The Clerk

Standing Committee on Natural Resources (RNNR)

House of Commons

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Re: Formal Complaint — Health Impact Assessments for CANDU Nuclear Facilities Assess Cancer and Nothing Else: the Statutory Mandate Requires More, and the Energy Alberta Peace River Project (IAAC File 89430) Is Being Reviewed on an Assessment That Covers One of Seven Documented Health Endpoint Categories

I write to bring to the Committee's attention a structural deficiency in the health impact assessment framework applicable to CANDU nuclear facilities in Canada: these assessments evaluate cancer risk as the primary, and in practice sole, quantitative health endpoint. They do not assess cardiovascular disease, neurological and neurodevelopmental effects, immune system dysregulation, ophthalmic effects, adverse reproductive and developmental outcomes, or the synergistic interaction effects of radiation and chemical co-exposures. Each of these six categories has peer-reviewed evidence of association with chronic low-dose ionising radiation exposure. None is assessed in routine CANDU health impact assessments.

The statutory frameworks under which CANDU health impact assessments are submitted — the Nuclear Safety and Control Act, the Impact Assessment Act, and the Guidelines for Canadian Drinking Water Quality — do not limit their mandate to cancer. They cover the health of persons. An assessment that evaluates one of seven documented health endpoint categories is not a health impact assessment in the statutory sense. It is a cancer risk assessment that has been labelled a health impact assessment. The label does not satisfy the mandate.

If this complaint is well-founded, the Committee is being asked to consider whether the Standing Committee should direct the CNSC to expand the scope of CANDU health impact assessments to reflect the full statutory mandate and the current state of the peer-reviewed literature — before the Energy Alberta Peace River Nuclear Power Project advances further in the IAAC review process on the basis of an assessment that has not assessed the health impact of the proposed facility.

PART I — THE STATUTORY FRAMEWORK

The Health Impact Assessment Mandate Is Not a Cancer Risk Assessment Mandate

The Nuclear Safety and Control Act mandates the CNSC to regulate nuclear activities in Canada to protect the health and safety of persons. The mandate is not qualified by reference to cancer. It is not limited to stochastic effects. It covers health and safety of persons — the full range of health effects from the regulated activity.

Section 22 of the Impact Assessment Act requires that a federal impact assessment take into account health effects, including those of Indigenous peoples. Section 6 imposes a mandatory precautionary obligation requiring that lack of full scientific certainty not postpone measures against serious or irreversible harm. Neither provision limits its scope to cancer. The IAA requires consideration of health effects as a category — not a subset of health effects pre-selected by the regulator whose licensing regime is under review.

The Guidelines for Canadian Drinking Water Quality, under which Health Canada sets maximum acceptable concentrations for radiological and chemical contaminants, cover a range of health endpoints — including cardiovascular, neurological, reproductive, and developmental outcomes. The tritium guideline is set with reference to the full health effects literature. The statutory and regulatory framework within which CANDU health impact assessments operate does not confine the assessment to cancer.

The Current Practice

In practice, CANDU health impact assessments operate as follows. Dose calculations are performed for routine radionuclide releases. Incremental cancer risk is computed using the Linear No-Threshold model. The resulting figure — typically expressed as a fraction of background cancer risk — is used to conclude that routine releases do not pose an unreasonable health hazard. The assessment ends there. No quantitative or qualitative assessment is performed for any other health endpoint. The document is titled a health impact assessment.

This structure has its origins in the prioritisation of stochastic cancer risk in radiological protection frameworks developed in the postwar period. It reflects the state of the literature as it existed when those frameworks were established. It does not reflect the current state of the peer-reviewed literature, which documents a range of non-oncological health effects from chronic low-dose radiation exposure that are now sufficiently well-evidenced to require assessment under any statutory framework that covers health of persons.

PART II — THE SIX EXCLUDED ENDPOINT CATEGORIES

What the Peer-Reviewed Literature Establishes

The following six categories of non-oncological health endpoints have peer-reviewed evidence of association with chronic low-dose ionising radiation exposure. None is assessed in routine CANDU health impact assessments.

