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Oral presentation

Written submission from the Passamaquoddy Recognition Group Inc.

In the Matter of the

New Brunswick Power Corporation, Point Lepreau Nuclear Generating Station

Application for the renewal of NB Power's licence for the Point Lepreau Nuclear Generating Station

Commission Public Hearing
Part 2

May 11 and 12, 2022

Exposé oral

Mémoire du Passamaquoddy Recognition Group Inc.

À l'égard de la

Société d'Énergie du Nouveau-Brunswick, centrale nucléaire de Point Lepreau

Demande de renouvellement du permis d'Énergie NB pour la centrale nucléaire de Point Lepreau

Audience publique de la Commission
Partie 2

11 et 12 mai 2022

Canada

Submission by the Passamaquoddy Recognition Group Inc.

PRGI PO Box 144 St. Stephen NB E3L 2XL

To the Canadian Nuclear Safety Commission
Regarding The Renewal of the Point Lepreau Nuclear Generating Station Power Reactor Operating Licence

Hearing Reference: 2022-H-02

Prepared by:
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Sam Chrus

April 04, 2022

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... reconciliation requires talking, but our conversations must be broader than Canada's conventional approaches. Reconciliation between Aboriginal and non-Aboriginal peoples, from an Aboriginal perspective also requires reconciliation with the natural world. If human beings, resolve problems between themselves, but continue to destroy the natural world, then reconciliation remains incomplete.

- The Final Report of the Truth and Reconciliation Commission of Canada, Volume 6

Peskotomuhkat nil. … Pollock was the survival food for the Passamaquoddy. … I am (a) Passamaquoddy. … (person) Passamaquoddy … Passamaquoddy …

peskotomuhkat …

This Passamaquoddy child is good-natured. … Passamaquoddy … Passamaquoddy … peskotomuhkati

I live in Passamaquoddy territory. … in Passamaquoddy territory … territory … Passamaquoddy … Peskotomuhkatik

That is where I grew up, in Passamaquoddy territory. … in Passamaquoddy territory … territory … Passamaquoddy … among …

peskotomuhkatihkuk …[1]

[1] Passamaquoddy-Maliseet Language Portal. https://pmportal.org/search?query=passamaquoddy

Preamble - Opening Words

This submission is filed by the Passamaquoddy Recognition Group Inc (PRGI, the "intervenor") in response to the *Canadian Nuclear Safety Commission's ("CNSC") Revised Notice of Public Hearing dated October 13, 2021*, requesting comments on the application by New Brunswick Power Corporation (NBP) to renew its licence for the Point Lepreau Nuclear Generating Station (PLNGS) for a period of 25 years. A public hearing with respect to this matter is scheduled for May 11-12, 2022.

In areas where CNSC has responsibilities, we expect the Commission, as an *Agent of the Crown*, to uphold federal and internationally-agreed upon obligations to Indigenous Peoples. We urge the CNSC to meet these obligations with the Peskotomuhkati Nation.

To facilitate PRGI's intervention relevant to the mandate and jurisdiction of the CNSC - to confirm that in making a licensing decision, the CNSC ensures the adequate protection of environmental and human health (pursuant to the *Nuclear Safety and Control Act* ("NSCA") - we have shared pertinent Indigenous knowledge, and have retained legal and scientific experts who have shared in-depth knowledge on various matters of interest to us all. Findings relevant to the rights and interests of PRGI are presented within this document, and will be further expressed in an oral intervention during the 2nd part of the CNSC hearings, planned for May 11 and 12, 2022, in Saint John, New Brunswick.

Our multi-pronged review process has included:

a. Legal Analysis: led by Jamie Simpson based on a review of the application of such matters as the Peace and Friendship Treaties, UNDRIP, and recent court cases setting important national and international precedent.

b. Exploration and Application of Indigenous Knowledge: led by our in-house team.

c. Technical Reviews: Review, Analysis, and Opinions by Dr. Gordon Edwards (Appendix 1) and Dr. Ian Fairlie (Appendix 2) on subjects of interest to the Nation, the communities surrounding PLNGS, the CNSC, and the public at large. Dr. Susan O'Donnell provided consultation on technology adoption issues.

Interest and Expertise of the Intervenor

Passamaquoddy Recognition Group Inc. (PRGI)

PRGI is a not-for-profit Indigenous-led organization representing the Peskotomuhkati Nation in Canada.[2] We represent the interests of rights holders and the Peskotomuhkatik ecosystem, which includes PLNGS and areas that may be affected by it. Our duty is to protect our lands, waters, and environment for all present and future generations.

Conservation is our sector, and thriving, protected indigenous ecosystems is our mission. We aim to explore our history, share our stories, and protect our past. We are honoured and committed to meet the challenges of tomorrow with the teachings of yesterday.

[2] The Peskotomuhkati's traditional and current territories span the borders that were later created by the United States and Canada.

Our goal is to help re-establish the means to coexist with nature, eliminating the struggles caused by 20th and 21st century human pressures. Our strategies utilize modern best practices, alongside traditional methods.

We foster innovative practices, principled creativity, and proactive means to help ensure our traditional ecosystems can re-establish themselves into healthy, sustainable, and thriving wildernesses.

The Point Lepreau Nuclear Generating Station exists within Peskotomuhkatihkuk. It is a mere 45 km from our sacred capital, and 47km and 90km respectively from our communities of Sipayik (Pleasant Point) and Motahkomikuk (Indian Township).

Chief Hugh Akagi

Chief Hugh Akagi has been the voice of the Peskotomuhkati people for more than two decades. He has used his leadership to bring awareness to the issues of his people including in negotiations with federal and provincial governments.

Chief Akagi was born in the home he still lives in at Qonasqamkuk (Indian Point at St. Andrews, New Brunswick) the traditional territory of his people.

Working closely with researchers from around the world, Chief Akagi shared his vast knowledge of his traditional territory, the creatures found there, and an understanding of how to protect and restore the environment for future generations around the planet--Mother Earth.

To ensure the Passamaquoddy's voice is heard in the decision-making processes with current governments, Chief Akagi has travelled widely throughout

North America and Europe, including attending the *United Nations Permanent Forum on Indigenous Issues* every year for the last decade.

Independent Expertise Retained by PRGI

Dr. Susan O'Donnell

Dr. Susan O'Donnell is a social scientist specializing in technology adoption. She is Adjunct Professor at the University of New Brunswick since 2004 and Adjunct Research Professor at St. Thomas University since 2021. Dr. O'Donnell retired as a Senior Research Officer with the National Research Council of Canada in Fredericton in 2017. Her work at the NRC included reviewing and providing advice on technology development projects across Canada seeking public funding. From 2008 to 2016, Dr. O'Donnell was Vice-Chair of the National Research Council Research Ethics Board in Ottawa and in 2016 and 2017, she was a member of the Science Advisory Council of the Professional Institute of the Public Service of Canada in Ottawa. She served as a consultant to the PRGI, reviewing documents and participating in meetings to provide nuclear technology adoption expertise.

Dr. Ian Fairlie

Dr. Ian Fairlie is an independent scientist who specializes in radioactivity in the environment. One of his areas of expertise is the dosimetric impacts of nuclear reactor emissions. He has authored many articles in peer-reviewed journals on epidemiology studies of child leukemias near radiation facilities and on the hazards of radionuclides. He has been a consultant to UK Government departments, the European Parliament, the World Health Organisation, environmental NGOs, UK local authorities and he was head of the Secretariat to

the UK Government's Committee Examining the Radiation Risks of Internal Emitters (CERRIE). Of particular relevance to the CNSC hearings, Dr Fairlie has authored numerous scientific articles on the hazards of tritium which have been published in peer-reviewed journals. PRGI retained Dr. Fairlie to provide an independent expert report concerning the potential health impacts of certain nuclear reactor emissions.

Dr. Gordon Edwards

Dr. Edwards is a Canadian scientist and nuclear consultant. Dr. Edwards has been qualified as a nuclear expert by courts in Canada and elsewhere. Edwards has written articles and reports on radiation standards, radioactive wastes, uranium mining, nuclear proliferation, and the economics of nuclear power. He has worked as a consultant for governmental bodies such as the Auditor General of Canada, the Select Committee on Ontario Hydro Affairs, and the Ontario Royal Commission on Electric Power Planning. PRGI retained Dr. Edwards to provide an independent expert report on the decommissioning plan for PLNGS, in the context of this licensing hearing.

Highlighting the voices of others

Our submission includes insights from various rights holders, including those of members of the Nation and Chief Hugh Akagi. We also share the perspectives of interested parties who from time to time have been hired to represent the Nation. For instance, throughout the document, we share previous writings from Paul Williams, PRGI's Lead Negotiator & Legal Counsel, who has expressly written these communications for PRGI. We also share various understandings of Kim Reeder, MEM, a regular consultant for PRGI on matters

related to watershed restoration, community development and energy. Also, working specifically on this intervention, we share the words and analyses of Joel Mason, PhD., a scholar of social movements, new organizational models, and alternative financial and social metrics for re-valuing ecological health and wellbeing.

Finally, we have echoed sentiments from interventions to the CNSC with respect to NB Power licence applications for PLNGS in 2011 and 2017 which support our proposal, including the following: the Council of Canadians, Saint John Local Chapter (2011), the Environmental Coalition of Prince Edward Island (ECOPEI, 2011), the International institute for the Concern of Public Health (2011), the Energy Probe Research Foundation (2011), CCNB Action, Saint John, Fundy Chapter (2011), the Sierra Club Atlantic Canada Chapter (2011), the Sustainable Energy Group, Carleton Chapter (2011), the Fundy Baykeeper (2011), the Canadian Coalition for Nuclear Responsibility (2011), the Maliseet Nation of New Brunswick (2017), the Canadian Environmental Law Association and the Conservation Council of New Brunswick (2017), New Clear Free Solutions (2017), Mi'gmawe'l Tplu'taqnn Inc. (MTI 2017), the Canadian Environmental Law Association (2017) and Sipekne’katik (2017).

Intervention Objectives and Executive Summary

The **first and main objective** of this intervention is for the Commission to grant NB Power a 3-year license for 3 good reasons. Other intervenors have additional reasons why the Commission should decide for a short licence period. Here, our goal is that the rationale for your decision will be influenced by these 3 reasons:

(1) An understanding and application of Indigenous Knowledge (as explained in section 1),

(2) An understanding and acceptance of the high financial risk of NBP's Proposed Financial Guarantee and its direct impact on the health and safety of those who reside in Peskotomuhkatihkuk (as explained in section 2), and

(3) An understanding and acceptance of the risk of poor social management: specifically in this case, the risk of taking actions and positions that contravene the public's increasing support for Indigenous rights. In an era of widespread social movements against the Coastal Gas Link pipeline, the Dakota Access Pipeline, and fracking in New Brunswick, heavily vested but unpopular projects can become liabilities more quickly than was previously imagined (as explained in section 3).

We also have a **second objective**, which flows from the first: we want to invite you to become standard bearers for authentic Indigenous engagement in a manner that intersects our mutual interests. Thus, granting a 3 year license should be paired with the dedication of time and resources to building a consequential collaborative relationship, taking hold of an opportunity to initiate a legacy of positive Indigenous relations which will be seen and felt on provincial, national, and international stages.

Concern about the climate crisis is increasing and motivating many discussions of solutions involving a deluge of new approaches to the way we manage our behaviour, the environment, economy, and energy resources. Many of which are synchronous with the variety of Indigenous ways of thinking and

living alongside the environment. For instance, highly complex global propositions like measurable qualitative life indexes, and the pricing of environmental assets are examples of approaches that are currently being positively strengthened and redefined through consultation with Indigenous Knowledge, bringing our systems of knowledge together to form solutions to our present global and local problems. We should do the same with PLNGS.

Those who engage in these collaborations now will bear the fruit of it in their legacy tomorrow. In the spirit of friendship and forward-going good relations, the PGRI extends our knowledge and analysis and proposal for a 3 year license for 3 good reasons. We look for you and your kin on the horizon of the future, where we become history-makers together.

Critique

In order to reach our objectives, and implicit in our proposal that you, the Commissioners, grant a 3 year license to NB Power for 3 good reasons, is a substantial critique of the other options before you: NBP's proposal for a 25-year licence, the CNSC staff proposal to grant a 20 year license, as well as any implied reorienting of a 15 or 10 year license as a "rational" or "generous" option. Our critique runs as follows, that a 20 year license (and a 15 year license, and a 10 year license) constitutes in its effects:

1. A significant endangerment of the safety of the surrounding environment.
2. A significant endangerment of the safety of surrounding human communities.

3. An unjustified Infringement of Aboriginal rights and land title (including the excessive limit placed on Indigenous engagement by the proposed license length).

The remainder of this intervention is composed of a detailed rationale of our objectives and its reasons, the critique above, and, immediately below, an executive summary of all that has been introduced thus far. What follows is formatted as insights derived from Indigenous knowledge as well as independent expert reporting on the implications of the proposed re-licensing of PLNGS for the Peskotomuhkat and their treaty lands and traditional territories. The PGRI aims to bring to your attention these matters, reasons, and framings such that you may use them to justify the course we propose.

Summary of Expert Findings

Dr. Edwards on Decommissioning and Health and Safety Repercussions

The decommissioning of PLNGS is very important to us. We desire that there are no barriers to decommissioning, and that decommissioning is planned and implemented safely - improving the health and security of our people and environment. As such, we are very interested in the relationship between the high financial risk of the proposed financial guarantee and the health and safety of people and the environment. Twenty years ago, in 2002, the New Brunswick Energy and Utilities Board concluded that the proposed refurbishment of Point Lepreau was not in 'the public interest'.[3] However, the New Brunswick

[3] Transcript - New Brunswick Board of Commissioners of Public Utilities, In the Matter of an application by NB Power dated January 8, 2002 in connection with a proposal for Refurbishment of its facility at Point Lepreau. Delta Hotel, Saint John, N.B. September 24th 2002

government overruled the EUB and NB Power went ahead with it. It was not a sound economic decision because the re-build went significantly over budget. The original build and the refurbishment account for $3.6 billion of NBP's current $4.9 billion debt. Since the plant re-opened in 2012, NBP has experienced annual operating losses largely the result of poor operating performance at the Lepreau plant - how will this impact the security and health of people and the environment?

As discussed later in this intervention, now NBP is suggesting that the reactor might again be refurbished when it reaches its planned end of life. We strongly believe that the facility must instead be decommissioned, as soon as possible. Given NBP's past experiences with poor financial forecasting for major work on the plant, we were particularly interested in reviewing NBP's financial projections for decommissioning and the potential impacts of such. As such, we hired an independent expert to conduct the review found in Appendix 1.

Dr. Edwards finds the financial guarantee proposed by NB Power to be significantly out of sync in a number of areas of concern.

1. Dr. Edwards' findings connect the high financial risk of the proposed financial guarantee directly to the health and safety of Canadians. For instance, it is a badly constructed assumption that decommissioned PLNGS hazardous waste will be accepted by other municipalities, provinces, or territories. In fact, the opposite has proven to be true in similar contexts. Accepting this strategy as sound at the planning stage would endanger the current and future residents surrounding PLNGS by subjecting them to false expectations of an end date to ongoing exposure to hazardous materials.

- "The federal government does not accept responsibility for disposing of decommissioning wastes or any post-fission wastes other than the used nuclear fuel. Also Ontario Power Generation (OPG) has made it clear that any repository they build for non-fuel post-fission wastes is intended only for wastes from Ontario's reactors and not those from other jurisdictions. When Hydro Quebec suggested that they could send their refurbishment wastes to Ontario, OPG was quick to put the record straight by saying 'absolutely no.'"
- "If the Commissioners were to inadvertently approve a financial guarantee that is seriously inadequate, and if those inadequacies were to remain uncorrected for the rest of the plant's operational lifetime, the long-term repercussions could prove to be scandalous for the industry, the government and the regulator. Due to inadequate resources, or inadequate advance preparation, or both, the decommissioning waste could remain on site in perpetuity, improperly stored in a surface facility having a relatively short life time of a century or so, potentially a source of radioactive contamination for countless centuries thereafter."

2. Dr. Edwards is concerned about the accuracy of the financial guarantee proposed by NB Power, and therefore also the sufficiency of the timeline for the Commissioners to fulfill their obligations.
    - "The present report [Edwards' report, Appendix 1] recommends that the Commissioners refrain from granting a Power Reactor Operating Licence (PROL) for a period longer than **three years**, in part because of serious inadequacies in the proposed financial guarantee, **but**

more importantly because the Commission needs more time to fulfill its fundamental responsibilities, as articulated in the Nuclear Safety and Control Act."

- Edwards points out the "policy of CNSC as articulated on page 107 of CMD-H2: 'The CNSC ensures that all its licence decisions under the NSCA uphold the honour of the Crown and consider Indigenous peoples' potential or established Indigenous and/or treaty rights pursuant to section 35 of the Constitution.'"

3. Dr. Edwards is concerned about the contrast between NB Power's proposed financial guarantee and the current reality of decommissioning as both a pragmatic task and a repeatable practice.
    - "To date, no large CANDU reactor has ever been completely dismantled. Until the first dismantlement is completed we will not know exactly what to expect in the way of costs. The CANDU core area…is much more complicated than the cores of other reactors,"
    - "As previously remarked, there is no experience with the complete dismantling of a CANDU reactor, and so any cost estimates are necessarily speculative"
    - "The bottom line cost…translates to about $1.83 billion, expressed in 2022 Canadian currency. That's **two and a half times larger than the financial guarantee that the Commissioners are being asked to approve in the present hearings**."
4. Finally, Dr. Edwards points out that the financial estimates of similar projects are larger than that of the NB Power financial guarantee (indeed,

smaller projects have estimated costs greater than those specified in the guarantee).

- "Note one of the details in this [Nuclear Energy Agency] cost breakdown [see attached report for diagram]. The cost of "waste processing, storage and disposal" is a full 28 percent of the total decommissioning cost, whereas the Point Lepreau PDP [Annex A] assigns only 5.6 percent of overall cost to radioactive waste. That's exactly five times less than the percentage found by the Nuclear Energy Agency."

Dr. Fairlie on Potential Health and Safety Repercussions of PLNGS

Based on conversations, questions and answers with respect to tritium, we were guided by the CNSC staff to the CNSC website[4] which states that CNSC staff initiated research studies on tritium releases in Canada, and studied and evaluated global tritium processing facilities regarding best practices. CNSC staff initiated a Tritium Studies project which covered these activities until 2010. We were therefore concerned about any new tritium studies in the intervening decade. As such, we hired an independent expert to conduct the review found in Appendix 2.

Dr. Fairlie's work is summarized as follows

Tritium (^3H) is the radioactive isotope of hydrogen. Reports from several international agencies recognise that tritium is an unusually hazardous radionuclide.

[4] http://nuclearsafety.gc.ca/eng/resources/health/tritium/standards-and-guidelines-for-tritium-in-drinking-water.cfm

Annual tritium releases from the Point Lepreau reactor are very large in comparison with other nuclear reactors and have been increasing in recent years. According to New Brunswick Power's EIA, local residents receive radiation exposures from tritium. This is from ingested tritium, inhaled tritium, and tritium absorbed through skin. These intakes increase the probability of getting cancer and other radiogenic diseases. No measurements are made of HTO and OBT levels in people living near Point Lepreau.

Epidemiology studies at other Canadian facilities emitting tritium have indicated increases in cancer and congenital malformations. However no epidemiological studies near Point Lepreau have been commissioned or carried out to ascertain levels of adverse health effects in the local population. In addition, evidence from cell and animal studies, and radiation biology theory, indicates that radiogenic effects occur from exposures to tritium.

Recent, large-scale, statistically powerful, epidemiology studies of nuclear workers in UK, US and France have resulted in perceived increases in the radiation risks of low-LET radiation, including tritium. The new studies show a 47% increase in solid cancers and a 580% increase in leukemias. The evidence from these studies is applicable to tritium's radiation exposures at Point Lepreau NPS.

These high emissions, high levels of radioactive contamination, and increased estimates of cancer risks together mean that tritium poses worrying health risks to workers and to people near St John NB.

Under the Precautionary Principle, it is recommended that no further license be issued for the Point Lepreau NPS (Recommendation 1, Appendix 3).

Dr. Fairlie's report on Tritium (Appendix 2) provides further detail on the radioactive isotope of hydrogen – because the extremely large releases of tritium from Point Lepreau are a cause of concern. The report summarizes current understandings of the biological and health effects of exposure to tritium and comments upon the risks faced by local citizens. In particular, new evidence on increased radiation risks is discussed.

Dr. Fairlie's recommendations follow (see Appendix 3 for recommendations from the entire report):

2. CNSC should apply the Ontario Government's ODWAC recommended maximum of 20 becquerels per litre (Bq/L) for drinking water

3. CNSC should recommend its own design guide1 for ground water of 100 Bq/L for tritium.

4. Urine tests and non-invasive bioassay tests should be carried out on volunteers from the community to ascertain local HTO and OBT levels.

5. Residents within 10 km of the plant should be advised to avoid consuming locally-grown foods including honey from hives, wild foods such as mushrooms and berries, and produce from their gardens.

6. In view of the discussion in Appendix C, local women intending to have a family, and families with babies and young children should consider moving elsewhere. It is recognised this recommendation may cause concern but it is better to be aware of the risks to babies and young children than remain ignorant of them.

7. NB Power employees, especially young workers and women workers, should be informed about the hazards of tritium.

Summary of Risks and Benefits

Risk of Poor Social Management

As we are in an era of mass public reaction to perceived injustice and ecological mismanagement, leading to quickly arising and stubbornly enduring social organizations and actions, we propose the CNSC complete a risk assessment of the financial and social costs of proceeding with an unprecedented license duration of 25, 20, 15, or 10 years. In support of this proposal, we share the findings of a recent study in which Energy Transfer Partners (ETP) lost more than 7.5 billion dollars in its Dakota Access Pipeline project in direct relation to self-organized activities such as public protests, prolonged blockades, and social media awareness campaigns. It is understood that ETP would have engaged in such a risk assessment beforehand, if they knew what they know now. **Financial costs are also social costs extracted in the form of public confidence and good faith**; **withdrawn confidence by the public destabilizes social fabric and brings volatility to both industry and government operations; it is more imperative than ever that the public experience true confidence in the energy solutions deployed by its public utilities.**

Benefit of Indigenous Knowledge

This document aims to clarify the term “Indigenous Knowledge” using content understandable by the Commissioners, NB Power staff, and members of the public. Through this document, our perspective on “Indigenous Knowledge” is clarified and exemplified in its usage and application. **Indigenous Knowledge is**

(and should continually be reinforced as) an essential part of Canadian decision-making in matters concerning land, ecosystem, economy, and sociality.

Conclusion of Intervention Objectives

The objectives of this intervention are (1) that the Commissioners would grant a 3-year licence to NB Power, and (2) that they would utilize this 3 year duration to build an authentic, empowered, and publically beneficial working relationship with the Peskotomuhkati around issues pertaining to the safety and wellbeing of the resident of Peskotomuhkatikuk. The reasons to do so are myriad, but we highlight the benefits of Indigenous Knowledge, and the risks to the health and security of people and the environment of both the current decommissioning plan and guarantee, and the risks of poor social management.

We aim for you, the Commissioners, to read the document in its entirety, and consider it fully - engaging with the content from a number of different perspectives. We believe you will find the message within both rationally and intellectually compelling. During this process, we hope that you gain increased understanding of our perspectives and duties, and invite you to further discuss these matters during the hearings planned for May 11 and 12, 2022.

This document aims to be a repository for a history of our engagement with this issue in legal and extra-legal contexts, as well as a staging ground to update our interventions.

Importantly, this document will also be read by the public. Through it they can become familiar with the perspective of PRGI, the Peskotomuhkati, and the Chief of the Peskotomuhkati people at Skutik, Hugh Akagi, in relation to the caretaking of the territory in which he and his people live, and in which they enact

their responsibilities and obligations. Thus the public can read this document and be inspired to discuss and organize around the principles and rationales shared herein.

To conclude the statement of our intervention objectives, we offer the practical value of Indigenous Knowledge for the task at hand: a mechanism to lessen the risks signposted ahead of a 25, 20, 15, or 10 year license approval, both for the CNSC and for the residents of our territory. The legal reality of Aboriginal rights and land title make the Peskotomuhkati a pragmatic and inexorable part of this decision making process, without which the CNSC's risk portfolio may increase from another angle, that of the social and its management. Grant NB Power a 3 year license and invest with us in a future where our knowledge systems grow together for the prosperity and health of all.

What is Indigenous Knowledge and how can it be applied in this decision?

"I think of Indigenous knowledge and Western science both as powerful intellectual traditions, which grow from different worldviews, but can both illuminate the nature of the living world and how we might better care for it…

They are distinctive, sovereign systems of knowledge which can complement one another. Our capacity to achieve sustainability and a more positive relation with the natural world is strengthened when we use both."[5]

Robin Wall Kimmerer

"Both Western science and traditional ecological knowledge are methods of reading the land. That's where they come together. But they're reading the land in different ways. Scientists use the intellect and the senses, usually enhanced by technology. They set spirit and emotion off to the side and bar them from participating. Often science dismisses indigenous knowledge as folklore — not objective or empirical, and thus not valid. But indigenous knowledge, too, is based on observation, on experiment. The difference is that it includes spiritual relationships and spiritual explanations. Traditional knowledge brings together the seen and the unseen, whereas Western science says that if we can't measure something, it doesn't exist."[6]

Robin Wall Kimmerer

Why is it important that the Commissioners understand and apply Indigenous Knowledge in their decision-making? After reading the words of Dr. Kimmerer above, the following diagram stands as an example of the siloing that

[5] Robin Wall Kimmerer. *Braiding Sweetgrass*. xi.

[6] Ibid. "Robin Wall Kimmerer on Scientific and Native American Views of The Natural WOrld," *The Sun*, April 2016.

Kimmerer and others seek to rectify. This diagram in Figure 1., was produced as a projected slide by CNSC staff for a meeting with the Peskotomuhkati in 2022.

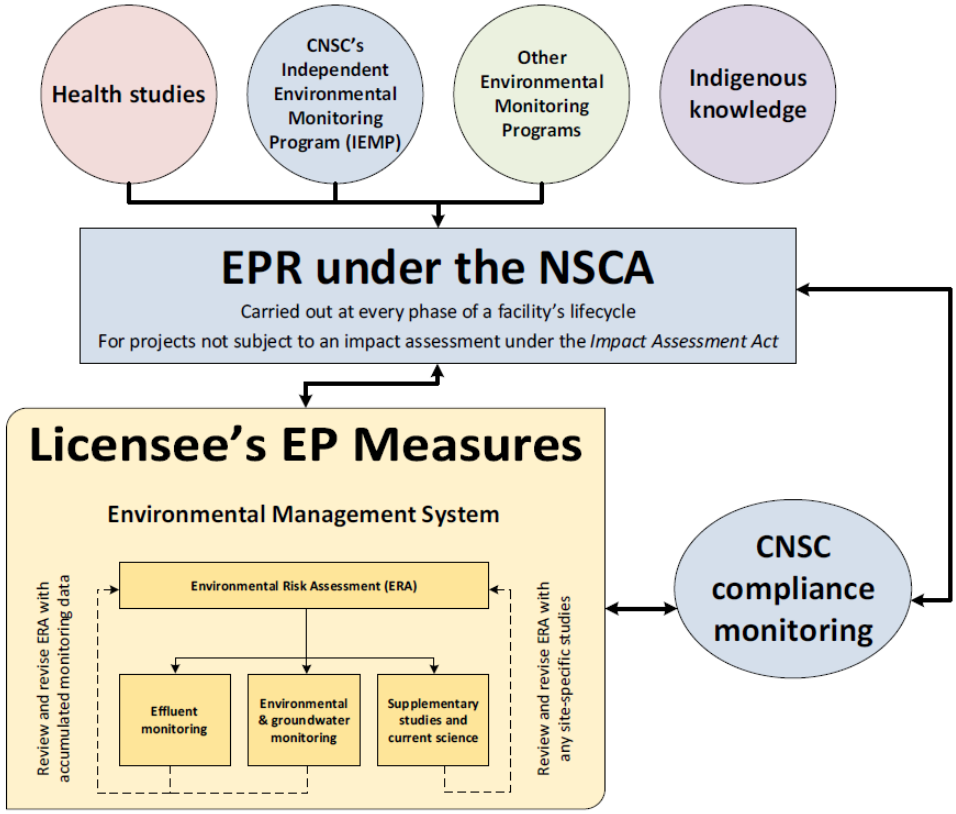


Figure 1. Image from the CNSC staff presentation to the Peskotomuhkati Nation from February 24, 2022

Notice how "Indigenous Knowledge'' is not connected to any aspect of the regulatory system, while every other object in the rest of the diagram is connected and presumably active and necessary. In the CNSC staff's own conception, Indigenous Knowledge has no connection or authority in the regulation of PLNGS. This visualized conception powerfully highlights an opportunity for growth and an opportunity to grow in stature in the eyes of the majority of Canadians as well the majority of the citizens of the world, who

support strong action on Indigeneous 'reconciling' through deep and authentic collaboration with Indigenous communities and Indigenous Knowledge.[7]

The understanding and application of Indigenous Knowledge (which we propose that the Commissioners undertake to whatever extent they can) means taking as authoritative narrative histories and community-based knowledge that–like scientific observation–are experimental modes of observation and strategies for knowledge retention. But, unlike scientific observation, Indigenous Knowledge is also an experiential mode of observation that includes the human actor as part of the ecology being observed. Because of this, as Kimmerer notes above, Indigenous Knowledge knows not just *about* things but about *how things affect each other* in the living of real life, i.e., matters of past, current, and future ecological activity and, especially, inter-activity.

When Indigenous Knowledge is sought to be understood and applied, it is typically integrated in two ways: knowledge that can apply in diverse contexts and not just in its observational/geographic origin, or knowledge that can only apply in the specific contexts in which it has emerged. In the context of his work in agricultural systems, George Kanyama-Phiri summarizes these two approaches:

> 1. Local knowledge [like Indigenous Knowledge] is a huge, largely untapped, resource that can be removed from its context and applied and replicated in different places (like formal science). Proponents of this perspective have scientifically validated

[7] "Indigenous Relations and Reconciliation: A Report from the Confederation of Tomorrow. 2021 Survey of Canadians." https://centre.irpp.org/wp-content/uploads/sites/3/2020/09/CoT-2021-Report-4-Indigenous-Relations-and-Reconciliation.pdf

> [Indigenous Knowledge] or sought similarities and complementarities between their knowledge and farmers' knowledge…
>
> 2. [Indigenous Knowledge] is based on empirical experience and is embedded in both biophysical and social contexts, and cannot easily be removed from them. It follows that the process by which [Indigenous Knowledge] is created is as important as the products of this research.[8]

On the one hand, the latter approach is helpful because it uses the similarities between local knowledge and the even more historically connected nature of Indigenous Knowledge to draw us closer to understanding what Indigenous Knowledge has to offer: an intimate and incredibly complex understanding of a specific territory (such as Peskotomuhkatikuk, in which PLNGS resides). On the other hand, Indigenous Knowledge as 'another universal' continues to contribute to the renewal and evolution of land resource management best practices around the world, at local and national levels.

As regards this intervention, it matters not which accepted definition of Indigenous Knowledge one accedes to as long as *one is accepted*. If one takes the definition bound by locality, PLNGS is within Peskotomuhkatikuk and thus is a part of the homeland and observatory authority of the intervenor; if one prefers the definition in which Indigenous Knowledge is exportable to other contexts, then the case is also strong, from the Amazon of Brazil to the Mesas of New Mexico, the goal is to facilitate nature's return to itself and, subsequently, us to nature.

[8] George Kanyama-Phiri**.** *Agricultural Systems: Agroecology and Rural Innovation for Development*, 15.

Either way, **for the pragmatic purposes of a 3 year license for 3 good reasons, Indigenous Knowledge is a valuable and necessary actor in the regulatory framework of decision-making concerning PLNGS and must be treated as such.**

The acceptance of the unique and important contribution of Indigenous Knowledge alongside scientific knowledge has been historically recognized in diverse contexts since "first contact." Again, Kanyama-Phiri writes, "Indigenous knowledge is the [historical] basis for local level decision-making in food security, human and animal health, education, NRM,[9] and other vital economic and social activities. Agricultural and social scientists have been aware of the existence of [Indigenous Knowledge] since colonial times."[10] Indigenous Knowledge is not new, and only appears as such (again and again) because it is drawn from a different methodology and arrives in a different format than currently prevailing modes. These structural or procedural differences between Indigenous Knowledge and scientific knowledge must be studied and understood just as much as the findings of each, for it is in the procedures of each that we find the real justifications for making decisions differently than we would if we had only the one or the other.

In the remainder of this section, we extrapolate on the foundation and content of this knowledge as it relates to our proposal that the Commissioners grant a 3 year license to NB Power within the bounds of the land we have borrowed from Creator, and to which we are gratefully responsible: Peskotomuhkatikuk.

[9] Natural Resources Management
[10] *Ibid*., 15.

Fourteen Thousand Years says "3 Year License"

Peskotomuhkat are the original inhabitants of this territory. Oral history and village sites (evidence of such dates from fourteen thousand years ago) affirm that Peskotomuhkat have continually used, occupied and cared for our lands and waters in what is now known as southwestern New Brunswick and Maine, since time immemorial. This oral and physical evidence is also punctuated with various written records. Specifically we draw attention to examples of Peskotomuhkat at Point Lepreau, including writings of the famous naturalists, James Audubon (1870) and G.H. Thomas (1889).

Box 1.

"…we arrived at Point Lepreaux Harbour…troops of Indians make their appeared in light bark canoes. They form their flotilla into an extended curve, and drive before them the birds…"

"…The Papamaquody chief is seen gliding swiftly over the deep in his fragile bark. He has observed a porpoise breathing…He rises erect; aims his musket…Amidst the highest waves of the Bay of Fundy, these feats are performed by the Indians during the whole of the season, when the porpoises resort thither."

John J. Audubon. 1870

~

In reference to Point Lepreau

"They made a landing place half a mile up the Point and portaged from there across the Point within camps a distance of about 1 mile…. I can remember this Portage being quite distinct …"

G.H. Thomas 1889

Our knowledge is a collection of experiences and observations from the lands and waters over the course of many millennia, and which continue to develop with every new generation. Our culture and our knowledge is additive, despite the subtractions that have been attempted. Therefore, from logical, legal, historical, and health and safety perspectives, shouldn't the relicensing process of PLNGS, which produces material that will last thousands of years, be guided by local knowledge gained over thousands of years?

All parties agree that there are impacts derived from the operations of PLNGS. While we assert that these impacts are critical and have numerous health, safety and environmental ramifications, many of which cause significant infringement of our Aboriginal and Treaty Rights and Title, NBP and the CNSC - have determined that the impacts are acceptable. We recommend (Recommendation 8, Appendix 3) that you, the Commissioners,

reconsider whether the impacts are acceptable

consider who and what bears the brunt of continued impacts

consider who and what gains benefit from PLNGS

based on what we anticipate will be your modified perspective, after reading and whole-heartedly considering this submission.

Further, please consider that in Wabanaki law, it is essential that our relationships are regularly revisited and renewed.[11] We ask you to respect our vital need to enact our law and to therefore affirm our proposal of a 3 year license. Any longer licence period blocks us from fulfilling our obligations to regularly assess and improve the health of the territories in which we live. As an *Agent of the Crown*, your obligation is to continue the government of Canada's commitment to work to restore respectful nation-to-nation relations.

[11] The Peskotomuhkati, Wolastoqewiyik, Wolastoqiyik or (Welustuk, Wolastokuk, also Maliseet), Mi'kmaq (Mi'kmaw, Micmac or L'nu, "the people", Micmac), and Penobscot (also Panuwapskewiyik), are known collectively as the Wabanaki, "People of the Dawnland." https://pmportal.org/

Interconnections - PLNGS and safety and health of Peskotomuhkatihkuk and its inhabitants

We are of course directly affected by the impacts of the proposed re-licensing. The continued occupation of Peskotomuhkatihkuk without governance collaboration, the continued emissions associated with the 'normal' operation and planned decommissioning of PLNGS, the effects of the marine-based infrastructure, and the effect of the risk of a catastrophic event looming near our homes, just beyond sight. Peskotomuhkatihkuk is also negatively affected by the continued production of long-lived toxic waste. Our physical, cultural and spiritual health is put under duress by the existence of the PLNGS.

Restoring the health of the lands and waters is a daunting challenge. There are too many factors to count. The lands and oceans are vast: our own efforts, as a people with heritage, knowledge, and rights, have been to focus on the things that we can immediately influence.

In our tradition, authority is always accompanied by responsibility, and rights are accompanied by obligations. If we have the right to fish, that right is not ours alone: it also belongs to future generations of our people. For them to have a meaningful right to fish, there must be fish for them to catch. Therefore, our own rights include the responsibility to ensure that there will be healthy lands and waters for human and natural populations in the future.

Indigenous Law

Before the arrival of the French in Passamaquoddy Bay in 1603, the Wabanaki (Dawn Land) nations - Penobscot, Peskotomuhkati, Wolastoq

(Maliseet) and Mi'kmaq - had their own laws. They had clear relations, both among themselves and with their neighbours. Wabanaki Treaties with the Crown stem from the earlier processes and principles of the relations between Indigenous nations. Within the Wabanaki Confederacy, for example, the Penobscot and Peskotomuhkati are the Elder Brothers, and the Mi'kmaq and Maliseet are the Younger Brothers. The relationship provides each side of the council fire with specific, family-based responsibilities.

In Peskotomuhkati society, as in most Indigenous societies, who you are is not defined by what you do for money, but by belonging, and that in turn is dictated by what you do in the community, and how you are related to other people. That relationship is not separable from place or time, which includes land and water, “understory” and “overstory.” All over North America, when two skicin[12] (Indigeneous people) meet, the first question is not "what work do you do?" but "where are you from?" For Indigenous peoples and nations, citizenship and family are inseparable. David Maybury -Lewis, the British-Xavante anthropologist, explained: "If I can call you cousin, you are one of us."

Once you realize that our people see the world in family terms, it is easier to accept what we really mean when we speak about "our mother the earth,'' "our brothers and sisters the animals”. A couple of generations ago, scientists would have considered this quaint. Now they acknowledge that we share over 90% of our DNA with other mammals, over 20% with plants. All living things are indeed our relatives. The next challenge is to accept that the modern decision about what is considered alive is itself a cultural construct. If the soil constantly

[12] (literally, surface-dweller; for vocative, see also ckin) … skicinuwok … Pihce skicinuwok neke yaluwawotultihtit, on yukt motewolonuwok, … human being … Native … Indian … person … aboriginal … skicin …https://pmportal.org/

produces living things, is it not alive itself? If landscapes, mountains, seashores, and continents are constantly changing, are they not alive? If we live all our lives touching them, affected by them, are they not our relatives?

Within families, we maintain peace through affection and respect. Family ways are spread to become the rules of society as well as the rules for addressing and protecting the natural world around us, our other relatives. When new people arrive in the land, if we are to have peace with them, they need to become family, too. What Canadian law calls treaty-making, Wabanaki people call *lakatuwakon*, making family.

We all carry a legacy from our ancestors, and obligations to our future generations. We do the best we can. We will make mistakes, and when we do, we will be forgiving toward one another, and work together to make things right.

Our ancestors are upstream from us, and our children are downstream. When we say we have obligations to future generations, we know some of them are far enough downstream, around the bend in the river, that we will never see their faces. We understand that our ancestors' legacy is memory, spirit, ways of living.

We are on a river of time together. We are often tempted to take a view only of what we can see, thinking of "the people" as those of us who are alive now, and not in terms of generations, upstream and downstream from us. We are all together in one canoe on that river.

An agreement between the Wabanaki nations predates the arrival of Europeans. Its symbol is a single wooden bowl with a wooden spoon in it. The

land and waters are like that bowl: everyone has the right to take food from them. There is a spoon in the bowl, rather than a knife, for there is to be no conflict between our people over food, no sharp knife that might draw blood. The Dish With One Spoon is mentioned between lndigenous nations from the Atlantic coast to west of the Mississippi, and from James Bay to the Creek Nation near Florida.

> To travel through Passamaquoddy country with a Passamaquoddy person familiar with his or her traditional knowledge is to travel through the places where Glooskap shaped the land and provided for the people and the animals. An Indigenous nation's Creation story, its explanation of how it came to this place, its role in this provident planet. occupies an important part of its legal system. That is, it is all about land, and it is all about law. These stories and songs explain, nurture, maintain and require the continuity of the relationship between the people and the place. They prescribe how the people are to conduct themselves in relation to the land.
>
> -Peskotomuhkati intervention, Supreme Court of Canada, Ktuoaxa Nation v. British Columbia, 2016

The legacy of newcomers

Out of compassion, the Peskotomuhkat helped the first French settlers on St. Croix Island to survive the winter of 1604. The French eventually moved to what is now known as Annapolis Royal in Nova Scotia.

Since then the encroachment and degradation of our homeland forced us to adapt, and to shift away from our traditional indigenous economies. Every Peskotomuhkati reserve in what is now Canada was either disposed of without a surrender, or never formally set aside. The people were literally marginalized: some lived at the fringes of British settlements - for example, our sacred capital Qonasqamkuk (Indian Point at St. Andrews) became not only the town commons, but also the town garbage dump. Many of our people, their expansive use of the

waters and lands taken from them, were driven onto the two reservations in Maine, refugees in their own homeland.

> The fundamental belief of First Nations is that their rights with respect to circulation within the territory of North America, referred to by many as Turtle Island derive from their inherent right as nations which existed prior to the arrival of Europeans and the imposition of today's international borders.
>
> First Nations therefore view the imposition of the Canada-US border, which in some cases literally divided their existing nations in two, as an unjustified and unlawful abridgement of their inherent rights which have a direct relation to their cultural survival...
>
> In some cases (or example, the Mohawks of Akwesasne in Central Canada, the Passamaquoddy in New Brunswick, and the White River First Nation in Yukon), existing communities have been literally divided in two.
>
> -Report of Ministerial Special Representative Fred Caron, August, 2017.

Today over 3,000 Peskotomuhkat reside both inside and outside of 'reserved' permanent settlements. Three distinct communities exist within Peskotomuhkatihkuk, our ancestral homeland, and include Sipayik (Pleasant Point), Motahkomikuk (Indian Township), and Skutik. Though separated by geography Peskotomuhkat continue to maintain close political, social and kinship ties as boundaries do not define us. The complexities associated with these political boundaries have not deterred us from working both autonomously and in collaboration, to advance our needs and desires, to fulfill our responsibilities to the land and water and their inhabitants; the fish and wildlife, and to safeguard our rights and interests.

Qonasqamkuk, also known as St. Andrews, New Brunswick - or Indian Point- is a preeminent traditional Peskotomuhkat Village. As well, because Qonasqamkuk is naturally situated at the confluence of the St. Croix river and

Passamaquoddy Bay, it has long represented a tribal gateway for cultural subsistence, sustenance and survival for its aboriginal caretakers. Despite the "historic loss" of Qonasqamkuk, we continue to assert our aboriginal land claim for the immediate return of our homeland. However, attached to this claim is a duty - a responsibility to live on this land as complimentary inhabitants, and safeguard it for future generations. Through thousands of years of perseverance, our people have gained knowledge that has served us both as a guide and a vital truth about how to survive. Returning to the crux of the issue, then, and speaking from this place of longstanding relation to this land, we submit that anything more than a 3 year license sets all residents of Peskotomuhkatikuk on an irrevocable course, causing significant endangerment to the safety and health of our surrounding ecosystem.

Wabanaki law, emanating from the stories of Creation that prescribe, through example and advice, how the people are to behave together and with the other parts or the natural world; this law views people, land, and other living beings in family terms. It considers the animals, birds and fish as our brothers and sisters. Linda Hogan explains how many Indigenous traditions hold this in common:

> “... the ancient intellectual traditions are not merely about belief as some would say. Belief is not a strong enough word. They are more than that: They are part of lived experience, the on-going experience of people rooted in centuries-old knowledge that is held deep and strong, knowledge about the natural laws of Earth, from the beginning of creation, and the magnificent terrestrial intelligence still at work, an intelligence now newly called ecology by the Western science that tells us what our oldest tribal stories maintain: the human animal is a relatively new creation here; animal and plant presences were here

> before us: and we are truly the younger sisters and brothers of the other animal species, not quite as well developed as we thought we were. It is through our relationships with animals and plants that we maintain a way of living, a cultural ethic shaped from an ancient understanding of the world, and this is remembered in stories that are the deepest reflections of our shared lives on Earth.
>
> That we held, and still hold, treaties with the animals and plant species is a known part of tribal culture. The relationship between human people and animals is still alive and resonant in the world. The ancient tellings carried on by a constellation of stories, songs, and ceremonies, all shaped by lived knowledge of the world and its many interwoven, unending relationships. These stories and ceremonies keep open the bridge between one kind of intelligence and another, one species and another."[13]

Today, our practice is that a person or community wishing to fish or hunt in the territory of another must show respect by asking permission - but the host, unless there is good reason, must give that permission. We can think of modern reasons why permission might be refused: if a population of animals or fish were seriously endangered, for example, or where we are concerned that the guests might be taking more than what is required for their food needs.

Out of respect, but also out of caution, we would expect that the guests would be accompanied by some of our own people. But make no mistake: the authority to allow people of the nations with whom we have this treaty relationship to hunt and fish in our lands and waters is *ours*.

