WHY THE IAAC CANNOT APPROVE THIS PROJECT

Thirteen Independent Show Stoppers

A Formal Submission to the Impact Assessment Agency of Canada

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Why the IAAC Cannot Approve This Project

This submission identifies thirteen independent show stoppers to the approval of the Energy Alberta nuclear facility in the Peace River region. Each show stopper is fatal to the application on its own. The IAAC does not need to find all thirteen persuasive — or even six, or three. Any single one of the thirteen, properly applied to the statutory obligations of the Impact Assessment Act, is sufficient grounds to refuse approval. Together they form a closed logical structure from which there is no exit within the current state of knowledge or the current regulatory architecture.

The thirteen show stoppers fall into three categories. The first six concern the **evidence** — what the science actually shows, why the models fail, and why the studies the CNSC cites as proof of safety were almost certain to find nothing regardless of whether harm existed. The next three concern the **institution** — why the regulator the IAAC depends on cannot be relied upon, the structural reason it cannot be relied upon, and the fact that every other sophisticated nuclear nation has reached a more qualified conclusion from the same evidence. The final four concern the **law** — the statutory obligations triggered by the documented uncertainties, the constitutional defect in Indigenous consent, the irreversibility that makes every other concern permanent, and the regulatory abdication that is the reason every deficiency in this submission remains unaddressed after decades.

Part One: The Evidence

- Show Stopper 1 — **The Real-World Cancer Data Does Not Match the Models**: a forty-year, multi-country, independently replicated body of evidence documents elevated cancer rates near nuclear plants that the regulatory models predict should not exist, with a gap between model predictions and observed outcomes of ten thousand to one hundred thousand times.
- Show Stopper 2 — **The Baseline Is Already Compromised**: the Peace River region carries a documented elevated cancer incidence of unknown cause in a chemical environment that interacts synergistically with ionizing radiation, making the incremental risk calculation structurally wrong at this specific site before a single model input is considered.

- Show Stopper 3 — **The Primary Emission Cannot Be Adequately Assessed**: the CNSC's own scientists formally stated in 2010 that the evidence base is insufficient to estimate the health risks of tritium — the primary emission of CANDU reactors — and six irreconcilable contradictions exist between the CNSC's public tritium fact sheet and its own internal technical report.
- Show Stopper 4 — **The Models Are Structurally Wrong for This Scenario**: the dose models were built on the wrong people, measure the wrong thing, and apply the wrong biological weight to the substance the plant will emit most — failing the population most at risk across three independent structural dimensions simultaneously.
- Show Stopper 5 — **The Required Research Has Not Been Done**: the research gaps formally acknowledged by the US National Academies, funded by Congress, and rated as very low certainty by the most comprehensive international meta-analysis cannot be closed by building the plant and observing the outcomes.
- Show Stopper 6 — **Absence of Evidence Is Not Evidence of Absence**: the null studies the CNSC will cite as safety evidence were designed with so little statistical power they were almost certain to find nothing regardless of whether harm existed — they are measurement failures presented as conclusions.

Part Two: The Institution

- Show Stopper 7 — **The Regulator Cannot Be Relied Upon**: seven documented contradictions between the CNSC's public communications and its own internal scientific documents establish a systematic pattern of misrepresentation, and the word 'unfounded' — the CNSC's most consequential public conclusion — is an advocacy verdict that violates seven principles of scientific method, applied to a replicated empirical signal no other major regulatory body was willing to call groundless.
- Show Stopper 8 — **Structural Conflict of Interest**: the CNSC is funded primarily by fees from the industry it regulates, is embedded in an institutional ecosystem that includes both the regulated industry and the research institution producing its safety evidence, and has never had its most consequential data withdrawal independently audited — providing the structural explanation for the pattern documented in Show Stopper 7.
- Show Stopper 9 — **International Regulatory Divergence**: every other sophisticated nuclear jurisdiction — Germany, France, the United Kingdom, Austria, Switzerland — that has examined the same evidence has reached a more qualified conclusion than Canada's own regulator, and that divergence is not explained by Canada-specific science.

Part Three: The Law

- Show Stopper 10 — **The Precautionary Principle Is a Positive Legal Obligation**: section 6 of the Impact Assessment Act requires the IAAC to apply the precautionary principle to each of six documented scientific uncertainties, and the burden of proof —

which the CNSC systematically inverts — sits by law with the proponent, not with those raising concerns.