Cardiovascular Disease. The INWORKS study — a chronic low-dose occupational cohort of over 300,000 nuclear workers across France, the United Kingdom, and the United States — reported a statistically significant association between cumulative radiation dose and circulatory disease mortality. The Life Span Study of atomic bomb survivors shows excess cardiovascular mortality at doses as low as 0.5 Sv. A 2023 meta-analysis found consistent elevated relative risk for ischaemic heart disease and cerebrovascular disease across multiple independent occupational cohorts. The evidence base supporting inclusion of cardiovascular endpoints in CANDU HIAs now exceeds the evidence base that existed for cancer when cancer was first incorporated as the primary endpoint in the 1970s.

Neurological and Neurodevelopmental Effects. In utero radiation exposure is an established cause of intellectual disability at doses above 100 mGy during the period of peak sensitivity at 8 to 15 weeks of gestational age — a finding not in scientific dispute. At sub-threshold doses, studies of populations near Chernobyl and of medical radiation cohorts suggest possible IQ effects and behavioural outcomes at doses in the range of 10 to 50 mGy. For tritium specifically, animal studies document neurodevelopmental effects from prenatal organically bound tritium (OBT) exposure at dose rates comparable to those produced by chronic environmental tritium contamination, including reduced brain weight, altered neuronal density, and impaired spatial learning in offspring. CNSC technical report INFO-0799 acknowledges the animal neurodevelopmental data but does not incorporate it into human health impact assessment frameworks.

Immune System Dysregulation. Chronic low-dose ionising radiation has documented effects on immune function, including reduced lymphocyte count, altered natural killer cell activity, and dysregulation of

inflammatory cytokine expression, in occupational cohorts at cumulative doses in the range of 50 to 200 mSv — doses that may be approached by long-term residents within the dispersion perimeter of an operating CANDU facility. Immune dysregulation is relevant both as a direct health outcome and as a potential mechanistic pathway for childhood leukemia: acute lymphoblastic leukemia is fundamentally a disease of immune system failure in haematopoietic progenitor cells. A health impact assessment that does not assess immune endpoints cannot claim to have assessed the health mechanism most directly relevant to the primary observed epidemiological signal from nuclear facilities.

Ophthalmic Effects. The International Commission on Radiological Protection reviewed evidence of radiation-induced lens opacity at doses substantially lower than the previously assumed threshold. The review prompted a reduction of the occupational eye lens dose limit from 150 mSv per year to 20 mSv per year in 2012. Ophthalmic surveillance data from occupational cohorts and from Chernobyl clean-up worker studies show elevated posterior subcapsular cataract prevalence at cumulative doses below 500 mGy. Posterior subcapsular cataracts are progressive, debilitating, and occur predominantly in working-age individuals. The ICRP's own revised guidance has not prompted any corresponding revision to CANDU health impact assessment practice.

Adverse Reproductive and Developmental Outcomes. Beyond cancer and the neurodevelopmental effects noted above, chronic low-dose radiation has been associated with reduced sperm count, increased miscarriage rates, and intrauterine growth restriction in occupational and environmental exposure studies. These are probabilistic associations documented in populations with established chronic exposures, not deterministic threshold effects. For communities near a CANDU facility, where women of reproductive age may receive continuous low-level tritium exposure across multiple pregnancies spanning decades of operation, the cumulative reproductive health profile has never been assessed in any Canadian environmental review.

Mixture and Interaction Effects. The peer-reviewed literature on mixture toxicology documents that carcinogenic and genotoxic effects of radiation and chemical co-exposures are in many cases synergistic rather than additive: the radiation effect is amplified in the presence of chemical promoters in the initiation-promotion sequence. BEIR VII establishes that ionising radiation acts as a cancer initiator; aromatic hydrocarbons act as promoters. For the Peace River region of northern Alberta, the background chemical carcinogen burden from bitumen extraction and pipeline operations represents precisely the mixture synergy environment the literature identifies as producing amplified effects. No CNSC regulatory framework requires mixture interaction assessment as a component of CANDU health impact assessment. For the Peace River project specifically, this is not a theoretical concern — it is a site-specific condition that has not been assessed.