[13] Linda Hogan, *First People*, in Intimate Nature: The Bond Between Women and Animals, as cited in Williams, P., 2016, *Peskotomuhkatiq - The Journey Continues*

We desire that you - the Commissioners, through your response to our proposal - would recognize and enable us to fulfill our role as caretakers of Peskotomuhkatikuk. Grant our request for a 3 year license on the condition that during these years partners are to start the work of implementation planning for decommissioning. If you do so, you will be fulfilling your role as an honourable *Agent of the Crown.* You will be protecting the safety and health of citizens, creatures and the natural environment who continue to be exposed to unnecessary and indeterminable risk. You will be shepherding an important partnership in the exercise of management, protection, maintenance, and restoration of lands and oceans, a partnership that will not be forgotten nor invisible to the public eye.

You will be supporting the reestablishment of nation to nation relationships, as is desired by the Government of Canada and expressed in the Prime Minister's 2021 mandate letters:[14]

> I am directing every Minister to implement the United Nations Declaration on the Rights of Indigenous Peoples and to work in partnership with Indigenous Peoples to advance their rights.

and, specifically, to Minister of Crown-Indigenous Relations

> As Minister of Crown-Indigenous Relations, your first and foremost priority is to work in full partnership with First Nations, Inuit and Métis to continue building nation to nation relationships

[14] https://pm.gc.ca/en/mandate-letters

The Treaty Relationship

Concerning treaties, we can compare how we think about that relationship, to "marriage." It is possible to think about it as a single event, a ceremony at which two families gather to witness the union of two of their members. Or it is possible to think of it as an ongoing, organic relationship, in which the original event is the formal beginning. That is how we think about the treaty relationship, constantly adapting, based on principles of respect, trust and friendship rather than on the details of a dusty document.

Respect, in this relationship, is crucial. The honour of the Crown and the honour of the Peskotomuhkat are fully engaged and bound up in the Treaties. This mutual engagement of honour reflects the mutual respect that must guide the relationship as we work together. Side by side.

Where Canadian courts and lawyers tend to see the treaties as events, the Wabanaki understand them as an organic, flowing relationship. For people of rivers and ocean currents, for people whose family relations are the core of their societies, they could not see the treaties in any other way.

The relationship between the Peskotomuhkati Nation and the Crown – the root of British government in Canada – is nearly three centuries old. From the Peskotomuhkat perspective, the treaty relationship is foundational. It is not only historic: it is constant and alive. It remains vitally relevant. It is also recognized and affirmed in the Constitution of Canada.

Today, the Government of Canada refers to the Treaties between the Wabanaki nations and the Crown as “Peace and Friendship Treaties.” They are

unlike later treaties signed in other parts of Canada as the Peace and Friendship Treaties did not involve First Nations surrendering rights to the lands and resources they had traditionally used and occupied.

The 1725 Treaty, taken as a whole, was not a surrender of land or rights: it was a sharing. **After 1725, the councils between the Peskotomuhkati Nation and the Crown continued to reaffirm earlier agreements and relationships, none of which contain surrender language.** In Wabanaki law, the relationship is like the rivers the people see every day: the treaty councils are like stones along its course, but what is most important is the flow of the river itself through time. Throughout the colonial period, people on both sides of the Council fire – the Crown's representatives and the Chiefs of the Indigenous nations – used metaphors that expressed their desire that the relationship should be constant and lasting. As long as the sun and moon shall endure, they said. As long as the grasses grow and the rivers flow. Hands clasped in perpetual friendship.

> The English commitment in Mascarene's promises to respect Aboriginal access to fish and game in Nova Scotia, not as an English-given right, but as an English obligation to recognize and respect the **pre-existing and continuing reality of Aboriginal survival derived from the land and its resources.** It comprises nothing more than what Natives enjoyed before the establishment or the English in Nova Scotia (peace and the right to share in the fruits of the land by hunting and fishing). By contrast, the benefits to the English from this treaty were to be much greater than they had hitherto enjoyed (the right to share the land in peace).
>
> - Andrea Bear Nicholas, Mascarene's Treaty of 1725, p. l0.

The Peskotomuhkati Council views the Covenant Chain as a distinct symbol of the relationship itself: it binds the nations' arms together in brotherhood, as long as they hold fast to it.

Across Canada, Indigenous elders explain that their ancestors, in making treaties with the Crown, had no concept of selling land: they believed they were clarifying how people would live together and share the land. The English words used in these treaties did not exist in either a legal or a societal vacuum. In the 18th century, the term “Peace and Friendship” was meaningful in political and legal terms, beyond the ways those words are generally used today.

In the 1749 renewal, the Governor referred to “amity and friendship.” Friendship implied, in many contexts, family relations. That would have been consistent with the way the Peskotomuhkati Chiefs would have understood it. The word also implied an alliance, and that, too, would have been welcomed.

The importance of reaffirmation continues in modern day

People who use their minds rather than paper to “preserve things in remembrance” tend to focus on principles rather than details. The annual cycle of ceremonies of thanksgiving reminds people of their relationship with the natural world. In the same way, regular reaffirmation of the Treaty relationship both reminds and renews the bond between the nations. Renewing the Treaty relationship is part of Wabanaki law. Reaffirmation is not new. It is restorative. After a century and more of neglect, it is also healing.

In May, 2016, at Qonasqamkuk, representatives of the Governments of Canada and New Brunswick met with the Peskotomuhkati Council around the ancient fireplace of the Peskotomuhkati Nation. Though this was before any formal mandate to negotiate, the three

The treaty relationship is the political and legal ecosystem in which any negotiations will take place, in which any future agreements will live, and in which reconciliation will be fostered.

governments agreed that the principles of the existing treaties between the Peskotomuhkati Nation and the Crown would continue to guide and govern their relationship. The principles are those of the Covenant Chain: respect, trust and friendship.

At the same meeting, the three governments agreed that it would be proper, before any new negotiations began, and to begin to accomplish what Prime Minister Trudeau set out in his mandate letters to the Ministers of Indigenous Affairs and Justice – "restoring respectful nation to nation relations" – that the existing treaty relationship should be formally reaffirmed.

The three sides agreed that the principles of the existing Treaties between the Peskotomuhkati Nation and the Crown – respect, trust and friendship – would continue to guide and govern their relationship.

The 2016 reaffirmation is only the latest in a long chain of renewals. To commemorate the reaffirmation of the treaties in 2016, the Peskotomuhkati Council commissioned the making of a new wampum belt.

The white line from end to end of the wampum symbolizes the clear path of honest, open communication between the partners – brother nations – in the relationship. The four white strips at each end remind us that the Peskotomuhkati Nation is part of the Wabanaki Confederacy, and at the reaffirmation ceremony, Mi'kmaq, Maliseet and Penobscot representatives fulfill their duty as witnesses to shared relations. The year 2016 places this ceremony in time, but also recalls that it confirms past reaffirmations.

In giving this new wampum to the Government of Canada, the Peskotomuhkati Council has created a new symbol to fulfill a role in an ancient

process. The custodian of the wampum, will bring it to each meeting between the three governments. **The presence of the wampum will mean that the work of restoring respectful nation-to-nation relations is in progress.**

Land Use & Assertions

Regarding land, Anglo-Canadian law has inherited the British view that it is a commodity capable of being owned, divided, sold, leased, and exploited. It also sees "waters," as subject to a legal and political regime that is distinct from solid ground. Wabanaki thinking does not make that distinction. Watersheds define a nation's territory. Passamaquoddy Bay and the Skutik River are the lifeblood of that territory. inseparable from the land around them.

The Peskotomuhkat have lived in this region for at least the past 14,000+ years. In contrast, the European newcomer governments (USA and Canada) have only been in this region for a mere 20 generations. This new USA-Canada boundary line was imposed on the Peskotomuhkat by the newcomer governments. The boundary line cuts right through the heart of our Ancestral Homeland. This new boundary was implemented about 200 years ago and has created serious problems for the Peskotomuhkat.

When Great Britain and the United States established a boundary between Maine and New Brunswick in 1842, the Peskotomuhkat were not consulted. The

result, the separation of Peskotomuhkat families and the seizure of traditional Peskotomuhkatihkuk. Our people more than a century later still carry on the fight for our ancestral homelands (Figure 2).

> The Peskotomuhkati were one nation when the treaties were made, more than half a century before the invention of the United States and the creation of the border. That Canada and New Brunswick would drive families from their homeland and then deny them rights because they live outside the country is shameful. That a country that takes in hundreds of thousands of foreign immigrants each year would deny the rights of families who have been in this land for millennia is immoral. This matter is far from decided. We remain one nation, undivided.

Peskotomuhkatihkuk is identified and highlighted based on traditional watershed areas used. The easternmost watershed (Lepreau River) empties out near Point Lepreau, NB. The western most watershed (Union River) empties out in the Union River Bay near Mt. Desert Island, ME. Neighboring Wabanaki tribes respected each other's traditional watershed territories, however some minor overlapping of territories did occur and was accepted between the Wabanaki tribes.

The St John River watershed (Maliseet Territory) is next to the Lepreau River watershed. The Penobscot River watershed is (Penobscot Territory) next to the Union River watershed.

Passamaquoddy Watersheds:

- Lepreau River Watershed, Canada
- New River Watershed, Canada
- Magaguadavic River Watershed, Canada
- Digdeguash River Watershed, Canada
- Letang River, Canada
- Bonny River, Canada
- Bocabec River, Canada
- Waweig River Watershed, Canada

- St Croix (Passamaquoddy) River Watershed Canada and USA (Schoodic)
- Little River Watershed, USA
- Pennamaquan River Watershed, USA
- Dennys River Watershed, USA
- East Machias River Watershed, USA
- Machias River Watershed, USA
- Pleasant River Watershed, USA
- Narraguagus River Watershed, USA
- Union River Watershed, USA

Figure 2. Peskotomuhkati Homeland - perceived as being borrowed from the Creator. Oral, written, and archeological accounts identify that although each Nation had a Homeland, movement outside of these 'borders' was common, and the 'borders' should be perceived as porous between Wabanaki tribes

> The fundamental belief of First Nations is that their rights with respect to circulation within the territory of North America, referred to by many as Turtle Island derive from their inherent right as nations which existed prior to the arrival of Europeans and the imposition of today's international borders.
>
> First Nations therefore view the imposition of the Canada-US border, which in some cases literally divided their existing nations in two, as an unjustified and unlawful abridgement of their inherent rights which have a direct relation to their cultural survival...
>
> In some cases (or example, the Mohawks of Akwesasne in Central Canada, the Passamaquoddy in New Brunswick, and the White River First Nation in Yukon), existing communities have been literally divided in two.
>
> -Report of Ministerial Special Representative Fred Caron, August 2017.

United Nations Declaration on the Rights of Indigenous Peoples

Indigenous Peoples have rights that are distinct from those enjoyed by non-indigenous persons in society. In best practice, far in advance of relicensing, principles of UNDRIP would have been applied to this relicensing process - ensuring free, prior, and informed consent (FPIC) - this is of paramount importance to the Peskotomuhkati Nation. In the present moment however, as *Agents of the Crown*, it is incumbent that the CNSC confirm that before making this decision, you have ensured collaboration to the furthest extent possible with our Nation affirming that the decision you make is respectful of our law and practices and the free, prior and informed consent (FPIC) principle.

The UNDRIP also includes a number of articles recognizing the need for a dominant state to respect and promote the rights of its Indigenous peoples as affirmed in treaties and agreements, including how Indigenous peoples participate in decision-making processes that affect their traditional lands and livelihoods.

Article 18 provides as follows:

> Indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedure, as well as to maintain and develop their own indigenous decision-making institutions.

Article 32 (2) of the UNDRIP states:

> States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water and other resources.

As well, security of First Nations' lands must be ensured through in-depth consultation and direct participation. Indeed, it is a principle of article, per Article 29.2 of the UNDRIP that specifically addresses the issues before the CNSC, requiring that; "States shall take effective measures to ensure that no storage or disposal of hazardous materials shall take place in the lands or territories of indigenous peoples without their free, prior and informed consent."

PLNGS was established in our territory without consultation or consent of the Peskotomuhkati, contrary to the terms of our Treaties. This remains an outstanding issue, we recommend further attention to this issue prior to a relicensing decision being taken (Recommendation 15, Appendix 3).

PLNGS continues to produce and store toxic waste in our ancestral homeland. This also remains an outstanding issue, we recommend further

attention to this issue prior to a relicensing decision being taken (Recommendation 16, Appendix 3).

Finally, to date, the Nation has not been engaged by either NB Power nor the CNSC on a nation to nation basis - this also remains an outstanding issue, we recommend further attention to this issue prior to a relicensing decision being taken (Recommendation 17, Appendix 3).

We recommend that NB Power and CNSC policies should be assessed for their substantive content, normative language, potential weaknesses, and possible impact on Peskotomuhkati treaty rights, title and interests, UNDRIP, as well as rights, title and interests more recently reconfirmed through Canadian and provincial courts. In particular, paying close attention to whether NB Power and CNSC policies have enough ingredients to meaningfully contribute to the achievement of the above-listed rights, title and interests, and UNDRIP goals (Recommendation 18, Appendix 3).

We recommend that the UNDRIP must be a minimum framework for the relationship between Indigeneous peoples and the Canadian government and nuclear development decisions across Canada (Recommendation 19, Appendix 3).

Further, due to the nature of PLNGS, especially in light of its pervasive level of influence on Peskotomuhkuk, CNSC must, as an essential basis for the relationship with the Peskotomuhkat, apply the principles of the UNDRIP to its relicensing decision (Recommendation 20, Appendix 3).

Therefore, we recommend the CNSC utilizes the UNDRIP principles as a rubric with which they can compare their rationale for their decision the NB Power application for relicensing (Recommendation 21, Appendix 3).

Prior to the final decision with respect to the NB Power application for relicensing, we recommend you have ensured collaboration with our Nation to the furthest extent possible, and worked in good faith to rectify our outstanding concerns (Recommendation 22, Appendix 3).

Should you chose to approve a licence length over 3 years, we desire (Recommendation 23, Appendix 3) that your decision describes and specifically details how you have applied consideration to

- Peskotomuhkat Treaty Rights
- The rights and interests of the Peskotomuhkat as confirmed by federal and provincial court decisions, and
- the principles of the United Nations Declaration on the Rights of Indigenous Peoples

Infringement of Aboriginal rights and land title

We are cautious to protect our rights: but Canadian government has enabled the operation of PLNGS in our territory. We provide the following excerpt from 2011, in reference to our position and to support our current statements:

November 14, 2011 - In the Matter of

New Brunswick Power Nuclear

Request for Approval to Reload Fuel and Restart Point Lepreau Nuclear Generating Station, and Application to renew the Power Reactor Operating licence for the Point Lepreau Generating Station

EXCERPT

I have already said (reference: attachment #2) that the Passamaquoddy have never given approval for renewing or extending or reloading or restarting or commissioning or operating Point Lepreau. Such approval was never requested of our Nation. This is in violation of Supreme Court decisions. Also, I refer you to the decision of Newfoundland Court of Appeal in Newfoundland and Labrador v. Labrador Métis Nation, 272 Nfld & PEIR 178; 288 DLR (4th) 641 (affirming a lower court decision at 258 Nfld & PEIR 257, [2006] 4 CNLR 94) in which an Aboriginal group which had no formal recognition from the Canadian or Provincial Government was found to be owed a duty to consult in respect of activities in their traditional territory. I further point you to numerous decisions of the New Brunswick Courts which have found that Nonstatus Indians living on or off reserve could be recognized as Aboriginal Peoples, and therefore do have aboriginal rights, including Hopper v. R. (2008), 331 N.B.R. (2d) 177, R. v. Acker (2004), 281 N.B.R. (2d) 275, and R. v. Lavigne (2007), 319 N. B.R. (2d) 261.

Hugh M. Akagi

Chief of Passamaquoddy Peoples

Canadian Law and the Duty to Consult

During the February 2022 meeting with CNSC staff, Peskotomuhkati Nation representatives asked CNSC staff about the Duty to Consult and what level of consultation would be completed for the Point Lepreau Relicensing process. “CNSC staff indicated that licence renewals that propose no changes to an existing facility

and its operations, do not raise the legal Duty to Consult as these types of Commission decisions do not lead to any new potential impacts on the exercise of Indigenous or treaty rights. The Point Lepreau Licence Renewal would allow the existing facility to continue doing what it is doing today".[15] However, we assert that the new, toxic waste which is to be created and stored in Peskotomuhkatihkuk creates new infringements of our rights, therefore meriting Duty to Consult (Recommendation 24, Appendix 3).

Further, we assert that the infringement of Peskotomuhkati rights by NB Power cannot be legally justified, even though we fully understand from the Marshall and Sparrow cases that Treaty rights *can* be "infringed" upon through a dance of justification, consultation and compensation - but the infringement must be justified.

While courts have decided that conservation is a justifiable objective, the **2016 Tsilhqot'in decision says that the infringement must be consistent with the constitutionally mandated goal of reconciliation**. The federal government must show that the objective cannot be met except by infringing the Aboriginal rights, and the right must be curtailed as little as possible to meet the objective. As well, other users of the resource must be cut back first: we would say there is a "first in, last out" rule. **We ask - if we apply these decisions to energy production in New Brunswick, understanding that NB Power utilizes PLNGS not only to meet the needs of New Brunswickers, but exports energy - what would the courts say?**

[15] e-Docs 6747689 (Appendix 4)

The answer to this question is important, as it helps to set the tone and spirit of every aspect of restoring our relationship with the Crown and with our ecosystems. We see 'thriving ecosystems' as the rubric within which to judge energy production in New Brunswick. Thriving ecosystems means not only functioning, biodiverse ecosystems, but also the cultural and physical health of our people, and of future generations.

> The point is that the treaty rights-holder not only has the right or liberty "enjoyed by other British subjects" but may enjoy special treaty protection against interference with its exercise.
>
> -R. v. Donald Marshall Jr.
> Supreme Court of Canada, 1999, paragraph 47.

As an Agent of the Crown, it is incumbent upon the Commission that it takes the Duty to Consult seriously. By its legal definition the Peskotomuhkati has not been consulted regarding any activity past, present or future regarding the Lepreau site, and while we have found the engagement of NB Power representative Kathleen Dugay to be excessively helpful, we view that bi-annual update meetings with the CNSC and much more frequent updates by NB Power are not a replacement for specific consultation and accommodation process agreements. Although the outcomes of communication are not always clear (see the *Cumulative Impacts to our Health section on Language and Trust*), we view these engagement efforts by CNSC and NBP staff as a step in the right direction.

Process Inequities

We feel that because the CNSC staff have recommended a 20 year relicensing, prior considering or analyzing information from intervenors - this lessens the contribution of intervenors and heightens contribution of staff. We believe intervenor submissions should merit more than the perfunctory discussion that the strict time limits of the hearing will impose. **Principles of fairness require that all points of view be heard and given full consideration before conclusions are reached or recommendations are offered.** Because this is not the current process, we worry that you, the Commissioners, will not be exposed to a balanced understanding of the circumstances.

Accordingly, we request that any decision about relicensing be delayed until CNSC staff can direct due attention to the information presented by intervenors, respond on the record to our concerns and those of other intervenors, and allow intervenors the opportunity to discuss the CNSC staff's responses on the record (Recommendation 25, Appendix 3).

Further, we recommend that the relicensing process is reformed so that it allows the CNSC staff and Commissioners to review and discuss at length, the factual, technical, scientific or Indigeneous knowledge and evidence tendered by proponents and intervenors with sufficient rigour and minimum procedural safeguards in place so that CNSC's purpose of disseminating information to the public per section 9(b) of the NSCA and ensuring a licensing decision is arrived at in a fair and credible manner, can be fulfilled (Recommendation 26, Appendix 3).

Financial Support

We received approximately 55% of our Participant Funding Program (PFP) financial request and acknowledge that while this funding has allowed a basic intervention, the level was inadequate for PRGI to fill in many information gaps.

We recommend that adequate resources to carry out meaningful responses are negotiated, not unilaterally determined by CNSC staff (Recommendation 27, Appendix 3). The availability of adequate participant funding is essential to PRGI's ability to participate in CNSC licensing hearings.

Access to documentation

To enable efficient research and work by intervenors, we recommend all documents referenced in the CMDs should be provided (via a working link in the CMD) instead of intervenors having to request documentation. Currently, much of the PFP funding gets directed to chasing documents (Recommendation 28, Appendix 3).

As well, to enable further efficiencies, we recommend the provision of a document regarding naming conventions, or the use of meaningful document titles (Recommendation 29, Appendix 3).

Although much documentation is forthcoming from both NB Power and CNSC staff, during preparation for this intervention, there have been 3 instances of requests for information being denied. One was our request for the Hazard Screen, though we did receive a heavily redacted version. **The other two requests which were denied outright, were the most recent reports from each, the**

Nuclear Safety Review Board (NSRB) and Corporate Nuclear Oversight Team (CNOT). This inhibits our review of procedures and activities which have direct bearing on the lands and waters of our traditional territory.

Since our intervention work started, we have amassed approximately 40 pages of questions and answers. Although much documentation is forthcoming from both NB Power and CNSC, we have found the answers regularly necessitate follow up questions or further research (which brings us back to the need for adequate resourcing). We provide just 2 examples below, one relatively simple, and one more complex to reflect the spectrum of questioning, desire for understanding, and work created in order to gain such understanding.

Example 1>

Our question: **What triggers an event review?**

CNSC staff response: All event reports that are required to be submitted to the CNSC in accordance with regulatory document REGDOC-3.1.1 or any other regulatory requirement are reviewed by CNSC staff. The trigger of an event review is the receipt of an event report.

The next question would be, and what triggers an event report…

Example 2>

Our 1st Question:

In section 4.1.1 Analysis - Can you provide a status update on the following:

General - *Why does the RP program have exceptions for the collective dose for activities involving tritiated heavy water?* (emphasis added)

ii - Expected & potential hazards - again with exceptions for tritium?

iv - ...activities that may re-suspend contamination

1st CNSC Response:

The report was issued to NB Power on January 14, 2013.

The finding in Section 4.1 states the following 'The RP Program does not define complete criteria for assessing radiological risk in order to properly classify radiation work (e.g. high, medium, low). Consequently, the RP program documentation is not sufficient to demonstrate that work planning & control requirements for radiation work will be commensurate with radiological risk in all instances.'

The associated enforcement action, Directive PLRPD-2012-23-D1 stated 'NBPN is required to establish a work planning process that provides a) complete and clear radiological criteria to assess radiological work; b) appropriate work classification based on risk, and c) complete and clear requirements based on work classification to provide assurance that work planning (e.g. levels of review and approval) and work control (e.g. pre-job briefings, special monitoring, oversight, post-job reviews, etc.) will be commensurate with radiological risk.'

The enforcement action (a directive in this case) was raised to get NB Power back into compliance. To do so, NB Power updated their work planning process and provided this document for CNSC staff to review. These changes were also rolled out to the workers during their radiation protection refresher training and to the work planners.

On February 27, 2014, after CNSC staff reviewed the updated process and once roll-outs of the procedures were complete, this directive PLRPD-2012-23-D1 was closed.

Our follow up question: *Why* (emphasis added) does the RP program have exceptions for the collective dose for activities involving tritiated heavy water? And for Expected & potential hazards - again with exceptions for tritium? (Noted in reference to # PLRPD-2012-23)

CNSC Staff follow up response: At the time of the inspection (in 2012), it was noted that the criteria used to determine the requirements for radiation work planning was determined based on the estimated collective dose for a work activity, *except for the activities involving tritiated heavy water* (emphasis added). Also, the criteria used to assess the radiological risk did not completely address the expected and potential hazard levels and the potential exposure levels, except for the instances where tritium was of concern.

There was (and there is) NO exceptions made for activities involving tritiated heavy water (emphasis added). Internal hazards, including tritium, are always carefully reviewed to ensure that appropriate measures are taken to manage the radiological internal hazard and to keep doses to workers ALARA (As Low As Reasonably Achievable).

Although thorough, the answers related to this question necessitated many reads and follow up conversations and questions with experts, to comprehend. It is now assumed, based on these answers that the RP has a) complete and clear radiological criteria to assess radiological work; b) appropriate work classification based on risk, and c) complete and clear requirements based on work classification to provide assurance that work planning (e.g. levels of review and approval) and work control (e.g. pre-job briefings, special monitoring, oversight, post-job reviews, etc.) will be commensurate with radiological risk.' especially

with respect to tritium. Our next follow up step would be to check the RP documentation, however, due to limited capacity, we will have to take the word of CNSC that the RP is in proper order.

Excessive limit placed on Indigenous engagement by the proposed license length

In Part 1 of the hearings, Commissioner Berube echoed many of our concerns with his line of questioning (reproduced here for convenience);

> "Part of the reasons that I am concerned … the public engagement, Indigenous engagement activities. And also now that things are changing fairly radically with the climate, climate change issues coming over that period of time also factor into this… So my questions to you are basically in this area. To what extent have you given these three factors weight in this recommendation for a 20-year licence?"

For the Peskotomukati, Dr. Viktorov's response (p.73 of the Part 1 Hearing transcript) provided little clarity, and unfortunately, worked to further instill doubt (reproduced here for convenience);

> "... certainly public engagement is one of the considerations that's upfront and draws attention in many decisions we make or recommendations we develop. **And the relicensing is one of the opportunities, but only one of them.**
>
> We emphasize that even with longer licence durations there will be ongoing other opportunities which are well-established, such as **annual regulatory oversight reports on nuclear generating sites,**

> **essentially monthly station updates, event reports as necessary, or the Commission has the authority to request an update** at any given time to consider overall performance or any particular aspects of performance. And that may include, of course, any rapidly evolving aspects that we are facing, be it climate change or technology or anything else.
>
> Again, that's not taken away and will be with us. Again, **it will fall onto Staff to avail and exercise the other available means of updating the Commission and involving public.**
>
> Again, we interact, engage, maintain our relationship with public not just through the Commission meetings. There are many other opportunities and options when we do update the public on regulatory activities.
>
> I'm not sure if I've covered all the points."

The reason we incur doubt is that we feel that Dr. Viktorov's response did not cover all the points - he made no reference to rights holders in his remarks. He did mention that relicensing hearings were one way of 'engaging' but other 'engagement methods' he listed; monthly station updates, event reports and Commission-requested updates, are one-way communications and do not 'engage' either the public, or rights holders. On this point, the Executive Vice-President, Ramzi Jammal, during the Part 1 hearings, seems to partially agree with our perspective - at least in reference to RORs when he stated, "It's one of the instruments, but it's not the best instrument..."

Further, Dr. Viktorov explains that it is the CNSC staff who will avail and exercise means to involve the public, and because of our past experiences related to a tendency of 'muddy' communications regarding PLNGS, (as further explained in the section on *Cumulative Impacts on our Health - Language and Trust*) we do not have strong confidence that the CNSC can indeed meet its purpose of disseminating information to the public per section 9(b) of the NSCA; *(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).*[16]

In one last example related to CNSC staff's past efforts of Indigeneous engagement - we provide an excerpt from our intervention in 2011;

November 14, 2011 - In the Matter of

New Brunswick Power Nuclear

Request for Approval to Reload Fuel and Restart Point Lepreau Nuclear Generating Station, and Application to renew the Power Reactor Operating licence for the Point Lepreau Generating Station

EXCERPT

[16] https://laws-lois.justice.gc.ca/eng/acts/n-28.3/FullText.html#:~:text=Objects&text=(b)%20to%20disseminate%20objective%20scientific,to%20in%20paragraph%20(a).

"Please be aware that since our last written interventions (reference correspondence to CNSC) before the Commissioners, **we have attempted to open a dialogue with CNSC and Point Lepreau.**

Regarding the interests of Aboriginal people, we offered a process for establishing consultation; CNSC staff has reported to you that they cancelled the meeting intended to open these discussions.

I ask you to acknowledge that we have continued to write and voice many vital questions to CNSC staff, most of which they have not answered. We have been told that a "team" has been assembled to address some important written questions sent by ourselves and our colleagues over this year, but most of which remain unanswered and without provision of any estimate of the time required for response. We were also denied funding for legal representation from a CNSC public participation program for these hearings."

Also,

"I want the Commissioners to know that some of the information intrinsic to these volumes has been **effectively denied to us, inaccessible because of the significant costs involved, and for other reasons.** I will be pleased to further elaborate on our concerns at the public hearing on December 1st and 2nd, 2011.

Hugh M. Akagi

Chief of Passamaquoddy Peoples"

We feel the above needs no further explanation.

As far as the relicensing, it is indicated within the 2022-H-02 CMDs and the Day 1 hearing transcripts that the CNSC staff recommendation for a 20-year license is based, in part, on the past behaviour of NB Power. We agree that past behaviour may be a good indication of future behaviour. Members of our team can attest to the excellent work of NB Power representative Ms. Kathleen Duguay, and the high quality relationship she has forged with us over many years. We have also witnessed many examples of the safety culture of NB Power in action. However - we do not see the same precaution used in their management of communications (outside of Ms. Duguay's work) or in their consideration of high-risk ventures. As explained throughout this document we feel that the current impacts of the PLNGS as well as potential risks are too great to bear. Also, we point out the high-risk behaviour witnessed during the establishment of PLNGS (as shared previously from Secord, 2020) and in reference to the decision made regarding refurbishment - although unsupported by the Public Utilities Board. We also note that various other high-risk endeavours such as those related to Coleson Cove and Ore Emulsion, as well as JOI Scientific reinforce our concerns. Therefore and unfortunately, we do not feel confident that NB Power or the CNSC staff prioritize the best interests of Peskotomuhkatihkuk.

Indigenous Responsibilities: Health & Safety Concerns at PLNGS

Emissions

During its 'normal' operation, PLNGS creates hundreds of radioactive materials that are highly dangerous and that did not occur in Peskotomuhkatihkuk prior to PLNGS.

It is worrisome that, as Dr. Fairlie's report highlights, tritium releases at Point Lepreau have been steadily increasing. However, we do know that the older a reactor becomes the higher its tritium inventories in the moderator and cooling circuits, thus, the higher its annual tritium releases. Without a means of removing tritium, the inventory and releases will continue to increase.

Point Lepreau's annual air emissions are higher than those from other CANDU nuclear reactors and significantly higher than other reactor types around the world. The emissions from PLNGS lay on our lands and waters and bioaccumulate in some of the Plants, Animals and Sea-Creatures that also call our territory home. Local populations are thus exposed to radiation as a result of the tritiated water vapour in the air, drinking water in local wells, diving for sea urchins, harvesting clams and dulse, eating local seafood, harvesting of local wild foodstuffs such as mushrooms, berries and other fruits, garden vegetables, and the associated harvesting of seaweeds for fertilizer. Many of these items are also exported for food and ingredients in various products around the world.

The radioactive poisoning of our lands and seas is deeply offensive. Emissions contaminate and deplete our homeland and food sources, at a time when we are finally experiencing some willingness to advance nation to nation relations and resurrect our ability to hunt, fish, travel and trade within our territory. **PLNGS endangers our way of life.** Because PLNGS exists on our lands, we bear a disproportionate share of the burden for practices and wastes that are harmful.

Marine-based Infrastructure Effects

Though we have stated these sentiments before, we remain concerned about the direct impact of the operation of the PLNGS on the marine

environment through impingement, entrainment, the thermal plume and any fish or marine mammals that get drawn into the forebay. We are especially interested in more information on the planktonic species affected by PLNGS, as the Bay of Fundy is known to be one of the most productive marine locations along the Atlantic coast and planktonic species are the essential element that allows this diversity to thrive (see Appendix 5).

Should the station be relicensed, we recommend the measures proposed below be included as conditions of the license (Recommendation 30, Appendix 3):

- continuous and stringent measures to monitor the impacts of each impingement and entrainment on the Bay of Fundy ecosystem. Specifically, we recommend that any license include conditions stipulating that the operator of the PLNGS take weekly samples of the water flowing into and through the plant to collect data on casualties of each impingement and entrainment. These samples should be analyzed for all organisms they contain, including but not limited to, fish, fish larvae, zooplankton, and phytoplankton. The results of this weekly sampling should be made available to the public on an ongoing basis as the samples are analyzed.
- the development and analysis of a cumulative impacts study regarding the marine environment, providing trend information regarding the local fisheries starting before the construction of PLNGS, as a baseline
- the keeping and public release of records of any fish or marine mammals that have been drawn into the forebay as well as reports of live releases back to the bay or mortalities. We suggest these reports be made public at least on a monthly basis.

Catastrophic Failures

As the Canadian Coalition for Nuclear Responsibility reminds us, experience with nuclear power has now given us the basis on which to project the likelihood of catastrophic failures and associated contamination - a risk that no insurance company or government has, can, or will ever be able to 'cover'. The consequences of Three Mile Island, Chernobyl and Fukushima have varied from extremely expensive to unimaginable. We are also currently faced with heightened hazards related to both Chernobyl and Zaporizhzhia. This has brought into sharp focus the risks of PLNGS versus its benefits.

Further, Canadian Coalition for Nuclear Responsibility has highlighted in past interventions that it is important to note that the understanding of risk that New Brunswick accepted when Point Lepreau was first licensed in 1982 was prior to two of the catastrophes named above. Careful consideration must therefore be given to the lessons now being learned, and the associated human, and environmental price being paid. Both the Chernobyl and the Fukushima disasters have proven that unanticipated natural events combined with human miscalculations and operational errors makes nuclear power far too dangerous and costly, regardless of the safety record of PLNGS or any other nuclear power plant. The possibility of one such disaster occuring in our territory exerts a responsibility on us and on you. Grant a 3 year license.

Waste

Nuclear waste - we ask you to pause, and to question - as we do, both the basis and the sanity of choosing to allow the production of a substance so toxic. In 1993, a task force set up more than 10 years prior to develop messaging intended to deter exposure to nuclear waste repositories in the far future, would

recommend that the main messaging should be guided by the following examples:[17]

This place is not a place of honor... no highly esteemed deed is commemorated here... nothing valued is here.

What is here was dangerous and repulsive to us.
This message is a warning about danger.

The danger is still present, in your time, as it was in ours.

This place is best shunned and left uninhabited.

Trauth, K.M.; Hora, S.C.; Guzowski, R.V. (1993). *Expert judgment on markers to deter inadvertent human intrusion into the Waste Isolation Pilot Plant.* Sandia National Labs., Albuquerque, NM (United States): F-49–F-50.

The waste thus far accumulated on our territory is deplorable, offensive and entirely unacceptable. However, it is concurrently so dangerous and repulsive

[17] Nuclear semiotics is an interdisciplinary field of research first explored by the American Human Interference Task Force in 1981 which included engineers, anthropologists, nuclear physicists, behavioral scientists and others. Their mandate involved developing long-term nuclear waste warning messages intended to deter exposure to nuclear waste repositories in the far future.
Specifically, the Task Force was examining the use of long-time warning messages to prevent future unintended human interaction with wastes in the planned, but now defunct, deep geological nuclear waste repository project of Yucca Mountain. The work was in response to the acknowledgement that for non-Indigeneous societies, there is no method known or practised to continuously share knowledge over thousands of years. The written historical tradition of humanity is only about 5,000 years old and the writings of the Indus Valley civilization are already illegible after a few thousand years. It has been acknowledged that the culture of earlier centuries becomes incomprehensible when it is not practised or translated somehow every few generations. Using the example of our people who have inhabited Peskotomuhkatihkuk for millenia, because our knowledge and cultural practices have been exposed to efforts of eradication and purposeful dismantling for the last four centuries, we are now working to recover important and essential ancestral knowledge.

to us, that we can not abdicate our responsibility for it, and at this time we cannot agree that it should be exported from our territory *or* stored as is.

The first thing that we must do, in an effort to rectify this terrible conundrum, is to 'stop the bleed,' we must stop producing this toxic long-lived poison. Then we must put our minds to the task of keeping the toxic waste separated from the biosphere for up to one million years – about 30,000 human generations. The earlier assumptions - based on a period of 10,000 years, seemed to be too short given the half-life of certain radioactive isotopes (for example, Plutonium-239 at 24,000 years).

We invite you to grant a re-licensing only for the next 3 years, in which time we will work with you, CNSC and NB Power to immediately start implementing decommissioning now.

> How can anyone classify a waste product which will contaminate this planet for thousands of years as anything but a hazard and a risk to "health, safety and security"?
>
> Hugh M. Akagi
> Chief of Passamaquoddy Peoples

Cumulative effects on our health

In recognizing that our spiritual, mental and physical equilibrium can only be attained within the context of our social and physical surroundings, the Peskotomuhkat earnestly request support. We stress that to do anything less perpetuates the extermination of our culture and our people. Four centuries of cultural pressure, development pressure and direct efforts to exterminate Indigenous peoples contribute to the health of our peoples. These factors are

implicated in the onset of physical, spiritual and mental sickness. The multiple and accumulating stresses to which we are exposed have long lasting effects and can also lead to behaviors that may cause further risk to health.

Relationships as they affect well-being

For most of society (Indigeneous and non-Indigeneous), part of health and well-being is to feel included in society, and to feel that our opinions matter - this is some of our common ground. Because these feelings, and therefore all linked communications and relationships - are impacted by our use of language and levels of trust, we provide you a summary of various issues related to communication and trust, within the PLNGS (including owners and regulators who are now known as NB Power and the CNSC) - Pesktomuhkat relationship.

> There is a re-awakening happening today. The youth are seeking out their identity and their roots. They want to understand who they are and where they came from. They are beginning to practice some of their ancient ceremonies. The modem culture of materialism is not satisfying their desire to feed their souls. They hear the old stories about how our ancestors lived and they dream of a healthier environment and way of life. They know their ancestors are buried within the surrounding hills, islands and valleys and culture is sacred to them. They want to strengthen their connection, because they hear the whisper of their ancestors in the wind and in their heart.
>
> - Ed Bassett, Peskotomukat

To provide context for our relationship with the PLNGS (as described above), we offer a condensed history of its dishonourable beginnings, which worked to set the tone of our current positions. Then we will provide more recent examples of behaviour with which we struggle to reconcile. We provide these examples only so that you may understand the basis of our more ‘sweeping

statements' and perspectives. We will start however, by integrating the two - to enable a glimpse into how our minds connect the past and future.

In January of 2022, in Part 1 of the relicensing hearing for Point Lepreau, NB Power representative, Mark Power stated,

> **"...We understand that our operation is founded on the social license of those in our communities to support our operations".**

However, as you will see below, the statement is unfounded - the failure to honour social license is consistent throughout the history of PLNGS.

A short history of the establishment of the PLNGS

As described in Andrew Secord's 2020 article (Appendix 6), *Nuclear Power Decision-Making in New Brunswick, 1971-1975*, what was originally designed as a small reactor program to produce plutonium for American nuclear weapons[18] evolved into AECL's distinctive commercial heavy water CANDU design, which AECL hoped could compete in domestic and international markets.[19]

[18] The role of AECL in supplying plutonium to the American nuclear weapons program is well documented; see, for example, Duane Bratt, "Canada's Nuclear Schizophrenia," Bulletin of the Atomic Scientists 58, no. 2 (March/April 2002): 45-50. The economic justification for AECL's first reactor, NRU, was based in part on selling plutonium for about $5,000 per ounce to the American weapons program in the 1950s. As in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150.

[19] Various sources document the history of AECL and their marketing strategies by the late 1960s. See Robert Bothwell, Nucleus; Duane Bratt, The Politics of CANDU Exports (Toronto: University of Toronto Press, 2006); Ron Finch, Exporting Danger: A History of the Canadian Nuclear Energy Export Program (Montreal: Black Rose Books, 1986); Fred Knelman, Nuclear Energy (Edmonton: Hurtig, 1976); and Laurel Sefton MacDowell, "Nuclear Power," in Powering Up Canada, ed. R.W. Sandwell (Montreal and Kingston: McGill-Queen's University Press, 2016), 329-52. The CANDU (Canada Deuterium Uranium) design used natural uranium fuel with heavy-water moderation and cooling and a pressure tube core (calandria) rather than the enriched-fuel, pressure-vessel design of the more common American and European light-water reactors. As in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150.

Further, Secord recounts that in the late 1960s New Brunswick Electric Power Commission (NBEPC, now NB Power) managers began to create conditions for transitioning to nuclear power generation in the 1970s, in the process **committing to a path they were unwilling to abandon.** They directed their corporate investments to high-voltage transmission interconnections with New England, which was a necessary condition for their all-nuclear strategy. **When, in 1972, New England utilities rejected nuclear purchases from New Brunswick, NBEPC's exported nuclear strategy had effectively failed. At this point, however, NBEPC managers continued along the nuclear path, exhibiting higher risk behaviour in the process.** Both individually and as an organization, they continued as enthusiastic supporters of AECL's CANDU technology. Consistent with Helga Drummond's analysis of a "lock-in" psychology, as NBEPC executives spent more time and resources on the nuclear option, their personal attachment and the associated institutional commitment increased.

Secord reminds us that,

> **"In their original discussions with the federal government in 1971, NBEPC managers were adamant that they would not go forward with nuclear unless it was no more expensive (or risky) than a conventional oil-fired generator. However, between 1971 and 1974, NBEPC managers were willing to take on increasing levels of economic and financial risk, to the point where they were willing to proceed without sales participation agreements, without federal coverage for**

unforeseen construction cost increases and poor operating performance, and without a federal guarantee on the federal loan.

In 1975, in response to a near-doubling of the capital cost estimate, they responded by taking on the uncertainties of self-management of the construction of the nuclear steam supply system. **At each step of the way, NBEPC managers, between 1972 and 1974, took on additional risk as costs increased and potential partners could not be found.** While investing in the physical infrastructure for nuclear exports, NBEPC officials also developed a social network with officials at EMR and AECL who had a shared interest in the promotion of nuclear power and were prepared to **act in opposition to other officials in the federal departments of Finance, Environment, and Treasury Board Secretariat.** Federal officials within the network provided assistance to NBEPC in writing proposals to federal ministers, developing common positions, sharing background information in advance of negotiations, and recommending tactics for dealing with other federal agencies as well as arguing the NBEPC case before Cabinet committees. **This cross-government network of interests was especially active as NBEPC confronted the federal Cabinet on the location, environmental assessment, and economic appraisal of the nuclear project. With the collaboration of EMR and AECL officials, NBEPC managers were able to counter the federal Cabinet initiative to locate the reactor in the north for economic development purposes, undermine the environmental assessment process, and avoid a federal economic appraisal.**

In this case, social networks built up over several years, although invisible to outsiders, were an essential component of the capacity of **NBEPC executives to continue locked-in on the nuclear path to the bewilderment of both officials of the federal Department of Finance and the people of the Lepreau communities.**

The bewilderment is evidenced in many ways, "At a community meeting on 25 July, 1974 at the Dipper Harbour Church Hall, **three-quarters of the 200 people in attendance stood to express their opposition to the proposed Lepreau nuclear reactor.** When they asked the representative of New Brunswick Electric Power Commission (NBEPC) at the meeting to explain why they planned to build the reactor in their community, he limited his reply to the local factors that would reduce the costs of the nuclear project: access to cooling water from the Bay of Fundy and proximity to transmission lines.[20] Unsatisfied with such simplistic explanations, **many demanded the project be cancelled while others worked for a delay and public inquiry**."[21]

Again in 1975,

"The participants at the Saint John meeting were opposed to the nuclear reactor by a 5-to-1 ratio, with many challenging the legitimacy of the process, the justification for the reactor, the

[20] "Shore Residents Don't Want Lepreau Nuclear Power Plant," Telegraph Journal (Saint John), 27 July 1974, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150.

[21] "Reactions Vary on Nuclear Plant," Telegraph Journal, 20 July 1974, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150.

> economic viability of nuclear power, the adequacy of the preliminary study as a basis for environmental approval, and/or the problem of the radioactive wastes (especially plutonium with a half-life of 24,000 years)."[22]

The Environmental Review process for PLNGS has a similar sordid history. Secord recounts,

> "The location of the reactor resolved, NBEPC managers turned their attention to gaining approval from the federal Department of Environment in the context of the federal **Environmental Assessment and Review Process (EARP); this procedure was introduced by Cabinet for all federal agencies in December 1973.** The Cabinet directive stated that the review was to occur before "irrevocable decisions" had been taken and that environmental problems should be given "the same degree of consideration as that given economic, social, engineering and other concerns."[23] Reviews were to be carried out by a project specific Environmental Assessment and Review Panel (EA Panel) consisting primarily of federal government officials, including a representative from the initiating department; this type of self-assessment was "intended to diffuse environmental responsibility

[22] Proceedings of the Public Meeting on the Preliminary Environmental Impact Statement Lepreau Nuclear Generating Station, 3 April 1975. Prepared by the Saint John River Basin Board Public Participation Section, Government Documents, Harriet Irving Library, University of New Brunswick, Fredericton. The document includes both a verbatim transcript and copies of the 40 written briefs that were submitted to the panel, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150.