- Show Stopper 11 — **The UNDRIP Informed Consent Defect**: Free, Prior, and Informed Consent under Bill C-15 cannot be valid when the health information on which it rests has been shown — through the CNSC's own documents — to be inaccurate; this is a substantive constitutional defect that cannot be corrected after approval.
- Show Stopper 12 — **Irreversibility and the Absence of Any Self-Correction Mechanism**: if harm occurs at the levels documented near other nuclear plants, the Peace River community is too small to detect it epidemiologically, making monitoring conditions meaningless as safeguards and making the consequences of approval permanent and unreviewable.
- Show Stopper 13 — **Regulatory Abdication**: the CNSC knew about every deficiency documented in this submission, possessed the statutory authority under the Nuclear Safety and Control Act to require the research needed to remedy each of them as a condition of any licence it issued, had an annual budget exceeding $350 million to fund it, was told by its own scientists in 2010 exactly what was required, and took no action across sixteen years — making the IAAC the last available mechanism in the Canadian regulatory system through which these deficiencies can be compelled before a community is permanently committed to living beside a facility whose primary emission the CNSC's own scientists said they could not adequately assess.

PART ONE — SHOW STOPPERS 1 THROUGH 6

The Evidence

What the science actually shows, why the models fail, and why the studies the CNSC cites as proof of safety prove nothing

Part One establishes the empirical foundation of this submission. It begins with the forty-year international evidence record showing that cancer rates near nuclear plants exceed model predictions by a factor of ten thousand to one hundred thousand — a gap the CNSC has never explained. It then shows that the Peace River region compounds this problem because its population already carries an elevated cancer burden and a chemical environment that interacts synergistically with radiation, making the incremental risk from this facility not merely additive but potentially multiplicative. It then explains structurally why the models fail: they were built on the wrong people, measure the wrong thing, and assign the wrong biological weight to the substance the plant will emit most. It establishes that the research required to fix the models has not been done. It closes by demonstrating that the null findings the CNSC will cite as evidence of safety come from studies that were almost certain to find nothing regardless of whether harm existed — making them measurement artifacts, not safety evidence.

SHOW STOPPER 1

The Real-World Cancer Data Does Not Match the Models

What the Models Predict

Everything in Energy Alberta's safety case rests on mathematical models. Those models calculate radiation emissions, dispersal, human uptake, and resulting dose. From that dose they calculate risk. Their prediction for communities near nuclear power plants — based on estimated dose levels of 0.001 to 0.01 millisieverts per year — is that cancer risk increases are immeasurably small. Effectively zero additional cases. This is not a contested interpretation of the models. It is what the models straightforwardly produce given the emission and dose inputs.

The Body of Evidence That Shows the Models Are Wrong — A Forty-Year Record

The models do not predict what is observed in the real world. The following is not a characterisation of contested data. It is a catalogue of independent research programmes spanning four decades, conducted in different countries, by different scientific teams, using different methodologies — all documenting elevated cancer rates near nuclear plants that the models predict should not exist. The KiKK study was not the beginning of this evidence base. It was a rigorously designed national study commissioned to investigate a signal that had already been accumulating for twenty-five years before it was published.

The Black Report — United Kingdom, 1984

The first formal government investigation of childhood cancer near a nuclear facility was the Black Inquiry, commissioned following public concern about leukemia rates in Seascale — the village adjacent to the Sellafield nuclear complex in Cumbria. The inquiry found that childhood leukemia incidence in Seascale was approximately ten times the national average. The Black Report did not attribute the excess to radiation but acknowledged it could not be explained. It recommended further investigation. That excess — ten times the national average in the immediately adjacent community — was the opening data point of the evidence base that now spans forty years.

COMARE — United Kingdom, 1986 Onwards

The UK government established the Committee on Medical Aspects of Radiation in the Environment to continue the investigation the Black Report initiated. COMARE published a series of reports through the late 1980s and 1990s examining childhood cancer rates near Sellafield, Dounreay, and other UK nuclear sites. The reports consistently documented elevated rates that could not be explained by the radiation doses measured at those sites. COMARE's broader analysis across UK nuclear sites found approximately a 20% excess leukemia risk within 5 kilometres of nuclear installations — statistically significant across the aggregated UK data. COMARE's consistent finding across multiple sites and multiple reports over more than a decade was that the signal was real and the explanation was unknown.