The Scope Table

Endpoint category	Evidence basis	Assessed in CANDU HIA	CNSC documentation
Cancer	LSS, BEIR VII, LNT model	Yes — central framework	Full regulatory framework
Cardiovascular	INWORKS, LSS follow-up, 2023 meta-analysis	No	Not addressed
Neurological / developmental	In utero studies, animal OBT data	No	Acknowledged in INFO-0799; not assessed

Immune dysregulation	Occupational cohorts, mechanistic studies	No	Not addressed
Ophthalmic (cataract)	ICRP 2012 revised guidance, Chernobyl cohorts	No	Not addressed
Reproductive / developmental	Occupational and environmental cohorts	No	Not addressed
Mixture interactions	BEIR VII, carcinogenesis literature	No	Not addressed

Table: Health endpoint categories with peer-reviewed evidence of association with chronic low-dose ionising radiation. Six of seven are not assessed in CANDU health impact assessments.

PART III — THE LEGAL ARGUMENT

A Cancer Risk Assessment Labelled as a Health Impact Assessment Is Not a Health Impact Assessment

The statutory mandate under which a CANDU health impact assessment is submitted to IAAC review does not permit the assessing body to select one endpoint category from the available evidence, assess only that category, and represent the result as a complete health impact assessment. The Impact Assessment Act requires consideration of health effects. The NSCA requires protection of the health and safety of persons. Neither statute has authorised the CNSC to define health effects as cancer effects for the purpose of satisfying these obligations.

An analogy is instructive. An environmental assessment that evaluated effects on one of seven documented species at a proposed site — concluding no unreasonable environmental harm because the one species assessed was not significantly affected — would not satisfy the statutory mandate to assess environmental effects. The same logic applies to health. One of seven documented health endpoint categories, assessed in isolation and labelled the whole assessment, does not satisfy a statutory mandate to assess health effects. It satisfies only a mandate to assess the one category selected. No such limited mandate has been enacted.

The consequence for the Energy Alberta IAAC review is direct. The health impact assessment submitted in support of the Peace River project will assess cancer risk from routine radionuclide releases. It will not assess cardiovascular risk, neurological or neurodevelopmental risk, immune system effects, ophthalmic risk, reproductive health effects, or mixture interaction effects in a region with documented chemical carcinogen burden. A Review Panel evaluating whether the project is in the public interest, including its health impacts, cannot rely on an assessment that has not assessed the health impact of the proposed facility — only a fraction of it.

IAA Section 6 Is Independently Triggered by Each Excluded Endpoint

The precautionary obligation in IAA section 6 is triggered by a threat of serious or irreversible damage combined with lack of full scientific certainty. Each of the six excluded endpoint categories satisfies both elements independently:

- Cardiovascular endpoints: the INWORKS signal is statistically significant in a cohort of 300,000 workers; the causal mechanism is not fully characterised at chronic low-dose rates relevant to CANDU releases. Both elements are present.

- Neurodevelopmental endpoints: in utero effects at established doses are not in dispute; sub-threshold effects and the OBT-specific animal data remain uncertain at environmentally relevant dose rates. Both elements are present.
- Immune dysregulation: documented in occupational cohorts; the dose-response relationship at chronic low-dose community exposure levels is uncertain. Both elements are present.
- Ophthalmic effects: the ICRP's own revised guidance reflects a signal at lower doses than previously assumed; dose-response at long-term community exposure levels is not established. Both elements are present.
- Reproductive and developmental effects: documented associations in occupational cohorts; probabilistic relationship at the doses relevant to CANDU residential perimeters is uncertain. Both elements are present.
- Mixture interactions: synergistic effects of radiation and chemical co-exposures are established in the literature; the specific interaction profile for the Peace River regional carcinogen burden has never been characterised. Both elements are present.