[23] The Cabinet meeting of 20 December 1973 confirmed the recommendation of the Cabinet Committee on Science, Culture, and Information; see Environmental Assessment and Review Process, 20 December 1973, EMR Records, file X-085-2-1, LAC, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150.

throughout Government."[24] **At a meeting on 21 May 1974, EMR officials informed NBEPC's general manager that the nuclear project would require Department of Environment approval through the federal EARP process. According to meeting notes, the general manager expressed "grave concern" as the process could lead to a 12-month delay.**[25] Once the official guidelines for a comprehensive environmental review were available, EMR officials arranged a 4 November 1974 meeting with officials from NBEPC, EMR, and the chair of the EA Panel, Dr. R.R. Logie. **According to EMR's staff meeting notes, NBEPC indicated that they were already proceeding with the project and did not intend to stop for the EARP process. Acquiescing to NBEPC's pressure, the EA Panel agreed to postpone the one-year comprehensive assessment and require only a preliminary assessment that NBEPC's consultants said they could complete in four weeks.** The revised guidelines for a preliminary environmental review were approved four days later. In a letter from Dr. Logie to EMR's member of the EA Panel, it was pointed out that **the Minister**

[24] Robert Gibson has extensively analyzed the evolution of environmental assessment in Canada, including this early phase of self-assessment; see Robert B. Gibson, "From Wreck Cove to Voisey's Bay: The Evolution of Federal Environmental Assessment in Canada," Impact Assessment and Project Appraisal 20, no. 3 (September 2002): 151-9, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150.

[25] F.C. Boyd to G.M. MacNabb, "Note to File-New Brunswick Nuclear Power Station," 21 May 1974, Records of the Minister of EMR, file X085-3, Energy & Power-Nuclear-New Brunswick Nuclear Power Station, LAC. For details of NBEPC's response, see Memorandum from F.C. Boyd to G.M. MacNabb, Subject: New Brunswick Nuclear Power Plant Environmental Assessment, 24 May 1974, EMR Records, file X085-2-1, LAC, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150, as cited in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150.

of Environment was “very unhappy with the notion of having to give environmental approval on the basis of incomplete environmental information.”[26]

A focus on language and trust

Without listing all of the similar acts related to PLNGS since 1975, let us fast forward to recent decades.

Words matter. Language matters. The English language, which has become the world's language of commerce and science, has a huge vocabulary but it is devoid of many of the tenses, cases and forms that Indigenous languages use to remind speakers of relationships - to people, to things, to places. The English language flattens relationships, focussing objects rather than relations, and making them inert rather than alive.

If this document were written entirely in Peskotomuhkati, you would be impelled to consider who you are, in relation to this place, this planet, these people. **Disembodied from relationships, you are freed to consider living beings as "natural resources," “economic entities,” and “commodities.” Language matters.**

Therefore, we bring to light various examples of language being used by the CNSC staff, NB Power and others which affect our relationship and our perception

[26] Letter from R.R. Logie, Environment Canada to F.C. Boyd, Assistant Advisor on Nuclear Energy, EMR, 10 December 1974, EMR Records, file X085-2-1, LAC. It is unclear, based on available documentary evidence, why the minister did not take a stronger position, especially given the strength of the Cabinet directive, as in Secord, A. (2020). Nuclear Power Decision-Making in New Brunswick,1971-1975. Acadiensis, 49(1), 123–150.

that the obligations to protect the health and safety of people, as well as our environment, are being fulfilled.

Peskotomuhkati people value collaborative processes that are clear, transparent and predictable, and where information is shared in a timely and accessible manner. This requires moving forward with ethical frameworks for consultation for nuclear projects on our lands to be worked out in a nation-to-nation fashion.

One of the longstanding communications issues we endure relative to the PLNGS is the life extension and the answer to the outstanding question, 'when will we get our land back?'.

Example 1: Refurbishment

During initial refurbishment discussions, and until at least until 2 years ago, we had been hearing from CNSC, NB Power and the media that the refurbishment (on which we were not consulted) was to provide an extension to the life of the plant for 25-30 additional years. However, during conversations with the CNSC staff and through media reports over the past two years, we are concerned that this intention has changed and we have not been informed.

In the October 2021 CNSC/PRGI meeting, we note -

Referring to the concerns of PRGI, and written by CNSC as 'meeting notes' (e-Docs 6666861, Appendix 7)

> "Concerns were raised regarding the infrastructure as the original station was designed to operate approximately 25 years. **Through refurbishment the design life of the station was extended up to an**

> **additional 30 years,"** (emphasis added). "This does not imply that the station was granted a licence by the Commission to operate for the extra 30 years. **NB Power has to consistently seek a licence to operate through the Commission every time their licence to operate Point Lepreau NGS is about to expire.**"

In the February 2022 CNSC/PRGI meeting, we note (written by CNSC as 'meeting notes' (e-Docs 6747689, Appendix 4)

> Peskotomuhkati Nation commented that the licensing periods keep getting longer and asked if there is a connection between the licensing length and oversight.
>
> CNSC staff consider the request from the Licensee when making a recommendation to the Commission. NB Power requested a 25-year licence and CNSC staff have recommended a 20-year licence. Part of the reasoning is that 20 years aligns with the expected end of plant life. Point Lepreau was returned to service in 2012 after a refurbishment that extended the plant life **up to an additional 30 years,** (emphasis added) in part because the pressure tubes have a design life of 30 years. **CNSC staff estimate that in approximately 20 years, NB Power would be required to decided** [sic] **to either refurbish or commence end of commercial operations** and would be required to seek Commission approval at that time. (emphasis added)
>
> **NB Power can do a reassessment to determine if the pressure tube life could be extended longer than 30 years. However, that would**

require NB Power to complete additional analysis and go before the Commission for a decision again. (emphasis added)

Even more recently , we note a quote in the March 26th, 2022 edition of the Huddle[27] from an NB Power representative which stated, "NB Power refurbished the Point Lepreau Station in 2012 – a process that extended its life by 30 **to 35 years**…" (emphasis added). Additionally, the NB Power representative wrote, "that **a 25-year license will coincide with end-of-life decisions and whether the utility refurbishes or decommissions the station,**" (emphasis added).

We find the communications and process in which the Nation is involved to be contradictory - case in point - is the scope of this hearing, which is currently assessing the decommissioning plan, reinforcing our belief that the PLNGS is to be decommissioned. As well, we note there is a difference in the various life extension times referred to between NB Power and CNSC staff representatives.

We also note in the same Huddle Article that the NBP representative used the often quoted phrase "...produces non-emitting electricity…" This phrase was also used by Mark Power, during Part 1 of this hearing, "...and non-emitting electricity for an additional 25 to 30 years," but the statement is misleading. Yes - the nuclear fission reactions themselves do not emit greenhouse gasses, although they emit other toxic radioactive materials. However, the stages of the nuclear power cycle at which greenhouse gases are emitted include: uranium mining, uranium milling, conversion of uranium ore to uranium hexafluoride, uranium

[27] https://huddle.today/2022/03/25/opponents-claim-nuclear-license-request-will-silence-an-entire-generation/

enrichment, fuel fabrication, reactor construction, reactor decommissioning, fuel reprocessing, nuclear waste disposal, mine site rehabilitation, and transport throughout all stages.

Example 2: SMNRs and PLNGS

Since our original conversations regarding small modular nuclear reactors, the industry and government proponents of this technology have since dropped the reference to nuclear, in what we believe is an effort to make the technology more palatable. We believe the 'N' in SMNR has been dropped, because it is *nuclear* that is off-putting to the public.

On the same topic, we have major concerns about how this current relicensing may enable the development of SMNRs on the Point Lepreau site. We have been told numerous times that there is no '**direct** link' (emphasis added). The October CNSC/Nation meeting notes (e-Docs 6666861, Appendix 7) reflect that we were told,

> "... a separate site preparation licence would be required for an SMR and the Point Lepreau site licence would also need to be amended."

We also note that recently, in the March 26th, 2022 edition of the Huddle[28]

> "Moltex Energy and ARC Nuclear Canada, New Brunswick's two nuclear startups vying to build a small modular nuclear reactor at Point Lepreau site, both told Huddle they are **not directly affected** by the utility's

[28] https://huddle.today/2022/03/25/opponents-claim-nuclear-license-request-will-silence-an-entire-generation/

nuclear licensing process because they are in the midst of their own, separate licensing processes". (Emphasis added)

"Erin Polka, vice president of communications for Moltex, said a 25-year license extension to run the Point Lepreau Generating Station would be a potential boon for Moltex."

"Our reactor runs on recycled, spent fuel, so the longer the Point Lepreau reactor is running, the more spent fuel they amass – that's what we use in our reactor."

"Polka noted Moltex supports NB Power's push for a 25-year license period, saying "A longer license period will give customers, suppliers and potential investors confidence in the company's long-term prospects." (Emphasis added)

We question how the two are not linked if the 25 year license will provide confidence to investors in the company's long-term prospects. We believe it is obvious why we remain concerned that indeed, the existence of the PLNGS is a facilitating factor for SMNRs to become established in Peskotomuhkatihkuk.

Finally, to set the record straight - in recent months, via direct conversation with NBP representatives, we have heard that the Peskotomuhkati are not 'interested' in SMNRs, which could not be further from the truth. We are excessively interested in the topic. In an interview

with the news network APTN, Chief Akagi stated that it was unlikely he would ever give his support to an SMNR project at Point Lepreau.[29]

Further, we understand that SMNR development at Point Lepreau will not trigger a federal Impact Assessment under Environment and Climate Change Canada, but will trigger a provincial EIA as well as a number of assessments through the CNSC, and no formal advancements have yet been made to establish an official consultation agreement. We also note that a federal IA is more comprehensive than the CNSC assessments that do not include a full socio-economic review.

Example 3: Waste (reference e-Docs 6747689 in Appendix 4)

During the February 2022 CNSC/Peskotomuhkati Nation meeting, the "Peskotomuhkati Nation asked if waste is moved off-site and who is responsible for waste management. "**CNSC staff indicated that waste from nuclear power plants is not usually transported off-site.** (Emphasis added). CNSC staff committed to having the experts in waste management and transportation come to a future meeting to discuss this topic further".

Yet, we understand that waste is indeed regularly moved off site, though it does return to site. It seems the PLNGS ILW is regularly transported outside of Canada for incineration?

Example 4: CNSC - 'no concerns' (reference e-Docs 6747689 in Appendix 4)

[29] Read, C. (2021) Peskotomuhkati chief unhappy about nuclear reactor testing on his traditional territory. APTN, May 16.

In the CNSC written documentation (e-Doc 6631324 (PDF) pg 108/109) for the current re-licensing, referencing meetings held with members of the Peskotomuhkati Nation, **it is stated, "CNSC staff note that there are no concerns that are directly related to the licence renewal application."** (Emphasis added). This statement is either a misinterpretation or misrepresentation. In fact, during each and every conversation with CNSC and NBP staff, it would be fair to say that the Nation and its representatives have not only expressed concern but made it abundantly evident that the Nation has grave concerns with the existential and operational concerns regarding PLNGS, the Solid Radioactive Waste Management Facility (SRWMF) and SMNRs. The Peskotomuhkati have participated as intervenors in past hearings related to PLNGS. In both 2011 and 2017 the Nation expressed concerns related to the PLNGS, and the SRWMF.

Summary of our focus on language and trust

We believe it is easy to understand why the Nation feels it is not in a relationship of mutual respect and honest communications. Though we indeed desire a healthy and productive relationship, we have no evidence that our concerns are being integrated into the CNSC and NB Power decision-making processes, an essential component of nation-to-nation relations. Therefore, we do not have a firm belief in the reliability, and/or the ability of the CNSC and NB Power to carry out the protection of the health and safety of Canadians and others living within Peskotomuhkatihkuk, as well as our environment.

Conclusion - Health section

To restore our physical and spiritual connection to Peskotomuhkatihkuk - therefore our health - incompatible occupation and exploitation of our lands and waters must cease.

Peskotomuhkat cultural values are grounded in the incontrovertible understanding of interconnections among all animate and inanimate beings. We are duty-bound to caretake Peskotomuhkatikuk, and must encourage all residents and visitors to live harmoniously with the Plants, Animals and Sea-Creatures that also call our territory home. The PLNGS is a barrier to us being able to carry out our duties - and if we cannot carry out our duties - who are we then?

Because we both seek to meet our responsibility of protecting future generations and the environment by initiating the decommissioning of the PLNGS and the Solid Radioactive Waste Management Facility ("SRWMF"), but also understand there are related financial and energy management challenges, we invite a 3 year relicensing period over which we can engage more thoroughly on how to reconcile these concerns and initiate decommissioning together. We are interested in being part of realistic energy solutions that will contribute to the long-term health of Peskotomuhkatikuk and its human and natural communities.

We acknowledge that we live in overlapping nations with overlapping modes of knowledge, therefore let us apply both modes to shared current and future health and environmental challenges.

Conclusion

We are all connected. What can it mean? For you? For us? For this moment?

Sometimes the paths ahead of us seem predetermined. The pressures and expectations that surround us, the positions that we've taken up (often to make a better life for those we love), and the performances that others expect of us, all these things add up to a constricted space difficult to speak about, much less

maneuver in. It can be hard to bear, and it can be hard to believe in the finding of new paths. But it is far from impossible.

Hear us when we say: the coalition of the future is much larger than our present day divisions would have us believe. In reality, we are everyday much closer together and more dependent on one another than we were the day before. Smaller issues fade as interdependence becomes the rule, not the exception (as it has always been for us). The challenges of our world are forcing us into a cooperation that, while we did not choose it, we increasingly realize we are made for: cooperation is our essence as people.

Those with monetary resources and those with social resources are coming together to change the world's most prevalent systems, which were never outfitted for ecological long life in the first place. In 5 years, the public dialogue about energy management will be unrecognizable, as the aspirations of builders, thinkers, doers, and healers come together to insist on a new possible: we must slow down and come into good relation with one another and with the earth.

We, the Peskotomuhkati, submit this intervention requesting the Commissioner's consideration of our proposal that NBP be granted a 3 year license for 3 good reasons; for the depth of Indigenous Knowledge, for the health and financial risks of an underfunded and under-visioned decommissioning plan, and for the social risks of betting on the wrong horse at the wrong time in history.

The Peskotomuhkati further request that an authentic collaboration and engagement begin today, one that allows us to move through all that has come before and to together lay hand to trowel as part of our common future. It is here now.

Appendix 1

Report by Dr. Gordon Edwards

Paying for Radioactive Rubble:

is the financial guarantee enough?

a report
prepared by Gordon Edwards (Ph.D.)
at the request of the
Passamaquoddy Recognition Group Inc.

for use during the
Canadian Nuclear Safety Commission
public hearings May 11-12, 2022

on the re-licensing of the
Point Lepreau Nuclear Generating Station
owned by the New Brunswick Power Corporation

contact: Kim Reeder 506-467-1927

March 16, 2022

CONTENTS

1. Background

This report was prepared at the request of the Passamaquoddy Recognition Group Incorporated (PRGI). PRGI is "*a not-for-profit Indigenous-led organization representing the Peskotomuhkati Nation in Canada which aims to ensure the Commission hears and considers the observations, perceptions, and concerns of the Nation regarding the NB Power re-licensing application for the Point Lepreau Nuclear Generating Station. The Passamaquoddy Recognition Group Inc. (PGRI) aims to bring to the attention of the Commission, insights derived from indigenous traditional knowledge, as well as the PFP-funded discovery of potential implications of the re-licensing on treaty lands, traditional territories and related rights and interests.*"

The Point Lepreau Nuclear Generating Station is sited on a peninsula bordering the Bay of Fundy. For thousands of years before the first Europeans arrived in the New World, these lands were used by aboriginal inhabitants for hunting, fishing and habitation. The government of Canada has recognized the legitimacy of land claims by Indigenous people and is currently negotiating with the Passamaquoddy, Mi'kmaq and Wollastoq peoples, together with representatives of provincial governments, to arrive at a mutually agreeable settlement based on the rulings of the Supreme Court of Canada and the provisions of the relevant Treaties.

Fourteen thousand years of Aboriginal Traditional Knowledge have shown the need to include the voice, and respect the values of the Peskotomuhkati in any decision-making process. As signatories to the Peace and Friendship Treaties, consultation must take place in accordance with claims and rights as protected by the treaties, courts and the constitution.

2. Financial Guarantee

One of the important decisions the Commissioners will have to make at the conclusion of these hearings is whether or not to accept NB Power's Financial Guarantee of $711 million as adequate to allow for the complete decommissioning of the Point Lepreau nuclear plant at the end of its lifetime, under any reasonably foreseeable circumstances.

From ENVIRONMENTAL IMPACT STATEMENT FOR THE IN SITU DECOMMISSIONING OF WR-1 AT THE WHITESHELL LABORATORIES SITE – EXECUTIVE SUMMARY Revision 2. [WLDP-26000-ENA-002]

The following graph illustrates the simple fact that decommissioning wastes remain radioactive for more than 100,000 years, based on the purely physical characteristics of the radioactive materials. In this case, the wastes are from a nuclear reactor (the WR-1 research reactor at Pinawa, Manitoba) that is 35 times less powerful than the Point Lepreau reactor.

It is an interesting observation that the radiotoxic impact of these wastes is expected to peak at about 1000 years after emplacement, then decline until about 50,000 – 70,000 years after emplacement, and then increase again until well beyond 200,000 years after emplacement.

Although the calculated radiation doses to humans portrayed in this graph are reassuringly very low, it is important to realize that those calculations are based on many questionable assumptions about the behaviour of nature for unimaginably long periods of time into the far distant future. Such assumptions are not subject to verification by any scientific method known.

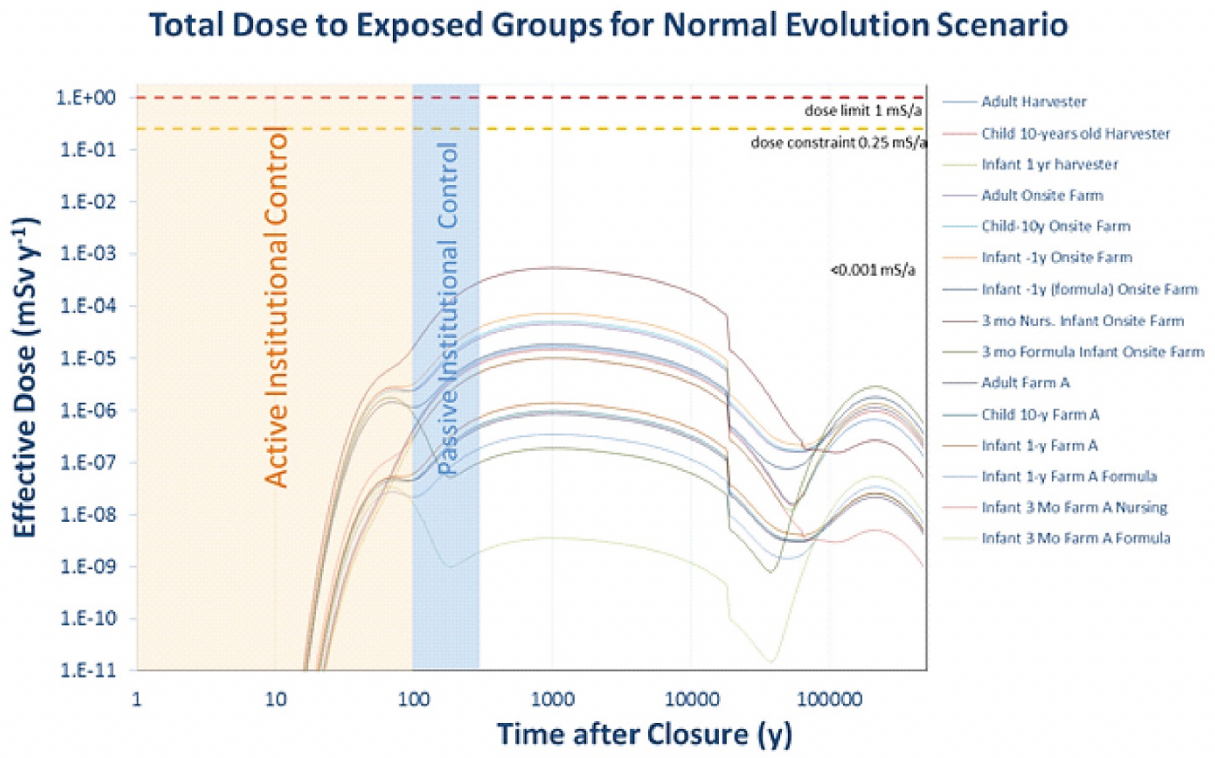


Figure 1. Longevity of radioactive decommissioning waste

Not long ago, the CNSC staff mistakenly reported that the Commission "accepts" NB Power's financial guarantee based on the Point Lepreau Preliminary Decommissioning Plan document. The staff, however, is not authorized to decide such things. The Commissioners themselves must shoulder the responsibility for making the decision whether or not to accept the financial. guarantee.

As the staff admitted in an "erratum" at the end of its powerpoint presentation during Part 1 of these hearings, while CNSC staff may "accept the decommissioning plan and associated cost estimate as the foundation of the financial guarantee, the financial guarantee requires the approval of the Commission."

The financial guarantee is intended to include the cost of managing and disposing of the large volume of intermediate level radioactive waste (ILW) and low-level radioactive waste (LLW) that will result from the dismantling of the plant. See Table 4 of the Point Lepreau Preliminary Decommissioning Plan, reproduced as Annex A. The decommissioning wastes must be isolated from living things for very long periods of time – for many thousands of years, indeed hundreds of thousands of years, as shown on the previous page. Such a time frame dwarfs the span of recorded human history.

One reason offered by the licensee for deferring the complete decommissioning of the plant for decades after the final shutdown is the lack of any final repository for LILW (low-level and intermediate-level radioactive waste). It is assumed by the licensee, without any evidence, that such a repository will become available in time to accept the large volumes of long-lived radioactive decommissioning waste, as well as the previously accumulated 1100 cubic metres of radioactive refurbishment waste (which is a bit similar but much smaller in volume than decommissioning wastes).

The federal government does not accept responsibility for disposing of decommissioning wastes or any post-fission wastes other than the used nuclear fuel. Also Ontario Power Generation (OPG) has made it clear that any repository they build for non-fuel post-fission wastes is intended only for wastes from Ontario's reactors and not those from other jurisdictions. When Hydro Quebec suggested that they could send their refurbishment wastes to Ontario, OPG was quick to put the record straight by saying "absolutely no".

It therefore appears necessary for NB Power to locate and construct its own waste repository for LILW, to house the existing refurbishment wastes as well as the voluminous decommissioning wastes that will be produced. This raises the question: does the financial guarantee cover such costs?

Unless the existence of a permanent resting place for the LILW from Point Lepreau can be established beyond doubt, there is nothing to prevent these wastes from remaining on site indefinitely, severely limiting the possibility of restoring this land to the Indigenous people from whom it was taken long ago without their permission.

Such a turn of events would be contrary to the expressed policy of CNSC as articulated on page 107 of CMD-H2: “The CNSC ensures that all its licence decisions under the NSCA uphold the honour of the Crown and consider Indigenous peoples’ potential or established Indigenous and/or treaty rights pursuant to section 35 of the Constitution.”

In section 4.1.2. of CMD-H2 we read “CNSC staff conclude that the licence renewal will not cause any new adverse impacts to any potential or established Indigenous and/or treaty rights.” If the financial guarantee turns out to be inadequate to pay for the lengthy process of siting and constructing a permanent repository for LILW, however, this conclusion may be invalidated. It follows that any approval of the financial guarantee at this time is not advisable unless the Commission members plan to revisit this matter in the near future – certainly not 20 or 25 years from now.

3. Term of the Operating Licence

At the same time, the Commissioners will have to decide whether to grant a 25 year operating licence, as requested by the proponent, or a 20 year licence, as recommended by the CNSC staff, or a much shorter licence, in conformity with past practice. For instance, the current Power Reactor Operating Licence (PROL) for the Point Lepreau Nuclear Generating Station was granted for five years.

If the Commissioners were to grant an operating licence for 20 years or more, and at the same time accept the proposed financial guarantee, there will be no opportunity for the Commissioners or the public to revisit that financial decision until the plant is permanently shut down. At that point it is

no longer generating any revenues that could be used to bolster those financial guarantee. If the money is found to be insufficient, there is no easy way to increase it to an amount that is more adequate to the task.

Experience has shown that it is a difficult task to have the inhabitants of one jurisdiction accept radioactive wastes that were generated in another jursdiction. to The Preliminary Decommissioning Plan, on which the proposed financial guarantee is based, has only two pages of text in section 9, entitled DECOMMISSIONING COST ESTIMATE, and only two sentences in the following section 10, entitled FINANCIAL GUARANTEE ARRANGEMENTS. Both are reproduced in Annex A.

4. Role of the CNSC

The present report recommends that the Commissioners refrain from granting a Power Reactor Operating Licence (PROL) for a period longer than three years, in part because of serious inadequacies in the proposed financial guarantee, but more importantly because the Commission needs more time to fulfill its fundamental responsibilities, as articulated in the Nuclear Safety and Control Act, article 9:

> **9** The objects of the Commission are
>
> - **(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).

If the Commissioners were to inadvertently approve a financial guarantee that is seriously inadequate, and if those inadequacies were to remain uncorrected for the rest of the plant's operational lifetime, the long-term repercussions could prove to be scandalous for the industry, the government and the regulator. Due to inadequate resources, or inadequate advance preparation, or both, the decommissioning waste could remain on site in perpetuity, improperly stored in a surface facility having a relatively short life time of a century or so, potentially a source of radioactive contamination for countless centuries thereafter.

The present report provides reasons for the Commissioners not to accept this financial guarantee if it also means foregoing the opportunity to insist on revisions while there is still time to do so, in the last two or three decades of the plant's operating history. The easiest way to accomplish this is to grant a PROL for not more than three years, and to make acceptance of the financial guarantee conditional on subsequent revisions to the amount proposed based on subsequent experience and perceived shortcomings in the Preliminary Decommissioning Plan.

Some of these perceived shortcomings are discussed in the remainder of this paper.

5. Perceived Shortcomings

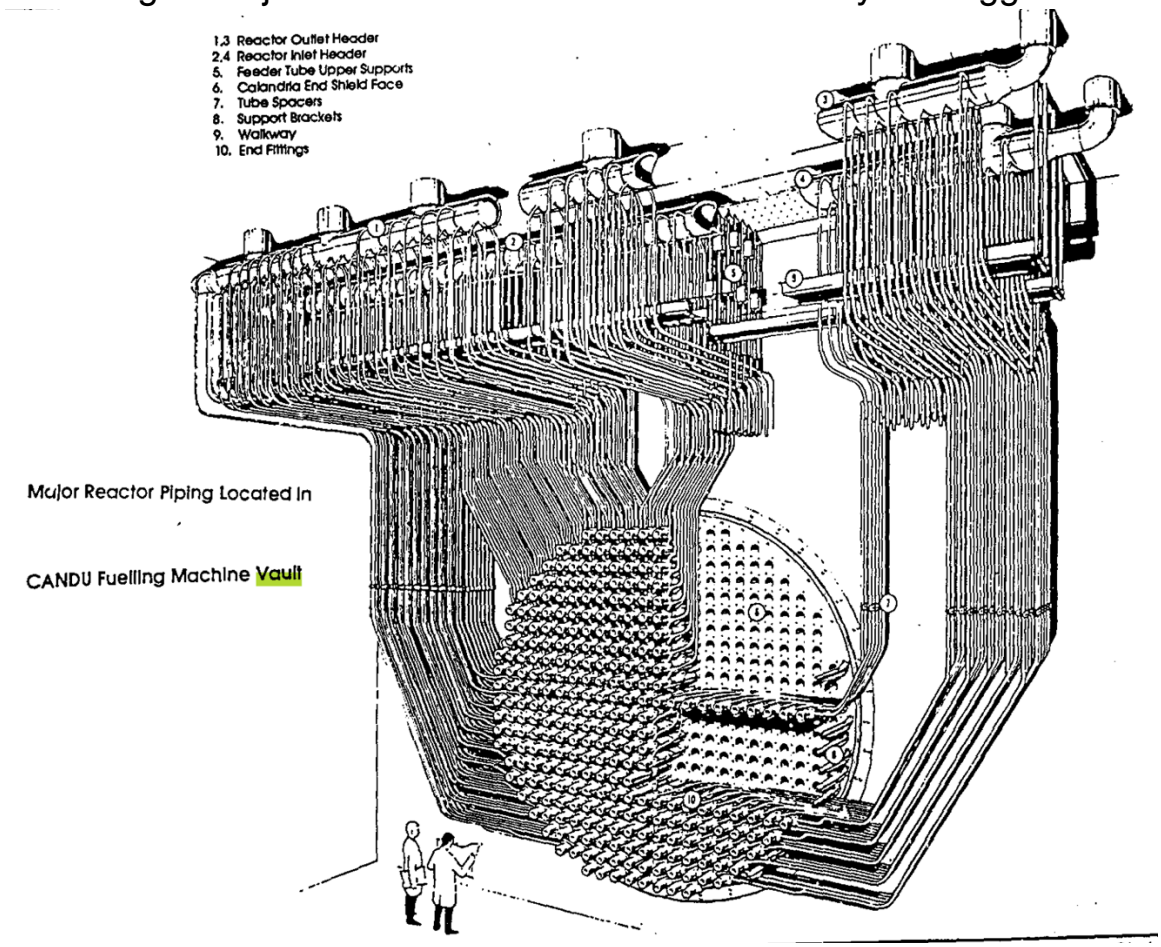
5.1 Cost Overruns

Between 2009 and 2012, Point Lepreau was refurbished at a cost initially estimated at $1.4 billion, but the actual expenditure turned out to be one billion dollars more, leaving NB Power at that time with a $4.6 billion debt.

If a similar cost over-run were seen during decommissioning, the estimated cost would double and the financial guarantee of $711 million would prove to be inadequate. According to the present Preliminary Decommissioning Plan (PDP), the estimated cost for the total decommissioning of the Point Lepreau reactor is $1.08 billion (Table 4, PDP Appendix A).

To date, no large CANDU reactor has ever been completely dismantled. Until the first dismantlement is completed we will not know exactly what to expect in the way of costs. The CANDU core area (see drawing) is much

more complicated than the cores of other reactors. That, and the limitations on worker exposures, makes dismantling a CANDU reactor a slow, difficult, and dangerous job. Contaminated airborne dust may not trigger alarms.



The CANDU core, with 380 individual fuel channels and 760 contaminated feeder pipes, is geometrically complicated, making it hard for workers to avoid spreading contamination while cutting the pipes apart.

Figure 2. The complicated geometry of a CANDU core

5.2 Radioactive Contamination

In 2009, some 500 tradesmen working on the refurbishment of the Bruce Unit 1 reactor inhaled plutonium- and americium-contaminated radioactive dust (emanating from contaminated feeder pipes) for a period of two and a half weeks, due to lack of proper alpha radiation monitoring. The workers had been told they did not need to wear respirators or other protective gear in that space at that time. The radioactive material they inhaled is not soluble and will remain in their lungs for a long time. Such dust will also be present in the Lepreau reactor pipes during decommissioning. Those alpha emitters have very long half-lives, measured in centuries and millennia. Such considerations

can add considerably to the cost of decommissioning. The necessary monitoring slows things down and costs a bundle.

On an earlier occasion, workers at the Pickering plant carried radioactive carbon-14 dust out of the plant and to their homes for a considerable period of time due to inadequate beta radiation monitoring. Some of these workers contaminated furniture and bedclothes in their homes that had to be subsequently confiscated by the authorities as radioactive waste material.

Unlike highly penetrating gamma radiation, which is easily detected with a Geiger counter, alpha and beta radiation can be notoriously difficult to detect and may pass through regular radiation monitors without triggering an alarm. Such hazards will also exist during decommissioning work.

Special precautions will have to be taken during decommissioning to prevent this very fine radioactive dust from spreading into the environment, whether air-borne or water-borne, and to prevent such dust from contaminating clothes and equipment. It all costs money.

5.3 Underestimating the Costs

As previously remarked, there is no experience with the complete dismantling of a CANDU reactor, and so any cost estimates are necessarily speculative, However there are CANDU reactors that have been shut down for over 40 years and could be dismantled at any time if the decision is made to do so. These include the Gentilly-1 reactor at Bécancour Quebec, and the Douglas Point reactor at Kincardine Ontario, There are also two larger Pickering A reactors just east of Toronto that have been closed for 25 years. With a shorter licence, the Commissioners will have an opportunity to relate the decommissioning cost estimates to actual experience.

The Nuclear Energy Agency of the OECD (to which Canada belongs) has published a large and detailed report entitled “Costs of Decommissioning Nuclear Power Plants” (**2016, NEA No. 7201, NUCLEAR ENERGY AGENCY**) based on estimates and decommissioning experiences in a variety of countries. The overall conclusions regarding the cost of decommissioning are summarized in the following table, where all cost figures are expressed in 2011 euros.

Table 8.4: ISDC structure of the principal activities considered for cost estimates

Cost item	Cost group					
	Labour		Capital	Expenses	Contingency	Total
	hours	NCU EUR	NCU EUR			NCU EUR
01 Pre-decommissioning	N.A.	41 227 803	0	5 798 786	89 412	47 116 001
02 Facility shutdown	N.A.	16 346 779	32 069 318	11 149 824	397 685	59 963 607
03 Additional activities for safe enclosure and entombment	N.A.	0	0	0	0	0
04 Dismantling activities within the controlled area	N.A.	73 902 174	21 311 707	26 341 346	23 884 298	145 439 526
05 Waste processing, storage and disposal	N.A.	171 182 411	49 360 370	59 082 462	47 027 477	326 652 720
06 Site infrastructure and operation	N.A.	47 442 393	12 262 440	85 176 458	1 548 742	146 430 033
07 Conventional dismantling demolition and site restoration	N.A.	78 482 682	2 390 044	94 877 535	11 494 035	187 244 295
08 Project management, engineering and site support	N.A.	124 751 999	1 577 450	44 956 239	11 965 668	183 251 357
09 Research and development	N.A.	0	0	0	0	0
10 Fuel and nuclear material	N.A.	322 861	5 566 580	21 568 521	0	27 457 962
11 Miscellaneous expenditures	N.A.	0	0	17 740 093	0	17 740 093
Total		553 659 104	124 537 910	366 691 264	96 407 316	1 141 295 594

Figure 3. Decommissioning costs as estimated by OECD-NEA

The bottom line cost of 1.141 billion euros, expressed in 2011 EU currency, translates to about $1.83 billion, expressed in 2022 Canadian currency. That's two and a half times larger than the financial guarantee that the Commissioners are being asked to approve in the present hearings.

Note one of the details in this NEA cost breakdown. The cost of "waste processing, storage and disposal" is a full 28 percent of the total decommissioning cost, whereas the Point Lepreau PDP [Annex A] assigns only 5.6 percent of overall cost to radioactive waste. That's exactly five times less than the percentage found by the Nuclear Energy Agency. If the PDP waste estimate is multiplied by 5 to bring it into line with the NEA

report, we would have to add an extra $240 million to the financial guarantee – a 33% increase. If we adjust the PDP cost figure to align with the NEA estimate, we would have to add an extra $452 million to the financial guarantee – an increase of more than 63%.

5.4 Siting a Repository

In the mid 1980s, the Government of Canada tried to make good on a promise made to the town of Port Hope Ontario. The government promised to remove from the town a large volume of radioactive waste, most of it low-level but potentially dangerous, that had been carelessly dumped in ravines, in the harbor, on a public beach, and in the building materials used to construct hundreds of buildings, necessitating extensive remediation.

A federal agency was established, called the Siting Task Force, to find a willing host community somewhere in Ontario that might be willing to receive the Port Hope wastes for state-of-the-art safe disposal in geological formations that were considered suitable for the task. An environmental Assessment Panel had warned that the Port Hope area was not ideal to safely contain the long-lived radioactive waste materials due to a number of factors including proximity to Lake Ontario, rapid erosion of the shore, and an unsatisfactory geological foundation to support a permanent waste repository.

After eight years of effort and millions of dollars in expenditure, the Task Force came up empty handed. No other community could be found to take the wastes. As a result, Port Hope is now undergoing a $1.2 billion cleanup to consolidate the wastes in a gigantic above-ground engineered mound that is designed to last for about 500 years. The mound is not considered a permanent solution, but it is unclear what will be done as a sequel.

More recently, the Nuclear Waste Management Organization has spent more than ten years trying to find a willing host community somewhere in Ontario to host all of Canada's high-level radioactive waste, which would include the irradiated nuclear fuel from the Point Lepreau reactor. It is still unclear whether NWMO may also possibly come up empty-handed, as the number of candidate sites has been narrowed down from an original 22 sites to only 2. NWMO hopes to be able to announce that they have successfully identified a site by next year, but there are no guarantees.

Experience has shown that choosing a site for the permanent disposal of long-lived radioactive waste is not an easy matter. It takes time, money and a lot of patience. The costs are not insignificant; NWMO has disbursed many millions of dollars along the way.

An earlier repository site, chosen by Ontario Power Generation (OPG) to host a Deep Geological Repository (DGR) for the low-level and intermediate-level radioactive wastes from its own fleet of nuclear power reactors, was cancelled after almost fifteen years of effort because the Saugeen Ojibway First Nation – on whose unceded territory the repository was to be located – voted overwhelmingly against allowing it on their ancestral territory.

Locating a Waste Facility is not an easy task, and if NB Power expects to have one available by the time Point Lepreau is decommissioned (as they clearly indicate in their justification for delaying the decommissioning of the reactor earlier) they are already late in starting. There is no repository site anywhere in Canada that is willing or able to accept decommissioning wastes at the present time. Moreover, the management and disposal of decommissioning wastes is not a federal responsibility, but a provincial one. Hopefully, CNSC Commissioners can help to put pressure on NB Power to do the necessary work to find a site and construct a repository before the money set aside for decommissioning has all been spent. Experience suggests that the search for a site should be a distinct line item in the PDP and should be clearly reflected in the financial guarantee.

5.5 Coping with Longevity

All industries have waste of one kind or another, but the nuclear industry is the only one that creates significant amounts of new radiologically toxic elements during normal operation.

A radioactive element is made up of atoms that are unstable. Such an unstable atom will suddenly disintegrate, giving off subatomic projectiles (called “atomic radiation”) that are damaging to nearby living cells. Chronic exposure to such radioactive emissions can result in an increased incidence of cancer, leukemia and genetic damage among those so exposed. Unnecessary exposure is to be avoided if possible, and minimized otherwise.

The most intense accumulation of new radioactive elements is in the used fuel bundles themselves. Cracks or leaks in the outer coating of the fuel can spread radioactive contamination throughout the reactor, especially in the primary cooling system.

The half-life of a radioactive element is the time it takes for half of its unstable atoms to disintegrate. Some radioactive elements are so short-lived they disappear in the blink of an eye. Others remain radioactive for centuries or even millennia.

Radioactivity is a form of nuclear energy that cannot be turned off; that's why we have a radioactive waste problem. Since most engineered structures are in danger of cracking or crumbling or falling apart eventually, the safe isolation of very long-lived radioactive materials is extremely challenging. This is especially so in the case of used nuclear fuel.

In the core area of a nuclear reactor, structural materials can also become intensely radioactive as a result of "activation". Activation turns non-radioactive atoms into radioactive ones, and we do not know how to turn them back again.

For example, non-radioactive cobalt-59 atoms are transformed into radioactive cobalt-60 atoms. Non-radioactive hydrogen atoms become radioactive tritium atoms. Non-radioactive oxygen-17 atoms become radioactive carbon-14 atoms.

And each of these radioactive activation products has a different half-life: for cobalt-60, it is 5.3 years; for tritium, it is 12.3 years; for carbon-14, it is 5,700 years.

Due to a combination of activation and radioactive contamination, many of the structural materials in a nuclear reactor, especially in the core area of the reactor and the primary cooling system, become very long-lived radioactive wastes. Such materials cannot normally be recycled for any other commercial use, they have to be isolated from the environment forever.

As a result of activation, a single pressure tube taken from the core of a CANDU reactor immediately after shutdown can give a lethal dose of

radiation in half an hour to an unshielded human being in close contact with it (850 rems per hour). The unshielded calandria vessel can give a lethal dose in half a minute (49,000 rems per hour). The thermal shield can do the same in 5.5 seconds (260,000 rems per hour). These data are taken from the Pickering Preliminary Nuclear Decommissioning Cost Study. No such information is to be found in the Point Lepreau PDP.

These extremely high levels of radiation die down over the years, making it much safer for workers to deal with the materials – but they are still quite dangerous even after decades have gone by. Inhaling or ingesting tiny amounts of radioactive materials, or becoming contaminated with radioactive dust, can still endanger life as these radioactive elements become “internal emitters”, sometimes absorbed or lodged in bodily organs.

Here are some activation products, listed with their half-lives, that can make decommissioning wastes dangerous even after thousands of years:

carbon-14	5,700 years
calcium-41	102,000 years
chlorine-36	301,000 years
nickel-59	76,000 years
nickel-53	101,000 years
nionium-94	29,300 years

In cases when there are no activation products created directly in a structural component, radioactive contamination can still make it a “forever” problem. For example, look at the radionuclides that accumulate in the thousands of narrow little tubes inside the steam generators, quite far away from the core of the reactor where all these radioactive elements are created.

Over 90 percent of the mass of radioactive material accumulating in the steam generator pipes is plutonium – five varieties of plutonium – a highly toxic material created inside the solid ceramic fuel pellets. Somehow, these plutonium isotopes manage to escape from the fuel pellets into the primary cooling water and are carried through the pipes right into the heart of the steam generators. Plutonium-239 has a half-life of 24,000 years. Note there are 6 other nuclides in the list with half-lives more than 10,000 years.

Plutonium in the Bruce "A" nuclear steam generators

Here is a partial list of radioactive contaminants inside a single used steam generator from each one of the two reactors (Units 1 and 2 of Bruce A), according to CNSC (document CMD-10-H19B). The mass (in grams) of each of the radioactive materials listed is estimated by CNSC staff.

RADIONUCLIDE		***MASS***	
Name of Isotope (with Atomic Mass)	Half-Life (years)	Unit 1 (grams radioactive material)	Unit 2 (grams radioactive material)
Americium-241	430 y	0.103412	0.102412
Americium-243	7 400 y	0.002162	0.002432
Carbon-14	5 700 y	0.009065	0.072501
Curium-244	18 y	0.002644	0/000347
Cobalt-60	5.3 y	0.001781	0/000881
Cesium-137	30 y	0/000249	0.000238
Europium-154	8.8 y	0.000027	0.000290
Iron-55	2.7 y	0.000272	0.000290
Hydrogen-3 (Tritium)	13.0 y	0.000057	0.000051
Hafnium-181	2.7 y	0.000001	0.000001
Iodine-129	17 000 000 y	0.000060	0.000060
Niobium-94	20 000 y	0.002159	0.002158
Nickel-59	75 000 y	0.173601	0.036723
Nickel-63	96 y	0.030194	0.006526
Neptunium-237	2 100 000 y	0.028703	0.033295
Plutonium-238	*88 y*	*0.007507*	*0.004703*
Plutonium-239	*24 000 y*	*2.124977*	*2.471769*
Plutonium-240	*6 500 y*	*0.827304*	*0.957105*
Plutonium-241	*14 y*	*0.021309*	*0.030809*
Plutonium-242	*380 000 y*	*0.048762*	*0.056317*
Antimony-125	2.8 y	0.000001	0.000001
Strontium-90	29 y	0.009097	0.007581
Technetium-99	210 000 y	0.000143	0.000092
TOTALS			
Long-lived (> one year half-life)		**3.416108**	**3.787315**
Mass of plutonium isotopes only		**3.029859**	**3.520703**
Percent plutonium		**88.7%**	**93.0%**
TOTAL MASS		*(Source: CNSC)*	

There are 5 plutonium isotopes present in the steam generators. In addition there are 18 other long-lived isotopes listed.

In the 16 Bruce A steam generators (8 from Unit 1 and 8 from Unit 2), the total mass of radioactive material is estimated to be about 57.6 grams, of which 52.4 grams is plutonium. So plutonium makes up 91.0 percent of the mass of radioactive material in the steam generators.

Plutonium is extremely dangerous even in minute quantities. The maximum permissible "body burden" of plutonium-239 for an atomic worker (for instance, someone working in the nuclear weapons industry) is 0.7 micrograms. Inside the steam generators there are 36.8 grams of this one particular isotope – enough, in principle, to give over 52 million atomic workers their maximum permissible body burden of plutonium-239. If we include all five isotopes of plutonium, the number of atomic workers who could be overdosed, in principle, is just about doubled.

Plutonium isotopes also have very long half-lives, ranging from decades to hundreds of thousands of years. This means that any accident which resulted in a spill could pose long-lasting dangers.

- Gordon Edwards, Ph.D., November 8, 2010

Figure 4. Radioactive contamination of steam generators

This cutaway diagram gives you an idea of what the “tube bundle” inside a steam generator looks like. (It is not a CANDU steam generator, but it is quite similar.)