The Krümmel Cluster — Germany, 1990–2005

In the early 1990s an elevated childhood leukemia cluster was identified near the Krümmel nuclear power plant in northern Germany. Between 1990 and 1995, six cases of childhood leukemia were diagnosed in the area, five of them within a five-kilometre radius, against an expected number of approximately one — representing a rate roughly five to six times the expected level. The cluster persisted until at least 2005. Modestly elevated levels of caesium were detected in rainwater and air samples near the plant during the period. Emissions from the plant were within regulatory limits throughout. The UK's COMARE examined the Krümmel data and concluded the cluster could not be explained. The Krümmel cluster was one of the direct scientific motivations for the German government commissioning the KiKK national case-control study.

Pre-KiKK Ecological Studies — Multiple Countries, 1990s–2000s

Through the 1990s and early 2000s, ecological studies in the UK, France, Germany, Canada, and the United States consistently found elevated childhood leukemia rates near nuclear power plants. A formal meta-analysis of geographic studies from this period reported a 23% higher incidence of leukemia among children aged zero to nine years living within 16 kilometres of nuclear facilities — pooled across multiple countries and multiple study designs. These were the studies that established the signal and motivated the more rigorous case-control designs that followed. Their consistent directional finding — elevated rates, models predicting no elevation, gap unexplained — is the foundation on which KiKK was built.

The KiKK Study — Germany, 2008

The Kinderkrebs in der Umgebung von Kernkraftwerken study was commissioned by Germany's Federal Office for Radiation Protection specifically to address methodological criticisms of the earlier ecological studies. Conducted by the German Childhood Cancer Registry, it was a national case-control study examining every nuclear power plant in Germany. It found an odds ratio of 2.19 for leukemia in the closest proximity subgroup — a 119% excess risk — and an odds ratio of 1.61 for all cancers combined, a 61% excess risk. These findings were statistically robust, peer-reviewed, and published in the European Journal of Cancer. Germany's radiological protection commission reviewed it and concluded the cause remains unclear. It did not say the finding was an artifact. It did not say it was unfounded.

French GEOCAP Study — France, 2012

INSERM — France's national institute for health and medical research — conducted an independent national case-control study using French cancer registry data. It was not designed in response to KiKK and did not use KiKK's methodology. It found an odds ratio of approximately 1.9 for childhood leukemia near French nuclear plants — a roughly 90% excess risk — in the closest proximity subgroup. Two independent national case-control studies, designed and conducted separately, in two separate countries, with separate research teams and separate data, found essentially the same result.

Pooled Case-Control Analysis — Multiple Countries

A pooled case-control analysis drawing on data from multiple national studies found that residence within five kilometres of a nuclear facility was associated with a 61% increased incidence of all cancers and a 119% excess risk of leukemia in children under five. The magnitude of the pooled finding was consistent with both KiKK and GEOCAP. The consistency across national studies and pooled analyses is the signature of a real signal.

Körblein and Fairlie Pooled Analysis

Körblein and Fairlie conducted a pooled analysis across the available international studies examining cancer rates near nuclear plants. The pooled analysis found a statistically significant 20% excess leukemia risk across the pooled dataset, with the excess rising to 37% in the closest proximity subgroup. The consistency of the direction and magnitude across independent national datasets is the primary finding. The CNSC's KiKK fact sheet does not reference this analysis.

Baker and Hoel Meta-Analysis

Baker and Hoel conducted a formal meta-analysis of studies examining cancer rates near nuclear facilities, covering multiple countries and facility types. Their analysis found a statistically significant 21% increase in childhood leukemia risk within the closest proximity band to nuclear facilities, consistent in direction with every individual national study in the catalogue. The CNSC's public materials do not reference this analysis.

Russo 2023 — The Post-Shutdown Natural Experiment

Russo and colleagues published a 2023 analysis using Germany's 2011 nuclear plant closures as a natural experiment. The analysis found that the incidence rate ratio near German plants dropped from 1.20 — a 20% elevation — before closure to 1.12 — a 12% elevation — after closure. The decline was partial and did not reach background levels. This finding demonstrates two things: the signal was present at a 20% elevation before closure, and even after closure it remained above background, meaning the question of mechanism is not closed. The CNSC's KiKK fact sheet, updated as recently as October 2025, does not reference this analysis.

