for: Maximum arsenic, cobalt, copper, lead, molybdenum, nickel, and zinc for Earthworms; Maximum arsenic, cobalt, copper, lead, molybdenum, nickel, tin and zinc for terrestrial plants; Maximum copper, lead, selenium, and zinc for terrestrial birds; Maximum arsenic, cadmium, copper, molybdenum, selenium and zinc for terrestrial mammals"* (DNGS ECo ERA 2020 p.4.125). The impacts of these elevated metal concentrations are considered localized, however future risk characterizations should be proactively communicated to the public for their supported feedback.
- MNR (Ministry of Natural Resources) estimates of rainbow smelt, Alewife and round goby populations in Lake Ontario in 2009 are used to show that losses due to impingement and entrainment are negligible in terms of loss of biomass (DNGS ECo ERA 2020 p. 4.137). However, the public has no access to more recent fisheries management data or ecosystem based risk assessments that consider translate to understanding food web dynamics. This MNR data is too outdated and loses its reliability as a reference.
- Deep water sculpin: a species of special concern whose populations in Lake Ontario are recovering, is of interest because it is not listed as a VEC for the DNGS, even though a 2015-2016 entrainment study at DNGS estimated 724,746 larvae to be entrained annually. OPG's approach should be reconsidered and more data on this issue generated for public access.

- *"There is some uncertainty around the risk from NOx (oxides of nitrogen) for ecological receptors, as modelled concentrations were used as the basis for the assessment"* (DNGS ECo ERA 2020 p.5.4). A plan for risk refinement is shown however the public should have access to more updates on this, since these are harmful for humans as well.

Concluding Statement

As discussed above with support from multiple studies, project-environment interactions could change significantly in the upcoming 30 years at the Darlington unclear site and these interactions could be **confounded, complicated and exacerbated** due to Climate change. These unpredictable ecological changes can make it more challenging to track potential environmental impacts of routine operations at the Darlington Nuclear Generating Station. It would also be extremely difficult for a licence to proactively account for these changes over a future 30-year period. As such, frequent amendments may be required to OPG and CNSC staff's approach to environmental protection over this time – changes the public should be supported in engaging with via more frequent licence renewal hearings.

- Historical background temperature used to determine normal baseline thermal conditions of Lake Ontario are predicted to change. Warm water temperature could become the new normal, which could also mask the anthropogenic contribution (DNGS in this case) versus that from global climate warming. This would be a confounding situation.
- Biological responses of animals and plants to stress could change because organisms would respond to cumulative thermal stress. For example, climate warming would put species under stress, which could manifest as decrease in immunity and higher susceptibility to parasites and diseases; so even minor heat inputs (like thermal discharge from DNGS) may cause disproportionate stress or mortality. It might be hard to separate the fish mortality due to disease versus due to impingement and entrapment.

- In future the physiological and ecological responses of aquatic biota are predicted to change due to Climate change, thus altering species phenology, metabolism, spawning and migration patterns and increased mortality. Many native fish species that have narrow thermal tolerance limits like round white fish and lake trout could be vulnerable. Certain life stages like spawning adults, and developing embryos have narrow thermal tolerance ranges and high sensitivity (Dahlke et al., 2020). As a result, even marginal increases in temperature from anthropogenic inputs may lead to increased mortality. This would be a situation where global warming can exacerbate the project's impact (DNGS). In the bigger context of Lake Ontario ecosystem, it might become hard to determine the project (DNGS) specific impacts.
- Climate change can exacerbate other stressors like hypoxia due to warmer water, changes in thermal stratification, and altered nutrient cycles as discussed above. In the bigger context of Lake Ontario, these compounding factors would make it hard to isolate the specific impacts of the DNGS project.
- As the thermal regime of Lake Ontario would change, so would the context in which anthropogenic stressors operate, complicating efforts to quantify or predict their ecological consequences. Historical or long-term datasets may no longer represent future conditions, making it hard to quantify the project's (DNGS) impacts. Accurate predictive models or impact assessments may become less reliable because the background climate conditions would no longer stable. This would be a confounding situation.
- Change in biodiversity would forecast a change in baseline conditions for site specific monitoring which would likely translate to change in site specific list of VEC species. The over arching question is that change is predicted to be rapid and accelerating and animal and plant species' responses, plasticity, resilience and their adaptive potential to such change is uncertain and unknown. Natural change happens at a pace that generally allows species to adapt to the changing environments. Hence, reliable ecological risk assessments might be difficult.
- With such complex and wide scale changes the importance of frequent and supported relicensing hearings would be more than ever. These future ecological changes may call for collection of board scale data qualifying for a

probabilistic risk assessment that can accurately quantify the uncertainties associated with the deterministic risk assessment used in the DNGS Eco ERA (2020).

- In the future, a holistic Whole Ecosystem Approach would be needed for ERAs. This approach should consider moving beyond single species model and look at the ecological processes, biodiversity, food webs, and habitat connectivity (answer questions like how ecosystem respond to complex interacting hazards). It should evaluate combined effects of multiple stressors (e.g., thermal discharge, radioactivity and chemicals, atmospheric emissions, climate change); predict the spatial and temporal effects of stressors on ecosystems (e.g., cumulative and indirect effects on ecosystems); and involve meaningful and supported public involvement with an aim to support sustainable resource use through management and effective mitigation. Frequent public involvement could also provide an avenue to understand rate and extent of change; individual species population level response and resilience to change; design and efficacy of site specific and regional mitigative measures for protection of species of special concern; and updated strategies for resource management.

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