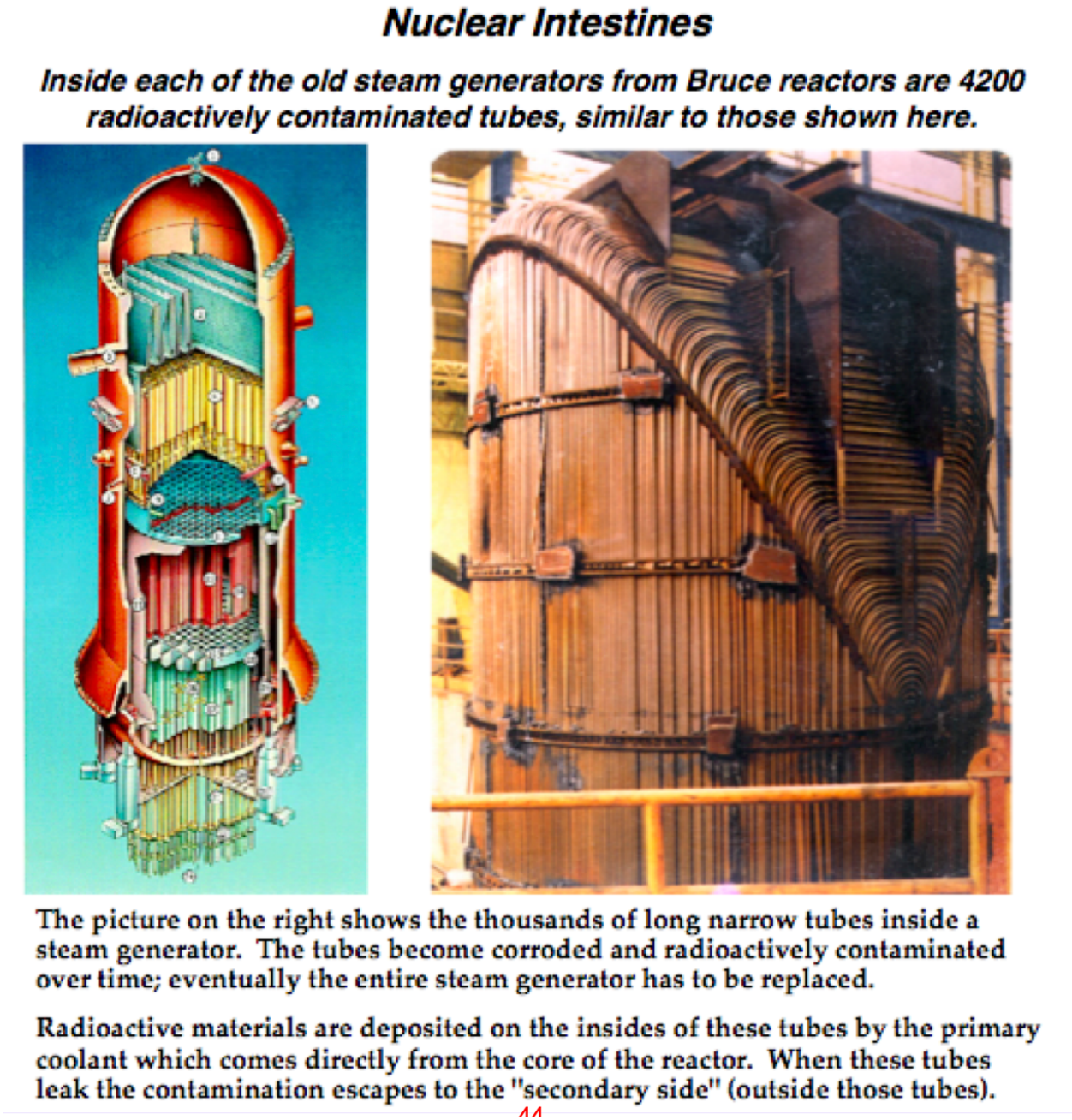


Figure 5. The inner “tube bundle” of a steam generator

The important thing for everyone to realize is that all of this voluminous material, weighing thousands of tonnes, has become long-lived radioactive waste that will remain problematic for many thousands of years.

Does NB Power have the resources, the expertise and the determination to keep these radioactive poisons out of the biosphere for hundreds of thousands of years? Do the Commissioners have the sagacity to insist that the financial guarantee be commensurate with the challenge? Many believe that the perpetual sequestration of radioactive wastes is one of the major unsolved problems of the human race. We cannot afford to cut corners.

5.6 Mobility of Radionuclides

Everybody knows about vacuum cleaner bags. They end up being the dirtiest things in the room, by far. Air filters also become clogged up, rendering them no longer useful. In nuclear plants, gelatinous materials called “ion exchange resins” are used to filter out the radionuclides that keep leaking into the various aqueous reservoirs, such as the spent fuel pools, the moderator circuit, the primary and secondary cooling circuits, and so forth.

It turns out that spent ion-exchange resins are among the most fiercely radioactive items in the intermediate-level waste category.

In an on-line Q&A session entitled “Responses to Questions Raised from Peer Review of Canada’s Fifth National Report for the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management”* (see link below), CNSC states the following:

“Spent ion exchange resin represents more than one half of OPG’s intermediate-level radioactive waste category at OPG’s generating stations. The resins in storage tanks are not routinely agitated or fluidized and are kept fully submerged, as operating experience has indicated that carbon-14 emissions . . . increase if the resins are exposed to air while in the moist state. OPG does measure . . . airborne carbon-14 release when resin is slurried from the tanks into shipping containers.”

https://nuclearsafety.gc.ca/pubs_catalogue/uploads/Responses-to-Questions-Fifth-Report-Joint-Convention-Safety-of-Spent-Fuel-Management-and-Safety-of-Radioactive-Waste.pdf

Of all the power reactors in use around the world, CANDU reactors create the most tritium (radioactive hydrogen) and the most carbon-14 (radioactive carbon). In both cases it is because of the use of a large volume of “heavy water” as a moderator.

In heavy water, the hydrogen atoms in the H_2O molecules are replaced by non-radioactive “heavy hydrogen”, also known as deuterium. In addition, some of the normal oxygen-16 atoms are replaced by non-radioactive “heavy oxygen”, oxygen-17.

When a deuterium atom absorbs a stray neutron it gets even heavier, and it becomes unstable. It has been “activated” and is now a radioactive form of hydrogen called tritium. Tritium atoms are three times as heavy as normal hydrogen atoms. CANDU reactors produce at least 30 times more tritium than light-water reactors, and a lot of the tritium escapes into the environment in a gaseous form (as radioactive water vapour) or as a liquid effluent. (radioactive water). The “tritiated” vapour turns into radioactive rain or radioactive snow which falls out on the ground below.

In a similar way, when an oxygen-17 atom absorbs a stray neutron it is transformed a radioactive atom of carbon-14. Since heavy water has an unusually high concentration of oxygen-17 to start with, CANDU reactors produce a lot more carbon-14 than other reactor types.

Tritium and carbon-14 have some important similarities. They each give off a form of atomic radiation that is difficult to detect but nevertheless is harmful inside the body. They are radioactive versions of ordinary hydrogen and non-radioactive carbon, which are the basic building blocks of all organic molecules, including DNA molecules. As such they pose biological dangers that are unique, and they can both become “organically bound”. They are both very mobile in the environment and can be given off in gaseous form as radioactive water vapour or radioactive carbon dioxide or carbon monoxide. They both have relatively long half-lives – 12.3 years for tritium and 5,700 years for carbon-14 – which allows them to persist and accumulate in the environment. Moreover, since there are few if any containers that can be counted on to contain a radioactive gas for thousands of years, it is inadvisable for intermediate-level waste such as spent ion exchange resins to be stored on the surface or very near the surface.

However, if NB Power is unable to construct a robust radioactive waste containment facility, which will undoubtedly be costly, the decommissioning wastes from Point Lepreau – including the ion exchange resins – may be stored on site in an above ground or near surface facility that is in effect an

engineered radioactive dump. This will turn the traditional Indigenous territories in question into a permanent radioactive waste site, with chronic leakage of carbon-14 and other long-lived radionuclides that are environmentally mobile into the local air, food and water supplies.

If the CNSC Commissioners take steps to shorten the licence period to no more than three years and determine to actively pursue the adequacy of decommissioning waste management for the very long term, insisting on a financial guarantee that will permit the licensee to do not just a minimal job but a superb job, everyone will be the better for it. Because such decision affect the health and safety of future generations and the integrity of the local environment, such decisions should not be left to the discretion of CNSC staff, but should be borne by the Commissioners themselves. They are the appointed decision makers under the law.

5.7 Contaminated Soil

Because of the use of large volumes of deuterium oxide (D2O, or “heavy water”) as both moderator and coolant, CANDU reactors generate and release large amounts of tritium. Because tritium is chemically identical to ordinary hydrogen, tritiated water is also chemically identical to ordinary water. As such, tritium is notoriously difficult to contain.

As tritiated water cannot be easily separated from ordinary water, it routinely escapes into the environment in both aqueous effluents and as water vapour or steam. Tritium emissions from CANDU reactors are much greater than from any other kind of commercial reactor, in the order of 100 trillion becquerels per year per unit.

The significantly increased concentration of tritium in Lake Ontario compared with that in Lake Superior is almost entirely due to tritium emissions from reactors at Pickering, Darlington and Bruce.

After complete decommissioning of a CANDU power station, once the used fuel and heavy water has been safely packaged and securely stored in leak-proof containers, there remains a significant source term of tritium contamination in the groundwater and soil beneath the plant’s foundations.

Unfortunately there is no data readily available on this matter for Point Lepreau, but in the case of the Pickering plant, the underground tritium source term is estimated to be several quadrillion becquerels – disregarding other radioactive contaminants that may also be there.

Dr. Frank Greening, who worked for 23 years in the Ontario nuclear industry, and who once headed the Ontario Hydro Radioanalytic Laboratory, has kindly provided me with some figures (see the latter portion of Annex C).

Measurements of groundwater samples taken from beneath the Pickering Nuclear Generating Station indicate an average tritium concentration of more than 8 million becquerels per litre (Bq/L) – far in excess of the Canadian regulatory limit of 3 million Bq/L for non-potable water.

This radioactive water (tritiated water) is chemically identical to ordinary water and will be available to enter Lake Ontario for centuries to come if not removed. Tritium is a highly mobile contaminant that enters freely into all living things and, indeed, into all organic molecules, including DNA.

The total inventory of tritium in the groundwater beneath the Pickering plant is conservatively estimated by Dr. Greening at two and a half quadrillion becquerels: 2.5 x 10^15 Bq of tritium. (Annex C). That's enough to render 315 trillion litres of water undrinkable using the existing Canadian standard for tritum in drinking water, 7000 Brecquierels per litre.

315 trillion litres is about 2/3 the volume of water in Lake Erie.

As part of the decommissioning plan for Point Lepreau, the extent of soil contamination underneath the plant should be assayed, and plans be made to excavate the contaminated soil as part of the decommissioning activity.

Report by Gordon Edwards for the Passamaquoddy Recognition Group Inc., March 30 2022

ANNEX A

9. DECOMMISSIONING COST ESTIMATE

TLG prepared the original decommissioning assessment for Point Lepreau in 2000 (Ref. 9) and updated this estimate in 2005 (Ref. 10), 2010 (Ref. 11), 2015 (Ref. 12) and most recently in 2020 (Ref. 8). The purpose of these analyses was to provide New Brunswick Power (NBP) with sufficient information to assess its financial obligations as they pertain to the eventual decommissioning of the Point Lepreau Nuclear Generating Station. The TLG analysis provided a scenario-dependent cost estimate prepared in advance of the detailed engineering preparations required to carry out the decommissioning of Point Lepreau. The decommissioning strategy assumed by TLG for this cost estimate is in agreement with the Deferred Removal strategy presented and described within this PDP.

The decommissioning activities are performed in accordance with current regulations that are assumed still in place at the time of decommissioning. Changes in current regulations may have a cost impact on decommissioning. The cost estimate includes activities and costs necessary to manage the decommissioning in accordance with the requirements of CSA Standard N286-12 (Ref. 13) and includes necessary activities identified in CSA N294-09 “Decommissioning of Facilities Containing Nuclear Substances.” (Ref. 14)

The total projected cost, in thousands of year 2019 Canadian dollars, to decommission the Point Lepreau facility is estimated to be $1,083.1 million . This cost reflects site specific features of the station, NBP-specific conditions, the local cost of labor, and projected future costs for radioactive waste disposal. Summaries of the major activities contributing to the total cost are provided in Table 4. The anticipated annual costs are provided in Table 5. All costs in both tables include appropriate levels of contingency.

This decommissioning cost is based on the acceptance and transfer of all Point Lepreau irradiated fuel at a Canadian national repository no later than the year 2067. Following the transfer, radiological remediation will be initiated.

The TLG decommissioning cost analysis for Point Lepreau was based upon current regulatory and technical requirements and their present-day costs, available technologies, and current decommissioning philosophies. Program management (Utility and DOC) including management, engineering, specialists, technicians, and clerical represent the majority of the costs to decommission the Point Lepreau Station. These costs, which include the plant staff, are incurred at varying levels throughout the project, from shutdown through transition, safe-storage, and final dismantling. The next largest component is associated with the direct labor, equipment, and radioactive waste management costs associated with decontamination and dismantling the station.

Security is another substantial contributor to the overall project costs. These costs are also incurred throughout the decommissioning project, with annual staff and cost reductions as the reactor is defueled, and as spent fuel is transferred from wet to dry storage. Most of these costs are a direct result of the labor-intensive nature of the decommissioning process, as well as the required management controls needed to ensure a safe and successful decommissioning program.

Radioactive waste disposal rates projected are indicative of the life-cycle expenses incurred in siting, developing, and licensing new disposal facilities, and then operating and maintaining them. Packaging and transportation costs are sensitive to the waste volume generated in the D&D process, transportation regulations and fees, and the final destination location (i.e., distance to the disposal site).

The removal costs for systems, components, and structures are primarily driven by the cost of labor. These costs reflect composite “craft” labor costs for Point Lepreau, as supplied by NBP. Materials and consumables associated with removal activities were included using representative costs for the region. Selected special materials or equipment required for the decommissioning were assumed to originate in the U.S. and reflect appropriate currency conversions. Productivity adjustments were applied to activity durations, based on the anticipated working conditions for each particular station area or major component.

There are many “Other” costs that are projected to be incurred during decommissioning and significantly impact the estimate. These include property taxes, insurance, corporate overhead and shared services, regulatory and emergency responder costs or fees, energy, contracted engineering, and extensive surveys to ensure the decommissioning meets the defined station release criteria. Costs such as property taxes, corporate overhead and shared services and emergency responder costs or fees were provided by NBP and incorporated directly into the estimate. Other costs such as insurance, regulatory costs and fees, and energy were based on existing operational data, with adjustments made in annual costs to reflect changes in the plant configuration as the decommissioning project progresses.

10. FINANCIAL GUARANTEE ARRANGEMENTS

The initial decommissioning financial guarantee was provided to the CNSC by NBP in July of 2003. The guarantee will be revised as a result of the 2020 decommissioning cost update and reported to the CNSC under the current PROL Condition G.5.

TABLE 4 : SUMMARY OF DECOMMISSIONING COSTS (Ref. 8)

Cost Elements	Costs 2019$ CAD (thousands)	Percent of Total Cost
Decontamination	11,337	1.0
Removal	91,900	8.5
Packaging	22,293	2.1
Shipping	34,623	3.2
Waste Disposal	60,858	5.6
Property Taxes	79,321	7.3
Insurance	35,684	3.3
Regulatory and Enviromental Fees	18,060	1.7
Emergency Response Fees	19,808	1.8
Emergency Response Fee (CSIS)	8,342	0.8
Spent Fuel Pool O&M	5,795	0.5
SRWMF and Dry Fuel Storage O&M	7,946	0.7
Plant energy budget	30,877	2.9
Contract Engineering	20,311	1.9
Security	139,085	12.8
Program Management (Utility)	123,112	11.4
Program Management (DOC)	69,915	6.5
Corporate Overhead & Shared Services	34,767	3.2
Characterization	4,250	0.4
Independent Verification	13,357	1.2
Remedial action surveys	3,123	0.3
Spent Resin Volume Reduction	14,600	1.3
Liquid Radwaste Processing Equipment/Services	1,720	0.2
Isolate Spent Fuel Pool Systems	12,325	1.1
Equipment (not accounted for under the "Decontamination" or "Removal" cost categories)	19,376	1.8
NBP Emergency Response Team	40,855	3.8
Contingency	159,489	14.7
Total[1]	1,083,130	100.0

1. Columns may not add due to rounding

To whom it may concern:

Please accept this email as an intervention concerning the CNSC's REGDOC-2.11.2, entitled *Decommissioning*, issued July 2019. I wish to thank the CNSC for providing an opportunity for interested parties to contribute to the debate on the vitally important issue of nuclear power plant (NPP) decommissioning.

Having reviewed the 20 or so pages of text that constitute the issues addressed by REGDOC-2.11.2, my first reaction is that the document as it now stands is of little practical value to a reactor owner/operator wishing to decommission a nuclear facility, largely because of its non-prescriptive approach. Nevertheless, in looking at the interventions that have already been submitted to the CNSC with regard to REGDOC-2.11.2, it appears that there are essentially *three* approaches to NPP decommissioning that need to be considered:

(i) Immediate dismantling of the facility
(ii) Delayed or deferred dismantling of the facility for periods up to 50 years
(iii) Entombment of the facility

Generally speaking, option (i) is favored by environmentalists, while options (ii) and (iii) are favored by NPP owner/operators. However, it is worth noting that the International Atomic Energy Agency, the IAEA, has tacitly rejected option (iii), facility entombment, as a viable approach to decommissioning. Thus, in the IAEA document entitled: *Decommissioning of Facilities,* General Safety Requirements Part 6, GSR Part 6, issued in 2014, we read:

Entombment, in which all or part of the facility is encased in a structurally long-lived material, is not considered a decommissioning strategy and is not an option in the case of planned permanent shutdown. It may be considered a solution only under exceptional circumstances (e.g., following a severe accident).

The rationale behind this opinion from the IAEA will not be discussed in this intervention. Therefore, we shall restrict our evaluation of decommissioning strategies to the relative *pros and cons* of options (i) and (ii): immediate dismantling and delayed dismantling, respectively.

1a. Immediate Dismantling, Pros:

The main positive attribute of Immediate Dismantling of an NPP as a decommissioning strategy is that it fast-tracks the removal/disposal of something that has served its design purpose and is no longer capable of further safe, reliable operation. In this "no longer of any use" state, a shutdown nuclear facility is universally regarded as an eyesore – a structure that despoils a potentially pleasant landscape, and therefore something that should be removed as quickly and as efficiently as possible.

In this regard, most people consider a shutdown nuclear reactor as something akin to an old car that sits abandoned on a downtown lot. And to continue this analogy, environmentalists dream of this old car being towed away to a scrap yard with a minimum of fuss, and the lot converted into a park or children's playground – the ideal *green field* final state for a former nuclear site.

1b. Immediate Dismantling, Cons:

A preference for, and the positive picture painted by many environmentalists of the immediate dismantlement of an NPP, needs to be tempered by the fact that the radiation fields emanating from a nuclear reactor are at their *maximum* immediately after reactor shutdown, even if these fields decay at a predictable rate thereafter. Thus, delayed dismantlement is a simple way to reduce reactor shutdown radiation fields to more acceptable levels and thereby reduce the radiation exposure of workers assigned to tasks requiring close proximity to a reactor's core, where the fields are very, and frequently unacceptably high.

It is tempting to estimate the radiation doses expected for workers involved in a CANDU *decommissioning* by referring to the known doses for workers involved in reactor *refurbishments* such as those that have been successfully carried out on Units 1 & 2 at Bruce A. However, the dismantlement of a CANDU reactor involves cutting up *reactor core components* that are much more radioactive than the pressure tubes, calandria tubes and feeder pipes that constitute the main radioactive wastes associated with CANDU refurbishments.

Thus, the radiation field emanating from removed pressure tubes is about 800 rem/hr – which, in the absence of shielding, will give a lethal dose to an exposed individual in less than 30 minutes; by comparison, the radiation fields coming off reactor core components such as the thermal shield, calandria shell and dump tank are 260,000 rem/hr, 49,000 rem/hr and 12,000 rem/hr, respectively. These are truly dangerous radiation fields that are lethal in less than 1 minute of exposure and are impractical to shield!

The predicted radioactivity of such CANDU core components is described in detail in OPG's *Preliminary Nuclear Decommissioning Cost Study*, issued in 1981. For the present discussion, Co-60 is the most important radionuclide since it is the principal gamma-emitter in the decommissioning waste for a mature reactor, at least for the first 50 years or so after reactor shutdown. Thus, in Table 5-4 of OPG's 1981 report we find estimates of the Pickering A shutdown activity of Co-60 in components of interest as follows:

Pressure Tubes = 3,300 TBq
Calandria Tubes = 1,200 TBq
End Fittings = 19,000 TBq

This gives the total Co-60 activity of Pickering A's <u>*refurbishment waste*</u> at shutdown of 23,500 TBq.

By comparison, OPG's 2016 prediction of the Co-60 shutdown activity of Pickering A, (See *Preliminary Decommissioning Plan – Pickering Generating Stations A & B*), is 75,000 TBq, or about 3 times the refurbishment waste activity.

Fortunately, Table 5-4 of OPG's 1981 *Decommissioning Cost Study* also provides estimates of the Pickering A shutdown activity of Co-60 for the major core components as follows:

Calandria Shell = 37,000 TBq
Thermal Shield = 19,000 TBq
Calandria Tube-sheet = 8,500 TBq
Containment Shell = 4,100 TBq
Adjuster Rod Guide Tube = 520 TBq
Shutoff Rod Guide Tubes = 410 TBq
Moderator Dump Tank = 3000 TBq

This gives a total Co-60 activity of Pickering A's *decommissioning waste* of 72,530 TBq, as noted above, or about 3 times the refurbishment waste activity of 23,500 TBq also noted above. As described below, these activities, and the associated doses to decommissioning workers, may be significantly reduced by allowing time for radioactive decay.

2a. Deferred Dismantling, Pros:

The main reason to defer the decommissioning of a CANDU reactor is to allow the shutdown activity to decay to acceptable levels. As previously noted, Co-60, with a half-life of 5.27 years, is the main activity responsible for over 90% of the reactor's radiation field at shutdown. For this reason, decay periods measured in tens of years are required to achieve significant reductions in the radiation fields, as shown in Table 1 below.

Table 1: Decay of Cobalt-60 as a Function of Time

Decay Period	(Years After Shutdown)					
	0	10	20	30	40	50
Decay Factor	1	0.269	0.072	0.019	0.0052	0.0014

From Table 1 we see that a decay of 50 years reduces a Co-60 radiation field to a mere 0.14 % of its shutdown activity. Such a means of dose reduction is in line with the ALARA (As Low As Reasonably Achievable), principle of radiation protection by reducing a worker's dose commitment from decommissioning activities to an acceptable level.

2b. Deferred Dismantling, Cons:

The main disadvantage of deferring the dismantlement of an NPP, apart from the public's perception of a problem left unresolved, is that the facility has to be monitored on a 24-hour/7-days-a-week basis for an extended period of time – potentially up to 50 years. However, this monitoring, and the associated staffing of the facility, will be far less than the staffing that would be required for a normally operating facility.

Discussion:

So far in this intervention the radio-activation of an NPP's physical structure has been considered as the only radiological factor of concern in the dismantlement of the facility. However, in the case of Pickering NGS, and to a lesser extent Bruce NGS, tritium that has escaped from containment and entered the local aquifer is a very significant issue that must be dispositioned, especially if the ultimate goal of the decommissioning is to return these facilities to a green-field state. For this reason, we shall review what is known about the extent of this tritium escape problem with particular focus on Pickering NGS.

The main source of tritium in a CANDU reactor is the moderator system which typically contains about 300,000 kilograms of heavy water, or D_2O. Virgin D_2O contains no tritium, but tritium (as DTO) builds up in a moderator during reactor operation at an initial rate of about 2 Ci/kg per year; with a combination of decay and de-tritiation, an "equilibrium" state is attained whereby the reactor operates with about 10 Ci of tritium per kilogram of D_2O. Thus, a mature CANDU moderator contains 10 (Ci/kg) × 300,000 (kg) of tritium, which equals 3 million Curies or 1.11×10^{17} Bq of tritium.

In the early years of operation of the CANDU Units at Pickering and Bruce, heavy water leaks and spills were quite common, resulting in the following average leakage rates:

PNGS 'A' heavy water leakage rate (1978 estimate): 3.3 ± 0.2 kg/hour
PNGS 'A' heavy water spillage rate (1978 estimate): 8.5 ± 1.2 kg/hour

Total: 11.8 kg/hour

Total per year: $11.8 \times 24 \times 365 = 103{,}368$ kg

Bruce 'A' moderator heavy water leakage (1982): 0.48 kg/hr = 16,800 kg/year
Bruce 'A' PHTS (IX and filter room) leakage (1982): 0.50 kg/hr = 17,500 kg/year

However, during this period, most of the heavy water that leaked or was spilt was recovered. Thus, for PNGS 'A' Units, in comparison to the data given above, only 11,000 kg of heavy water per year was actually lost, about 50% via airborne and 50% by waterborne emissions. Similarly (in 1979), the Bruce 'A' heavy water loss was estimated to be 0.735 kg/hour per Unit. Thus, the total heavy water loss for four Bruce 'A' Units in 1979, (again about 50% via airborne and 50% by waterborne emissions), was equal to $0.735 \times 4 \times 24 \times 365$, or 25,754 kg/year.

Station condition records for the first decade of operation of Units at Pickering and Bruce show that accidental spills and unexpected leaks were quickly dealt with and contained. Furthermore, there is no evidence from that time period of any chronic escape of tritiated water from containment. However, in 1997, for the very first time, OPG acknowledged the presence of tritium in Pickering A groundwater samples. The samples in question were collected in monitoring wells and groundwater tubes located adjacent to the Heavy Water Upgrader Plant and the Auxiliary Irradiated Fuel Bay. In addition, in the year 2000, very high levels of tritium were observed to be leaking into the site groundwater via the Unit 1 moderator pit.

Between the years 2000 and 2005, highly elevated levels of tritium were identified in groundwater samples collected at various locations, both at PNGS A and at PNGS B. The samples listed below revealed just how serious groundwater contamination was at that time:

- PNGS A Unit1 moderator purification room pit had tritium concentrations up to 1.04×10^{10} Bq/L
- PNGS A & B foundation drain sumps had tritium concentrations up to 1.3×10^{5} Bq/L
- PNGS A reactor auxiliary bay sumps had tritium concentrations up to 1.9×10^{8} Bq/L
- PNGS B reactor auxiliary bay sumps had tritium concentrations up to 8.0×10^{6} Bq/L
- PNGS B irradiated fuel bay ground-tubes had tritium concentrations up to 4.0×10^{6} Bq/L

It is important to note that several of these samples show Pickering groundwater with contamination levels that are well above the CNSC limit of 3×10^{6} Bq/L for tritium in non-potable water, (See Footnote 1). Indeed, tritium concentration contour maps of the Pickering site measured between 2000 and 2003 show an area centered on Unit 1, Unit 2 and the Vacuum Building with a groundwater tritium concentration over 32,000,000 Bq/liter.

More recent data on Pickering groundwater samples show that Unit 1 foundation drains continue to exhibit very high levels of tritium, with concentrations as high as 1.19×10^{9} Bq/L measured as recently as the first quarter of 2018. Other Pickering site locations tend to show somewhat lower tritium activities but many sampling locations, (for example the Irradiated Fuel Bay between Units 2 and 3 and Monitoring Wells, (MWs), Nos 235-30, 239-30 and 273-20), have consistently exhibited tritium concentrations above the CNSC limit of 3×10^{6} Bq/L over the past ten years.

So, we need to ask: what is the impact of these elevated levels of tritium in Pickering's groundwater on the decommissioning of this site? OPG's position on this was made quite clear in its 2016 Report P-PLAN-00960-00001 entitled *Preliminary Decommissioning Plan – Pickering Generating Stations A & B*, where we read:

> *Localized areas of slightly elevated tritium concentrations are present in the groundwater located within the protected area of the Pickering site. The sources of these historical releases were identified by previous assessments and subsequently eliminated through procedural and/or operational changes, with steps taken to mitigate the risk of future releases. Previous Environmental Assessments (EAs) indicate that tritium concentrations are not migrating off-site and that no effects result from the tritium in groundwater on biota are likely. The groundwater monitoring program will continue to track, monitor, and report on the groundwater quality on site.*

Furthermore, at the CNSC Licence Renewal Hearing for OPG's Pickering Nuclear Generating Station, held on April 4th 2018, the Commission concluded:

> *Tritium in groundwater is mainly localized within the station's Protected Area. The foundation drains act as hydraulic sinks that capture most of the tritium plumes in the groundwater. The groundwater monitoring program results confirmed the site perimeter concentrations remain low, indicating no off-site impacts.*

Thus, we have statements by OPG and the CNSC that make two significant claims:

(i) OPG considers Pickering groundwater samples to exhibit only "*slightly elevated tritium concentrations*", even though many samples have consistently exhibited tritium concentrations well above the CNSC limit of 3×10^6 Bq/L over the past ten years.

(ii) Tritium in Pickering groundwater is "*not migrating off-site*" because "*the foundation drains act as hydraulic sinks that capture most of the tritium plumes in the groundwater.*"

However, in stark contradiction to claim (ii), we are also told in OPG's *Preliminary Decommissioning Plan – Pickering Generating Stations A & B*, that:

> *After the PNGS A and B Units are shut down and all the sources of tritium leakage have been terminated, significant decreases in overall groundwater tritium concentrations can be expected to occur over the course of the 30-year Safe Storage period due to dispersion and radioactive decay over time. As such, tritium concentrations will naturally decrease to levels that would meet the release criteria for the site.*

Thus, when it comes to decommissioning, in spite of it being captured in a "*hydraulic sink*", OPG believes that Pickering's groundwater tritium activity will "*significantly decrease*" due to "*dispersion and radioactive decay over time*". The amount of radioactive decay of tritium may be precisely determined from its half-life of 12.3 years, as shown in Table 2, below.

Table 2: Decay of Tritium as a Function of Time

Decay Period	(Years After Shutdown)					
	0	10	20	30	40	50
Decay Factor	1	0.569	0.324	0.184	0.105	0.0598

From Table 2, we see that for a decay of 30 years, the tritium activity will be 18.4% of its value at shutdown. Thus, for example, an initial tritium activity of 32×10^6 Bq/L will have decayed in 30 years to 5.9×10^6Bq/L, which is still well above the CNSC limit of 3×10^6 Bq/L for tritium in non-potable water.

And I would ask OPG to explain by what mechanism the tritium currently "*captured*" beneath the Pickering facility will be "*dispersed*", especially in view of OPG's and the CNSC's claim that "*Environmental Assessments indicate that tritium is not migrating off-site*".

<u>Tritium in Groundwater: The Source Term for Pickering NGS</u>

As we have seen, very high levels of tritium are known to be present in the groundwater located beneath the foundations of Pickering NGS. However, in order to quantify the impact of this radioactive contamination on the decommissioning of this facility we need a precise estimate of

the tritium in groundwater source term. Unfortunately, detailed records of when, where, and how much tritium has leaked into Pickering's foundation drains since the commissioning of this facility in the early 1970s, (Pickering A), and early 1980s, (Pickering B), have not been published by OPG – quite often because such data were not always collected. Thus, some tritiated heavy water leaks at Pickering NGS were first "discovered" at some unknown point in time that was evidently long after the leak began. Indeed, many heavy water leaks in CANDU reactors are initially too small to detect – typically less than 1 gram/hr – but increase with time until they eventually become detectable.

Nevertheless, some *average* leak rate data have been published in documents such as the annual COG *D_2O Management Reports* that allow an estimate to be made of the current source term for tritium in Pickering's groundwater. These reports show that Pickering's D_2O loss rate for the mature station has typically been about 0.8 kg/hour/Unit. It is also known that the main sources of D_2O escape are moderator purification and heat exchanger maintenance, especially during spent moderator resin and drum handling. These activities result in an average loss rate of "*high-Curie*" D_2O of about 0.4 kg/hour/Unit for which we estimate an average tritium concentration of 0.5 Ci/kg. In addition, we shall assume about half of this D_2O, or 0.2 kg/hour/Unit has entered the groundwater beneath Pickering, which is equivalent to 1750 kg/year/Unit.

Starting with these assumptions, the Pickering tritium in groundwater source term, S_{GW}(Bq), may be determined using the following equation and parameter values:

$$S_{GW}(Bq) = R(kg/year) \times C(Ci/kg) \times N(Units) \times T(years) \times D(decay\ factor) \times 3.7 \times 10^{10}\ (Bq/Ci)$$

Where,

R is the rate of ingress of D_2O into Pickering groundwater = 1750 kg/year/Unit

C is the average Curie content of the D_2O = 0.5 Ci/kg

N is the number of operating Units = 2 PNGS A + 4 PNGS B = 6 Units

T is the effective operating time for each Unit = 30 years

D is an average decay factor for tritium taken as a decay of 15 years = 0.43

Hence,

$$S_{GW}(Bq) = 1750\ (kg/year/Unit) \times 0.5\ (Ci/kg) \times 6\ (Units) \times 30\ (years) \times 0.43 \times 3.7 \times 10^{10}\ (Bq/Ci)$$

$$S_{GW}(Bq) = 2.5 \times 10^{15}\ Bq$$

Furthermore, if we assume the contaminated groundwater occupies a volume equal to the Pickering A & B site area of (750 × 200) m^2 extending to a depth of 2 meters, we have an effective average tritium in groundwater concentration of 8.3×10^6 Bq/L; this is well within the range of tritium concentrations measured in monitoring wells at Pickering, as previously discussed.

To provide some perspective on these tritium amounts and concentrations it is useful to consider some comparative data, generously provided by Dr. Greening (Appendix A):

Tritium inventory accumulated at Pickering NGS site at shutdown = 7.0×10^{17} Bq

Tritium source term for Pickering groundwater = 2.5×10^{15} Bq = 0.36% of station inventory

Tritium average concentration in Pickering groundwater = 8.3×10^{6} Bq/L

Tritium inventory in OPG's proposed DGR = 1.5×10^{14} Bq

Average tritium concentration in DGR waste = 1.5×10^{6} Bq/L

Tritium inventory in CNL's proposed NSDF = 8.9×10^{14} Bq

Tritium average concentration in NSDF waste = 1.0×10^{6} Bq/L

These data show that Pickering groundwater is contaminated with tritium to a level that is significantly *higher* than in the Low and Intermediate Level wastes slated for disposal in a DGR or NSDF.

Interestingly, however, OPG *does* address the issue of the disposal of contaminated soil at Pickering NGS in its 2015 *Preliminary Decommissioning Plan* report, where we read:

> *The longer half-life radionuclides that are typically found during decommissioning are Co-60, Cs-137 and Sr-90. This contamination is likely to be found in soil relatively close (within a few meters) to the underside of the structure or components from which the leakage occurred. Remediation would likely entail excavation of the affected soil, with off-site disposal of the soil as radioactive waste. A preliminary estimate has been made, which indicates six affected locations with an affected soil volume of 6,730 m^3 that will have to be excavated and disposed.*

Clearly, OPG's "plan" does *not even mention* tritium as a contaminant of concern in Pickering's near-surface soil; but I would argue that this tritium contamination must be properly dealt with during the decommissioning of this facility simply on the basis of its high specific activity in the site's foundation drains. It also follows that the amount of soil requiring excavation and disposal will be orders of magnitude greater that the 6,730 m^3 estimated above by OPG. Indeed, if tritium contamination of the Pickering site is taken seriously, it could well prove to be a proverbial "show stopper" because of the sheer volume of contaminated material involved and the cost entailed in its removal, shipping and emplacement in an appropriate disposal facility.

Footnote 1:

As first pointed out by W. Ruland in his October 2019 report for Lake Ontario Waterkeepers, the CNSC limit of 3×10^{6} Bq/L for tritium in non-potable water appears to have no scientific basis, and is much higher than the US NRC Regulatory Limit of 37,000 Bq/L for the release of tritium to groundwater. In addition, a large nuclear power station such as Pickering, Bruce and Darlington, is restricted in its tritium discharges to its DRL limited concentration of about 0.5×10^{6} Bq/L, or 6 times lower than the CNSC's "non-potable water" discharge limit of 3×10^{6} Bq/L. The CNSC needs to explain these anomalies.

Conclusions:

(i) Deferred or delayed dismantling of the Pickering, Bruce and Darlington NPPs is the *only* viable option for the safe, ALARA decommissioning of these facilities.
(ii) The high levels of tritium in groundwater currently located beneath the foundations of Pickering NGS pose a serious waste disposal problem that threatens the economic viability of the decommissioning of this site and could potentially prevent it from ever being returned to a true *green field* state.

> *For which of you, desiring to build a tower, does not first sit down and count the cost, whether he has enough to complete it?*
>
> *Luke 14:28*

F. R. Greening
Hamilton, ON
December 2019

Curriculum Vitae – Gordon Edwards

January, 2022

Personal:

Born: July 18, 1940, Lansdowne, Ontario **Citizenship:** Canadian

Education:

Queen's University	Ph.D.	Mathematics	1972
University of Chicago	M.A.	English Literature	1964
University of Chicago	M.S.	Mathematics	1962
University of Toronto	B.Sc.	Mathematics & Physics	1961

- Academic Awards -

University of British Columbia:

National Research Council Post-Doctoral Fellowship 1972

Queen's University:

Queen Elizabeth II Doctoral Fellowship 1971
Canada Council Doctoral Fellowship, 1970
National Research Council Doctoral Fellowship, 1969

University of Chicago:

U. of Chicago Teaching Fellowship 1962-63
Woodrow Wilson Fellowship, 1961

University of Toronto:

Gold Medal in Mathematics and Physics, 1961
Arthur W. Anglin Memorial Scholarship, 1960
First Agnes Kelly Award in Math & Physics 1957

- Non-Academic Awards -

Peace Quest – named one of 150 Canadian Peacemakers 2017
YMCA Peacemaker Medallion Award 2014
The Rosalie Bertell Lifetime Achievement Award 2007
The Nuclear Free Future Award, Window Rock, Arizona 2006
White Owl Conservation Award 1985

Teaching Experience

- College and Undergraduate University -

Vanier College	Professor, Mathematics and Science	1974 to 2010
Concordia University	Environmental Studies	1974 to 77
U. of British Columbia	Calculus and Vector Geometry,	1972/73
Queen's University	Differential Equations, Linear Algebra	1969 to 72
University of W. Ontario	Abstract Algebra, Analysis, & Shakespeare	1962 to 64
University of Chicago	Finite Mathematics, Logic, Calculus	1962 to 64
University of Toronto	Differential Equations for Engineers	1960/61

- Honorary Appointments -

Concordia University, Adjunct Professor of Science & Human Affairs 1976 to 79

- Post-Graduate Courses -

Concordia University Chemistry in Society *(Masters level course)* 1976
McGill University Biology in Society *(Masters level course)* 1977

Work Experience (non-teaching)

- Appointments -

Science Council of Canada	Nation-wide study of Math in Canada	1973/74
Fire Marshal of Ontario	Ontario Lightning Rod Inspector	1958 to 61

- Consulting Work -

South Bruce Citizens Liaison Cttee	*surface risks of handling used nuclear fuel*	2020
Hornepayne Citizens Liaison Cttee	*new thoughts on high-level nuclear waste,*	2019
Manitouwadge Citizens Liaison Cttee	*health dangers of nuclear fuel waste,*	2018
Hornepayne Citizens Liaison Cttee	*technical challenges of Nuclear Fuel Waste,*	2018
Environmental Law Association	*health issues re uranium fuel fabrication [CARN]*	2020
Citizens of Renfrew County	*radioactive liabilities at Chalk River Labs*	2019
Ontario Clean Air Alliance	*nuclear waste management, Pickering NGS*	2017
Citizens of Renfrew County	*legacy nuclear waste at Chalk River Labs*	2016
Auditor General of Canada,	*performance audit - Atomic Energy Control Board*	2015
Citizens of Renfrew County	*licence extension hearings, Chalk River Labs*	2011
Mouvement vert Mauricie	*3 critical analyses, Darlington New Build*	2011
Mining Watch Canada	*critique of EIS for Matoush Uranium project*	2010
Serpent River First Nation	*workshop: health hazards of uranium mining*	2009
Conférence régionale des élus de la Côte-Nord	*medical aspects of radionuclides and impacts of uranium exploration and mining*	2009
Nunavut Planning Commission,	*issues on uranium exploration and mining*	2007
Congress of Aboriginal Peoples,	*issues on high-level radioactive waste*	2006 & 07
Inuit Tapiriit Kanatami (4 times)	*background on high-level rad waste*	2006 & 07
Chippewas of Nawash First Nation,	*dry storage of irradiated nuclear fuel*	1998
Ontario Siting Task Force,	*looking for a home for Port Hope radwaste*	1990 & 93
Canadian Environmental Advisory Council (CEAC),	*nuclear power, uranium & radioactivity, plus associated health & environmental issues*	1990 to 92
National Film Board of Canada,	*"Uranium"~ research related to film (60 m)*	1990
Energy Mines & Resources,	*"Energy Options" ~ public consultation process*	1987
U.S. NRC Safety & Licensing Board	*deterioration at the Turkey Point reactor (Miami)*	1985
Auditor General of Canada,	*comprehensive audit - Atomic Energy Control Board*	1985
National Film Board of Canada,	*"Speaking Our Peace" ~ documentary film (30m)*	1985
National Film Board of Canada,	*energy policy & uranium mining*	1978, 84-85, 88-90
C.T.V. television network,	*depleted uranium and nuclear weapons*	1985
T.V. Ontario (Toronto),	*nuclear safety issues in Ontario [TV series]*	1984
Prince Edward Island Electric Power Inquiry,	*externalities of the Point LePreau nuclear power plant in New Brunswick*	1982
Select Committee on Ontario Hydro Affairs (Legislature)	*reactor meltdowns, uranium processing issues, and radioactive waste management options*	1978/79
Ontario Royal Commission on Electric Power Planning,	*reactor safety, radioactive waste, reprocessing, and cross-examination of experts (5 months)*	1977/78
Consumer & Corporate Affairs,	*nuclear economics in Canada*	1977/78
United Steelworkers of America,	*radon exposure standards for new homes*	1977/78
Science Council of Canada,	*consultant on radiation health effects,*	1977 & 78
C.B.C. "The Nature of Things",	*long-term health effects of atomic radiation,*	1977
Cluff Lake Board of Inquiry on Uranium Mining (Saskatchewan),	*issues related to the uranium fuel chain and cross-examination of experts (5 weeks)*	1977

- Invited Testimony to Legislative Committees -

House of Commons Standing Committees:

Natural Resources Committee,	*on the status of Canada's nuclear industry*	2016
Natural Resources Committee,	*on radioactive steam generator transport*	2011
Natural Resources Committee,	*on the isotope production crisis*	2008
Natural Resources Committee,	*on nuclear liability and compensation*	2008
Foreign Affairs Committee,	*on plutonium and the MOX initiative*	1998
Energy Mines and Resources Cttee,	*on nuclear energy and sustainability*	1991
Environment and Forestry Cttee,	*on high level radioactive wastes*	1987

Consumer & Corporate Affairs,	*on issues related to food irradiation*	1987
Commission permanente de l'énergie et des ressources de l'Assemblée nationale,	*sur les alternatives énergétiques*	1983
Legislative Assembly of the Northwest Territories (Yellowknife), 3 sessions	*on uranium mining in arctic regions*	1980/81
Energy Committee of the New Brunswick Legislature,	*on CANDU reactor safety analysis*	1979
House of Commons Standing Committee on National Resources & Public Works,	*on the management of irradiated nuclear fuel*	1978
Commission permanente de l'énergie et des ressources de l'Assemblée nationale,	*sur l'énergie nucléaire au Québec*	1977
Prince Edward Island Legislature,	*on nuclear power issues in the Maritimes*	1974

- Expert Sworn Testimony -

US Federal court, Lansing Michigan	*transport of weapons plutonium to Canada*	2000
Federal Court, Ottawa	*dry storage of irradiated nuclear fuel*	1999
DFAIT, Gov't of Canada, Ottawa	*expert group on nuclear weapons policy*	1999
National Energy Board, N. Brunswick	*externalities of nuclear power*	1980
US Atomic Safety & Licensing Board	*safety of Turkey Point (Miami) reactor*	1985
Select Committee on Ontario Hydro	*reactor safety, nuclear wastes, uranium*	1979/80
Royal Commission on Electric Power	*radioactive waste and reactor safety*	1977/78
Cluff Lake Inquiry on Uranium Mining	*weapons proliferation, health, reactor safety*	1977

- Testimony at Environmental Assessment Hearings -

Quebec BAPE hearings on uranium	*extending Quebec's uranium moratorium*	2014
Deep Geologic Repository: Kincardine	*critique of OPG EIS, for the LILW DGR*	2013/14
Darlington New Build - CEAA hearings	*critique of OPG EIS, for Darlington NGS*	2011
Joint EA hearings: Matoush U project	*critique of Strateco EIS, for Matoush project*	2010
Federal hearings: Midwest U project	*critique of Midwest EIS, uranium mine*	2007
Quebec BAPE hearings on Gentilly-2	*Expansion of Radwaste Management Area*	2004
Federal hearings on BRUCE spent fuel	*dry storage of high-level radwaste*	1998
US DOE hearings on MOX transport	*proposed plutonium fuel shipments*	1997
Seaborn hearings on used nuclear fuel	*AECL's proposed geologic repository (HLW)*	1990-97
Federal hearings on radioactive tailings	*proposed Elliot Lake decommissioning*	1996
Joint hearings on *Projet Grande Baleine*	*critique of H-Q energy demand analysis*	1995
BAPE hearings, *Gentilly-2 nuclear waste*	*dry storage of high-level radioactive waste*	1994
Joint hearings on Sask. Uranium Mines	*uranium mill tailings management*	1993
Federal hearings on Eldorado project	*uranium refinery (UO_3 plant)*	1978, 1980
Federal hearings on Brinex project	*proposed uranium mine in Labrador*	1979
Elliot Lake hearings on radon in homes	*re-analysis of lung cancer risk data*	1978