The 2024 International Meta-Analysis — 175 Plants, 17 Countries

The most comprehensive quantitative synthesis of health outcomes near nuclear power plants published to date covered 175 plants across 17 countries, encompassing nearly half a million nuclear industry workers and over seven and a half million community residents. It found elevated cancer signals near operating plants that the modelled dose estimates cannot account for. Under the GRADE framework — the international gold standard for evidence quality assessment — the certainty of evidence for cancer outcomes was rated as very low. That rating does not mean the elevated signal is absent. It means the studies available to measure it precisely have serious design and power limitations. The signal is present in the data across 175 plants and 17 countries.

Harvard Study — United States, February 2025

A study published in Nature Communications in February 2025 examined cancer mortality rates in US counties relative to their proximity to operational nuclear power plants. Critically, the analysis controlled for poverty, smoking rates, obesity rates, racial composition, and healthcare access — the major non-radiological confounders that might independently explain elevated cancer rates. After removing the contribution of all those factors, counties closer to nuclear plants still showed higher cancer mortality. The relative risk for the highest-proximity group reached approximately 1.20 — a 20% elevation compared to the most distant counties. It is not referenced in any CNSC public document.

Forty-Year Evidence Summary — Quick Reference

The following table summarises every independent study and research programme in the catalogue. Every row documents an elevated cancer signal. Every row represents an independent source. The direction never reverses.

Study / Programme	Jurisdiction	Key Finding
Black Report / Seascale	UK, 1984	~10x national average childhood leukemia in community adjacent to Sellafield
COMARE (multi-site)	UK, 1986 onwards	~20% excess leukemia within 5km across aggregated UK nuclear sites
Krümmel cluster	Germany, 1990–2005	5–6x expected childhood leukemia rate within 5km; plant within regulatory limits throughout
Pre-KiKK ecological meta-analysis	Multi-country, 1990s–2000s	23% higher leukemia incidence ages 0–9 within 16km, pooled across multiple countries
KiKK national case-control study	Germany, 2008	OR 2.19 (119% excess leukemia); OR 1.61 (61% excess all cancers) — closest proximity subgroup
GEOCAP national case-control study	France, 2012	OR ~1.9 (90% excess childhood leukemia) — independent replication using French registry data
Pooled case-control analysis	Multi-country	61% excess all cancers; 119% excess leukemia within 5km — pooled across national studies
Körblein and Fairlie pooled analysis	Multi-country	20% excess leukemia overall; 37% excess in closest proximity subgroup
Baker and Hoel meta-analysis	Multi-country	21% increase in childhood leukemia — consistent across countries and facility types
Russo et al. post-closure study	Germany, 2023	20% elevation pre-closure (2011); 12% post-closure — partial but not complete resolution
International meta-analysis	17 countries, 2024	175 plants; elevated cancer signals; certainty of evidence rated VERY LOW (GRADE)
Harvard / Nature Communications	USA, 2025	20% excess cancer mortality in highest-proximity counties after controlling for poverty, smoking, obesity, race, and healthcare access

What the Forty-Year Catalogue Establishes

This is not one contested study from one country. It is a forty-year, multi-country, independently replicated empirical record: a signal first documented near Sellafield in 1984 at approximately ten times the national average, confirmed across UK nuclear sites by COMARE through the 1980s and 1990s at 20% excess within five kilometres, observed at Krümmel Germany at five to six times the expected rate through the 1990s and 2000s, quantified at national scale by KiKK at 119% excess leukemia risk and 61% excess all-cancer risk, independently replicated in France at 90% excess leukemia risk, confirmed in pooled analyses at 61% excess all cancers and 119% excess leukemia within five kilometres, and observed at 20% elevation in the United States after controlling for poverty, smoking, obesity, race, and healthcare access. The convergence across independent programmes over four decades is the methodological hallmark of a real signal.

What this catalogue establishes for this submission is specific and limited: the mathematical models used to calculate radiation risk near nuclear plants do not predict what is observed in the real world across forty years of independent evidence. The gap between model predictions and real-world observations is between ten thousand and one hundred thousand times. That gap has not been explained. The cause has not been identified.