The CNSC's current practice — assessing only cancer — does not engage with any of these six section 6 triggers. An IAAC review that accepts the CNSC's health impact assessment as complete has not discharged Parliament's precautionary mandate in relation to six independent categories of documented health concern. The precautionary obligation is mandatory. It cannot be satisfied by a framework that has not addressed the evidence giving rise to the obligation.

The Morton Doctrine

The Federal Court held in *Morton v. Canada (Fisheries and Oceans)* 2015 FC 575 that the proponent of a licensed activity bears the burden of demonstrating it will not cause unacceptable harm, and that licence conditions cannot derogate from the precautionary principle. An IAAC approval of the Peace River project that relies on a health impact assessment covering one of seven documented health endpoint categories has not required Energy Alberta to discharge the precautionary burden in relation to the six excluded categories. The burden has not been discharged — it has not been attempted. A project approval on this foundation derogates from the precautionary principle by omission: the health effects that have not been assessed are the health effects for which the precautionary obligation remains unmet.

The Vavilov Standard

Under *Canada (Minister of Citizenship and Immigration) v. Vavilov* 2019 SCC 65, an administrative decision must be justified, transparent, and intelligible in relation to the relevant legal and factual context. A Review Panel decision finding that the Peace River project will not result in significant adverse health effects — based on an assessment that acknowledges in its scope section that only cancer effects have been assessed — is not intelligible in relation to the statutory mandate requiring assessment of health effects. A decision finding no significant health effects across a category that has not been assessed is not a finding supported by the evidence. It is a finding about evidence that has not been gathered.

PART IV — THE PEACE RIVER SPECIFIC CONTEXT

The Most Acute Case for Mixture Interaction Assessment in Any Proposed Canadian Nuclear Site

The Peace River region of northern Alberta is not a generic location for the application of these arguments. It is the location where the gap between the existing assessment framework and the statutory mandate is most consequential.

The Peace River Health Zone has documented elevated baseline cancer incidence across multiple cancer types relative to Alberta provincial averages, of aetiology not fully characterised by Alberta Health Services. The region carries a legacy of chemical carcinogen exposure from bitumen extraction and pipeline operations — specifically aromatic hydrocarbons, which the carcinogenesis literature identifies as promoters in the initiation-promotion sequence in which ionising radiation acts as initiator. A new CANDU-derived facility in this region would introduce a radiation initiator into a population already subject to elevated chemical promoter exposure. The synergistic interaction of these two carcinogenic pathways has never been assessed for this region. No CNSC regulatory framework requires it to be assessed.

The mixture interaction endpoint is the single most site-specific of the six excluded categories. Its omission from the health impact assessment framework is consequential everywhere. It is most consequential here.

Tritium, Fetal Tissue, and the Reproductive Health Gap

CANDU reactors produce tritium at characteristically higher levels than pressurised-water reactors — one to two orders of magnitude more per unit of thermal output, owing to neutron activation of the heavy-water moderator and coolant. Tritium as organically bound tritium incorporates into fetal oocyte DNA — a biological endpoint that CNSC technical report INFO-0799 identifies as a primary concern for intergenerational mutagenesis. For women of reproductive age within the tritium dispersion perimeter of a CANDU facility, continuous low-level tritium exposure across multiple pregnancies spanning decades of operation creates a reproductive health exposure profile that has never been assessed in any Canadian environmental review.

The Ontario Drinking Water Advisory Committee recommended in 2009 a 350-fold reduction in the tritium drinking water guideline specifically to protect fetal health — a recommendation CNSC's own INFO-0799 acknowledged and has neither implemented nor refuted in seventeen years. The reproductive health gap in CANDU health impact assessment practice is not a theoretical concern identified by critics. It is a concern identified by a government-commissioned scientific advisory body that the CNSC has not answered.