- Interventions at Licensing Hearings –

Chalk River Laboratories under CN:	renewal of omnibus operating licence	2017
Darlington, Bruce and Pickering NPPs	extending operations & reactor rebuilding	2015
SRB Technologies, Pembroke Ontario	betalight manufacture using waste tritium	2015
US DOE hearings on MOX transport	proposed plutonium fuel shipments	1997
Federal hearings on spent nuclear fuel	AECL's proposed geologic repository	1990-97
Federal hearings on radioactive tailings	proposed Elliot Lake decommissioning	1996
Joint hearings on *Grande Baleine*	critique of H-Q energy demand analysis	1995
BAPE hearings on *Gentilly II*	dry storage of high-level radwaste	1994
Joint hearings on Sask. Uranium Mines	radioactive tailings management	1993
Federal hearings on Eldorado project	uranium hexafluoride refinery	1978, 1980
Federal hearings on Brinex project	proposed uranium mine in Labrador	1979
Elliot Lake hearings on radon in homes	expert re-analysis of lung cancer risk data	1978

- Volunteer Work -

World Social Forum (Montreal)	Planning Committee	2016
World Uranium Symposium (Quebec City)	Planning Committee	2015
Green Energy Conference (Montréal)	Executive Director	1989 to 90
Vanier College (Executive Committee 1990)	Board of Directors	1987 to 90
Canadian Peace Alliance	Steering Committee	1987 to 89
Integrated Science Program, Vanier College	Academic Council	1985 to 87
Integrated Science Program, Vanier College	Program coordinator	1985 to 87
Canadian Coalition for Nuclear Responsibility	Chairman & President	since 1975
SURVIVAL (international ecology magazine)	English edition editor	1970 to 74

Publications

- Mathematical Publications -

My Encounter with Grothendieck, Mathematical Intelligencer, 2017
Background Study No. 26, A.J. Coleman, G. Edwards and K. Beltzner,
final report of Mathematics Study, Science Council of Canada, 1976
Mathematical Sciences in Canada, A.J. Coleman, G. Edwards and K. Beltzner,
preliminary report of Mathematics Study, Science Council of Canada, 1975
Mathematics in Today's World, ed. G. Edwards, pub. Science Council of Canada,
Proceedings of Three Ottawa Conferences: I. Mathematics & Policy Planning
II. Mathematics, Statistics & the Environment III. Mathematics & Technology
(limited editions; copies deposited in all Canadian university libraries) 1974
"Beverton-Holt Model of a Commercial Fishery: Optimal Dynamics",
C. Clark, G. Edwards & R. Friedlaender, *Journal of the Fisheries Research Board* 1974
"Primitive Elements in Symmetric Algebras," *Canadian Journal of Mathematics*, 1974
Lie Algebras of Infinitesimal Group Schemes, Queen's University Ph.D. thesis, 1972
An Introduction to Lie Algebras, Gordon Edwards & Richard Pollack,
Queen's Papers in Pure and Applied Mathematics (Queen's University Press), 1970

- Non-Mathematical Publications -

Health Implications of Fuel Pelleting in Peterborough, CELA publication 2020
Regulating Liabilities at Chalk River – a Nuclear Sacrifice Area 2016
Canada and the Bomb, Past and Future – *Canadian Dimension Magazine* 2014
"Radiation is Invisible – but must the facts be hidden as well?",
A C*ritique of the Strateco EIS for the Matoush U Project:* 2010
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Uranium, the shape-shifter, Nuclear Energy Information Servuces (Chicago) 2022
Uranium – premises, promises, & predicaments, Saskatoon Public Library 2021
Small Modular Reactors – the historical context, CRED-NB (New Brunswick) 2020
Radioactive Wastes and First Nations, UN Permanent Forum on Indigenous Issues (NYC) 2018
Keynote Address, Regional Forum on Reactor Decommissioning (Garrison NY) 2017
The Age of Nuclear Waste: From Fukushima to Indian Point (Westchester NY) 2017
The Health Dangers of Uranium Mining, Greenland Symposium (Narsaq GL) 2016
Nuclear Power, Nuclear Weapons, and Uranium, World Social Forum (Montreal QC) 2016
Uranium, Radioactivity and Ionizing Radiation, IPPNW (Johannesburg, SA) 2015
Nuclear Fuel Waste: Questions and Challenges, CLC-NWMO (White River, Ontario) 2015
Uranium: The Canadian Story, World Uranium Symposium (Quebec City) 2015
Nuclear Fuel Waste: History and Prospects, CLC-NWMO (Schreiber, Ontario) 2015
Uranium – its Uses and Dangers, Association of First Nations of Quebec & Labrador Seminar re. Environmental Assessment Hearings (Wendake Quebec) 2014
Nuclear Waste Governance in Canada, 19th Annual Meeting of the REFORM Group, Week-long seminar at Leopoldskron, (Salzburg Austria) 2014
Lessons From Fukushima, Manitoba Environmental Industries Assoc. (Winnipeg) 2014
In a Nuclear Weapons-Free World, Can We Still Have Nuclear Power?, Science-for-Peace/Pugwash Annual Lecture (Toronto, Ontario) 2013

Nuclear Labyrinth on the Great Lakes, keynote address,
Nuclear Power and the Great Lakes Conference (Huron, Ohio), 2012
Nuclear Power – Challenges and Choices, keynote address, Fukushima Anniversary
"Nuclear Labyrinth in Asia" conference (Hong Kong), 2012
Will Saskatchewan Host Ontario's Nuclear Waste?, (Pinehouse, Saskatchewan) 2011
Healing the Planet, keynote address,
Physicians for Global Survival Conference (Montreal), 2009
From Uranium to Isotopes to Bombs, keynote address,
Physicians for Global Survival Conference (Ottawa), 2009
Prescription for Survival, keynote address,
Physicians for Global Survival Conference (Halifax), 2008
Nuclear Power: Hope or Hoax?, keynote address,
University of Alberta (Fredericton), 2008
Uranium, the Shape-Shifter, keynote address (with Robert Del Tredici),
"Nuclear Free Future" Conference (Salzburg, Austria), 2007
Radioactive Legacy of the Nuclear Age, keynote address (with Robert Del Tredici),
"Coping with Nuclear Waste" Conference (Stockholm, Sweden), 2007
Global Importance of Uranium, keynote address,
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The Secret Life of Uranium, International Uranium Congress (Saskatoon), 1987
Legal Issues in Nuclear Waste Management, McGill University Law School, 1986
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Nuclear Wastes in Canada, Past and Future, Nuclear Waste Conference (Winnipeg), 1986

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Technical Panel, Vermont Public Interest Research Group (Montpelier), 1985

Issues of CANDU Safety, Dalhousie University Law School (Halifax), 1982

Legal Aspects of Nuclear Power, Canadian Bar Association (Saskatoon), 1981

Nuclear Debate, sponsored by the Canadian Institute of Public Affairs,
Supreme Court Justice Howard Krever presiding, April 1978

Nuclear Wastes, SCITEC seminar for MPs and Senators (Parliament Hill), 1977

Nuclear Issues, Whiteshell Nuclear Research Establishment (AECL, Pinawa, MB), 1976
Energy Days, televised live from the Prince Edward Island Legislature, 1976

Energy and People conference: Keynote Speaker, introduced by Robert Stanfield, 1975

- Television Features - ***(excluding news coverage)***

Nuclear Revival, on high-level radwaste and new reactors, APTN (50 min), 2020

Nuclear Courtship, 2-part documentary on high-level radwaste, APTN (50 min), 2020

The Fukushima Nuclear Crisis, a three-week series of 23 interviews on the
Fukushima disaster featuring Gordon Edwards, CTV (90 min), 2011

The Nature of Things, special program on nuclear power featuring
G Edwards and B Hawthorne (president of Bruce Power) CBC (60 min), 2010

The Nature of Things, special program on nuclear power and plutonium
with G Edwards and A Mayman (ex-VP of AECL) CBC (60 min), 1998

Speaking Out, panel discussion with Edwards, the Ontario Energy Minister, and
VP of the Canadian Nuclear Association, TV Ontario (90 min), 1986

Energy: Search for an Answer, one of a seven part educational series,
produced by TV Ontario and Energy, Mines & Resources (30 min), 1984

The Evolution of Geometrical Thought, by G. Edwards, a series of five TV shows (30 min each), University of the Air (CTV), I. Ancient Discoveries; II. Curved Space; III. Geometry of Shadows; IV. Higher Dimensions; V. Topology: the "Rubber Sheet" Geometry. 1979

Quarterly Report on Energy, hosted by Barbara Frum, featuring G. Edwards et al, CBC TV (60 m), June 1979

The Watson Report, hosted by Patrick Watson, CBC TV (60 m), featuring G. Edwards et al on nuclear safety, May 1978

The Schulman File, hosted by Morton Schulman, City TV (60 m), featuring G. Edwards et al on nuclear issues, 1978

A Power Trip, G. Edwards et al on renewable energy, CBC Ideas (radio, 60 m), 1977

The Great Debate, hosted by Pierre Berton, featuring Gordon Edwards vs. Edward Teller, Global TV (50 m.) October 1974

Nuclear Debate, hosted by the *B.C. Environmental Council* and broadcast on cable TV from the Vancouver Planetarium (120 m.) February 1973

- Audio-Visual Presentations -

What is Nuclear Waste? [20m] prepared for members of the US Congress 2021

Nuclear Fuel Waste: Questions & Challenges [57m] Liaison Cttee (Schreiber ON) 2015

How I Became a Nuclear Skeptic [48m] The Green Majority (Toronto ON) 2015

Nuclear Dangers Update [90m] Montreal Press Club on Hiroshima Day 2012

Shipment of Radioactive Steam Generators [33m] Press Conference (Ottawa ON) 2010

Nuclear Power, Hope or Hoax? [90m] University of Alberta, Edmonton AB 2008

The Radioactive Legacy of the Nuclear Age [60m] Stockholm, Sweden 2007

Port Hope – Plans to Process Enriched Uranium [43m] Port Hope, Ontario 2004

The SLOWPOKE District Heating Reactor [2h] U of Saskatchewan, Saskatoon 1989

Cross-Examination of AECL Nuclear Safety Expert, [50m] video-taped at the Ontario Royal Commission on Electric Power Planning, CCNR 1977

Appendix 2

Report by Dr. Ian Fairlie

Tritium Hazards:
Report Prepared on behalf of Passamaquoddy Recognition Group Inc.

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Report prepared at the request of the Passamaquoddy Recognition Group Inc.

for use during the Canadian Nuclear Safety Commission
public hearings May 11-12, 2022
on the re-licensing of the Point Lepreau Nuclear Generating Station owned by the
New Brunswick Power Corporation
2022-H-2

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Executive Summary

I prepared this expert report on behalf of the Passamaquoddy Recognition Group Inc to review New Brunswick Power's application for a further licence to operate its reactor at Point Lepreau, New Brunswick.

Tritium (^3H) is the radioactive isotope of hydrogen. Reports from several international agencies recognise that tritium is an unusually hazardous radionuclide.

Annual tritium releases from the Point Lepreau reactor are very large in comparison with other nuclear reactors and have been increasing in recent years. According to New Brunswick Power's EIA, local residents receive radiation exposures from tritium. This is from ingested tritium, inhaled tritium, and tritium absorbed through skin. These intakes increase the probability of cancer and other radiogenic diseases. No measurements are made of HTO and OBT levels in people living near Point Lepreau.

Epidemiology studies at other Canadian facilities emitting tritium have indicated increases in cancer and congenital malformations. However no epidemiological studies near Point Lepreau have been commissioned or carried out to ascertain levels of adverse health effects in the local population. In addition, evidence from cell and animal studies, and radiation biology theory, indicates that radiogenic effects occur from exposures to tritium.

Recent, large-scale, statistically powerful, epidemiology studies of nuclear workers in UK, US and France have resulted in perceived increases in the radiation risks of low-LET radiation, including tritium. The new studies show a 47% increase in solid cancers and a 580% increase in leukemias. The evidence from these studies is applicable to tritium's radiation exposures at Point Lepreau NPS.

These high emissions, high levels of radioactive contamination, and increased estimates of cancer risks together mean that tritium poses worrying health risks to workers and to people near St John NB.

Under the Precautionary Principle, I recommended no further license be issued for the Point Lepreau NPS. In more detail, I also recommend

i. **CNSC should apply the Ontario Government's ODWAC recommended maximum of 20 becquerels per litre (Bq/L) for <u>drinking water</u>**
ii. **CNSC should recommend its own design guide[1] for <u>ground water</u> of 100 Bq/L for tritium.**
iii. **Urine tests and non-invasive bioassay tests should be carried out on volunteers from the community to ascertain local HTO and OBT levels.**
iv. **Residents within 10 km of the plant should be advised to avoid consuming locally-grown foods including honey from hives, wild foods such as mushrooms and berries, and produce from their gardens.**

[1] Canadian Nuclear Safety Commission. An Update on Tritium Contamination in Groundwater at SRBT. March 2010 (e-doc 3523400)

v. **In view of the discussion in Appendix C, local women intending to have a family, and families with babies and young children should consider moving elsewhere. It is recognised this recommendation may cause concern but it is better to be aware of the risks to babies and young children than remain ignorant of them.**

vi. **NB Power employees, especially young workers and women workers, should be informed about the hazards of tritium.**

Tritium Hazards

A. Introduction

1. I prepared this report on behalf of the Passamaquoddy Recognition Group Inc to review New Brunswick Power's application[2] for a further licence to operate its reactor at Point Lepreau, New Brunswick. This report is focussed on tritium - the radioactive isotope of hydrogen – because the extremely large releases of tritium from Point Lepreau are a cause of concern. This report summarizes current understandings of the biological and health effects of exposures to tritium and comments upon the risks faced by local citizens. In particular, new evidence on increased radiation risks is discussed.

2. I am a Canadian citizen resident in the United Kingdom. I am an independent scientist who has specialised on radioactivity in the environment with degrees in chemistry and radiation biology. My doctoral studies at Imperial College, UK and Princeton University, US examined nuclear waste technologies. One of my areas of expertise is the dosimetric impacts of nuclear reactor emissions. I have authored many articles in peer-reviewed journals on epidemiology studies of child leukemias near radiation facilities and on the hazards of radionuclides. I have been an employee of, and advisor to, UK Government departments, the European Parliament, the World Health Organisation, environmental NGOs, and UK local authorities. Between 2000 and 2004, I was head of the Secretariat to the UK Government's Committee Examining the Radiation Risks of Internal Emitters (CERRIE). Of particular relevance to these CNSC hearings, I have authored numerous scientific articles on the hazards of tritium which have been published in peer-reviewed journals, as follows

- Fairlie I. (2014) A hypothesis to explain childhood cancers near nuclear power plants J Environ Radioact. 133 (2014) pp 10- 17
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- Fairlie I. Tritium Hazard Report: Pollution and Radiation Risk from Canadian Nuclear Facilities. Published by Greenpeace Canada. June 2007. http://www.greenpeace.org/raw/content/canada/en/documents-and-links/publications/tritium-hazard-report-pollu.pdf
- Fairlie I**.** Tritium Hazard Report on Cernavoda 3/4: Environment Impact Analysis: Report for Greenpeace Romania. Published by Greenpeace Central Europe. November 2007.

[2] https://www.nuclearsafety.gc.ca/eng/the-commission/hearings/cmd/pdf/CMD22/CMD22-H2-1.pdf

http://www.greenpeace.ro/uploads/articole/Cernavoda%20Report%20for%20GP%20Central%20Europe.pdf

- Fairlie I. Uncertainties in Doses and Risks from Internal Radiation. Medicine, Conflict and Survival, Vol 21:2. pp 111 – 126. (2005) http://www.informaworld.com/smpp/content~content=a714004320~db=all~order=page
- Fairlie I. Tritium: The Overlooked Nuclear Hazard. The Ecologist. 22 No 5. 228-232 (1992)

B. Tritium Releases

3. In recent years, Point Lepreau has continued to release large quantities of tritium - see Table 1. These are of the order of hundreds of terabecquerels per year (TBq/a – see radioactivity units at Annex B). One terabecquerel is 10^{12} Bq, or one trillion Bq, ie 1,000,000,000,000 Bq - a very large amount or radioactivity. The Point Lepreau reactor releases more tritium than any other single nuclear reactor in Canada. This is a matter of some concern. It is also worrisome that, in recent years, tritium releases at Point Lepreau have been steadily increasing.

4. Tritium is released mainly in two forms – tritium gas (HT) and tritiated water or water vapour (HTO), in other words radioactive water or radioactive water vapour. As a result of molecular exchange - explained in the BOX below - these two types of releases are added together and treated as HTO. This is an important matter as the ICRP (in its Annual Limits of Intake - https://www.icrp.org/docs/Occupational_Intakes_P1_for_consultation.pdf) considers HTO, i.e., radioactive water, to be 25,000 times more radiotoxic than HT, radioactive hydrogen gas. It is also important because official regulatory models for atmospheric releases of tritium do not deal with doses from emissions of tritiated hydrogen gas (HT) and conversion of HT to HTO in the environment.

BOX. Molecular Exchange

In the environment, tritium atoms in HT rapidly exchange with stable H atoms in water through the phenomenon of molecular exchange. Therefore here all tritium releases are treated as HTO. This is common practice in OPG and AECL reports (Davis et al, 1997).

In more detail, in matter, all atoms engage in exchange reactions with like atoms in other molecules to varying degrees. This means that tritium atoms in HT swap positions with stable H atoms in the environment in the hydrosphere and in biota, including humans. H and T, the smallest atoms (apart from deuterium) are prominent as regards exchange reactions. These exchange reactions are very quick, taking about 10^{-15} seconds on average.

As the most common hydrogenous material in the environment is water in liquid or vapour forms, this means that tritium released as HT relatively quickly transfers to HTO. In practical terms, open water surfaces and biota downwind, including food growing in the area, plants, animals and humans, would become contaminated with tritium up to the tritium concentration in the atmosphere. For example, it would include vegetables and fruit in exposed market stalls and shops (Inoue, 1993).

5. A third form of tritium exists - organically bound tritium (OBT). Official models for tritium do not address exposures from ingesting tritium incorporated into organic compounds (Peterson and Davis, 2002).

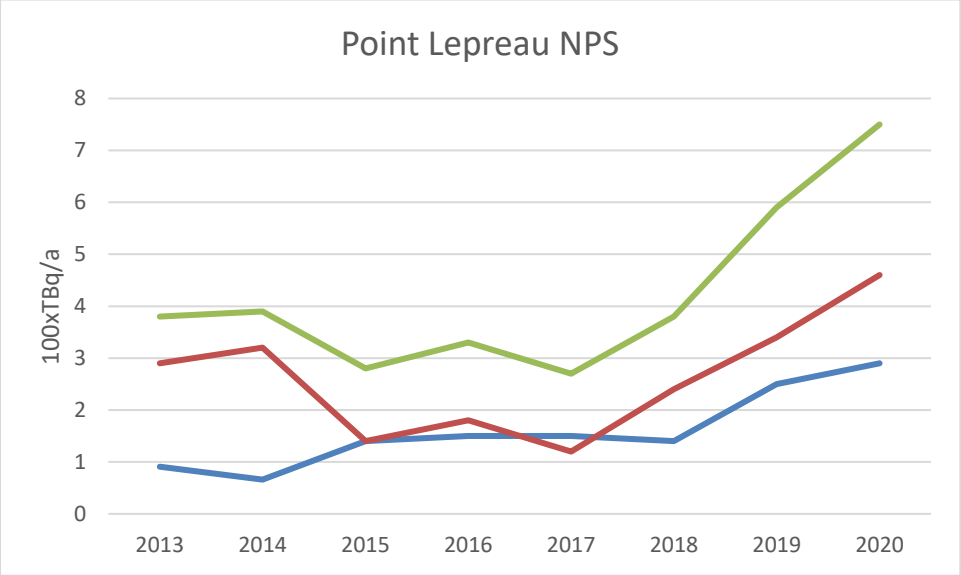
6. Annual tritium releases from Point Lepreau are set out in table 1 – 100 x TBq/a - correct to two figures. No data have been published for 2021 releases.

TABLE 1

Year	Tritium emissions to air 100xTBq/a	Tritium discharges to sea 100xTBq/a	Total Tritium releases 100xTBq/a
2021	-	-	-
2020	2.9	4.6	7.5
2019	2.5	3.4	5.9
2018	1.4	2.4	3.8
2017	1.5	1.2	2.7
2016	1.5	1.8	3.3
2015	1.4	1.4	2.8
2014	0.66	3.2	3.9
2013	0.91	2.9	3.8

7. These data are presented in chart form in figure 1 below. It can be seen that tritium total releases have been increasing each year since 2017.

Figure 1. Tritium releases at Point Lepreau



Legend
Red = tritium discharges to sea.
Blue = tritium releases to air.
Green = combined tritium releases to sea and air

8. Point Lepreau's annual air emissions are higher than those from other CANDU nuclear reactors and significantly higher than other reactor types around the world – see Table 2.

TABLE 2. Annual tritium air emissions per reactor from various nuclear power facilities

Facility	Number of operating reactors	TBq/a per reactor (average)
Point Lepreau -New Brunswick (2020)	1	290
Bruce -Ontario (2019)	8	100
Pickering -Ontario (2019)	6	80
Darlington- Ontario (2019)	3	75

Dungeness B (AGR) UK in 2016	2	6
Sizewell B (PWR) UK in 2018	1	3
Dungeness A (Magnox) UK in 2010	1	1.3
German NPPs in 2015 (average)	16	0.5

Ontario NPP data from http://nuclearsafety.gc.ca/eng/resources/publications/reports/regulatory-oversight-reports/npgs-report-2019.cfm

9. Air emissions are more important than liquid discharges for two reasons. First, the key parameter in estimating radiation exposures to local people is the nuclide concentration in environmental materials. Contrary to what many people think, air emissions result in higher environmental concentrations than water discharges do. The reason is dilution. A cubic metre of water contains a million grams of water which dilutes radioactive contaminants far more effectively than a cubic metre of air which only has ~10 grams of water: ie >100,000 times more effectively. This is not to accept that dilution is the solution to pollution - it isn't - it merely reflects existing (unsatisfactory) methods of disposing of gaseous nuclear wastes. Second, individual exposures and collective exposures from air emissions are much larger than from discharges to water. Accordingly this report deals mainly with air emissions.

10. It is correct that emissions of noble radioactive gases including Kr-85 and xenon isotopes from Point Lepreau NPS are also relatively high. However these nuclides are chemically inert and are not thought to be particularly toxic to humans. For example, when they are inhaled, they are exhaled straight back out without interacting significantly with the body – unlike tritium. Skin doses will also occur but these are estimated to be very low, in comparison with tritium doses.

11. The EIA published[3] by NB Power has admitted that local populations would be exposed to radiation as a result of the tritiated water vapour in the air, drinking water in local wells, diving for sea urchins, harvesting clams and dulse, and eating local seafood. The EIA could also have added exposures from the harvesting of local wild foodstuffs such as mushrooms, berries and other fruits, gardening vegetables, and the harvesting of seaweeds for fertiliser. These are all important matters for indigenous peoples who take pride in living close to their lands and seas. The radioactive poisoning of their lands and seas is deeply offensive.

12. The above data on the high, and annually increasing, tritium releases from Point Lepreau NPP are worrisome. It is well understood that the older a reactor becomes the higher its tritium inventories in the moderator and cooling circuits. And ergo- the higher its annual tritium releases. Without a means of removing tritium, its inventory and releases will continue to increase.

13. These worries are exacerbated by NB Power's proposed 25 plant life extension from 2022 to 2047. The reactor started operations in 1982 with retubing between 2008 and 2012. CNSC is apparently minded to allow NB Power to operate its reactor for another 20 years to 2042, see the CNSC's response. However this would mean that the reactor would have operated for 60 years which is unacceptably long as it was originally designed with an approximately 30 year lifespan.

14.

C. The Hazards of Tritium

[3] https://www.nbpower.com/media/1490873/2021-06-30-application-by-new-brunswick-power-for-the-renewal-of-170-1-2022.pdf

15. In order to understand and appreciate tritium risks to local people, we need to discuss tritium's properties in detail. In the past, nuclear scientists had tended to minimise the risks from tritium and to regard it as being only "weakly" radiotoxic. This is incorrect and perceptions are slowly changing: in the last decade, 10 major reports on tritium have been published by radiation safety agencies in the UK (AGIR, 2008), Canada (CNSC, 2010a; 2010b) and France. In France, the French Nuclear Safety Authority (ASN, 2010) published a comprehensive White Paper on tritium and the French Institute de Radioprotection and Nuclear Safety published six major reports on tritium (IRSN, 2010a; 2010b; 2010c; 2010d; 2010e; 2010f). In particular, these reports all noted that tritium exposures resulted in internal radiation doses whose estimation contained uncertainties which could render them unreliable.

16. The most comprehensive report on tritium remains the report by UK Government's senior Advisory Group on Ionising Radiation (AGIR, 2008). This strongly recommended that tritium's hazard (ie, its radiation weighting factor, w_R) should be doubled from 1 to 2. Other scientists (Fairlie, 2008; Fairlie, 2007a; Fairlie, 2007b; Melintescu et al, 2007; Makhijani et al, 2006) have presented evidence for even larger increases in tritium's radiotoxicity, including the US EPA (2006) which recommended a 2.5 fold increase.

17. These reports all drew attention to tritium's properties which mark it out as an unusually hazardous radionuclide. These include

a. its relatively long half-life of 12.3 years,
b. its mobility and cycling (as H_2O) in the biosphere,
c. its multiple pathways to man,
d. its ability to swap instantaneously with H atoms in adjacent materials,
e. its relatively high relative biological effectiveness (RBE) of 2 to 3,
f. its ability to bind with cell constituents to form organically-bound tritium (OBT) which is heterogeneously distributed in humans,
g. its long residence time in bodies as OBT, and
h. its short-range beta particle, meaning that its damage depends on its location within cellular molecules, e.g. DNA

18. It is necessary to take into full account the long biological half-lives of OBT. Recently Matsumoto, Hideki et al (2021) stated

> "*To understand the effects of internal exposures by tritium … it is important to realize that a part of tritium atoms (5–6% of HTO absorbed into the body) exists as a component of the body due to exchange with hydrogen atoms in organic compounds such as proteins and carbohydrates in the body, the so-called OBT. OBT, especially tritium bound to carbon atoms in organic compounds, remains longer in the body, because such OBT is difficult to exchange for other atoms in organic compounds. Thus, the biological half-life of OBT is about 40 days for a short-term component and about one year for a long-term component*."

19. For these reasons, tritium presents severe challenges to conventional dosimetry and health-risk assessments. The unfortunate reality is that official models for tritium DO NOT take the above properties of tritium into account.

20. Also, tritium in its elemental form diffuses through most containers with relative ease, including those made of steel, aluminium, concrete and plastic. Furthermore, in either form, tritium is not detected by commonly-used survey instruments (Okada et al, 1993). Normally liquid swabs have to be taken which are then sent to specialist laboratories to determine their tritium concentrations.

21. When tritium is emitted from Point Lepreau NPS, it travels via multiple environmental pathways to humans including through air. It cycles in the environment, because tritium atoms swap quickly with stable hydrogen atoms in the biosphere and hydrosphere. This means that all open water surfaces, rivers, streams and all biota, local crops and foods in open-air markets (Inoue, 1993) animals and humans will become contaminated by tritiated moisture up to ambient levels – that is, up to the air concentrations of the emitted tritium.

22. When tritium is emitted into the atmosphere, local residents and nuclear workers can become tritiated by skin absorption, and by breathing in contaminated water vapour. Because tritium is quickly transferred to food and water, workers and the public will also get tritium by eating contaminated food and drinking liquids (Inoue,1993). When tritium enters the body, it is readily taken up by exchange mechanisms, by metabolic reactions and by cellular growth. Over 60 per cent of the body's atoms are hydrogen atoms and every day about five per cent of them are engaged in metabolic reactions and cell proliferation. The result is that a proportion of the tritium taken in is fixed to proteins, lipids and carbohydrates, including nucleo-proteins such as DNA in our cells.

23. This is termed organically bound tritium (OBT) which is non-uniformly distributed and is retained in our bodies for longer periods than tritiated water. Radiation exposures from OBT are therefore higher than from HTO. The longer people are exposed to tritiated water emissions (ie in terms of the numbers of days), the higher their levels of OBT become until, in the case of repetitive exposures lasting years, equilibria is established between HTO and OBT levels.

24. Unfortunately, the dose models used by the International Commission on Radiological Protection (ICRP) assume the opposite – that tritium is homogenously distributed in the body/tissue/organ of interest and is quickly excreted. And ICRP's models only consider single not chronic exposures so that their model estimates of OBT levels become very unreliable.

25. It can be seen that tritium has unusual properties which suggest that it should be regarded as hazardous in radiation protection advice. Unfortunately, these properties are not recognised by the ICRP and authorities, such as CNSC, which take their lead from the ICRP. This bad situation is made worse by the ICRP's incorrect dose model for tritium which results in the underestimation of tritium 'doses' and its risks. For example, the ICRP's dose conversion factor for tritium intakes is 1.8×10^{-11} Sv per Bq, the lowest of any common nuclide by some margin. It is about 1,000 times smaller than that for Cs-137. One major controversy, which has lasted for about 60 years, is the ICRP's continued recommendation of the radiation weighting factor (w_R) for tritium of 1. See Fairlie (2007a). This value is simply wrong and should be at least doubled or trebled.

26. The major problem, in a nutshell. Is that CNSC and NB Power exclusively use unreliable ICRP dosimetry models for tritium. It should be borne in mind that the ICRP is not an official body, but a voluntary one. It operates rather like a trade association, as it is principally concerned with protecting the interests of its members rather than those of the general public. It appears that non-scientific considerations may have played a part in the ICRP's decisions on tritium, as regards nuclear weapons production plants in the past, nuclear reactors at present, and proposed fusion facilities in the future.

D. New Evidence on Radiation Risks

27. In recent years, important new epidemiological evidence has been published indicating that **all low-LET radiation risks have increased**. Low-LET radiation means low linear energy transfer and includes beta particles like tritium's, gamma rays and most X-rays.

28. The new evidence is from the International Nuclear Workers' Study (INWORKS) meta-studies of nuclear workers in the US, UK and France. The meta-studies are very large (>300,000 participants) which lends considerable authority to their findings. The new studies do not estimate tritium risks directly but do so indirectly. Since tritium is emitted from all nuclear facilities, all nuclear workers in these studies were exposed to tritium as well as to gamma rays which were measured in their film badge dosimeters, of which records had been kept for many years.

29. In late 2015 and in subsequent years, the INWORKS studies of nuclear workers in France, United Kingdom, and United States (Hamra et al, 2016) consisted of three large studies. The first examined associations between low dose-rate radiation and **leukemia/lymphoma** (Leuraud et al, 2015, 2021). The second studied **solid cancers** (Richardson et al, 2018), and the third studied **circulatory disease** (Gillies et al, 2017).

30. The main findings from the first two were that radiation risk estimates were broadly similar to, but higher than, the risk estimates derived previously from the Japanese bomb survivors' studies. For example, in the solid cancer study, the authors stated "*Our estimated association between radiation and solid cancer (ERR = 0.47 per Gy; 90% confidence interval 0.18 to 0.79) is larger than but statistically compatible with the estimate from a mortality analysis of male survivors of the Japanese atomic bomb exposed at ages 20-60 years (ERR = 0.32 per Sv; 95% confidence interval 0.01 to 0.50).*"

31. The phrase "*statistically compatible*" in the above quote is a jargon phrase used in statistics. It does not mean 'the same or similar'. It means that the confidence intervals in the two studies overlapped – quite a different matter. **Therefore it is necessary to compare the main point estimates of risk**. The actual observed increase between the two studies was 0.47/0.32 = 1.47 fold, or a 47% increase - a significant amount.

32. Similarly for leukemias. The more recent study in the INWORKS leukemia risks (Leurad et al, 2021) stated "i*n the dose range … 0–500 mGy, the linear estimated ERR/Gy …..derived from LSS (0.59; 90% CI − 0.43; 2.03) is substantially smaller than that derived from INWORKS (3.46; 90% CI 1.29; 6.19)".*

33. The actual increase in point estimates here was 5.8 fold or 580%. This very large increase was driven mainly by the 11- fold increase in chronic myelogenous leukemia (CML) in older workers. In myeloid leukemia, the cancers occur in cells that form red blood cells, some other types of white cells, and platelets.

34. The third study on cardiovascular risks somewhat surprisingly reported brand new risks of heart disease and strokes. These are not taken into account in official risk estimates by regulatory agencies which only consider cancer risks - but they should be.

35. A main assumption of this report is that the recorded external gamma doses in the new occupational studies may be used to comment upon tritium risks. **This is reasonable because when tritium risks are calculated, the risk from external gammas is used as a factor. Therefore when external gamma risks are increased so are tritium's risks**. It is also reasonable because both forms of radiation i.e. gamma rays and the beta particles from tritium are low-LET forms of radiation and, at least in official reports, both use the same radiation weighting factor, i.e. 1.

36. It is important to note this report does NOT take the absolute numerical risks from gamma ray exposures cited in the published studies and apply them to tritium. Instead it uses the risk **increases** (i.e. the ratios of the INWORKS risks compared to the LSS risks). This safeguard allows us to extract useful information from gamma risks and apply it to

tritium risks, i.e. the observed risk increases (i.e. in ERRs per Sv) from external gamma rays can be applied as well to tritium.

37. The new INWORKS radiation studies remain pertinent to whether a further license extension should be given to NB Power for a number of other reasons as follows. The INWORKS studies

a. provide ***strong evidence*** of a dose-response relationship between cumulative, chronic, low-dose, exposures to radiation and leukemia.
b. confirm that radiation risks exist even **at very low dose rates** (average = 1·1 mGy per year).
c. **observe** risks at low dose rates rather than extrapolating them from high dose rates. (e.g. as in the LSS study of Japanese bomb survivors)
d. found that risks **do not depend on dose rate** thus contradicting the ICRP's use of a Dose and Dose Rate Effectiveness Factor (DDREF) (which acts to reduce by half its published radiation risks).
e. found radiogenic leukemia risks decline **linearly** with dose, contradicting earlier studies suggesting a lower, linear-quadratic relationship for leukemia.
f. **strengthen** the Linear No-Threshold (LNT) model of radiogenic risks, as it now applies to leukemias as well as solid cancers.
g. found **no evidence of a threshold** below which no effects are seen.
h. found a trend of **increasing risk of solid cancer by attained age.**

38. Because these findings are far-reaching in their implications, it is necessary to double-check the INWORKS studies. A recent exhaustive review (Hauptmann et al, 2020) of these studies examined possible sources of bias[4] and confounding[5]. It concluded that the new epidemiological studies directly support the conclusion of excess cancer risks from low doses of ionising radiation, with little evidence of bias and confounding. This is similar to the findings of another study (Berrington et al, 2020) which reviewed the INWORKS studies using specialist statistical and epidemiological methods to look for evidence of bias and found none.

E. CNSC's Initial Response

39. In January 2022, the CNSC published its initial comments[6] on NB Power's application. CNSC staff agreed with NB Power's conclusions that the overall risk to the environment and human health from Point Lepreau NGS was acceptably low, and they concluded that NB Power maintained an adequate licensing basis for continued safe operations.

40. However the CNSC's views are fundamentally based on the low doses estimated to local people from the radioactive discharges at Point Lepreau and these estimates are flawed and unreliable as explained next.

F. Unreliable Dose Estimates

41. NB Power's EIA estimates of very low radiation doses to local residents from the plant's discharges and emissions are unreliable as they contain very large uncertainties. The

[4] statistical bias occurs when a model or statistic is unrepresentative of the population being studied: several sources of bias can occur, eg selection bias
[5] Confounding occurs when an extraneous factor causes inaccuracy in the estimated measure of an association, eg smoking in a lung cancer study
[6] https://www.nuclearsafety.gc.ca/eng/the-commission/hearings/cmd/pdf/CMD22/CMD22-H2.pdf

EIA dose estimates should not be used to justify further licenses to operate the Point Lepreau reactor. There are several reasons for this statement.

42. The first is that NB Power's EIA does not explain how its dose estimates are derived. This process is complex and poorly understood by many people: the process is explained in Appendix B below. Another reason is that no monitoring exists of any health outcomes among local residents. For example, no epidemiological health studies have been carried out in the area. In addition, no monitoring of HTO and OBT levels in local residents is carried out.

43. Third, unsafe limits including DRLs are derived from the unacceptably high level of tritium in drinking water - 7,000 Bq per litre - currently used by Health Canada. This is extremely lax given the current recommendation[7] of the Ontario Drinking Water Advisory Council (ODWAC) of 20 Bq per litre. It is recommended that this safer recommended tritium limit should be used throughout these documents. See table 3 on official drinking water limits in use.

Table 3. Official Tritium (HTO) limits in drinking water

Agency	**Tritium limit** (Bq per litre)
Health Canada	7,000
European Union	100
Recommended by Ontario Government's ACES in 1994	20
Recommended by Ontario Government's ODWAC in 2009	20
US State of Colorado	18
US State of California	15

44. The current Canadian limit for tritium in drinking water of 7,000 Bq//L is unsafe compared with the limits set by all other agencies. Even the current US limit[8] is 740 Bq/l, and is based on a maximum dose to the public of 40 μSv per year from drinking water. The European Commission's limit is 100 Bq per litre. The US State of Colorado has set a standard[9] for tritium in surface water, of 18.5 Bq/l, and the US Department of Energy specified the Colorado state action level for tritium in surface water in its clean-up program at the Rocky Flats plutonium plant in Colorado. The US State of California recommends a limit[10] of 15 Bq/L. Both limits are based on a 10^{-6} lifetime risk of a fatal cancer, which is the clean-up goal under the US Comprehensive Environmental Response Compensation and Liability Act (CERCLA), commonly known as the Superfund Act.

45. Health Canada's limit for tritium corresponds to a risk of 350 excess fatal cancers per million people which is considerably more lax than the 1 to 10 excess fatal cancers per million normally used in toxicity limits. For example, Health Canada's drinking water objectives for **chemicals** only allow a lifetime risk of 1 to10 fatal cancers per million people. The primary reason for the difference is that the predicted radiogenic cancers are calculated using ICRP dosimetry, which assumes only ***one year's*** consumption of drinking water. With chemicals, it is assumed that people consume drinking water for their whole lifetime—commonly set at 70 years.

[7]Ontario Drinking Water Advisory Council, *Report and Advice on the Ontario Drinking Water Quality Standard for Tritium* (2009), available online: http://meteopolitique.com/Fiches/nucleaire/documentation/01/Nucleaire_eau-potable-Ontario-Tritium.pdf

[8] 20,000 picocuries per litre.

[9] 500 picocuries per litre.

[10] 400 picocuries per litre.

46. In 2009, the Ontario Government's Ontario Drinking Water Advisory Council (ODWAC) published a comprehensive report[11] which recommended that the tritium limit in drinking water should be tightened to 20 Bq per litre. The difference between 7,000 and 20 Bq/l was partly due to ODWAC's choice of a stricter fatal cancer risk factor of 10^{-6} and partly due to its use of a lifetime instead of a first year risk. Interestingly, the 2009 ODWAC report's recommendations were identical to a 1994 report by the Ontario Government's Advisory Council on Environmental Standards on tritium. In other words, two separate Governmental committees with different scientific memberships over 15 years apart came to very similar conclusions. However the Federal Health Canada department remains in denial of these reports. This report also recommends that the ODWAC/ACES limit should be used.

G. Epidemiological evidence of risks at other tritium-emitting nuclear sites

47. It is an obvious step to look for evidence of ill health at other areas where people are exposed to radiation. However many epidemiology studies are ecologic studies (Wakefield, 2008), that is, quick studies which look at health or population statistics and not at individual data. Their findings are usually regarded as indicative and not conclusive. If their findings suggest an adverse effect then these should be investigated further by more detailed cohort or case-control studies. The latter match "cases" (i.e. those which have an adverse effect) with randomly-selected similar individuals, in order to minimise under-ascertainment. However fewer of these are carried out because of their expense and long timespans.

48. Below are some ecologic studies near Canadian nuclear facilities.

Leukaemia in children near Candu nuclear facilities

49. Clarke et al (1991) studied mortality and incidence of childhood leukaemia near nuclear facilities in Ontario. Its first report considered leukaemia deaths and cases at ages 0-4, and the second (Clarke et al. 1991) considered cases and deaths at ages 0-14. Data for areas "nearby" (<25 km) the 16 reactors at Bruce and Pickering over the period 1971-1987 were pooled together to increase statistical significance. The findings were 36 leukemia deaths aged 0-14 vs 25.7 expected (SMR = 1.40, 95% CI 0.98 - 1.9) indicating excess leukemia mortality with borderline statistical significance. However the confidence intervals were wide: the data were consistent with there being no increase and with there being a 90% increase in leukemia.

50. However there were indications which warranted further investigation: higher leukemia death rates after the reactors had started than before; more deaths when counted at place of birth than at place of death; and the size of the higher confidence interval. It is notable that different levels of statistical significance were adopted by the two reports. The first was 10%, and the second 5%. If the 10% level had been used in the second study as it had been in the first, the leukemia increase would have been considered "statistically significant". The authors recommended further case-control research which was not carried out.

Birth defects and infant mortality in the vicinity of the Pickering nuclear facility, Ontario

51. Johnson and Rouleau (1991) studied birth defects, stillbirths, perinatal, neonatal and infant mortality within 25 km of the Pickering nuclear station. They also studied these endpoints in relation to airborne and waterborne discharges of tritium from Pickering, concentrating on the Pickering and Ajax townships closest to the Pickering plant.

52. The incidence of central nervous system defects was significantly elevated in Pickering township for the highest level of airborne tritium emissions (odds ratio in highest

[11] http://www.odwac.gov.on.ca/reports/minister%20reports/minister_reports.htm

group = 4.01 (95% CI; 1.25, 14.04)), based on 6 cases)) but no statistically significant trends with tritium emissions (p=0.197) or ground monitoring data (p=0.24) were observed.

53. Births with Down Syndrome in Pickering township were significantly increased (24 observed *vs.* 12.9 expected (relative risk = 1.85, 95% CI = 1.19, 2.76)). But 23 other birth defect endpoints did not show such an excess. The raised incidence of Down Syndrome cases was notable, as many Chernobyl studies also indicate excesses in areas exposed to radioactive fallout. However the authors of the study queried why the incidence of Down Syndrome alone should be increased and not other forms of congenital malformation. This does not provide a reason to discount the observed association between tritium exposures and Down Syndrome.

Offspring of Canadian nuclear workers

54. Green et al (1997) assessed cases of congenital abnormalities and matched controls in the offspring of Canadian nuclear workers. (763 case-control pairs of fathers and 165 case-control pairs of mothers). Tritium doses were assessed for those cases/controls having a recorded tritium dose 60 days before conception vs. those with no dose. The study revealed increased chromosomal disorders with tritium exposure, but the number of cases (two) is small and confidence intervals wide.

Offspring of Ontario radiation workers

55. McLaughlin et al (1992, 1993) considered cases of childhood leukaemia in the offspring (aged 0-14) of Ontario radiation workers and matched cases. Tritium workers were those employed at the AECL laboratories at Chalk River, and 5 power stations (Rolphton, Pickering (A, B), Bruce (A, B); 112 cases and 896 controls). Preconceptional tritium doses were assessed for this group. There was some evidence of raised risks with internal tritium + external radiation exposures but with wide confidence intervals.

Durham Region Health Department (2007)

56. This study showed statistically significant elevated rates of several radiogenic cancers near the NPPs east of Toronto. Leukemia incidence was significantly increased in Ajax-Pickering and Clarington males in 1993-2004. This study was based on municipal borders, about 10 km from the reactors. The authors admitted some findings were of concern and recommended further more accurate studies, but none have been done. However the report incorrectly concluded that the overall findings did not indicate a pattern.

Lane Study (Lane et al, 2013)

57. This study purportedly sought to determine whether radiation doses to members of the public living within 25 km of the Pickering, Darlington and Bruce nuclear power plants (NPPs) were causing an increase in cancer rates from 1990-2008. It reported that some types of cancers were statistically higher than expected but radiation exposures were dismissed as a cause of these cancers “on the basis of current radiation risk estimates.”.

Wanigaratne et al Study (2013)

58. This study examined cancer incidences (1985–2005) among Pickering and north Oshawa residents including all cancers, leukemia, lung, thyroid and childhood cancers (6–19 years). Person-years analysis showed female childhood cancer cases to be significantly higher than expected (SIR = 1.99, 95% CI: 1.08–3.38). It concluded that “multiple comparisons were the most likely explanation for this finding”.

59. All of the above studies show increased ill effects, some statistically significant and others with borderline statistical significance. Some studies showed increases for some illnesses but not others. However as Altman and Bland (1995) stated “absence of evidence is not evidence of absence”. In addition, the methodological limitations, in particular the small sizes of some of these studies mean they were simply unable to detect effects with statistical

certainty. But lack of statistical significance should NOT be used as a reason for dismissing these studies. See https://www.ianfairlie.org/news/uk-and-us-scientists-call-for-statistical-significance-tests-to-be-dropped-in-health-studies/

60. Despite the positive numerical findings in all these studies, their published conclusions were invariably negative, often on flimsy or untenable grounds such as inconsistent results, too many comparisons, lack of an overall pattern, etc. In the case of the Lane et al study, it was because the observed increases in cancer incidence were greater than predicted by official estimates of radiation dose. In other words, the authors refused to accept the evidence of their own study, preferring to believe in official dose estimates. This is poor science,

61. Instead the above studies, taken together, provide indicative evidence for increased health effects from exposure to tritium. This could be confirmed with larger, case-control or cohort studies, or by meta-studies, but the CNSC has refrained from commissioning such studies or meta-studies.

H. CONCLUSION

62. Several reports by international agencies recognise that tritium has unusual properties marking it as a hazardous nuclide. It is extremely mobile in the environment, contaminates all biota including humans in nearby areas to ambient levels, and binds with organic matter to form OBT with long residence times in the body making it more radiotoxic. Epidemiology studies at other Canadian facilities emitting tritium suggest increases in cancer and congenital malformations: these could be confirmed with case-control or cohort studies. More important, considerable evidence from cell/animal studies and radiation biology theory indicates that adverse effects will occur. This is backed by evidence from recent, large scale, statistically powerful epidemiology studies – see above.

J. RECOMMENDATIONS

63. It is recommended that

vii. CNSC should apply the Ontario Government's ODWAC recommendation of 20 becquerels per litre (Bq/L) for drinking water
viii. CNSC should implement its own design guide[12] for groundwaterfor tritium of 100 Bq/L for tritium levels in wells near Point Lepreau NPS.
ix. Urine tests and non-invasive bioassay tests should be carried out on volunteers from the community to ascertain local HTO and OBT levels.
x. Residents within 10 km of the plant should be advised to avoid consuming locally-grown foods including honey from hives, wild foods such as mushrooms and berries and produce from their gardens.
xi. In view of the discussion in Appendix C, local women intending to have a family, and families with babies and young children should consider moving elsewhere. It is recognised this recommendation may cause concern but it is better to be aware of the risks to babies and young children than remain ignorant of them.
xii. NB Power employees, especially young workers and women workers, should be informed about the hazards of tritium.

[12] Canadian Nuclear Safety Commission. An Update on Tritium Contamination in Groundwater at SRBT. March 2010 (e-doc 3523400)

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APPENDICES

APPENDIX A. ORGANICALLY BOUND TRITIUM

Organically bound tritium (OBT) which is bound to carbon atoms is termed non-exchangeable OBT. It is produced through photosynthesis (ie growth) in plants and by metabolic reactions and growth (ie cell reproduction) in animals. It is detected in most organic materials in plants, animals and soils. A second form of OBT which is more loosely bound to P, N and S atoms is called exchangeable OBT.

The behaviour of OBT (both forms) in the environment is not particularly well understood. For example, its distribution in natural ecosystems is very heterogenous. Nevertheless OBT is increasingly recognized as being more significant than HTO in understanding tritium's behaviour in the environment. (Kim et al, 2013). This is partly because OBT measurements provide a more accurate representation of tritium in the environment due to its longer retention time than HTO. (Kim and Roche, 2012)

OBT can be incorporated into all biochemical compounds, including amino acids, sugars, starches, lipids and cell structural materials: it therefore has longer retention times than tritiated water which only has a biological half-life of about 10 days. Some biomolecules are very long-lived, e.g. phospholipids in nerve cells and the DNA and RNA macromolecules. These longer retention times result in OBT's greater radiotoxicity than tritiated water. The ICRP has recommended an OBT ingestion exposure coefficient 2.3 times greater than that for HTO[13]. However much evidence suggests it should be at least 5 times or more greater (Fairlie, 2008).

Following a single HTO intake, the current ICRP model assumes 3% is bound as OBT and "may be neglected". But Trivedi et al (1997) estimated that up to 9% is bound as OBT. Animal studies also indicate that OBT levels must be considered – essentially because OBT is cleared from the body much more slowly than HTO. Commerford et. al (1982) found, after a transient HTO exposure to mice, tritium remained bound to DNA and histone 8 weeks later. They concluded that the OBT doses from them would exceed HTO doses overall.

The same goes for chronic exposures except more so. Commerford, Carsten and Cronkite (1977) found most of the tritium dose came from OBT 2 to 3 days after stopping chronic HTO administration to mice. Rogers (1992) concluded OBT was the principal determinant in tritium doses to mice following chronic HTO exposure. More recently, Kim et al (2013a) discussed the OBT contribution to tritium exposures from chronic tritium releases to air. They compared 11 studies whose mean OBT contribution to total tritium exposures was 21%. In other words, any estimates of HTO exposures from Point Lepreau NPS emissions should be multiplied by the factor 5/4.

Longevity of OBT in the environment

Eyrolle-Boyer et. al (2014) stated that OBT levels can persist in the environment for several decades. They found that terrestrial biomass pools, contaminated by global atmospheric fallout from nuclear weapons testing in the 1950s and 1960s constituted a significant delayed source of OBT, resulting in an apparent enrichment of OBT levels compared to HTO. This finding helps explain OBT/HTO ratios greater than 1 observed in areas not affected by industrial radioactive wastes. This finding supports the findings by Ichimasa (1995) of long-term raised OBT levels near Chalk River following chronic HT releases.

A more recent study (Thompson et al, 2015) has emphasised the importance of OBT in the environment. It stated that, as soil acts as a repository for decaying organic matter, OBT soil concentrations represents long-term reservoirs of past tritium releases. It added "Our data support the mounting evidence suggesting that some parameters used in environmental transfer models approved for regulatory assessments should be revisited to better account for the behaviour of HTO and OBT in the environment and to ensure that modelled estimates (e.g. plant OBT) are appropriately conservative." Unfortunately, these parameters have not been revisited by the CNSC.

[13] ICRP dose coefficients for adults are 1.8×10^{-11} Sv/Bq for tritiated water and 4.2×10^{-11} Sv/Bq for OBT.

APPENDIX B. UNCERTAINTIES IN "DOSE" ESTIMATES

The EIA and CNSC reports contain dose estimates to members of the public: these are invariably very small. However these do not explain that these are estimates not measurements and may contain large uncertainties.

How these dose estimates are derived is not widely understood by scientists, and usually not at all by members of the public. In fact, the method is complicated, as they are derived using many computer models in sequence, with the median value from each model being plugged into the next model and so on. Although there are many smaller sub models, the main models include:

- environmental transport models for radionuclides, including weather models
- human metabolism models for nuclide uptake, retention and excretion
- dose models which estimate doses from internally retained nuclides, and
- risk models

A major source of uncertainty is that we often do not know where radionuclides wind up inside the body after inhalation/ingestion. It is often assumed they are uniformly distributed - but this there is no way of proving this.

Each of the above model results will contain uncertainties which have to be combined to gain an idea of the overall uncertainty in the final dose estimate (Fairlie, 2005). Further uncertainties are introduced by unconservative radiation weighting factors and tissue weighting factors in official models (Fairlie, 2007a). The cumulative uncertainty in dose estimates could be very large as formally accepted by the UK Government's CERRIE Committee in 2004 (www.cerrie.org) particularly for internal emitters.

APPENDIX C: INCREASED INCIDENCES OF CANCER NEAR NPPS

Recent epidemiological studies indicating increases in child leukemias near NPPs in Europe are of relevance to the Point Lepreau NPS situation as both emit relatively large amounts of tritium.

The most important of these is the KiKK study (*Kinderkrebs in der Umgebung von Kernkraftwerken* [translated as: 'Childhood Cancer in the Vicinity of Nuclear Power Plants']. Spix et. al (2007) and Kaatsch et. al (2008) found a 60% increase in solid cancer risk in embryos and a 120% increase in leukemia risk among children under 5 years living within 5 km of all German nuclear reactors. The KiKK findings are important because it was a large well-conducted study, because it was scientifically rigorous, because its evidence was very strong and because the German Government, which had commissioned the study, confirmed the researchers' findings.

The KiKK study is presently the subject of much debate in scientific communities. It is too early to provide an explanation for the increased cancers, although there is evidence to implicate radiation exposures with cancer effects. One hypothesis, (Fairlie, 2014) proposes that infant leukemias are a teratogenic effect of *in utero* exposures to radiation from intakes of radionuclides during fetal development in pregnancies. The German study suggests that exposures from NPP emissions to embryos/foetuses in pregnant women living nearby may be much larger than currently estimated. For example, haematopoietic tissues (ie blood-forming cells) are known to be more radiosensitive in embryos and foetuses than in adults. Also, children, particularly in the first six years, undergo rapid development. The combined immaturity of children's nervous systems and blood-forming systems make them particularly vulnerable to chronic radiation exposures.

Official organizations have found it difficult to accept that the large cancer increases near NPPs are due to radioactive emissions. This is mainly because their “dose” estimates from NPP emissions are too small by factors of 100 to 1000 times to explain the observed increases in risks. This of course assumes that official dose estimates and risk models are correct and without uncertainties. Importantly, the UK Government CERRIE Committee in 2004 www.cerrie.org concluded the opposite.

APPENDIX D. CURRICULUM VITAE FOR Dr IAN FAIRLIE

Address	115 Riversdale Road LONDON N5 2SU United Kingdom
Email:	ianfairlie@gmail.com
Website:	www.ianfairlie.org
Nationality	Canadian

Education

1993 -1997	Imperial College of Science, Technology and Medicine Centre for Environmental Technology London SW7 2PE, UK • PhD (health impacts of radioactive waste technologies)
1996	Princeton University Centre for Energy and Environmental Studies Princeton NJ 08544, USA • Visiting Fellow (health impacts of radioactive waste technologies)
1990-1992	Medical College of St Bartholomew's Hospital Department of Radiation Biology Charterhouse Square London EC1M 6BQ UK • MSc Radiation Biology
1962-1966	University of Western Ontario London, Ontario, Canada • BSc Chemistry
1957-1962	Sarnia Northern Collegiate Institute and Vocational School Sarnia, Ontario, Canada • Honours Graduation Certificate (Grade 13)

Consultancies

Ontario Clean Air Alliance, Toronto, Ontario, Canada
Canadian Environmental Law Association, Toronto, Ontario, Canada
City Government of Vienna, Austria
International Agency on Research on Cancer, Lyon, France
SAGE Peterborough, Ontario, Canada
Greenpeace Canada
Greenpeace Europe
European Parliament
UK Nuclear Free Local Authorities
International Physicians for the Prevention of Nuclear Warfare, Germany
International Society of Doctors for the Environment, Italy and
Physicians for Global Survival, Canada

EMPLOYMENT

2000-2005 UK Government Committee Examining the Radiation Risks of Internal Emitters(CERRIE) www.cerrie.org
Department for the Environment, Food and Rural Affairs
Nobel House, 17 Smith Square
LONDON SW1P 3JR, UK

- Head of Secretariat of Ministerial Committee on internal radiation risks

1996-2000 UK Food Standards Agency
Radiological Safety Unit
Ergon House
17 Smith Square
LONDON SW1P 3JR, UK

- Higher Scientific Officer in the Radiological Safety Unit on regulation of nuclide discharges and nuclear waste management programmes in UK

1992-1996 Imperial College of Science, Technology and Medicine
Centre for Environmental Technology
48 Prince's Gardens
LONDON SW7 2PE, UK

- PhD researcher and lecturer on radiation exposures from radioactive waste technologies

1975 -1989 Trades Union Congress
Great Russell Street
LONDON WC1B 3LS, UK

- Research Officer in occupational health and safety

Scientific Publications

2016

TORCH-2016: An independent scientific evaluation of the health-related effects of the Chernobyl nuclear disaster.
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Smith KR, Frumkin H, Balakrishnan K, Butler CD, Chafe Z, Fairlie I, Kinney P, Kjellstrom T, Mauzerall DL, McKone TE, McMichael AJ, Schneider M. Annual Review of Public Health 34: 1-25, (web published, Jan 16, 2013, 10.1146/annurev-publhealth-031912-114404)

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2009
Commentary on UNSCEAR 2006 Report: Annex C—the New Effects of Radiation Radiation Protection Dosimetry (2009) **Vol 137, Number 3-4** doi:10.1093/rpd/ncp280

Review of epidemiology studies of childhood leukaemia near nuclear facilities: Commentary on Laurier et al. (with Alfred Körblein) Radiation Protection Dosimetry (2009) **Vol 137, Number 3-4** doi:10.1093/rpd/ncp246

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Childhood Cancers Near German Nuclear Power Stations: the ongoing debate.Medicine, Conflict and Survival.Vol 25, No 3. 2009, pp 197–205

Childhood Cancers Near German Nuclear Power Stations: hypothesis to explain the cancer increases. Medicine, Conflict and Survival Vol 25, No 3. 2009, pp 206–220

2008

Depleted uranium: properties, military use and health risks. Medicine, Conflict and Survival. Vol 25:1. 2008 pp 41-64

The health effects of depleted uranium. Disarmament Forum.UNIDIR (2008) Vol 3. pp. 3 – 16. United Nations Institute for Disarmament Research.Geneva, Switzerland. http://www.unidir.ch/pdf/articles/pdf-art2756.pdf

The hazards of tritium – revisited. Medicine, Conflict and Survival. Vol 24:4. October 2008. pp 306 - 319.http://www.informaworld.com/smpp/content~content=a904743144~db=all~order=page

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2007

Dispersal, deposition and collective doses after the Chernobyl disaster.Medicine, Conflict and Survival, Vol 23:1, pp 10 –30. June 2007. http://www.informaworld.com/smpp/content~content=a770375304~db=all~order=page

RBE and w_R values of Auger emitters and low-range beta emitters with particular reference to tritium.Journal of Radiological Protection. Vol **27** pp 157-168. (2007)http://www.iop.org/EJ/abstract/0952-4746/27/2/003/

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2006

The Other Report on Chernobyl (TORCH). An independent scientific evaluation of the health-related effects of the Chernobyl nuclear disaster with critical analyses of recent IAEA/WHO reports.Ian Fairlie and David Sumner.Published by Greens/EFA in the European Parliament. April 2006. www.chernobylreport.org

2005
Uncertainties in Doses and Risks from Internal Radiation. Medicine, Conflict and Survival, Vol 21:2. pp 111 – 126. (2005)

New Information on Radiation Health Hazards. Energy and Environment.Vol 23. October 2005.

TECHNICAL ANNEXES

ANNEX A. ACRONYMS AND ABBREVIATIONS

AECB	former Atomic Energy Control Board (now CNSC qv)
Bq	becquerel (SI unit of radioactivity)
CERRIE	UK Committee Examining the Radiation Risks of Internal Emitters
Ci	curie (US unit of radioactivity)
COMARE	UK Committee on the Medical Aspects of Radiation in the Environment
CNSC	Canadian Nuclear Safety Commission
DDREF	dose and dose-rate reduction factor
DRL	derived release limit
DNA	deoxyribose nucleic acid
EC	European Commission
EPA	US Environmental Protection Agency
EU	European Union
Gy	gray (unit of absorbed radiation dose)
HTO	tritiated water
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
LET	lineal energy transfer (energy transferred per unit length of track)
LNT	linear no-threshold (model of radiation's dose-effect relationship)
LSS	Life Span Studies of the Japanese bomb survivors
NEA	Nuclear Energy Agency of the OECD
NCI	US National Cancer Institute
NPP	nuclear power plant
NRC	US Nuclear Regulatory Commission
NRPB	former UK National Radiological Protection Board
OBT	organically bound tritium
rad	US unit of absorbed radiation dose
rem	US unit of radiation dose
SI	Systeme Internationale
Sv	sievert (SI unit of equivalent or effective radiation dose)
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
WHO	World Health Organisation

ANNEX B. SYSTÈME INTERNATIONALE (SI) UNITS

E = exa	= 10^{18}	d = deci (one tenth)	= 10^{-1}
P = peta	= 10^{15}	c = centi (one hundredth)	= 10^{-2}
T = tera (one trillion)	= 10^{12}	m = milli (one thousandth)	= 10^{-3}
G = giga (one billion)	= 10^{9}	µ = micro (one millionth)	= 10^{-6}
M = mega (one million)	= 10^{6}	n = nano (one billionth)	= 10^{-9}
K = kilo (one thousand)	= 10^{3}	p = pico (one trillionth)	= 10^{-12}

Common examples are:

PBq	= petabecquerel (one million billion becquerels)	= 10^{15} Bq
TBq	= terabecquerel (one trillion becquerels)	= 10^{12} Bq
GBq	= gigabecquerel (one billion becquerels)	= 10^{9} Bq
mSv	= millisievert (one thousandth of a sievert)	= 10^{-3} Sv
µSv	= microsievert (one millionth of a sievert)	= 10^{-6} Sv
nSv	= nanosievert (one billionth of a sievert)	= 10^{-9} Sv

ANNEX C. GLOSSARY OF COMMON RADIATION TERMS

Absorbed dose — Quantity of energy imparted by ionising radiation to unit mass of matter such as tissue. 1 Gy = 1 joule per kilogram.

Activity — rate at which radioactive substances decay. Unit – the becquerel (Bq).
1 Bq = 1 disintegration per second.

Annual limit of intake (ALI) — The amount of material inhaled or ingested in 1 year that would result in a committed effective dose of 20 mSv.

Beta particle — An electron emitted by the nucleus of a radionuclide.

Decay — The process of spontaneous transformation of a radionuclide. The decrease in the activity of a radioactive substance.

Decay product — A nuclide or radionuclide produced by decay. It may be formed directly from a radionuclide or as a result of a series of successive decays through several radionuclides.

Dose — General term for quantity of radiation. See absorbed dose, effective dose, equivalent dose.

Dose factor — committed effective dose resulting from the inhalation or ingestion of 1 Bq of a given radionuclide. Unit - sievert per becquerel, symbol - Sv/Bq.

Effective dose — The quantity obtained by multiplying the equivalent doses to various tissues and organs by the tissue weighting factor appropriate to each and summing the products. Unit sievert, symbol Sv.

Equivalent dose — The quantity obtained by multiplying the absorbed dose by the appropriate radiation weighting factor to allow for the different effectiveness of the various ionizing radiations in causing harm to tissue. Unit sievert, symbol Sv.

Gamma ray — A discrete quantity of electromagnetic energy, without mass or charge.

Half-life — The time taken for the activity of a radionuclide to lose half its value by decay.

Ionisation — The process by which a neutral atom or molecule acquires or loses an electric charge. The production of ions.

Ionising radiation — Radiation that produces ionisation in matter.

Nuclear fission — The process in which a nucleus splits into two or more nuclei and energy is released.

Radionuclide — An unstable nuclide that emits ionizing radiation when it decays.

Risk factor — The probability of fatal cancer or leukaemia per unit effective dose.

Sievert — See effective dose.

Appendix 3

Recommendations

Recommendations from Dr. Ian Fairlie

1. Under the Precautionary Principle, it is recommended that no further license be issued for the Point Lepreau NPS
2. CNSC should apply the Ontario Government's ODWAC recommended maximum of 20 becquerels per litre (Bq/L) for drinking water
3. CNSC should recommend its own design guide1 for ground water of 100 Bq/L for tritium.
4. Urine tests and non-invasive bioassay tests should be carried out on volunteers from the community to ascertain local HTO and OBT levels.
5. Residents within 10 km of the plant should be advised to avoid consuming locally-grown foods including honey from hives, wild foods such as mushrooms and berries, and produce from their gardens.
6. In view of the discussion in Appendix C, local women intending to have a family, and families with babies and young children should consider moving elsewhere. It is recognised this recommendation may cause concern but it is better to be aware of the risks to babies and young children than remain ignorant of them.
7. NB Power employees, especially young workers and women workers, should be informed about the hazards of tritium.

Recommendations from the Submission by the Passamaquoddy Recognition Group Inc. Re 2022-H-2

8. We recommend that you, the Commissioners,
   - reconsider whether the impacts are acceptable
   - consider who and what bears the brunt of continued impacts
   - consider who and what gains benefit from PLNGS

   based on what we anticipate will be your modified perspective, after reading and whole-heartedly considering this submission.
9. We ask you to respect our vital need to enact our law and to therefore affirm our proposal of a 3-year license. Any longer licence period blocks us from

fulfilling our obligations to regularly assess and improve the health of the territories in which we live.

10. We desire that you - the Commissioners, through your response to our proposal - would recognize and enable us to fulfill our role as caretakers of Peskotomuhkatikuk. Grant our request for a 3-year license on the condition that during these years partners are to start the work of implementation planning for decommissioning.

11. PLNGS was established in our territory without consultation or consent of the Peskotomuhkati, contrary to the terms of our Treaties. This remains an outstanding issue, we recommend further attention to this issue prior to a relicensing decision being taken.

12. PLNGS continues to produce and store toxic waste in our ancestral homeland. This also remains an outstanding issue, we recommend further attention to this issue prior to a relicensing decision being taken.

13. Finally, to date, the Nation has not been engaged by either NB Power nor the CNSC on a nation to nation basis - this also remains an outstanding issue, we recommend further attention to this issue prior to a relicensing decision being taken

14. We recommend that NB Power and CNSC policies should be assessed for their substantive content, normative language, potential weaknesses, and possible impact on Peskotomuhkati treaty rights, title and interests, UNDRIP, as well as rights, title and interests more recently reconfirmed through Canadian and provincial courts. In particular, paying close attention to whether NB Power and CNSC policies have enough ingredients to meaningfully contribute to the achievement of the above-listed rights, title and interests, and UNDRIP goals.

15. We recommend that the UNDRIP must be a minimum framework for the relationship between Indigenous peoples and the Canadian government and nuclear development decisions across Canada.

16. Further, due to the nature of PLNGS, especially in light of its pervasive level of influence on Peskotomuhkuk, CNSC must, as an essential basis for the relationship with the Peskotomuhkat, apply the principles of the UNDRIP to its relicensing decision.

17. Therefore, we recommend the CNSC utilizes the UNDRIP principles as a rubric with which they can compare their rationale for their decision the NB Power application for relicensing

18. Prior to the final decision with respect to the NB Power application for relicensing, we recommend you have ensured collaboration with our Nation to the furthest extent possible and worked in good faith to rectify our outstanding concerns.

19. Should you choose to approve a licence length over 3 years, we desire that your decision describes and specifically details how you have applied consideration to

- Peskotomuhkat Treaty Rights
- The rights and interests of the Peskotomuhkat as confirmed by federal and provincial court decisions, and
- the principles of the United Nations Declaration on the Rights of Indigenous Peoples,

20. We assert that the new, toxic waste which is to be created and stored in Peskotomuhkatihkuk creates new infringements of our rights, therefore meriting Duty to Consult.

21. We request that any decision about relicensing be delayed until CNSC staff can direct due attention to the information presented by intervenors, respond on the record to our concerns and those of other intervenors, and allow intervenors the opportunity to discuss the CNSC staff's responses on the record.

22. Further, we recommend that the relicensing process is reformed so that it allows the CNSC staff and Commissioners to review and discuss at length, the factual, technical, scientific or Indigeneous knowledge and evidence tendered by proponents and intervenors with sufficient rigour and minimum procedural safeguards in place so that CNSC's purpose of disseminating information to the public per section 9(b) of the NSCA and ensuring a licensing decision is arrived at in a fair and credible manner, can be fulfilled.

23. We recommend that adequate resources to carry out meaningful responses are negotiated, not unilaterally determined by CNSC staff

24. To enable efficient research and work by intervenors, we recommend all documents referenced in the CMDs should be provided (via a working link

in the CMD) instead of intervenors having to request documentation. Currently, much of the PFP funding gets directed to chasing documents.

25. As well, to enable further efficiencies, we recommend the provision of a document regarding naming conventions, or the use of meaningful document titles.

26. We recommend the measures proposed below be included as conditions of the license:

- continuous and stringent measures to monitor the impacts of each impingement and entrainment on the Bay of Fundy ecosystem. Specifically, we recommend that any license include conditions stipulating that the operator of the PLNGS take weekly samples of the water flowing into and through the plant to collect data on casualties of each impingement and entrainment. These samples should be analyzed for all organisms they contain, including but not limited to, fish, fish larvae, zooplankton, and phytoplankton. The results of this weekly sampling should be made available to the public on an ongoing basis as the samples are analyzed.
- the development and analysis of a cumulative impacts study regarding the marine environment, providing trend information regarding the local fisheries starting before the construction of PLNGS, as a baseline
- the keeping and public release of records of any fish or marine mammals that have been drawn into the forebay as well as reports of live releases back to the bay or mortalities. We suggest these reports be made public at least on a monthly basis.

Appendix 4

Summary Notes provided by CNSC to PGRI after the

Feb 24, 2022

Biannual Update Meeting

Summary of Meeting with Peskotomuhkati Nation

February 24, 2022, 10:00 am to noon (AST)

Location: Teams meeting

Attendees:

CNSC	**Peskotomuhkati Nation**
Anupama Bulkan Heather Davis Patrick Collins Katelyn Peters Davis Szonyi Laura DeCoste Adrienne Ethier Kendra Warnock-Juteau	Chief Hugh Akagi Kim Reeder

Related documents: Presentation

Purpose: To discuss the following:

- Point Lepreau Nuclear Generating Station (PLNGS) and relicensing
- Environmental Protection Review (EPR) Report and Environmental Risk Assessments (ERA)
- Independent Environmental Monitoring Program

Topics Discussed:

- **General Overview of the CNSC:** Heather Davis provided a general overview of the CNSC. This included information about the independent Commission, CNSC staff and the facilities and activities that are regulated. CNSC provided a link with information about each of the Commission Members, also found here: http://www.nuclearsafety.gc.ca/eng/the-commission/commission-members/index.cfm
- **Regulatory Oversight:** Heather Davis gave an update on the inspections recently completed at Point Lepreau and the main inspections planned for fiscal year 2022/2023.

  Peskotomuhkati Nation asked questions about the lifecycle of the fuel used at Point Lepreau and where it comes from.

  - The CNSC maintains regulatory oversight from cradle to grave with all steps, including mining, taking place in Canada. The CNSC committed to providing information on where Point Lepreau specifically gets their fuel, prior to the intervention deadline.

  Peskotomuhkati Nation asked about the difference between Type I and Type II inspections, how frequently each inspection is done and what other Type I inspections have been completed. Note – additional information has been provided below

- Type I inspections are similar to an audit and are not done very frequently. They can be prompted by a new process or program occurring, significant changes to a program, or in areas where systemic failures are occurring. The Type I planned for the 2022 fiscal year is on Fitness for Duty because there is a new Regulatory Document that NB Power has committed to being compliant with.
- Type II inspections review the outputs and outcomes of programs and ensure that the processes are being followed. Type II Inspections can be either part of the Baseline Compliance Plan or otherwise reactive. Type II inspections on the baseline are typically completed once every 5 years. Reactive Type II inspections can result from changes to a program that affect the program outputs or outcomes, or repeated items of non-compliance.
- Field Inspections are completed every year. These are used to collect data on the outputs and outcomes of programs. They typically have limited scope and can be used to determine if further follow-up compliance activities are required.

CNSC confirmed that information that comes out of all inspections, surveillance, monitoring and compliance assessments are reported in the annual Regulatory Oversite Report. CNSC committed to providing a list of all Type I inspections done since the 2012 refurbishment.

- **Relicensing:** Patrick Collins provided updates on the relicensing process at the PLNGS. This included information about important dates, how to observe and/or participate a public commission meeting, CNSC staff technical assessment of the licence and the information that feeds into a Commission decision. The part 1 hearing was on January 26, 2022 and the part 2 hearing is planned for May 11-12, 2022. Applications for interventions are due by March 28, 2022.

  Peskotomuhkati Nation asked what happens if people miss the intervention deadline and how emails that simply support or oppose the facility are dealt with.

  - The Registry is able to offer extensions under exceptional circumstances that could be granted on a case-by-case basis. If an extension is needed, it is best to ask as soon as possible preferably before the March 28th deadline.
  - During the meeting, the CNSC offered the following answer, all intervenors are required to follow the formal intervention process and the structure of the template. If the Registry received an email that does not follow the template, the Registry would likely provide the template and offer to help fill in the template. The intervention would need to provide evidence or additional information, rather than just an email indicting support or opposition of the facility.
  - However, follow up with the Registry indicates that an e-mail intervention can be sent. The e-mail would need to indicate clearly why they want to participate and if they would like to participate in writing only or also my making an oral presentation. Interventions are accepted based on the relevance to the application in front of the Commission.

  Peskotomuhkati Nation asked how long the SCA framework had been used and where the information about the SCAs is found.

  - The framework was developed in 2008 and was applied in 2010/2012. SCAs can be adjusted and new SCAs can be added. The CNSC uses the SCAs to as an input for the

plant rating to determine if a licensee has been satisfactory or below expectations. This assessment is done yearly and posted in the RORs. For relicensing, the CNSC reviews each SCA over the whole licensing period to determine if the licensee has been showing a stable performance.

- Section 3 of the Point Lepreau staff CMD shows the information for the past 5 years. The overall rating is satisfactory.
- CNSC staff committed to providing the 2017 Point Lepreau CMD to compare the SCAs from the last relicensing.

Peskotomuhkati Nation asked when the decision will be made on if the Part 2 hearing will be virtual or in person and who makes the decision.

- CNSC confirmed the Registry makes the decision with input from the Commission. The CNSC does not have any information about the timing of the decision but committed to letting Peskotomuhkati Nation know if the hearing will be in person or virtual as soon as possible.

- **EPR Report and ERA:** Kendra Warnock-Juteau provided information on how the CNSC conducts EPR's for a nuclear facility and introduced the most recent EPR report that was developed for the Point Lepreau Nuclear Generating Station. These EPR reports will be updated every five years or so, as the licensee submits their updated Environmental Risk Assessments. As documented in the report, CNSC staff have found that the potential risks from physical impacts, as well as from radiological and hazardous releases to the environment from the Point Lepreau NGS are low to negligible. Additionally, the potential risks to human health are indistinguishable to health outcomes in the general public. Adrienne Ethier provided information about the PLNGS ERA. CNSC conducted a comprehensive review of the PLNGS ERA to ensure compliance with CSA N288.6, and to confirm the public and environment remain protected. Several recommendations were identified to fill knowledge and information gaps during CNSC staff review of the ERA that we will continue to follow-up on to ensure completion and incorporation of results into the next scheduled ERA review and update in 2025. The recommendations are included in the summary of the ERA, found here: https://www.nbpower.com/media/1491302/plngs-2022-era-english-final.pdf

  Peskotomuhkati Nation asked which health studies and Indigenous Knowledge studies have been considered for Point Lepreau, if any other EPRs have reported concerns with a facility and how often EPR reports and ERAs are completed.

  - Section 5 of the report (found here: https://nuclearsafety.gc.ca/eng/resources/publications/reports/PLNGS/index.cfm#sec-5-0) outlines which health studies were considered in the Point Lepreau EPR Report. It includes provincial studies, studies in other parts of Canada and regional studies conducted near the Point Lepreau facility.
  - The CNSC encourages licensees to seek out Indigenous Knowledge to inform their ERA and supporting documentation. The CNSC also seeks to include Indigenous Knowledge in the IEMP campaign, including in planning and sampling. The CNSC is looking at options to include Indigenous Knowledge more thoroughly in these EPR report.

- Periodic EPR reports are a new initiative from the CNSC (de-coupled from the licensing process). EPR reports (previously known as EA reports under the NSCA) consider environmental protection-related factors in a holistic approach. CNSC staff committed to providing a summary of the differences between the new periodic EPR reports and previous EPR report formats, as well as whether there have been any previous EPR reports that found concerns with a facility.
- The CNSC confirmed NB Power must complete an ERA every 5 years. The CNSC then completes the EPR report every 5 years. NB Power is also required to look at their monitoring programs and make updates as required. An ERA can be triggered sooner if there is a significant operational change at the facility.
- The CNSC confirmed that the PLNGS ERA was submitted in 2020. However, CNSC staff requested revisions and NB Power re-submitted the ERA in 2021. The Peskotomuhkati Nation requested a copy of all the comments the CNSC provided to NB Power on the 2020 ERA. The CNSC committed to confirming how the comments were sent to NB Power and will follow up with Peskotomuhkati Nation to provide more information.

- **Independent Environmental Monitoring Program:** David Szonyi discussed the samples that were taken as part of the 2020/2021 IEMP sampling campaign. The results from this campaign are scheduled to be posted on the CNSC website on March 1, 2022 (found here: https://nuclearsafety.gc.ca/eng/resources/maps-of-nuclear-facilities/iemp/point-lepreau.cfm). CNSC staff confirmed that nothing of concern was found and that results can be discussed more in depth at a future meeting.

  Once results become available, the IEMP team would be happy to collaborate with the Peskotomuhkati Nation to work on sharing the results with interested community members. Something recently developed is the IEMP results card. The CNSC committed to sending a follow up email outlining options to share the information.

  Peskotomuhkati Nation asked why no fish samples were taken in 2021/2022 and what would be sampled next time.

  - In 2014, 2015 and 2017 the IEMP sampled salmon and trout. CNSC staff indicated that it is difficult to sample fish local to the Point Lepreau Site. Whereas CNSC staff were able to sample shellfish near the site. CNSC staff also worked with a local lobster fisherman to obtain lobster samples. The IEMP tries to sample items the community may be eating. For example, only the meat of the lobster was analyzed. As the CNSC's lab is a chemistry lab, biological dissections and analyses are not performed. The samples are sent to the CNSC lab in Ottawa and tested by CNSC staff for radioactive contaminants.
  - The Point Lepreau site is not on the list for IEMP this year. The site is sampled four times every ten years, so the team will be back in a couple of years. The site has been sampled five times since 2012. The goal of the IEMP program is to be a snap-shot in time. An effort is made to take similar samples (water / soil / produce etc) as much as possible. CNSC staff emphasized that they are open to receiving comments on what other species could be sampled that are of interest to the Peskotomuhkati Nation.

- It is important to note that NB Power has a more fulsome monitoring program in place that the CNSC reviews. The IEMP results are compared to NB Powers results to ensure there are no major differences.

Peskotomuhkati Nation indicated that the lobster hepatopancreas (tomalley) is a delicacy frequently eaten by community members and would like it to be tested next time as contaminants may be concentrated there. They commented that lobster are also impacted by aqua culture and pesticides. CNSC staff thanked Chief Hugh Akagi for this knowledge. CNSC staff will consider sampling and testing the hepatopancreas during the next IEMP and invite the Peskotomuhkati Nation to collaborate on the sampling plan for the next campaign..

- **Webinar on March 2, 2022:** Heather Davis indicated that there is an upcoming webinar on the Point Lepreau Licence renewal on March 2, 2022. Registration is required to attend and can be done here: http://www.nuclearsafety.gc.ca/eng/stay-connected/get-involved/meet-the-nuclear-regulator/point-lepreau-webinar-2022.cfm

- **Discussion**

  Peskotomuhkati Nation asked if Natural Resources Canada (NRCan) is the Ministry responsible for looking at information related to nuclear in Canada.

  - CNSC staff clarified that NRCan is responsible for enabling the national policy around the nuclear sector but the CNSC reports to Parliament **through** the Minister of Natural Resources, not **to** the Minister. This distinction is important because the CNSC is an independent regulatory agency, and thus operates at arms-length from the government, including Natural Resources Canada. The CNSC is mandated to protect the health and safety of Canadians, as well as our environment, regardless of the direction industry is going.

  Peskotomuhkati Nation asked if waste is moved off-site and who is responsible for waste management.

  - CNSC staff indicated that waste from nuclear power plants is not usually transported off-site. CNSC staff committed to having the experts in waste management and transportation come to a future meeting to discuss this topic further.

  Peskotomuhkati Nation asked if international laws are developed under the Joint Convention on Waste Management, whether it is linked to the UN and if there is an international regulatory body that Canada reports to.

  - The Joint Convention allows countries to report on their own processes and share experiences. Canada has it's own framework and laws it has to follow.
  - The International Atomic Energy Agency (IAEA) is an organization within the UN system that we have an agreement with. However, it provides guidance that we do our best to follow, it is not law.
  - We participate on working groups to ensure that the CNSC's regulatory documents are consistent, as appropriate, with internationally agreed upon best practices and principles as well as sure that CNSC guidance, policies and technical standards are current.

- CNSC staff were not aware if members of the public are able to attend the international working groups, but the outcomes of the working groups (for example, reports) are publicly available.
- Additional information about the Joint Convention can be found here: https://nuclearsafety.gc.ca/eng/resources/publications/reports/jointconvention/

Peskotomuhkati Nation commented that the licencing periods keep getting longer and asked if there is a connection between the licencing length and oversight.

- CNSC staff consider the request from the Licensee when making a recommendation to the Commission. NB Power requested a 25-year licence and CNSC staff have recommended a 20-year licence. Part of the reasoning is that 20 years aligns with the expected end of plant life. Point Lepreau was returned to service in 2012 after a refurbishment that extended the plant life up to an additional 30 years, in part because the pressure tubes have a design life of 30 years. CNSC staff estimate that in approximately 20 years, NB Power would be required to decided to either refurbish or commence end of commercial operations and would be required to seek Commission approval at that time
- NB Power can do a reassessment to determine if the pressure tube life could be extended longer than 30 years. However, that would require NB Power to complete additional analysis and go before the Commission for a decision again.
- CNSC staff's regulatory oversight is independent of the licence duration and will continue to be conducted to confirm compliance with regulatory requirements.

Peskotomuhkati Nation commented that there needs to be accountability in the language used by the CNSC. For example, the CNSC says there are no anticipated health impacts which is not the same as no health impacts.

Peskotomuhkati Nation asked about the Duty to Consult and what level of consultation is done for the Point Lepreau Relicensing process.

- CNSC staff indicated that licence renewals that propose no changes to an existing facility and its operations do not raise the legal duty to consult as these types of Commission decisions do not lead to any new potential impacts on the exercise of Indigenous or treaty rights. The Point Lepreau Licence Renewal would allow the existing facility to continue doing what it is doing today.
- However, CNSC staff have conducted engagement activities for the Point Lepreau licence renewal with interested Indigenous Nations, communities and representative organizations and are committed to meaningful, ongoing engagement throughout the licencing period. CNSC staff indicated that we are happy to receive feedback on how to improve engagement.

CNSC staff asked Peskotomuhkati Nation how they felt about the approach and frequency of engagement taken so far and if anything should be adjusted. Peskotomuhkati Nation indicated

that twice a year worked for them. CNSC reiterated that staff are available to meeting more regularly as needed and are always available to answer any question.

Peskotomuhkati Nation commented that nuclear energy is often considered a green energy and they are concerned by this, partly due to the waste that is generated. Peskotomuhkati Nation noted that the CNSC had not said this but asked who decides what green energy is and if there is someone in the government that could provide an answer to this.

- CNSC staff confirmed that that is not something CNSC staff are involved in and is outside of the scope of the CNSC.
- CNSC committed to following up to see if there more information about this or a contact from another government department that would be provided.

Peskotomuhkati Nation commented that they have concerns with the amount of electricity and cables going on, the impacts on the magnetic field and how that effects animal such as birds and whales. CNSC staff acknowledged the concerns and indicated that it was out of scope for the CNSC.

Peskotomuhkati Nation asked if there was any information about the health of people who live in the area, such as the patterns of human health and rates of cancer.

- CNSC staff confirmed that there is a group within the CNSC that specializes in human health and committed to bringing experts to a future meeting to discuss this topic further.

Follow-up Actions:

Actions	**Response**
From CNSC staff	
1. CNSC staff to provide more information on the fuel lifecycle for Point Lepreau, prior to the deadline for interventions	Heather provided this information on March 21, 2022
2. CNSC committed to providing a list of all Type I inspections done since the 2012 refurbishment.	Heather provided this information and the inspection reports on March 2, 2022 & March 4, 2022
3. CNSC staff committed to providing the 2017 Point Lepreau CMD to compare the SCAs from the last relicensing.	Heather provided this document on February 28, 2022
4. CNSC staff will inform Peskotomuhkati Nation when the decision has been made if the Part 2 Hearing will be in person or virtual	In progress.
5. CNSC committed to providing a summary of the differences between the periodic EPR reports and previous EPR report formats, as well as if any of the previous reports found concerns with a facility	Heather provided via e-mail on March 17, 2022
6. The CNSC committed to confirming how the comments on the 2020 ERA were sent to NB Power and will follow	Heather provided comments on March 7, 2022

up with Peskotomuhkati Nation to provide more information on these comments.	
7. The CNSC committed to sending a follow up email outlining options to share the information about the IEMP results	Heather provided template on March 17
8. CNSC committed to following up on the question about green energy.	Natural Resources Canada (NRCan) confirmed they are the Federal Department responsible for providing recommendations and advice related to nuclear energy policy – this includes advice or recommendations regarding terminology or language to use with nuclear energy. NRCan stated that recent published policy documents (i.e. Government of Canada | SMR Action Plan) refers to nuclear energy as a non-emitting source of energy. If Peskotomuhkati Nation have additional questions regarding nuclear energy policy, including terminology used, please contact John Stronach, Senior Advisor for the Nuclear Energy Division at NRCan by phone (343) 543-6957 or email at john.stronach@nrcan-rncan.gc.ca

Future Topics of Discussion (next meeting possibly in August / September):

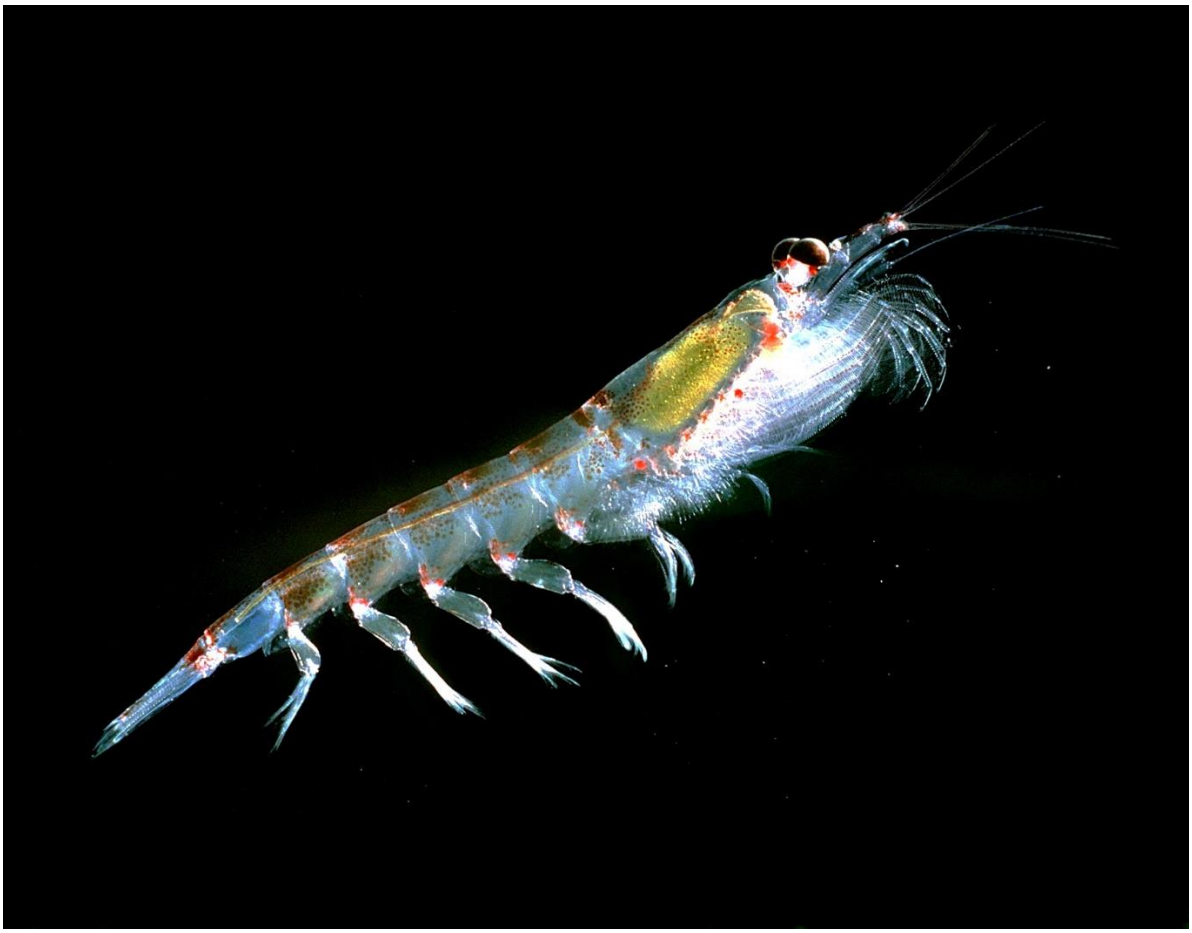
1. Waste Management and transportation
2. Human health

Appendix 5

A. MacKay

On The Negative Impact of the Point Lepreau Nuclear Plant on Marine Plankton and Larval Fishes of the Bay of Fundy

The Negative Impact of the Point Lepreau Nuclear Plant on Marine Plankton and Larval Fishes of the Bay of Fundy



by Art MacKay

HOW MUCH WATER DOES POINT LEPREAU USE?