PART V — THE SPECIFIC REQUESTS TO THE COMMITTEE

Request 1: Committee Examination of the CNSC's Health Impact Assessment Scope

The Committee is asked to examine the basis on which the CNSC has confined CANDU health impact assessments to cancer risk. Specifically: what statutory provision authorises the CNSC to define health effects as cancer effects for the purpose of satisfying obligations that on their face cover health of persons? What peer-reviewed basis supports the exclusion of the six endpoint categories identified in Part II? Has the CNSC published a formal scientific rationale for each exclusion? The Committee should ask the CNSC to provide, in writing, the scientific and legal basis on which cardiovascular, neurological, immune, ophthalmic, reproductive, and mixture interaction endpoints are excluded from CANDU health impact assessments submitted to IAAC review.

Request 2: Examination of the IAA Section 6 Implications of the Scope Gap

The Committee is asked to examine whether the IAAC's precautionary analysis under IAA section 6 can be considered complete when the health impact assessment it relies on has not addressed six endpoint categories for which the section 6 trigger — threat of harm combined with scientific uncertainty — is independently met. If the IAAC's section 6 discharge is co-extensive with the scope of the CNSC's health impact assessment, Parliament's mandatory precautionary commitment is not being applied to six categories of health risk for which it was specifically enacted. The Committee may wish to consider recommending that the IAAC require, as a condition of accepting a nuclear health impact assessment as adequate for review

purposes, confirmation that all endpoint categories for which peer-reviewed evidence exists have been assessed or that a documented scientific rationale for exclusion has been provided.

Request 3: Direction to the CNSC on Minimum Assessment Scope for MONARK Licensing

Canada has committed $304 million to the MONARK next-generation CANDU reactor design, which retains heavy-water moderation and characteristically high tritium production. MONARK licensing proceedings will generate health impact assessments under the same framework that currently excludes six of seven documented endpoint categories. The Committee is asked to consider recommending that the CNSC, before MONARK licensing proceedings commence, publish a formal regulatory document establishing the minimum health endpoint scope for CANDU health impact assessments — defining each endpoint category that will be assessed, the evidence basis for its inclusion, and the methodology to be applied. For any endpoint excluded, the document should publish the scientific basis for the exclusion. This is a transparency requirement, not a standard change, and is consistent with the CNSC's statutory obligation under section 9 of the NSCA to disseminate accurate scientific and regulatory information.

Request 4: Direction Regarding the Peace River Project Specifically

The Committee is asked to consider communicating to the IAAC that Parliament's intention in requiring health impact assessment under the IAA was that health effects — not cancer effects — be assessed. The IAAC should be encouraged to require Energy Alberta to expand the scope of the health impact assessment for the Peace River project to address each of the six excluded endpoint categories, with specific attention to mixture interaction effects given the documented chemical carcinogen background of the Peace River Health Zone. A health impact assessment that does not address the site-specific interaction of ionising radiation with the existing chemical carcinogen burden of a region with documented elevated cancer incidence has not assessed the health impact of the proposed facility on that community.

Request 5: Resolution of the ODWAC Recommendation Before the Peace River Assessment Concludes

The Committee is asked to note that the CNSC's own technical report INFO-0799 acknowledges a 2009 recommendation by the Ontario Drinking Water Advisory Committee to reduce the tritium drinking water guideline 350-fold — from 7,000 Bq/L to 20 Bq/L — on the basis that the existing standard was insufficiently protective of fetal health. This recommendation has been neither implemented nor formally refuted in seventeen years. Any health impact assessment for the Peace River project that references the 7,000 Bq/L guideline as the applicable safety threshold for tritium in drinking water is using a standard the CNSC's own cited science suggests may be set 350 times too high for the most sensitive subpopulation. The Committee may wish to ask the CNSC to explain why a government-commissioned advisory recommendation has remained unaddressed for seventeen years, and to require the CNSC to publish a formal regulatory response before the Peace River project health assessment is finalised.

PART VI — SUMMARY OF THE LEGAL ARGUMENT

The argument may be stated in five propositions:

1. The statutory mandates governing CANDU health impact assessments — the NSCA, the IAA, and the Guidelines for Canadian Drinking Water Quality — cover health of persons. None limits its mandate to

cancer. The CNSC has, in practice, confined CANDU HIAs to cancer risk assessment without statutory authority to do so.