In 1980 the New Brunswick Electric Power Commission described building a cooling system for the 600 MW nuclear generating station at Point Lepreau as follows:

Of major consideration in the design of a nuclear power plant is the enormous heat loss from the plant's operation, and the effective disposal of this heat energy through condensers and turbines into the environment. Heat diffusion was a factor in the selection of the Point Lepreau site. High tides with peak velocities of up to three knots cause effective mixing of the ocean waters and provide a heat sink large enough for two 600 MW units. It was decided to locate an intake tunnel off the east side of the peninsula and an outlet tunnel off the west side, surface structures having been ruled out because of possible wave damage. In addition to water flow rate and velocity, the protection of fish and shellfish, wave impact, and navigational clearance requirements had to be considered in the design of the intake structure.

Unfortunately, the impact on local plankton, invertebrates and fish larvae is not restricted to the impact of discharged wastewater into the Bay of Fundy, the real impact is to marine life killed by heating in the intake system.

A survey of fish landings in the area, showed seriously decreased landings that suggested something was impacting the commercial fishery in the area. To determine the impacts of kills in heated intake water, an analysis of water use was carried out using data from various NB Power publications about Point Lepreau Nuclear.

Estimated volume of water entering the Bay of Fundy each day - Assume, on average, 160 billion tons of water enter the Bay of Fundy on each tide or 160,000,000,000 x 269.01278331309 = **43,042,048,000,000 gallons every day**

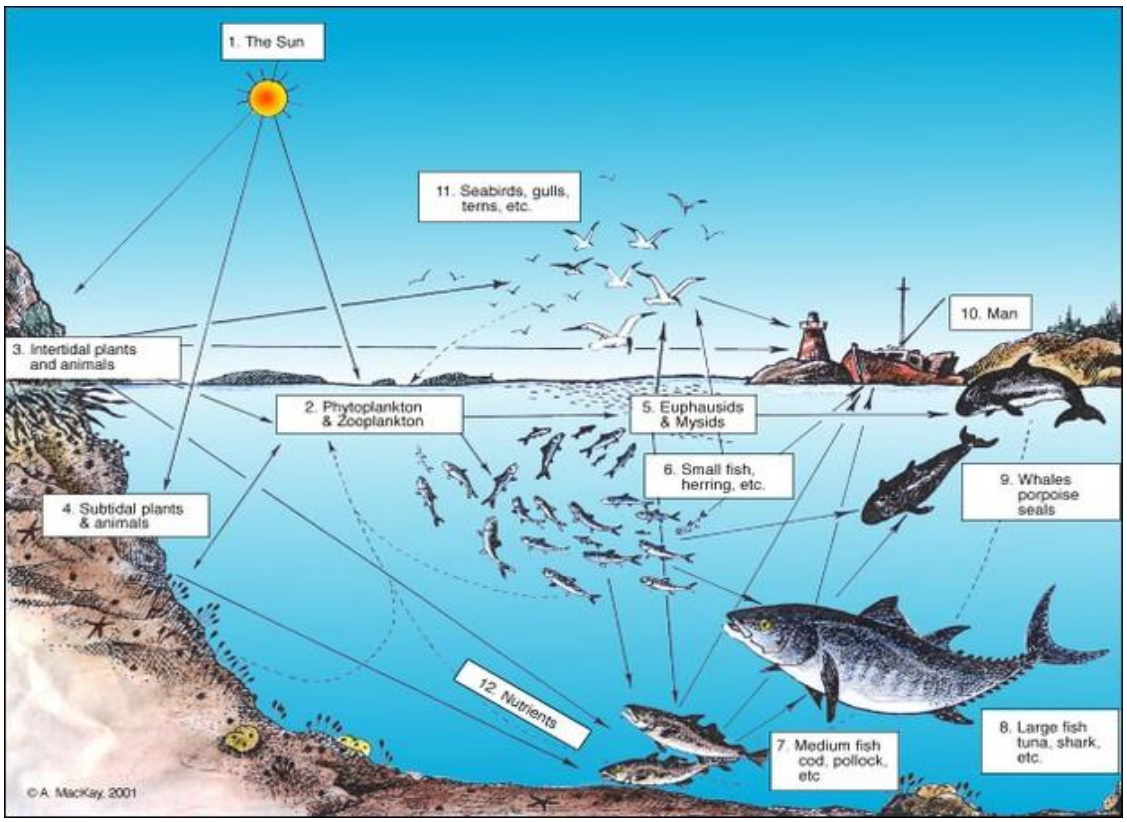
Estimated water volume at Point Lepreau - Based on data obtained from NB Power's website, the daily volume of water entering and passing through the cooling system at Point Lepreau is calculated as follows: 25.8 cubic meters per second equals 6,815,639 USLiquid gallons/second or 341,000 lgpm 341,00 lgpm x 1440/min/day = **491,040,000 USL gallons per day.**

<u>Estimated percentage of daily tidal water used by Point Lepreau cooling system</u> - 43,042,048,000,000 divided by 491,040,000 **= 1.14 percent daily.**

At this rate, it takes approximately 88 days for Point Lepreau to use the equivalent of all tidal waters entering the Bay of Fundy and destroying all the life in their intake cooling water.

LIFE IN BAY OF FUNDY WATERS

The Bay of Fundy is known to be one of the most productive marine locations along the Atlantic coast and planktonic species are the essential element that allows this diversity to thrive.



The plants and animals that are found in these waters are diverse and in addition to phytoplankton, can include adults and larvae from the following animal groups:

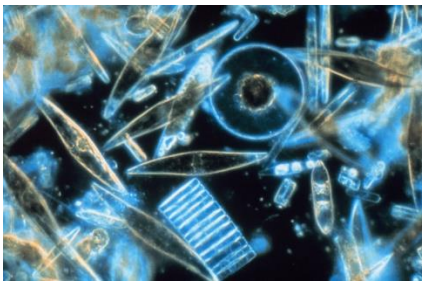
1. *Acoela, among the most primitive bilateral animals;*
2. *Annelida, (polychaetes and sea leeches);*

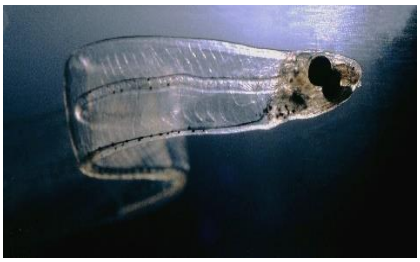
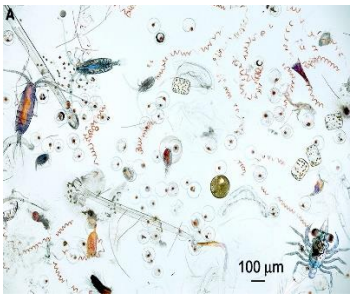
3. *Brachiopoda, marine animals that have hard "valves" (shells) on the upper and lower surfaces;*
4. *Bryozoa, also known as moss animals or sea mats.*
5. *Chaetognatha, commonly known as arrow worms, are a phylum of predatory marine worms that are a major component of plankton.*
6. *Cephalochordata represented in the modern oceans by the lancelets (also known as Amphioxus);*
7. *Cnidaria, such as jellyfish, sea anemones, and corals.*
8. *Crustacea, including lobsters, crabs, shrimp, crayfish, barnacles, hermit crabs, mantis shrimps, and copepods;*
9. *Ctenophora, also known as comb jellies, the largest animals that swim by means of cilia;*
10. *Echinodermata, including sea stars, brittle stars, sea urchins, sand dollars, sea cucumbers, crinoids, and sea daisies;*
11. *Echiura, also known as spoon worms;*
12. *Gnathostomulids, slender to thread-like worms, with a transparent body that inhabit sand and mud beneath shallow coastal waters;*
13. *Gastrotricha, often called hairy backs, found mostly interstitially in between sediment particles;*
14. *Hemichordata, includes acorn worms, solitary worm-shaped organisms;*
15. *Kamptozoa, goblet-shaped sessile aquatic animals, with relatively long stalks and a "crown" of solid tentacles, also called Entoprocta;*
16. *Kinorhyncha, segmented, limbless animals, widespread in mud or sand at all depths, also called mud dragons;*
17. *Loricifera, very small to microscopic marine sediment-dwelling animals only discovered in 1983;*
18. *Mollusca,including shellfish, squid, octopus, whelks, Nautilus, cuttlefish, nudibranchs, scallops, sea snails, Aplacophora, Caudofoveata, Monoplacophora, Polyplacophora, and Scaphopoda;*
19. *Myzostomida, a taxonomic group of small marine worms which are parasitic on crinoids or "sea lilies";*
20. *Nemertinea, also known as "ribbon worms" or "proboscis worms";*
21. *Orthonectida, a small phylum of poorly known parasites of marine invertebrates that are among the simplest of multi-cellular organisms;*
22. *Phoronida, a phylum of marine animals that filter-feed with a lophophore (a "crown" of tentacles), and build upright tubes of chitin to support and protect their soft bodies;*
23. *Placozoa, small, flattened, multicellular animals around 1 millimetre across and the simplest in structure. They have no regular outline, although the lower surface is somewhat concave, and the upper surface is always flattened;*
24. *Porifera (sponges), multicellular organisms that have bodies full of pores and channels allowing water to circulate through them;*
25. *Priapulida, or penis worms, are a phylum of marine worms that live marine mud. They are named for their extensible spiny proboscis, which, in some species, may have a shape like that of a human penis;*
26. *Pycnogonida, also called sea spiders, are unrelated to spiders, or even to arachnids which they resemble;*
27. *Sipunculida, also called peanut worms, is a group containing 144–320 species (estimates vary) of bilaterally symmetrical, unsegmented marine worms;*
28. *Tunicata, also known as sea squirts or sea pork, are filter feeders attached to rocks or similarly suitable surfaces on the ocean floor;*
29. *Some flatworms of the classes Turbellaria and Monogenea;*
30. *Xenoturbella, a genus of bilaterian animals that contains only two marine worm-like species;*

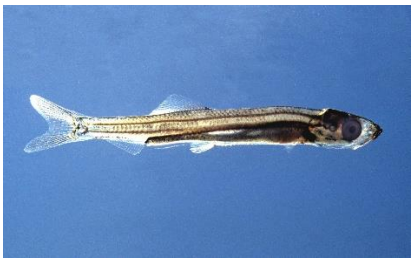
From Wikipedia

Arthropods total about 1,113,000, molluscs about 85,000 and chordates about 52,000.

The following images indicate the diversity in our marine waters which are literally filled with creatures of all kinds that are needed in a healthy marine environment.





Based on this analysis, it is apparent that the Point Lepreau Nuclear Station has a major detrimental impact on the marine life of the Bay of Fundy.

LINKS

Point Lepreau Nuclear Generating Station
Point Lepreau Nuclear Generating Station - NB Power
Nuclear - NB Power
Point Lepreau Nuclear Generating Station - Canadian ...
Questions about nuclear energy and Point Lepreau in the ...
(PDF) Marine Plankton: A practical guide to ecology ...
What are plankton? - National Ocean Service
Marine Phytoplankton Algae | Omega-3 | PlanktonHolland
Marine Life: Plankton
Plankton - Wikipedia
Phytoplankton responses to wastewater discharges at two ...
How nuclear pollution affects the ocean waters, the ...
17 Effects of Radioactive Waste in Ocean - DeepOceanFacts.com
13 Effects of Nuclear Waste on the Ocean - DeepOceanFacts.com
German expert: nuclear wastewater pollutants will reach ...

Appendix 6

A. Secord 2020

Nuclear Power Decision-Making in New Brunswick, 1971-1975

Acadiensis
Journal of the History of the Atlantic Region
Revue d'histoire de la région Atlantique

ACADIENSIS

Nuclear Power Decision-Making in New Brunswick, 1971-1975

Andrew G. Secord

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Article abstract

This article explores the origins of the Point Lepreau nuclear reactor in southern New Brunswick, with a focus on the corporate strategies of the two state enterprises most directly involved: the New Brunswick Electric Power Commission (NBEPC) and Atomic Energy of Canada Limited (AECL). Although their nuclear decision was increasingly challenged from within the federal state, NBEPC officials worked aggressively to maintain their nuclear timeline and took on additional risks in the process. At the final decision point in 1974, they proceeded notwithstanding unforeseen increases in estimated construction costs and without potential partners.

Nuclear Power Decision-Making in New Brunswick, 1971–1975

ANDREW G. SECORD

Cet article explore les origines du réacteur nucléaire de Point Lepreau, dans le Sud du Nouveau-Brunswick, et s'intéresse particulièrement aux stratégies d'entreprise des deux sociétés d'État les plus directement concernées : la Commission d'Énergie électrique du Nouveau-Brunswick (CEENB) et Énergie atomique du Canada limitée (EACL). Bien que leur décision en faveur du nucléaire ait été de plus en plus contestée au sein de l'État fédéral, les dirigeants de la CEENB déployèrent des efforts vigoureux pour maintenir leur programme nucléaire et, ce faisant, prirent des risques supplémentaires. Au moment de la décision finale, en 1974, ils allèrent de l'avant en dépit des augmentations imprévues des coûts de construction estimatifs et de l'absence de partenaires potentiels.

This article explores the origins of the Point Lepreau nuclear reactor in southern New Brunswick, with a focus on the corporate strategies of the two state enterprises most directly involved: the New Brunswick Electric Power Commission (NBEPC) and Atomic Energy of Canada Limited (AECL). Although their nuclear decision was increasingly challenged from within the federal state, NBEPC officials worked aggressively to maintain their nuclear timeline and took on additional risks in the process. At the final decision point in 1974, they proceeded notwithstanding unforeseen increases in estimated construction costs and without potential partners.

AT A COMMUNITY MEETING ON 25 JULY 1974 at the Dipper Harbour Church Hall, three-quarters of the 200 people in attendance stood to express their opposition to the proposed Lepreau nuclear reactor. When they asked the representative of New Brunswick Electric Power Commission (NBEPC) at the meeting to explain why they planned to build the reactor in their community, he limited his reply to the local factors that would reduce the costs of the nuclear project: access to cooling water from the Bay of Fundy and proximity to transmission lines.[1] Unsatisfied with such simplistic explanations, many demanded the project be cancelled while others worked for a delay and

1 "Shore Residents Don't Want Lepreau Nuclear Power Plant," *Telegraph Journal* (Saint John), 27 July 1974.

Andrew G. Secord, "Nuclear Power Decision-Making in New Brunswick, 1971–1975," *Acadiensis* 49, no. 1 (Spring/printemps 2020): 123–150.

public inquiry.[2] In her history of the local communities – Chance Harbour, Dipper Harbour, and Maces Bay – Ethel Thompson recounts: "The news that a scientific wonder, and industrial giant with a continuous threatening waste-control problem, was scheduled for placement in the centre of the traditional communities was received with mixed feelings."[3] This article explores the origins of the Point Lepreau nuclear reactor utilizing the archival records of the key organizations involved – the NBEPC and Atomic Energy of Canada Limited (AECL) – records that members of the local communities could not access at the time.

Academic research into nuclear power decision-making in Canada during the 1970s has focused on Ontario and Quebec.[4] The few academic references to the Lepreau decision speculate that the reactor was chosen by the New Brunswick government in response to rising international oil prices, energy security problems, and/or for economic development reasons.[5] Such explanations view the nuclear decision as a response to challenges external to the electricity sector. In contrast, this research situates the decision in the institutional context and growth dynamic of the public power sector in New Brunswick. Consequently, the research takes a state-centric approach and focuses on the policy formation process within the federal and provincial states – notably within NBEPC.[6] This research is also informed by the literature on organizational decision-making, especially the type of organizational path dependency where managers manifest "lock-in" behaviour and continue with major investments in spite of changed circumstances that nullify their economic viability. The phenomenon is not uncommon among industries, such as nuclear power, with exceptionally long planning and construction phases.[7] Daniel Kahneman and Amos Tversky theorize that as sunk costs

2 "Reactions Vary on Nuclear Plant," *Telegraph Journal*, 20 July 1974.

3 Ethel Anne Thompson, *The Tides of Discipline* (St. Stephen, NB: Print'N Press Ltd., 1978), 96.

4 See, for example, Robert Bothwell, *Nucleus: The History of Atomic Energy of Canada Limited* (Toronto: University of Toronto Press, 1988) and Mahdi Khelfaoui, "Le nucléaire dans la stratégie énergétique du Québec, 1963-2012," *Scientia Canadensis* 37, no. 1-2 (2014): 105-32.

5 See Bothwell, *Nucleus*, 423 and Duane Bratt, *Canada, the Provinces, and the Global Nuclear Revival* (Montreal and Kingston: McGill-Queen's University Press, 2012), 173.

6 For an overview of the productivity of the state-centric approach, see Theda Skocpol, "Bringing the Sate Back In: Retrospect and Prospect," *Scandinavian Political Studies* 31, no. 2 (May 2008): 109-24.

7 Werner F.M. De Bondt and Anil K. Makhija, "Throwing Good Money after Bad? Nuclear Power Plant Investment Decisions and the Relevance of Sunk Costs," *Journal of Economic Behavior and Organization* 10, no. 2 (September 1988): 173-99.

increase in magnitude then managers are willing to take on higher levels of risk to protect their previous investments.[8] Helga Drummond, in her survey of the organizational behaviour literature on institutional commitment to increasingly uneconomic megaprojects, provided an overview of the individual, institutional, and social mechanisms involved. Based on a survey of empirical studies, she included among causal mechanisms the psychological tendency to bias information to defend previous personal decisions, unconscious attachment to "pet" projects, and cultural biases against admitting major errors.[9]

In the late 1960s NBEPC executives focused their planning on creating the pre-conditions for a nuclear path, without which they would be restricted to oil-fired generation or long-term imports from Hydro-Québec. Because they were too small to risk a capital-intensive nuclear reactor on their own, they sought shared ownership with other, larger, utilities that they could only have if they developed high-voltage interconnections with New England. Consequently, they dedicated their resources to building high-voltage interconnections and exchanges with New England utilities to open up the US market for nuclear power from New Brunswick. The New England demand for Canadian nuclear power, however, never materialized and NBEPC managers were forced to shift their focus back to the smaller Maritime market. When their attempts at risk-sharing with other Maritime utilities also failed, NBEPC mangers decided to proceed with the nuclear option on their own. In the process, they worked with their pro-nuclear network within the federal state to avoid a federal economic evaluation and a complete environmental review as conditions for federal assistance.

Analysis of these inter-agency networks requires extensive documentary evidence. This article utilizes the archival material of several federal and provincial departments and agencies available through Library and Archives Canada and the Provincial Archives of New Brunswick as well as documents accessed through the New Brunswick Right to Information Act and the federal Access to Information and Privacy Act.

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8 Daniel Kahneman and Amos Tversky, "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica* 47, no. 2 (March 1979): 263–91.

9 Helga Drummond, "Megaproject Escalation of Commitment: An Update and Appraisal," in *The Oxford Handbook of Megaproject Management*, ed. Bent Flyvbjerg (Oxford: Oxford University Press, 2017): 194–216.

Nuclear power for export from a New Brunswick platform, April 1971-September 1972

The Canadian nuclear industry was dominated by the federal Crown corporation AECL, which by the late 1960s was the principal source of pure research, reactor design, and construction of experimental reactors in Canada.[10] What was originally designed as a small reactor program to produce plutonium for American nuclear weapons[11] evolved into AECL's distinctive commercial heavy water CANDU design, which AECL hoped could compete in domestic and international markets.[12] AECL's first commercial customer, Ontario Hydro, committed to four CANDU reactors (508 megawatts each) at Pickering in 1968 with expected completions between 1971 and 1973. Officials at AECL, the National Energy Board, and the federal Department of Energy and Resources Management were all strong advocates of the Canadian reactor design. Typical of this optimism was a 1968 article in the *Engineering Journal* of the Canadian Engineering Institute in which the author predicted that almost all new electrical energy generation after 1980 in Ontario, Quebec, and the Maritimes would be nuclear.[13] For AECL an expanding Canadian nuclear industry also depended on success in the international reactor market, which was dominated by global multinationals such as Westinghouse and General Electric. The most lucrative export market for AECL was the United States, and NBEPC took on a special role in AECL's marketing strategy – a role consistent with NBEPC's focus on the New England market.

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10 For a listing of the public and private design, component, and government agencies involved in the nuclear industry in Canada in the early 1970s, see *Nuclear Engineering International* 19, no. 217 (June 1974): 500-3.

11 The role of AECL in supplying plutonium to the American nuclear weapons program is well documented; see, for example, Duane Bratt, "Canada's Nuclear Schizophrenia," *Bulletin of the Atomic Scientists* 58, no. 2 (March/April 2002): 45-50. The economic justification for AECL's first reactor, NRU, was based in part on selling plutonium for about $5,000 per ounce to the American weapons program in the 1950s.

12 Various sources document the history of AECL and their marketing strategies by the late 1960s. See Robert Bothwell, *Nucleus*; Duane Bratt, *The Politics of CANDU Exports* (Toronto: University of Toronto Press, 2006); Ron Finch, *Exporting Danger: A History of the Canadian Nuclear Energy Export Program* (Montreal: Black Rose Books, 1986); Fred Knelman, *Nuclear Energy* (Edmonton: Hurtig, 1976); and Laurel Sefton MacDowell, "Nuclear Power," in *Powering Up Canada*, ed. R.W. Sandwell (Montreal and Kingston: McGill-Queen's University Press, 2016), 329-52. The CANDU (Canada Deuterium Uranium) design used natural uranium fuel with heavy-water moderation and cooling and a pressure tube core (calandria) rather than the enriched-fuel, pressure-vessel design of the more common American and European light-water reactors.

13 H.B. Merlin, "The CANDU Reactor and Canada's Economy," *Engineering Journal* 51, no. 10 (October 1968): 19-27.

During the 1950s the provincially owned NBEPC established a near-complete public monopoly of the generation, transmission, and distribution of electricity in New Brunswick, with a public mandate to exploit the province's hydroelectric resources arising from a power-for-industry strategy. The St. John River was transformed by a series of hydroelectric dams into an efficient hydro generating system supported by thermal investments in coal and oil-fired generation to complement hydro's uneven water-flow characteristics. In the process, electricity rates fell in real terms, rural electrification was completed, major inward investments in resource-processing industries (especially pulp and paper and base metal processing) were supplied with large quantities of electricity, and successive governments gained political benefits from the short-term construction jobs and spin-offs for local business.[14] In 1967, NBEPC managers, confronted with the exhaustion of profitable hydro sites and slower rates of growth in the resource sector, employed international consultants to assist in constructing an alternative organizational growth strategy for NBEPC. The result was a new export-led strategy, to be driven by electricity exports to the United States. It was hoped that NBEPC could overcome the constraints of their own small provincial market by building large generating units in New Brunswick to serve the New England market.

Between 1968 and 1971, NBEPC focused on developing high-voltage transmission interconnections, corresponding agreements, and sales contracts to facilitate export sales to New England utilities. Its first major export package involved sales to New England based on re-selling Hydro-Québec purchases between 1970 and 1975, in the process generating over $5 million in profits. The second major package involved exporting 400 megawatts yearly from 1976 to 1986 to a consortium of New England utilities from a new 900-megawatt, oil-fired generator at Coleson Cove, expected to generate $80 million in profits to NBEPC. Since NBEPC's sales revenue in 1970 was $48 million, the new export strategy was considered a tremendous success by NBEPC managers and provincial politicians given the magnitude of the growth in sales, corporate profits, short-term job creation, and business opportunities. As NBEPC managers developed the export market, they began to talk more about their

14 For an exploration of the origins of the power-for-industry strategy, see R.A. Young, "Planning for Power: The New Brunswick Electric Power Commission in the 1950s," *Acadiensis* XII, no. 1 (Autumn 1982): 73-99; James L. Kenny and Andrew Secord, "Public Power for Industry: A Re-examination of the New Brunswick Case, 1940-1960," *Acadiensis* XXX, no. 2 (Spring 2001): 84-108; and James L. Kenny and Andrew G. Secord, "Engineering Modernity: Hydro-Electric Development in New Brunswick, 1945-1970," *Acadiensis* XXXIX, no. 1 (Winter/Spring 2010): 3-26.

strategic geographical position as a basis to generate growth through exports and less about their power to attract industry to New Brunswick.[15]

NBEPC managers regarded oil-fired exports as only an interim supply choice until the CANDU nuclear system was at a mature stage of commercialization, capable of serving from New Brunswick both provincial demand and the New England market. In testimony before the National Energy Board in 1969 and 1972, NBEPC witnesses emphasized the connection between nuclear power and high-voltage interconnections "to permit installations in the Canadian system of extremely large units, such as are involved in the nuclear developments without which power costs in the Atlantic area will never be reduced."[16] Senior management of NBEPC had been actively involved in the development of the Canadian nuclear industry as members of the AECL board of directors since the early 1960s and in 1968 the general manager of NBEPC joined the board of directors of the Canadian Nuclear Association, the principal industry association and advocate for nuclear interests in Canada.[17]

With the completion of the interconnections with New England, NBEPC shifted its planning almost exclusively to nuclear power. At meetings in Toronto in April 1971, AECL Vice-President John Foster proposed a 500-megawatt reactor for NBEPC similar to the Pickering units in Ontario.[18] Senior executives of NBEPC and AECL met again in Fredericton on 22 July. There was shared optimism that NBEPC's current platform for exporting thermal power to New England could be doubled or tripled in size to serve what they viewed as a virtually unlimited export market for nuclear power. The meeting concluded with an agreement that AECL would develop cost estimates for the reactors, NBEPC would proceed with negotiations with American utilities, and both agencies would work jointly in preparing a submission to

15 This synopsis of the origins of NBEPC's export strategy is based on Andrew G. Secord, "NB Power 1967-72: Constructing the Export Dream," *Journal of New Brunswick Studies* 10 (Fall 2018): 3-20.

16 See the testimony of Frank MacLoon in 1972, repeating previous testimony of 1969, in transcript of National Energy Board Hearings of 18 April 1972 held in Fredericton, NEB Order No. EH-2-72, K9 C16h Ap. National Energy Board Library, Calgary.

17 Minutes of CNA board meetings for this period can be found in file 3-333 CNA, NB Power Central Records (Fredericton). In 1973 A.J. O'Connor, General Manager of NBEPC, was elected president of the Canadian Nuclear Association.

18 A summary of these discussions can be found in J.S. Foster, Vice-President Power Projects, AECL, to A.J. O'Connor, General Manager, NBEPC, 22 April 1971, file 3-333, Atomic Power 1971, NB Power Central Records.

the federal government for financial assistance.[19] Between July and December 1971, AECL and NBEPC managers constructed a proposal that included not only conventional financial assistance but also federal risk coverage and early regulatory approvals for two 600-megawatt CANDU reactors, with 1,000 megawatts dedicated for export over a 15-to-20 year period.[20] By December 1971, senior executives of AECL and NBEPC were discussing their common interests and the need for common action in dealing with other federal government agencies.[21]

On 6 December 1971, NBEPC's senior officials presented their nuclear export proposal, "An Export Power Program for New Brunswick with Nuclear Power," to senior officials of the federal departments of Energy, Mines, and Resources (EMR); Finance; Industry, Trade, and Commerce; Transport; Regional Economic Expansion; External Affairs; and Environment as well as the National Energy Board and AECL. NBEPC argued that it was uniquely positioned among Canadian utilities as a base to export CANDU nuclear electricity to the American market. For AECL officials, successful CANDU energy exports to the American market could establish the competitiveness of the CANDU design for future export sales to the United States and enhance the status of the CANDU technology for future international sales. Additionally, they argued that it could open up the possibility of locating CANDU reactors in the United States. For NBEPC, it would accelerate their transition to nuclear power.[22] The proposal also identified the basis upon which the CANDU exports could be competitive in the New England market. These included NBEPC's lack of corporate income taxation, lower rates of taxation on property and assets,

19 Minutes of Meeting AECL and NBEPC, Fredericton, 22 July 1971, Lepreau Records, 87-00000, General Project, folder 1, NB Power Central Records.

20 As part of their market research, in the summer of 1971 NBEPC solicited proposals from Westinghouse and General Electric for an American reactor for New Brunswick. The purpose of the process, as the general manager of NBEPC pointed out to Boston Edison representatives in January 1972, was to gain commercial information on their competitors. See Notes on Meeting with Vice-President of Boston Edison, 19 January 1972, Lepreau Records, 87-00000, folder 2, NB Power Central Records.

21 See, for example, General Manager, Nuclear Power Marketing, AECL to General Manager of NBEPC, 10 November 1971, Lepreau Records, 87-00000, folder 2, NB Power Central Records and "Notes on Nuclear Power Meeting AECL and Canatom, Dec. 13 and 14, 1971," 30 December 1971, file 3-333, Atomic, NB Power Central Records.

22 "An Export Power Program for New Brunswick with Nuclear Power," 6 December 1971, Department of Finance Records, RG 19, 5362, 3954, L599-1, Library and Archives Canada (LAC), Ottawa.

and fewer regulatory delays than in the U.S.[23] Moreover, American utilities were faced with continual and effective public opposition to nuclear reactors in the northeastern US, which NBEPC could avoid with early regulatory approvals from the National Energy Board, the Atomic Energy Control Board (AECB), and the Department of Environment (DOE).

The submission clarified the challenges facing NBEPC if it was to invest in nuclear power for the export market, including negotiating long-term contracts with New England utilities as well as receiving expeditious regulatory approvals from federal agencies, federal guaranteed loans to cover all or part of NBEPC's borrowing requirements, and federal government coverage of the risks of construction cost overruns and poor operating performance of the nuclear reactor. NBEPC senior executives argued that AECL should finance, design, and construct the plant, and then sell the site to NBEPC after five years of successful operation. Alternatively, they would accept the federal government providing sufficient financial participation and risk coverage to ensure that the nuclear plant would be no more expensive (or risky) than an oil-fired unit. They were specifically concerned with the "abnormal risks related to cost and performance" of nuclear technology, which was "not entirely proven."[24] This, they argued, was especially important as NBEPC's entire generating capacity in 1971 was less than the 1,200 megawatts of the proposed nuclear project.

In response to NBEPC's request for financial assistance, the federal government established an interdepartmental committee chaired by EMR's assistant deputy minister for Energy Development – other members included representatives from Finance; Industry, Trade, and Commerce; and AECL – to recommend a federal response to NBEPC's request.[25] The resulting Memorandum to Cabinet (10 March 1972) did not recommend any assistance to NBEPC to cover its exceptional risks in the areas of uncertain construction costs and reactor operating performance. There was no reference to AECL owning the reactor for five years or the federal government ensuring that the reactor would not expose NBEPC to any risks greater than an oil-fired

23 For example, local taxes in Massachusetts were as high as 16 per cent of revenue for some utilities; see "An Export Power Program for New Brunswick with Nuclear Power," pp. 10-11, Department of Finance Records, RG 19, 5362, 3954, L599-1, LAC.

24 "An Export Power Program for New Brunswick with Nuclear Power," p. 15, Department of Finance Records, RG 19, 5362, 3954, L599-1, LAC.

25 J.L. Gray, President, AECL to Jack Austin, Deputy Minister, Energy, Mines and Resources, 31 January 1972, EMR Records, Lepreau Nuclear Power Station, X-086-30/4-1, LAC.

alternative.[26] The Memorandum to Cabinet did recommend a federal loan for 50 per cent of the estimated construction costs (to be capped at a predetermined level), with the loan guaranteed by the province of New Brunswick and not the federal government.[27] Additionally, the choice of the site was to be the subject of future discussions regarding the federal government's broader employment and industrial considerations.[28] EMR officials worked closely with AECL and NBEPC to maximize federal assistance, but they were unable to overcome resistance from the federal Department of Finance to AECL owning the plant, unwilling to take on the risk of capital cost overruns and poor operating performance of a provincially owned electrical generator, and were doubtful that NBEPC could manage its own financial exposure.[29] Typical of the analysis by the Department of Finance officials was the memo of Myles B. Foster on 29 March 1972, in which he concluded: "The corporation is a small, high cost (11.75) utility with barely enough cash flow to finance its present debt. Its acquisition of two large nuclear reactors is the equivalent of a Volkswagen family acquiring a Cadillac as a second car."[30] Further, by the end of April, Finance officials concluded that the project was not competitive in the US market, and that NBEPC was not strong enough financially to carry out the project.[31] Adding to Finance's skepticism was the economic analysis that the federal Treasury Board Secretariat was completing on the economics

26 "Memorandum to Cabinet – Federal Support for a Nuclear Power Station in New Brunswick," 10 March 1972, EMR Records, Lepreau Nuclear Power Station, X-086-30/4-1, LAC.

27 In the proposed agreement, the federal government would borrow the funds and provide them to New Brunswick at the federal borrowing rate while New Brunswick was required to guarantee the loans. See Memorandum from R.N. Spalding to Myles B. Foster, Subject: Preliminary Analysis of New Brunswick Electric Power Commission, 14 June 1972, Department of Finance Records, RG 19, vol. 5362, file 3954-L599-3, pt. 3, Lepreau-Financing, LAC.

28 "The Cabinet Committee on Government Operations – Record of Committee Decision Meeting, Meeting of March 14, 1972 Federal Support for Nuclear Power Stations in New Brunswick and Quebec," 14 March 1972, EMR Records, X085-3, vol. 2, LAC.

29 S.S. Reisman to Jack Austin, Deputy Minister, Finance, 7 February 1972, RG 19, vol. 5362, file 3954/L599-3-pt. 1, LAC; "Memo from R.A. Fleming to Oestreicher, Thom Subject: New Brunswick Nuclear Power Project Meeting – February 4," 7 February 1972, Department of Finance Records, RG 19, vol. 5362, file 3954/L599-3, pt. 1, LAC.

30 M. Foster to D.M. Jacobs, 29 March 1972, Dept. of Finance Records, RG 19, vol. 3954/L599-3, pt. 2, LAC. NBEPC's average kilowatt hour cost was 11.75 mills versus Ontario Hydro's cost of 7.15 mills. A mill is one-tenth of a cent. See Myles Foster to R.N. Spalding, 14 April 1972, Department of Finance Records, RG 19, vol. 3954/L599-3, pt. 1, LAC.

31 Memorandum from R.A. Flemming to S. Reisman, Subject: New Brunswick Nuclear Power Project, 28 April 1972, Department of Finance Records, RG 19, vol. 5362, file 3954/L599-3, pt. 2, LAC.

of nuclear power in Canada. Specifically, Treasury Board officials challenged the assumption that rising fossil fuel costs would drive the demand for nuclear reactors in Canada as the relatively greater capital costs of nuclear power would likely escalate faster than fossil fuel prices.[32]

Further problems arose when the general manager of NBEPC finally met for serious discussions with New England utility executives (Central Maine Power, New England Electrical System, and Central Vermont Public Service) in August 1972, where the response was overwhelmingly negative.[33] Across New England, utilities were committing to US nuclear projects that, although over budget, were beginning to overcome regulatory interventions. The export strategy was confronted with what the general manager of NBEPC recorded in his meeting notes as "a developing sentiment for the US utilities to be self-sufficient."[34]

Although the export platform initiative failed in 1972, it was an important time for the construction of social relations among pro-nuclear agencies within the provincial and federal state. Especially relevant were the developing relations among a network of officials within NBEPC, EMR, and AECL, and their willingness and capacity to act strategically. The nuclear network had expanded from AECL providing assistance to NBEPC managers in preparing their brief in December 1971 to the point where they were developing common tactics in 1972 negotiations with other federal agencies,[35] sharing early drafts of provincial political correspondence with federal officials, and briefing each other before meetings with federal and provincial politicians.[36] AECL and NBEPC also shared information pertaining to the environmental opposition to nuclear power, including lists of writers to local newspapers, copies of their

32 "Efficiency Perspectives on Current Proposals for Canadian Nuclear Power Development," Planning Branch, Treasury Board Secretariat, May 1972, Deptartment of Finance Records RG 19, vol. 5358, file 3940-10, pt. 1, 1972-1973 Nuclear Power – Study of Nuclear Power Program, LAC. The conflict between the Treasury Board Secretariat and AECL over the economics of CANDU extended into 1973. See, for example, "Report Summary: Some Additional Comments on T.B.S. Perspective on the Canadian Nuclear Power Program," 8 March 1973, Department of Finance Records RG 19, vol. 5357, file 3940-02, pt. 1, Nuclear Power – Policy Dev. 1967-73, LAC.

33 The dates of eight such meetings are recorded in "Chronological Listing of the Nuclear Power Project," Lepreau Records, 87-00000, folder 1, NB Power Central Records.

34 "Notes of Meeting with New England Utility Representatives, August 22, 23, and 24, 1972," 1 September 1972, Lepreau Records, 87-00000, folder 4, NB Power Central Records.

35 "Notes on Nuclear Power Meeting AECL and CANATOM," 30 December 1971, file 10071-4566, NB Power Central Records.

36 A.J. O'Connor to G.M. MacNabb, 9 February 1972, file 3-333, Atomic 1972, NB Power Central Records.

responses, and analyses of the strengths of the environmental movement. They coordinated their public responses and worked closely with the Canadian Nuclear Association in their public relations campaigns in New Brunswick.[37]

Heavy water/nuclear complex, March 1973-October 1973

In March 1973, AECL approached NBEPC suggesting they together compete with Quebec, Saskatchewan, and Alberta as a site for AECL's proposed 800-ton-per-year heavy water plant in combination with a New Brunswick 600-megawatt nuclear reactor that would supply 200 megawatts of process steam to the heavy water plant.[38] The responses of NBEPC management and Premier Richard Hatfield were enthusiastic in light of a guaranteed market for one-third of the reactor's output and the estimated 1,875 construction jobs.[39] Working closely with EMR officials, NBEPC submitted its application on 13 July 1973 in which it was argued that the federal government should provide loans to NBEPC to cover 75 per cent of the cost of the nuclear reactor in order to maintain acceptable debit-equity ratios for NBEPC.[40]

EMR acted as the federal advocate for the NBEPC proposal, drafting a Memorandum to Cabinet in support of the NBEPC proposal on 13 July. While acknowledging that the New Brunswick site would rank fourth out of eight potential locations in terms of the costs of heavy water, EMR officials argued that a New Brunswick location would accelerate the introduction of nuclear power to the Maritimes and that "nuclear is essential in the Maritimes to prevent importing oil for electricity."[41] AECL, in contrast, supported the

37 See A.R. Burge to A.J. O'Connor, 11 February 1972, file 3-333 Atomic 1972, NB Power Central Records for correspondence regarding nuclear opponents. For an example of the nuclear industry's tactical analysis of the environmental opposition, see "A Report on Nuclear Protest Groups and the Apparent Development of a Social Movement," 26 November 1975, file 87-00174, Ontario Hydro Central Records (Toronto).

38 J. Stewart Brooks, Chairman, NBEPC to Premier R. Hatfield, 22 March 1973, with attached "Meeting Notes of March 22, 1973 Prepared by John Foster, Vice-President, AECL – Meeting between NBEPC officials and AECL," Hatfield Papers, RS 417, Atomic Energy 1973, PANB.

39 See "Heavy Water Plant Proposal New Brunswick Location," 6 April 1973, RS 417, NBEPC 1973, PANB for NBEPC's correspondence with the premier's office regarding the potential for 1,875 construction jobs and 350 permanent jobs.

40 "Nuclear Power Plant and Heavy Water Complex for New Brunswick," 6 July 1973, Lepreau Records, 87-00000, file 3, NB Power Central Records.

41 Memorandum to Cabinet "New Brunswick Proposal for Nuclear Generation and Heavy Water Production," 13 July 1973, Department of Finance Records, RG 19, vol. 5362, file 3954-L599-3, pt. 3, Lepreau Financing, LAC.

lower-cost Quebec site to minimize its heavy water costs.[42] Department of Finance officials maintained the position that any New Brunswick nuclear assistance should be deferred until the work of the ongoing Interdepartmental Working Group on Nuclear Power was completed, a key part of which was an evaluation of the economics of nuclear power in the Canadian context.[43] The deputy minister of Finance also argued that a nuclear delay in New Brunswick would provide time to examine alternatives to NBEPC's nuclear path in the context of several federal national energy policy initiatives, including the extension of the national oil pipeline to the Maritimes, east-coast oil developments, and possible NBEPC imports from hydro developments in Quebec and on the Lower Churchill.[44] On 21 September 1973, the general manager of NBEPC presented the New Brunswick case to the federal Cabinet at their meeting in Saint John, stressing NBEPC's commitment to nuclear power.[45] By October 1973, however, the New Brunswick government had accepted the failure of its heavy-water nuclear proposal, as the federal government opted for the lower-cost site in Quebec.[46]

Regional reactors (2 × 600), November 1973-March 1974

With the failure of both their nuclear export strategy and the combined reactor/heavy water complex, NBEPC managers shifted their focus to the eastern Canadian market. Their most optimistic scenario was summarized in a 13 December 1973 nuclear progress report to the NBEPC Board of Commissioners in which the general manager outlined a hypothetical

42 Memorandum from S.S. Reisman to Minister MacDonald, Subject: Cabinet Agenda, Location for New Heavy Water Production Plant: New Brunswick Proposal for Nuclear Generation and Heavy Water Production, 18 July 1973, Department of Finance Records, RG 19, vol. 5362, file 3954-L599-3, pt. 3 Lepreau-Financing, LAC.

43 For the mandate of the working group, see Memorandum from I.A. Stewart to G.F. Osbaldeston, Subject: AECL, 7 May 1973, Dept. of Finance Records, RG 19, vol. 5358, file 3940-02, pt. 2, Nuclear Power-Study of Nuclear Power Program 1973, LAC. For the position of the Department of Finance, see Memorandum from G.F. Osbaldeston to C.M. Drury, 16 July 1973, Department of Finance Records, RG 19, vol. 5362, file 3954-L599-3, pt. 3, Lepreau Financing, LAC.

44 Memorandum from S.S. Reisman to Minister MacDonald, 29 October 1973, Dept. of Finance Records, RG 19, vol. 5362, file 3954-L599-3, pt. 3, Lepreau Financing, LAC.

45 "New Brunswick's Electrical Energy Supply," 21 September 1973, Records of the Deputy Minister, Department of Regional Economic Expansion, file 116-A-13, Atlantic Power Development, LAC.

46 Memorandum from J. Austin to Minister MacDonald, Subject: New Brunswick Proposal for a Nuclear Project, 17 October 1973, EMR Records, X085-3, vol. 2, LAC and J. McNichols, Office of Minister D.S. MacDonald to Premier Hatfield, 7 December 1973, RS 417, Atomic Energy 1973, PANB.

scenario involving two 600-megawatt regional nuclear reactors supplying Hydro-Québec (300 megawatts), Nova Scotia (350 megawatts), and Maine (50 megawatts). They assumed that the federal government could be convinced to provide 50 per cent of the financing for both units, Nova Scotia would take a 25 per cent equity position, and the Hydro-Québec sales would generate profits for NBEPC. The construction costs were not yet confirmed, but they assumed $448 million for the first unit and $467 million for the second with AECL guaranteeing the construction costs of the nuclear steam supply system. In spite of their recent lack of success, they presented their impending nuclear decision to the NBEPC Board as almost inevitable: "The target would be to be in a position to sign letters of intent, tie down financial agreements and be prepared to place equipment on order as early as possible – optimistically by early spring."[47]

This early optimism had already started to deteriorate in the three weeks prior to the presentation. NBEPC's financial advisor, First Boston, advised NBEPC in November 1973 that in order to maintain its financial stability with any nuclear program NBEPC would need risk guarantees on the plant operating performance, negotiated take-or-pay sales contracts, a federal government cap on construction costs, and another financial backer who would both provide and guarantee 50 per cent of the loans.[48] None of these existed. In early discussions with EMR, the general manager of NBEPC had stressed loan guarantees with the federal government as NBEPC could be financially ruined if the reactor did not operate properly or was delayed.[49] Additionally, the federal Department of Finance officials were adamant in their opposition to guaranteeing provincial loans and to the prospect of covering risks of construction overruns and poor operating performance of a provincial nuclear plant.[50] Furthermore, negotiations with Hydro-Québec were stalled over the selling price.[51] Negotiations with Nova Scotia had not gone beyond

47 Memorandum from A.J. O'Connor to NBEPC Board of Commissioners, 13 December 1973, Lepreau Records, 87-00000, file 3-422b N, folder 6 (5-8-E), NB Power Central Records.

48 Meeting Notes: Meeting in New York-First Boston, 22 November 1973, Lepreau Records, 87-00000, folder 6, NB Power Central Records.

49 Memorandum from G.M. MacNabb to Minister MacDonald, Subject: New Brunswick Nuclear Plant, 19 November 1973, EMR Records, X085-3, vol. 2, LAC.

50 Memorandum from T.K. Shoyama to S.S. Reisman, Subject: New Brunswick CANDU Reactor, 14 December 1973, Department of Finance Records, RG 19, vol. 5362, file 3954-3, pt. 3 Lepreau-Financing, LAC.

51 Memorandum from G.M. MacNabb to Minister MacDonald, Subject: New Brunswick Nuclear Station, 6 December 1973, EMR Records, X085-3, vol. 2, LAC.

correspondence with the Nova Scotia premier, and it was expected that they would be difficult given Nova Scotia's interest in direct transmission access to the Hydro-Québec and New England markets through New Brunswick; direct transmission would have eroded NBEPC's export market potential.[52] In spite of these setbacks, NBEPC management persisted.