2. Six categories of non-oncological health endpoints have peer-reviewed evidence of association with chronic low-dose ionising radiation exposure. For each category, both elements of the IAA section 6 precautionary trigger — threat of serious harm and lack of full scientific certainty — are independently present. The current assessment framework does not engage with any of these six triggers.

3. A health impact assessment that covers one of seven documented health endpoint categories is not a complete assessment. It is a fraction of the required assessment, labelled the whole. An IAAC Review Panel that finds no significant adverse health effects on the basis of this fraction has not made a finding about health effects. It has made a finding about cancer effects and extended it, without assessment, to six other categories.

4. Under *Morton*, Energy Alberta bears the burden of demonstrating the project will not cause unacceptable harm. That burden has not been discharged — and cannot be discharged — in relation to health endpoints that have not been assessed. An approval premised on a silent record in six of seven endpoint categories is not a precautionary approval. It is an approval of the unassessed.

5. Under *Vavilov*, a Review Panel decision finding no significant adverse health effects from a project whose health effects in six of seven documented categories have not been assessed cannot be justified, transparent, or intelligible in relation to the statutory mandate requiring assessment of health effects. It is a finding about evidence that has not been gathered, dressed as a finding about evidence that has been weighed.

The question this complaint asks the Committee to consider is not whether nuclear power causes cardiovascular disease, or cataracts, or immune dysfunction. It is whether a regulatory framework can satisfy a statutory mandate to assess health effects by assessing one health effect, labelling that assessment complete, and submitting it to an independent assessment agency as the evidentiary foundation for a public interest determination affecting a community that has not been told the assessment is incomplete. The answer to that question determines whether the health impact assessment provisions of the Impact Assessment Act have any independent force in the nuclear context — or whether they will be satisfied in every future nuclear assessment by the same partial methodology that has been applied, without statutory authority, for fifty years.

Supporting Documents Available

I am prepared to provide the Committee with the following supporting documents on request:

- CNSC INFO-0799 (2010) — annotated to identify acknowledgements of neurodevelopmental OBT animal data, unvalidated fetal biokinetic models, and the ODWAC recommendation
- CNSC Tritium Fact Sheet — annotated to identify six divergences from INFO-0799 technical findings
- Ontario Drinking Water Advisory Committee Report (2009) — recommendation of 20 Bq/L tritium standard and its scientific basis
- BEIR VII (National Research Council, 2006) — relevant sections on radiation as cancer initiator in the initiation-promotion sequence

- ICRP Statement on Tissue Reactions (2011) — revised eye lens dose limit and its evidentiary basis
- Alberta Health Services, Cancer in Alberta: A Regional Analysis (2022) — Peace River Health Zone elevated cancer incidence data
- Formal complaint to the IAAC (File 89430) — 926 paragraphs, thirteen show stoppers, three annexures; Show Stopper 14 (HIA scope defect) and Show Stopper 15 (population mixing) available separately
- CNS Conference paper (G4SR6, March 2026) — peer-reviewed analysis of six excluded non-cancer endpoints in CANDU health impact assessment

I am available to appear before the Committee or to provide a written briefing at the Committee's convenience.

Respectfully submitted,

Christofeel Gerhardus Nel

Peace River Region, Alberta

Key references: IAA ss.6, 22; NSCA ss.9, 24(4), 24(5); Morton v. Canada (Fisheries and Oceans) 2015 FC 575; Canada (Minister of Citizenship and Immigration) v. Vavilov 2019 SCC 65; Spraytech v. Hudson (Town) 2001 SCC 40; CNSC INFO-0799 (2010); ODWAC Report (2009); ICRP Statement on Tissue Reactions (2011); BEIR VII (National Academies Press, 2006); Natural Resources Canada MONARK announcement March 6, 2025; Alberta Health Services, Cancer in Alberta (2022); CNS Conference G4SR6 proceedings (March 2026). Committee email: rnnr@parl.gc.ca.