Officials of EMR prepared a Memorandum to Cabinet requesting special support beyond the federal policy established by Cabinet in November 1973 of providing loans for 50 per cent of the construction costs of the first nuclear reactor in each province. EMR officials recommended, given possible participation by Nova Scotia in the power station, that the 50 per cent federal loan should extend to a second reactor as well. Also, EMR recommended further considerations for NBEPC given the exceptional financial exposure from construction delays and operational problems.[53] Officials of the Department of Finance were strongly opposed to both proposals, arguing that any assistance for a second reactor should be under the mandate of the Department of Regional Economic Expansion (DREE) rather than EMR.[54] The federal Cabinet decision of 17 January 1974 accepted EMR's recommendations for loans for two units (but with the second unit under DREE's mandate); stipulated that any further considerations were to be decided by an interdepartmental committee with representatives from Finance, EMR, AECL, and DREE; and required that there be a full evaluation of the economics of nuclear versus other sources of power in the New Brunswick case as suggested by Finance.[55] The Cabinet decision of 17 January reflected

52 See J. Stewart Brooks Chairman NBEPC to Premier Richard Hatfield, 25 September 1974, RS 417, Nuclear Power 1974, PANB.

53 See Memorandum to Cabinet "New Brunswick Nuclear Power Station," 8 January 1974, Dept. of Finance Records, RG 19 4825/L599-4, vol. 1, Nuclear Power – Domestic Projects Lepreau I (New Brunswick), LAC.

54 Memorandum from S.S. Reisman to Minister MacDonald, Subject: New Brunswick Nuclear Power Station, Cabinet Document 32-74 for Consideration by Cabinet Committee on Government Operations, 9 January 1974, Department of Finance Records, RG 19, 4823/L599-4, vol. I, Nuclear Power-Domestic Projects Lepreau I (New Brunswick) Financing, LAC.

55 Memorandum from S.S. Reisman to Minister MacDonald, Subject: Canadian Nuclear Power Program Cabinet Document 24-74 for Consideration at Joint Meeting of Cabinet Committees on Federal-Provincial Relations and Economic Policy, 9 January 1974, Department of Finance Records, RG 19 4823/L599-4, vol. I, Nuclear Power-Domestic Projects Lepreau I (New Brunswick) Financing, LAC.

the increasing importance of the departments of DREE and Finance in federal nuclear policy.[56]

In the negotiations that followed, NBEPC continued to ask for risk coverage for construction cost overruns and poor operating performance of the reactors. This entailed significantly more federal assistance than Hydro-Québec had received for the Gentilly II reactor, a federal loan for 50 per cent of a predetermined capital cost. The federal interdepartmental committee, with a strong Finance presence, was prepared to offer only a few incremental changes over the Hydro-Québec agreement: removing the cap on the federal loan, advancing federal loans on a regular basis to eliminate the need for NBEPC interim financing, and increasing the repayment period from 25 to 30 years. The federal interdepartmental committee would not agree to risk coverage of additional interest charges during construction due to any start-up delays and coverage of poor operating performance.[57] Finance officials had not altered their view that NBEPC, because of its small size, did not have the financial capacity to handle the risk of a nuclear plant, and that there was no evidence that nuclear power was a rational economic choice for New Brunswick given the possibilities of thermal generation and Hydro-Québec imports.[58] However, well in advance of the final federal decision, NBEPC decided in March to commit to the nuclear project without a federal agreement.

Going it alone with nuclear power

On 19 March 1974, in an eight-page presentation for the Board of Commissioners of NBEPC titled "Nuclear Power for New Brunswick in 1980," the executive director of NBEPC's Nuclear Power Program presented the

56 Privy Council Office, Record of Cabinet Decision, No. 24-74D, Canadian Nuclear Power Programme, 17 January 1974, EMR Records, X085-3, Energy & Power-Nuclear-New Brunswick Nuclear Power Station, LAC. For the perspective of Finance officials, see Memorandum from T.K. Shoyama to Mr. S.S. Reisman, Subject: Nuclear Power Memoranda: Discussion in Cabinet Committee on Government Operations, 17 January 1974, Department of Finance Records, RG 19, 4823/L599-4, vol. 1, Nuclear Power-Domestic Projects Lepreau I (New Brunswick), LAC.

57 Memorandum to Cabinet "Financing by the Federal Government of a Nuclear Power Station in New Brunswick," 24 April 1974, Department of Finance Records, RG 19, 4823/L599-4, vol. 1, Nuclear Power-Domestic Projects Lepreau I (New Brunswick), LAC.

58 For the reservations of the Finance Department's analysts, see Memorandum from Allan Blair to Myles B. Foster, Subject: AECL/NBEPC Nuclear Station, 14 February 1974 and Memorandum from R.A. Fleming to File, Subject: Meeting February 14, 1974 Financing of New Brunswick Nuclear Station, 15 February 1974, both in Department of Finance Records, RG 19, 4823/L599-4, vol. 1, Nuclear Power-Domestic Projects Lepreau I (New Brunswick) Financing, LAC.

argument for NBEPC proceeding with a one-unit nuclear project on its own.[59] The possible benefits of a quick nuclear decision were, according to the report, to avoid additional dependence on the international oil market, preserve their all-nuclear scenario, and avoid delays and increasing prices for the increasingly expensive nuclear components. The possible costs were identified as the risks of not getting participation agreements and the associated necessity to purchase or build expensive reserve capacity in the event of the unit going out of service. The submission to the Board of Commissioners made no reference to the risks of potential capital cost overruns, project delays, and poor operating performance, which were the substance of their negotiations with the federal government. Utilizing analysis provided by Montreal Engineering, the report claimed that nuclear power was the lowest-cost alternative for NBEPC.[60] It also stated that NBEPC would be able to borrow its 50 per cent share of the construction costs. The report recommended that the NBEPC Board approve what it referred to as the "go it alone scenario," a 600-megawatt unit for a 1980 start-up date while continuing discussions with regional utilities for possible participation. With the general manager supporting the nuclear decision, NBEPC's Board of Commissioners officially approved the nuclear reactor project on 20 March 1974.[61]

The federal conditions for the loan

On 2 May1974 the federal Cabinet approved a loan to New Brunswick for 50 per cent of the reactor costs for both a provincial reactor and a future second regional unit at the same site, but with a cap on the loan and several preconditions that would need to be met before the loan could be finalized.[62] In earlier discussions, there was no cap on the loan based on the assumption that AECL would provide a fixed-price contract for the nuclear steam supply system of the reactor. However, NBEPC managers were having little success

59 F.H. Ryder, "Nuclear Power for New Brunswick in 1980," 13 March 1974, Lepreau Records, 87-00002 (5-8-E), NB Power Central Records.

60 "The New Brunswick Electric Power Commission Assessment of Generation Alternatives for the Period 1980-82," prepared by Montreal Engineering Company Limited, 7 March 1974, RS 417, Nuclear Power 1974, PANB. Montreal Engineering, an engineering services company, provided a range of financial and project-evaluation services to NBEPC in the 1970s.

61 Board of Commission Minutes of 19 and 20 March 1974, NB Power Central Records.

62 Record of Cabinet Decision, meeting of 2 May 1974 (280-74RD), Financing by the Federal Government of Nuclear Power Station in New Brunswick, 2 May 1974, EMR Records, X085-2-1, LAC.

in having AECL commit to a fixed-price contract, and when they finally provided it in March 1974 it was on a cost-plus basis and considerably above the often-quoted figure of $488 million. NBEPC believed the AECL costs were inflated and "not a sound basis for a lump sum contract or for that matter any other type of contract."[63] Subsequently, NBEPC chose to take on the risk of self-management of construction of both the nuclear and conventional parts of the reactor project.[64] The federal Cabinet, in response to the arguments of the Department of Finance, decided to cap the 50 per cent federal loan, as they were not willing to accept the added risk of increased construction costs due to NBEPC's managing the construction.[65] Additional terms and conditions of the Cabinet decision were that the federal departments of DREE, the Department of Environment, and the AECB must approve the site, and that NBEPC must submit for approval of the federal government, prior to the arrangements for financing, "an evaluation of the economics and associated financial risks of the project, including a summary of cost estimates and commercial financing."[66]

Conflict over regional policy

NBEPC managers, and their allies among EMR and AECL officials, attempted to avoid the preconditions for federal involvement in site selection, environmental review, and evaluation of the economic viability of the nuclear project. NBEPC's export-led strategy, for instance, had, since the late 1960s,

63 Notes of Meeting with AECL-March 13, 1974, 14 March 1974, Lepreau Records, 87-00000, folder 7, NB Power Central Records. R.H. Ryder concluded from the meeting that AECL planned to charge cost plus 90% on engineering costs of the NSSS. The next day, at a meeting of NBEPC's Executive Committee, they decided that they could build the reactor at a lower cost than any turnkey contract with AECL. See Minutes of Meeting of Executive Committee, 14 May 1974, Lepreau Records, 87-00000, folder 7, NB Power Central Records.

64 See J. Stewart Brooks, Chairman, NBEPC to Dr. J.L. Gray, President, AECL, 29 March 1974, Lepreau Records, 87-00000, folder 7, NB Power Central Records and Memorandum from G.H.D. Ganong, Manager of Design and Construction to A.J. O'Connor, General Manager, 1 April 1974, Lepreau Records, 87-00000, folder 7, NB Power Central Records.

65 Memorandum from S.S. Reisman to Minister of Finance, Subject: Financing by the Federal Government of Nuclear Power Station in New Brunswick, 2 May 1974, Department of Finance Records, RG 19, 4823/L599-4, vol. 1, LAC. EMR officials, as well, had assumed NBEPC would sign a turnkey contract with AECL for the nuclear steam supply system (NSSS), the high-risk component of the project. See F.C. Boyd to G.M. MacNabb, "Note to File, New Brunswick Nuclear Power Station," 21 May 1974, EMR Records, X085-3, Energy & Power-Nuclear-New Brunswick Nuclear Power Station, LAC.

66 Record of Cabinet Decision, Meeting of 2 May 1974 (280-74D), Financing by the Federal Government of Nuclear Power Station in New Brunswick, 2 May 1974, EMR Records, X085-2-1, LAC. The federal conditions on the proposed federal assistance can also be found in Minister MacDonald to Premier Hatfield, 10 June 1974, RS 417, 5243-0, 1987 Policy, PANB.

created conflicts with federal policies encouraging regional cooperation, especially over joint transmission access and generation planning.[67] Added to the federal concern with rationalizing the Maritime electrical utility sector was the increasing importance of uneven regional development in the early 1970s.[68] Such was the importance of federal regional development objectives that EMR Minister Donald S. MacDonald was convinced, in March 1974, by the New Brunswick minister in the federal Cabinet, Jean-Eudes Dubé, that a northern New Brunswick site would be superior to NBEPC's planned southern site. MacDonald instructed his deputy minister in March to keep New Brunswick MPs Jean-Eudes Dubé and Herb Breau informed of the progress on the file.[69] The officials in the nuclear unit within EMR were disturbed by this challenge to their traditional authority, especially as NBEPC in April was already placing orders and negotiating engineering contracts based on a southern site.[70] Their fears were not unfounded: a Cabinet decision on 2 May gave DREE a veto over the site selection for the first reactor site on the grounds that the site chosen would also become the site for the second reactor.

DREE regional staff began their socioeconomic research in June; on 15 July they recommended to their minister that, from an economic development perspective, the project should be located in the north of the province at one of two sites NBEPC had previously considered and that DREE should provide assistance for related infrastructure and training costs.[71] Three days later, Premier Hatfield officially announced the choice of Lepreau in southern New Brunswick. His supporting documentation stated that the southern site was $30

67 See Andrew G. Secord, "NB Power 1967-72: Constructing the Export Dream," *Journal of New Brunswick Studies* 10 (Fall 2018): 10-12.

68 For an historical overview of regional policy in Canada, see Janine Brodie, *The Political Economy of Canadian Regionalism* (Toronto: Harcourt Brace Jovanovich, 1990), 168-75, 204-15. For its importance at the federal level in the early 1970s, see James Bickerton and Alain G. Gagnon, "Regional Policy in Historical Perspective: The Federal Role in Regional Economic Development," *American Review of Canadian Studies* 14, no. 1 (1984): 77-82 and Clyde Weaver and Thomas I. Gunton, "From Drought Assistance to Megaprojects: Fifty Years of Regional Theory and Policy in Canada," *Canadian Journal of Regional Science* V, no. 1 (Spring 1982): 13-14.

69 Minister Donald S. MacDonald to Deputy Minister, Proposed Siting of the New Brunswick Nuclear Plant, 12 March 1974, EMR Records, X085-3, Energy & Power-Nuclear-New Brunswick Nuclear Power Station, LAC.

70 Memorandum from F.C. Boyd to G.M. MacNabb, Subject: Points re New Brunswick Power Plant for Discussions with DREE Officials, 9 April 1974, EMR Records, X085-3, Energy & Power-Nuclear-New Brunswick Nuclear Power Station, LAC.

71 Memorandum from J.P. Francis, Acting Deputy Minister, DREE to Minister Jamieson, Subject: New Brunswick Nuclear Plant-Selection of Site, 15 July 1974, Records of the Deputy Minister of DREE, file 116-A-13, LAC.

million less expensive than a northern site, and could be completed sooner.[72] Hatfield was unequivocal in his support of the NBEPC recommendation that the choice of site should be based on minimizing NBEPC's costs. Over the summer, DREE officials continued their research into the value of the northern sites while federal Cabinet support for a northern site increased. The prime minister's office instructed the nuclear energy division within EMR to provide information on locations other than Lepreau,[73] and EMR Minister MacDonald informed Premier Hatfield that DREE would be evaluating all three project sites for their economic and employment impact.[74] MacDonald also informed the minister of Environment that three sites were still under consideration by DREE, and he recommended that the Department of Environment should not restrict its reviews to the one southern site.[75] DREE staff submitted their assessment of the three sites to their minister on 25 September, arguing that the socioeconomic benefits of a northern site exceeded any additional costs NBEPC might incur – costs for which DREE staff suggested compensation. The deputy minister stressed the value of direct job creation in one of the most economically depressed regions in the country. It was suggested that the socioeconomic advantage of a northern site would be upwards of $40 million.[76]

The nuclear unit within EMR, however, produced research for the minister of EMR in support of NBEPC's southern site. Based on the engineering and cost data provided by NBEPC, EMR officials stressed that a northern location would cost an additional $35 million plus a one-year delay in order to study cooling water issues at the northern site. Such delays would generate additional

72 For the complete press package with supporting documentation, see "Energy Planning for New Brunswick," 18 July 1974, RS 917, Records of the Deputy Minister of Finance 1974, Provincial Finance, Financing NB Power, PANB. The rationale for the nuclear decision is included as "Decade of Progress 1970-1980 Strategy Towards Oil Substitution and System Security."

73 George Post, Acting Deputy Secretary to the Cabinet to Dr. O.J.C. Runnals, Senior Advisor, Uranium and Nuclear Energy, EMR, 12 August 1974, EMR Records, X085-2-3-1, LAC.

74 Minister Donald S. MacDonald to Premier Richard Hatfield, 27 August 1974, RS 417, 5243-0, 1987 Policy, PANB.

75 John McNicholas, Executive Assistant to Minister MacDonald, to Roméo Beaupre, Executive Assistant to Minister of Environment, 10 September 1974, EMR Records, EMR X085-1, LAC. The letter also refers to the meetings among ministers MacDonald, Jamieson, and LeBlanc, who all supported this position.

76 Memorandum from J.D. Love, Deputy Minister, DREE to Minister Jamieson, Subject: New Brunswick Nuclear Plant-Site Selection, with attached study "Socio-Economic Aspects of the Site Selection Decision for the Nuclear Power Station in New Brunswick," 25 September 1974, Records of the Deputy Minister of DREE, file 116-A-13, LAC.

costs for financing and replacement power.[77] For NBEPC managers, delays and added costs for a northern site would cause fundamental problems for what was an increasingly costly and risky nuclear option. In a September briefing note to Premier Hatfield, the manager of NBEPC stated his position that "the only site that permits an all-nuclear expansion is the Pt. Lepreau site and then ONLY if we proceed on a continuous uninterrupted manner with the work."[78]

The conflict over the site was resolved in meetings in Ottawa on 18 and 19 September and a final meeting on 7 October.[79] The September meetings, with federal minsters Don Jamieson (DREE), Donald MacDonald (EMR), and Roméo LeBlanc (Fisheries), and Premier Hatfield, along with Arthur J. O'Connor, general manager of NBEPC, set out positions but produced no agreement.[80] The general manager of NBEPC steadfastly refused to consider a northern site. EMR Minister MacDonald supported DREE's focus on a site to meet federal regional development objectives; and Minister LeBlanc was specifically committed to the regional development agenda for the north of the province.[81] The 7 October's morning meeting consisted of officials of DREE, NBEPC, and EMR trying to reach agreement on the socioeconomic implications of the sites. Officials of EMR and NBEPC agreed that the extra costs to NBEPC of a northern site were in the range of $47-100 million, while DREE officials provided their much lower estimates. One of the attending EMR officials described the meeting as mostly arguments between DREE and NBEPC officials – "Two hours of occasional slightly heated exchanges without any sign of consensus."[82] In the afternoon, Hatfield, along with the general manager of NBEPC, met with federal ministers MacDonald, Jamieson, and

77 Memorandum from G.M. MacNabb to Minister MacDonald, Subject: Siting of the New Brunswick Nuclear Power Project, with attached report "Review and Assessment of the Selection of the Point Lepreau Site for a Nuclear Power Station in New Brunswick," 9 September 1974, EMR Records, file X085-2-1, LAC and F.C. MacLoon, Manager of Production and Planning, NBEPC to F.C. Boyd, Assistant Advisor-Nuclear Energy, 29 July 1974, EMR Records, file X086-30/4-1, LAC.

78 A.J. O'Connor, General Manager, NBEPC to Premier Richard B. Hatfield, handwritten notes (6 pages), September 1974, Hatfield Papers, RS 417, Nuclear Power 1974, PANB.

79 Memorandum from A.R. Scott to G.M. MacNabb, Senior Deputy Minister, EMR, 10 October 1974, EMR Records, file X085-2-1, LAC.

80 Roméo LeBlanc was appointed Minister of State for Fisheries on 8 August, replacing Jean-Eudes Dubé as the New Brunswick minister in the federal Cabinet.

81 See "Notes on Ottawa Meetings," 18, 19 September 1974, Lepreau Records, 87-00000, file 7 (5-8-G-a), NB Power Central Records.

82 Memorandum from A.R. Scott to G.M. MacNabb, Senior Assistant Deputy Minister, Subject: New Brunswick Nuclear Station, 10 October 1974, EMR Records, file X085-2-12, LAC.

LeBlanc but had no more success than their officials in reaching an agreement. In an interview with this author, Premier Hatfield commented: "Those negotiations were the worst I ever had. I mean it was at the point of anger. The discussion was at the point of shouting at each other."[83] In lieu of withdrawing the provision of federal loans for the project, the federal ministers agreed to continue with loans for the first unit but to withdraw financing for a second regional unit should it be pursued in the future. As for NBEPC, they gave up federal assistance for what they considered an inevitable second nuclear reactor in exchange for maintaining their autonomy in corporate decision-making.

The environmental review process

The location of the reactor resolved, NBEPC managers turned their attention to gaining approval from the federal Department of Environment in the context of the federal Environmental Assessment and Review Process (EARP); this procedure was introduced by Cabinet for all federal agencies in December 1973. The Cabinet directive stated that the review was to occur before "irrevocable decisions" had been taken and that environmental problems should be given "the same degree of consideration as that given economic, social, engineering and other concerns."[84] Reviews were to be carried out by a project-specific Environmental Assessment and Review Panel (EA Panel) consisting primarily of federal government officials, including a representative from the initiating department; this type of self-assessment was "intended to diffuse environmental responsibility throughout Government."[85]

At a meeting on 21 May 1974, EMR officials informed NBEPC's general manager that the nuclear project would require Department of Environment approval through the federal EARP process. According to meeting notes, the general manager expressed "grave concern" as the process could lead to a 12-month delay.[86] Once the official guidelines for a comprehensive

83 Premier Richard B. Hatfield, interview by Andrew G. Secord, 3 July 1990, Fredericton, transcript, MC 1677, PANB.

84 The Cabinet meeting of 20 December 1973 confirmed the recommendation of the Cabinet Committee on Science, Culture, and Information; see Environmental Assessment and Review Process, 20 December 1973, EMR Records, file X-085-2-1, LAC.

85 Robert Gibson has extensively analyzed the evolution of environmental assessment in Canada, including this early phase of self-assessment; see Robert B. Gibson, "From Wreck Cove to Voisey's Bay: The Evolution of Federal Environmental Assessment in Canada," *Impact Assessment and Project Appraisal* 20, no. 3 (September 2002): 151–9.

86 F.C. Boyd to G.M. MacNabb, "Note to File–New Brunswick Nuclear Power Station," 21 May 1974, Records of the Minister of EMR, file X085-3, Energy & Power-Nuclear-New Brunswick Nuclear Power Station, LAC. For details of NBEPC's response, see

environmental review were available, EMR officials arranged a 4 November 1974 meeting with officials from NBEPC, EMR, and the chair of the EA Panel, Dr. R.R. Logie. According to EMR's staff meeting notes, NBEPC indicated that they were already proceeding with the project and did not intend to stop for the EARP process. Acquiescing to NBEPC's pressure, the EA Panel agreed to postpone the one-year comprehensive assessment and require only a preliminary assessment that NBEPC's consultants said they could complete in four weeks. The revised guidelines for a preliminary environmental review were approved four days later. In a letter from Dr. Logie to EMR's member of the EA Panel, it was pointed out that the minister of Environment was "very unhappy with the notion of having to give environmental approval on the basis of incomplete environmental information."[87] In spite of the minister's reservations, the process went ahead, and McLaren Atlantic submitted their "Preliminary Environmental Impact Statement" to NBEPC on 4 February 1975. DOE released the study to the public on 6 March, and allocated one day for public responses on 3 April in Saint John.

The participants at the Saint John meeting were opposed to the nuclear reactor by a 5-to-1 ratio, with many challenging the legitimacy of the process, the justification for the reactor, the economic viability of nuclear power, the adequacy of the preliminary study as a basis for environmental approval, and/or the problem of the radioactive wastes (especially plutonium with a half-life of 24,000 years). Almost every component of the McLaren study was challenged,[88] reflecting the capacity of the opposition to nuclear power in New Brunswick[89] that had been coalescing into the Maritime Coalition of Environmental Protection Associations since the first rumours of building

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Memorandum from F.C. Boyd to G.M. MacNabb, Subject: New Brunswick Nuclear Power Plant Environmental Assessment, 24 May 1974, EMR Records, file X085-2-1, LAC.

87 Letter from R.R. Logie, Environment Canada to F.C. Boyd, Assistant Advisor on Nuclear Energy, EMR, 10 December 1974, EMR Records, file X085-2-1, LAC. It is unclear, based on available documentary evidence, why the minister did not take a stronger position, especially given the strength of the Cabinet directive.

88 Proceedings of the Public Meeting on the Preliminary Environmental Impact Statement Lepreau Nuclear Generating Station, 3 April 1975. Prepared by the Saint John River Basin Board Public Participation Section, Government Documents, Harriet Irving Library, University of New Brunswick, Fredericton. The document includes both a verbatim transcript and copies of the 40 written briefs that were submitted to the panel.

89 A report for Ontario Hydro and shared with NBEPC, identified 48 anti-nuclear groups in the Maritimes and 35 in Ontario based on their consultants' "informally participating" and collecting "personal information" to identify number of members, revenues, and activities; see "A Report on Nuclear Protest Groups and the Apparent Development of a Social Movement," Public Attitude Research Department, Ontario Hydro (File 87-00174), 26 November 1975, Lepreau Records, 87-00000, NB Power Central Records.

nuclear reactors for export to the United States in 1971.[90] Although part of the scope of the preliminary assessment, the EA Panel did not address any of the public's arguments challenging the economics and need for the nuclear reactor. Instead, they forwarded a list of eight question areas to the nuclear unit at EMR for responses. The assessment panel did not utilize any independent expertise and instead relied entirely on responses from EMR, which had been constructed with assistance from AECL and AECB.[91]

The EA Panel's report was submitted to the minister on 2 May.[92] On 7 July 1975, Minister Sauvé forwarded the conclusions of the EARP process to Minister MacDonald. Aside from a few requirements for environmental monitoring, the principal recommendation was that "a national policy for the storage, disposal, and reprocessing of radioactive waste be developed as soon as possible." In Sauvé's opinion, "I believe we came jointly to a good conclusion in this environmental assessment but it will be of course meaningless if the recommendations are not followed through."[93] On 20 August, Minister MacDonald responded to Minister Sauvé's letter, indicating that they would leave the issue of high-level radioactive waste to the Atomic Energy Control Board, which intended to set up a committee to look at the problem.[94] In his evaluation of the environmental assessment process in Canada in the 1970s, D. Paul Emond, of the Osgoode Hall Law School, wrote: "As far as Point Lepreau was concerned, EARP was clearly an empty and meaningless exercise."[95]

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90 For a listing of the associations challenging the nuclear project, see Maritime Coalition of Environmental Protection Associations, *Nuclear Reaction: The Maritime Voice Against Nuclear Power* (Fredericton: Maritime Coalition of Environmental Protection Associations, Summer 1975), p. 4. The issues of *Nuclear Reaction* can be found in MC 326, MS6B1, Nuclear Reaction Issues, PANB.

91 Letter from F.C. Boyd to Dr. R.R. Logie, Chairman, Canadian Environmental Advisory Council, "Point Lepreau Generating Station Questions from the Public," 28 April 1975, EMR Records, file X085-2-1, LAC.

92 "Report to: The Minister of the Environment from: The Environmental Assessment Panel, Point Lepreau New Brunswick Nuclear Generation Station," 2 May 1975, DREE Records, file 116-A-13, LAC.

93 Letter from Jeanne Sauvé, Minister, Department of Environment to D.S. MacDonald, Minister, Department of Energy, Mines and Resources, 7 July 1974, EMR Records, file X085-2-1, LAC.

94 Letter from Minister Donald S. MacDonald to Minister Jeanne Sauvé, 20 August 1975, EMR Records, file X085-2-1, LAC.

95 D. Paul Emond, *Environmental Assessment Law in Canada* (Toronto: Edmond-Montgomery, 1978): 250.

Economic and financial review

The last prerequisite proved the most difficult for NBEPC: providing evidence of the economic and financial viability of the nuclear project. NBEPC's Board of Commissioners based their decision in March 1974 on an analysis prepared by Montreal Engineering. As discussed previously, they did not address the financial risks associated with construction delays, construction costs overruns, and unplanned outages – all risks that NBEPC management had unsuccessfully tried to reduce through federal coverage.[96] Financial analysis was reduced to a statement by First Boston Corporation, their fiscal agent, that the required loans would not exceed the borrowing capacity of New Brunswick.[97] Officials with the federal Department of Finance required a much more rigorous analysis.

EMR initiated a meeting in Ottawa on 20 June 1974 with officials of AECB, DOE, DREE, and NBEPC to "review, for mutual benefit, the requirements, procedures and status of approval by each of three agencies."[98] While most of the time was spent providing guidance to NBEPC on dealing with DREE and DOE, EMR staff also advised NBEPC executives on the required economic and financial evaluation of the project. Frank Ryder of NBEPC recorded in his meeting notes that the assistant deputy minister of EMR stressed (based on analysis by the Organization for Economic Cooperation and Development) that oil prices would rise until 1978 and then "drop drastically as a result of overcapacity,"[99] effectively undermining NBEPC's economic analysis as provided by Montreal Engineering. In response, EMR staff advised NBEPC to shift their argument to the security of supply issue rather than the price of oil,[100] an argument that found little support in the federal Department of Finance given the availability of western Canadian oil and the potential for a national pipeline.

96 For EMR's identification of these limitations, see Memorandum from F.C. Boyd to G.M. MacNabb, Subject: New Brunswick Nuclear Power Plant Meeting with NBEPC, Fredericton, 26 July 1974, EMR Records, X086-30/4-1, LAC.

97 Letter from Edward Townsend, Senior Vice President, First Boston Corporation to A.J. O'Connor, 4 September 1974, RS 417, Nuclear Power 1974, PANB.

98 Memorandum from F.C. Boyd to G.M. MacNabb, Subject: New Brunswick Nuclear Power Plant Approval of Site, 21 June 1974, EMR Records, file X085-2-3-1, LAC.

99 F.H. Ryder, Notes of meeting with Department of Energy, Mines and Resources, 20 June 1974, Lepreau Records, 87-00000, folder 7, NB Power Central Records.

100 F. MacLoon, Notes of meeting with Department of Energy, Mines and Resources, 20 June 1974 Lepreau Records, 87-00000, folder 7, NB Power Central Records.

NBEPC resubmitted its economic and financial analysis to EMR on 21 August,[101] and F. Boyd, Assistant Advisor, Nuclear Energy at EMR forwarded the work to E.T. Houston of their financial section for his evaluation of the adequacy of NBEPC's submission. Houston responded that the NBEPC analysis was inadequate as an evaluation of the economics and financial risks of the nuclear project. Specifically, the analysis had not examined the sensitivity of the results to a number of factors including capital cost overruns, higher interest rates, and lower capacity utilization rates – all factors that would increase the risks associated with the more capital-intensive nuclear choice.[102]

Officials at the Department of Finance also examined the adequacy of NBEPC's August 1974 economic and financial justification of the project. Trent Gow, Chief of General Economic Studies in the Economic Development Division, pointed out that NBEPC did not consider sources of power from outside the province and the economic costs of foregoing such purchases. His assessment was that NBEPC provided an engineering/financial review with some limited sensitivity analysis, but that it was not an economic evaluation or complete financial risk analysis. Much more would need to be done to include "a range of cost overruns, delays and combinations identifying decision 'crossover' points" and a "comprehensive assessment of the feasibility of such project-reversing occurrences."[103] In September 1974 NBEPC management acknowledged that they had no confidence in the $499 million capital cost estimate they had used in the August economic analysis, but it was not until 30 January 1975 that NBEPC officially revealed its $700 million capital cost estimate at a joint meeting with AECL, EMR, and Finance officials.

In response to the higher estimate, both EMR and Finance officials concluded that the economic and financial analysis would have to be redone.[104] In spite of several requests by EMR for NBEPC to do a revised economic

101 Letter from F.C. MacLoon, Manager of Production and Planning, NBEPC to F.C. Boyd, Assistant Advisor, Nuclear Energy, EMR, 21 August 1974, Dept. of Finance Records, RG 19, 4825/L599-4, vol. 2, Nuclear Power-Domestic Projects Lepreau I (New Brunswick) Financing, LAC.

102 Memorandum from E.T. Houston to F.C. Boyd, Subject: New Brunswick Nuclear Power Plant, August 1974, Dept. of Finance Records, RG 19, file 4825/L599-4, vol. 2, Nuclear Power-Domestic Projects Lepreau I (New Brunswick) Financing, LAC.

103 Memorandum from Trent Gow to R.N. Spalding, Subject: New Brunswick Nuclear, 25 Sept 1974, Dept. of Finance Records, RG 19, 4825/L599-4, vol. 2, Nuclear Power-Domestic Projects Lepreau I (New Brunswick) Financing, LAC (quotations on p. 2).

104 Memorandum from R.N. Spalding to Myles B. Foster, Department of Finance, Subject: AECL/NBEPC Financing Agreement, 3 February 1975, Department of Finance Records, RG 19, 4825/L599-4, vol. 5, LAC.

analysis, nothing was submitted to EMR until 28 April, in the form of a slight modification to the August 1974 submission. Boyd at EMR had previously, on 10 April, asked T. Tuschak, Senior Advisor in their financial section, to comment (hopefully affirmatively for the project) on the implications of the new $700 million capital cost.[105] However, Tuschak reported to Boyd on 29 May that the issues he had raised in August 1974 to NBEPC's submission still had not been addressed – namely, the inadequacy of the commercial financing submission and the need for a complete sensitivity analysis. In his view, the economic and financial analysis was inadequate. Given the current $700 million capital cost estimate, Tuschak commented that "the nuclear choice if it was to be made today is not that clear cut."[106] Finance officials were even more critical, not only raising the issue of the poor methodology of NBEPC's work but also pointing out the "serious omission" of the April 1975 submission in omitting sensitivity analysis for interest rates, capital costs, delays, and operating equipment failures. The latest NBEPC report provided even less sensitivity analysis than the inadequate August 1974 one. Finance officials also pointed out that the incorrect costing of spinning reserves would, if done properly, shift the cost advantage from nuclear to oil.[107]

In spite of what Finance considered to be the lack of an adequate economic and financial analysis, the federal loan for the NBEPC nuclear project was approved by Treasury Board on 24 July 1975 as a financing agreement between AECL and NBEPC. The decision indicated that "Treasury Board discretion was virtually nil" given that federal support was public, AECB had given a construction licence, and AECL and NBEPC had issued contracts. The issues that Finance had been raising since January 1974 were not addressed.[108] In the

105 Memorandum from F.C. Boyd to T. Tuschak, Subject: New Brunswick Nuclear Power Plant-Economic Evaluation, 10 April 1975, EMR Records, file X085-2-1, LAC. The memorandum indicates that EMR officials had asked NBEPC to update their analysis for the higher capital cost, but nothing was provided to EMR.

106 Memorandum from T.S. Tuschak to F.C. Boyd, Subject: New Brunswick Nuclear Power Plant, 29 May 1975, Department of Finance Records, file 4825-L599-4, vol. 4. LAC. In a hand-written note attached to a 15 May 1975 memo from Gore to Gow, Gore refers to EMR's Houston's view that "the consultant's report is a pretty shoddy job."

107 Their additional methodological concerns and identification of specific omissions are described in two memos from G.E. Gore to Trent Gow, Subject: Consultants Reports on Nuclear versus Alternative Generation Methods in New Brunswick (1980-82), 15 May and 21 May 1975, Department of Finance Records, RG 19, file 4825/L599-1, LAC.

108 Treasury Board Submission TB 737879EMR, Subject: Authority for the Financing Agreement Between Atomic Energy of Canada Limited (AECL) and New Brunswick Electric Power Commission (NBEPC) re. Nuclear Power Plant, 21 July 1975, EMR Records, file X085-2-1, LAC. For confirmation of the Treasury Board decision on 24 July, see Letter

final memorandum to Treasury Board, it was left to AECL (not Finance or EMR) to state that, in its opinion, the economic and financial prerequisites were met.[109] If NBEPC's strategy was to avoid revealing the poor economics of the project by delay, it was successful as the long process of obfuscation extended to the point where the federal government accepted that the project was too far advanced to hold up federal funding due to lack of proper economic and financial analysis. In spite of the power of the federal Department of Finance, the federal government had failed to bring serious economic and financial analysis to the case of the New Brunswick reactor.

Conclusion

NBEPC managers began in the late 1960s to create conditions for transitioning to nuclear power generation in the 1970s, in the process committing to a path they were unwilling to abandon. They directed their corporate investments to high-voltage transmission interconnections with New England, which was a necessary condition for their all-nuclear strategy. When, in 1972, New England utilities rejected nuclear purchases from New Brunswick, NBEPC's export-led nuclear strategy had effectively failed. At this point, however, NBEPC managers continued along the nuclear path, exhibiting higher risk behaviour in the process. Both individually and as an organization, they continued as enthusiastic supporters of AECL's CANDU technology. Consistent with Helga Drummond's analysis of a "lock-in" psychology, as NBEPC executives spent more time and resources on the nuclear option, their personal attachment and the associated institutional commitment increased. In their original discussions with the federal government in 1971, NBEPC managers were adamant that they would not go forward with nuclear unless it was no more expensive (or risky) than a conventional oil-fired generator. However, between 1971 and 1974, NBEPC managers were willing to take on increasing levels of economic and financial risk, to the point where they were willing to proceed without sales participation agreements, without federal coverage for unforeseen construction cost increases and poor operating performance, and without a federal guarantee on the federal loan. In 1975, in response to a near-doubling of the capital cost estimate, they responded by taking on the uncertainties

from R.L. Richardson, Assistant Secretary, Treasury Board to J.S. Foster, President, AECL, 31 July 1975, Department of Finance Records, RG 19, file 4825-L599-4, vol. 4, LAC.

109 See Treasury Board Submission, 21 July 1975 in Department of Finance Records, RG 19, file 4825-L599-4, vol. 4, LAC and handwritten comment by Finance official on their copy of the Treasury Board submission: "AECL has left government no option but to approve it."

of self-management of the construction of the nuclear steam supply system. At each step of the way, NBEPC managers, between 1972 and 1974, took on additional risk as costs increased and potential partners could not be found.

While investing in the physical infrastructure for nuclear exports, NBEPC officials also developed a social network with officials at EMR and AECL who had a shared interest in the promotion of nuclear power and were prepared to act in opposition to other officials in the federal departments of Finance, Environment, and Treasury Board Secretariat. Federal officials within the network provided assistance to NBEPC in writing proposals to federal ministers, developing common positions, sharing background information in advance of negotiations, and recommending tactics for dealing with other federal agencies as well as arguing the NBEPC case before Cabinet committees. This cross-government network of interests was especially active as NBEPC confronted the federal Cabinet on the location, environmental assessment, and economic appraisal of the nuclear project. With the collaboration of EMR and AECL officials, NBEPC managers were able to counter the federal Cabinet initiative to locate the reactor in the north for economic development purposes, undermine the environmental assessment process, and avoid a federal economic appraisal.

An adequate explanation for why a nuclear reactor was built in the midst of the communities of Maces Bay, Dipper Harbour, and Chance Harbour requires much more than a reference to ahistorical statistics such as the temperature of cooling water in the Bay of Fundy or the international price of oil. In this case, social networks built up over several years, although invisible to outsiders, were an essential component of the capacity of NBEPC executives to continue locked-in on the nuclear path to the bewilderment of both officials of the federal Department of Finance and the people of the Lepreau communities.

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Appendix 7

Summary Notes provided by CNSC to PGRI after the
Oct 13, 2021
Biannual Update Meeting

Summary of Meeting with Peskotomuhkati Nation

October 13th, 2021 – 1:00 pm to 3:00 pm (AST)

Location: Teams meeting

Attendees:

CNSC	**Peskotomuhkati Nation**
Anupama Bulkan	
Heather Davis	Chief Hugh Akagi
Patrick Collins	Kim Reeder
Adam Levine	John Ames
Katelyn Peters	
Wish Yen	
Stephen Eckstein	
Marius Chirila	
Kiza Sauve	
Josue Wamegni	
Katelyn Peters	
Alex Lemieux	
Davis Szonyi	
Heather Harpell	

Related documents: Presentation (e-Doc 6639876)

Purpose: To discuss environmental reviews, and relicensing; to give an update on the Point Lepreau Nuclear Generating Station and the Independent Environmental Monitoring Program; and to discuss the Regulatory Oversight Report.

Topics Discussed:

- **General Overview of the CNSC:** Anapuma Bulkan provided a general overview of the CNSC.
- **Participant Funding Program:** Adam Levine provided information on the Participant Funding Program. Funding can be sought for a legal review/analysis of materials, however, a lawyer is not required to be present for the proceedings. A lawyer is welcome to attend the proceedings and answer questions in support of Indigenous Nations as part of their intervention, however, full legal representation at the proceedings is not eligible for funding (i.e. the lawyer being the only representative for the Nation at the hearing). The amount of funding available to be applied for is $100,000 total regarding the licence renewal application. This total will be divided amongst the applicants. The independent funding review committee reviews all applications and recommends the amount of funding each applicant should receive. Typically, funding does not get paid out until after the hearing and once a final financial report has been submitted, however, some funds can be provided in advance if requested. Funding decision reports are typically posted prior to the hearing and are included in the CNSC presentation to the commission.

- **Regulatory Oversight:** Heather Davis gave an update on the inspections for this fiscal year and the CNSC staff's role in the Point Lepreau Synergy Exercise.
- **Regulatory Oversight Report:** Stephen Eckstein presented information on the Regulatory Oversight Report (ROR) including and explanation on the ratings and important dates. The ROR is presently posted for pubic review. The deadline for interventions is November 1st and the ROR will be presented to the Commission on December 15/16th. The ROR is a summary of each licensee's safety performance and state of compliance over the past year. The report utilizes data from inspection reports, technical assessment reports, performance indicators data, and various other reports (responses to corrective actions, REGDOC implementation updates, regular REGDOC-3.1.1 reports, etc.). Using this data, licensees are given a rating in each of the 14 Safety and Control Areas (SCAs).
- **Relicensing:** Patrick Collins provided updates on the relicensing process at the PLNGS. This included important dates, how to observe and/or participate a public commission meeting, and the information that feeds into a commission decision. The part 1 hearing is January 26, 2022 and the part 2 hearing is planned for May 11-12, 2022. Applications for interventions are due by March 28, 2022. The environmental protection review report is expected to be posted on the CNSC website in late November 2021 and the CNSC staff CMD will be posted to the CNSC website in late December 2021.
- Concerns were raised regarding the infrastructure as the original station was designed to operate approximately 25 years. Through refurbishment the design life of the station was extended up to an additional 30 years. This does not imply that the station was granted a licence by the Commission to operate for the extra 30 years. NB Power has to consistently seek a licence to operate through the Commission every time their licence to operate Point Lepreau NGS is about to expire. The CNSC has two primary means to ensure that safety upgrades are constantly improving throughout the operating life of a station. The first way is through a periodic safety review (PSR). The PSR is a licenced requirement for NB Power to assess the current state of Point Lepreau and its performance to determine the extent to which it conforms to applicable modern codes, standards and practices, and to identify any factors that would limit safe long-term operation. More details can be found in a regulatory document REGDOC-2.3.3*, Periodic Safety Reviews*. The second way the CNSC ensures that safety upgrades are constantly improving is through updating the station's Licence Conditions Handbook. These updates reflect newly published REGDOCs, CSA Standards, and NB Power process level documents.
- **Independent Environmental Monitoring Program:** Katelyn Peters discussed the samples that were taken as part of the 2020/2021 IEMP sampling campaign. The results from this campaign will be posted on the CNSC website in approximately March 2022. The purpose of IEMP is to verify that the public and the environment around licensed nuclear facilities are safe. It is separate from, but complementary to, the CNSC's ongoing compliance verification program. It is independent/separate from the monitoring that NB Power completes. The IEMP involves taking samples from public areas around the facilities, and measuring and analyzing the amount of radiological (nuclear) and hazardous substances in those samples. Samples may be taken for air, water, soil, sediment, vegetation such as grass and weeds, and some food, such as meat and produce based on NB Power's approved environmental monitoring program and CNSC regulatory staff's experience with the site. NB Power also submits monthly reports to the province of New Brunswick regarding the wastewater treatment system. This report includes the metal content of the lagoon discharge including arsenic, barium, cadmium, chromium, copper, iron, nickel, lead, vanadium, zinc and mercury. CNSC staff committed to:

- Provide a copy of the 2020/2021 sampling plan
- Provide the link to the map depicting the sample locations

- **Environmental Reviews:** Heather Harpell presented information on the environmental review pathways including integrated impact assessments, federal lands reviews, provincial or land claim environmental assessments, and environmental protection reviews within the CNSC licensing process. The type of environmental review depends on the proposed project location and the applicable legislation. A licence application is required and needs to be reviewed before a determination can be made on which environmental pathway would be followed.

  Small Modular Reactors: the environmental review slides led to a discussion on Small Modular Reactors (SMRs), in that the type of environmental review conducted for any SMR application on the Point Lepreau site would depend on the characteristics of the project proposal submitted. It is an expectation that an SMR application describes the proposed project in its entirety, including any plans for potential expansions later. In a follow-up email exchange with the Impact Assessment Agency of Canada about how proponents are deterred from "project splitting" (submitting applications in piecemeal), Agency staff referred to the Agency's Guide to Preparing an Initial Project Description and a Detailed Project Description - Canada.ca. This guide talks about what is required to be included an initial project description (IPD), the summary of issues, and the subsequent response to the summary of issues and detailed project description. It also addresses the factors that the Agency considers in determining whether activities that are incidental to the designated project should be considered as part of the project. Concerns raised during the review of the IPD would be reflected in the Summary of Issues prepared by the Agency. The proponent would have to respond to that concern in its response to the summary of issues and make any necessary updates in its detailed project description. If it continues to be an issue, it could be addressed through the Tailored Impact Statement Guidelines, whereby the proponent could be directed to address that specific issue in its Impact Statement.

  CNSC staff explained that a separate site preparation licence would be required for an SMR and the Point Lepreau site licence would also need to be amended. The current Point Lepreau application for licence renewal is not considering an SMR. The CNSC regulatory framework is technology neutral and an applicant is required to demonstrate how requirements are met. Once the CNSC receives a project description or licence application the CNSC will initiate its formal consultation and regulatory process.

Follow-up Actions:

Actions	**Response**
From CNSC staff	
Previous Actions	
1. CNSC staff to provide more information on Environmental Assessment and how that fits in the licensing process.	Complete – SMEs invited to meeting October 13th
2. CNSC staff will share high level information on decommissioning activities.	To be discussed at a future semi-annual meeting. CNSC website link sent in e-mail April 21st.

New Actions	
1. CNSC staff to provide a copy of the 2020/2021 sampling plan	Completed November 18th – attached in e-mail
2. CNSC staff to provide a link to the sampling map	Completed November 18th – provided in e-mail

Future Topics of Discussion (next meeting possibly in March-April):

1. Sampling results from 2020/2021 IEMP sampling campaign
2. Small Modular Reactor Regulatory Process
3. Waste and decommissioning