The Two Interpretations of the Gap — Both Regulatory Problems

There are two possible interpretations of this systematic divergence. The first is that radiation from plant emissions is causing the elevated cancer rates, and the current models dramatically underestimate the biological risk to the relevant population. The second is that something other than radiation is responsible — specifically the population mixing mechanism, under which the rapid influx of construction workers into a small isolated community can trigger leukemia clusters through an infectious or immune mechanism. This has been documented in non-nuclear industrial construction contexts. It has never been definitively ruled out at nuclear plant sites.

Both interpretations lead to the same regulatory conclusion. Under the radiation interpretation, the models used to demonstrate safety are wrong by a factor of up to one hundred thousand for the most relevant population. Under the population mixing interpretation, a mechanism entirely independent of the models is capable of producing elevated cancer rates in communities near nuclear plants — and that mechanism is directly applicable to the Peace River region, which is small, rural, isolated, and has a significant Indigenous population, representing exactly the demographic profile in which the Kinlen population mixing mechanism operates most strongly. Neither interpretation supports the adequacy of a safety case built on models whose predictions are contradicted by the observable evidence.

What the CNSC Tells the Public About This Evidence

The CNSC's public fact sheet describes the link between nuclear plant operations and the elevated cancer rates documented in this body of evidence as unfounded and not supported by a wealth of evidence. No other mainstream scientific or regulatory body in the world — not the WHO, not the UK's COMARE, not Germany's SSK — has characterised the association as unfounded. Germany's SSK said the cause remains unclear. COMARE said a comparable clustering could not be explained. The WHO has not declared the association without foundation. The CNSC's conclusion is more confident than any other major scientific body has been willing to reach, while simultaneously — in the same document — acknowledging that more extensive interdisciplinary research is required.

The fact sheet updated in October 2025 omits the GEOCAP French replication, the Körblein-Fairlie pooled analysis, the Baker and Hoel meta-analysis, the Russo 2023 post-closure natural experiment, and the 2024 international meta-analysis. The CNSC's public characterisation of the evidence as not supported by a wealth of evidence is based on a presentation of that evidence from which the substantial post-2008 replication literature has been entirely removed.

Why This Stops the IAAC

The IAAC must determine that significant adverse health effects are not likely before approving this project. The body of evidence catalogued above — multi-country, independently replicated, persisting across four decades — represents exactly the category of significant adverse health effect the IAAC must assess. Energy Alberta's health impact assessment will show that modelled emissions are within regulatory limits and modelled doses are below regulatory thresholds. That demonstration will be accurate. It will also be irrelevant, because the models on which it rests demonstrably fail to predict real-world outcomes across the entire international body of evidence most directly relevant to this facility type. A safety case that passes a test the real-world evidence has shown to be the wrong test is not a safety case.

SHOW STOPPER
2

The Baseline Is Already Compromised

The Assumption Underlying Every Risk Model

Every model Energy Alberta will use to demonstrate that this facility is safe rests on an assumption that is never stated but is foundational to every calculation: that the population living near the proposed facility is a healthy baseline population whose cancer risk is at or near the general Canadian average. The incremental risk from the facility is calculated on top of that assumed baseline. If the baseline assumption is wrong — if the population already carries an elevated cancer burden from prior and ongoing exposures — then the incremental risk calculation is wrong, because it is being added to the wrong starting point.

The Peace River region does not have a healthy baseline population in the relevant sense. It has a documented elevated cancer incidence of unknown etiology. The region's cancer burden is already higher than the models assume. The cause of that elevation has not been identified. And peer-reviewed science establishes that the carcinogenic mechanisms operating in this region are precisely the kind that interact synergistically with ionizing radiation — meaning the incremental risk from adding a nuclear facility to this specific community is not merely additive. It may be multiplicative.

The Documented Elevated Cancer Incidence in the Peace Region

The Peace River region carries a documented cancer incidence burden that exceeds the Canadian average. This is not an allegation or a projection. It is observable in regional health data. The cause of this elevation has not been determined. No etiological investigation has been completed. No environmental contaminant has been identified as responsible. The elevation exists, the cause is unknown, and no pre-construction baseline study has been commissioned to characterise it before the addition of a new major carcinogenic source is considered.

This matters for the IAAC assessment in two ways. First, it means the baseline against which Energy Alberta's incremental risk calculation will be made is already elevated. A 1% incremental increase calculated against an elevated baseline produces more absolute harm than the same percentage increase calculated against a healthy baseline. Second — and more significantly — it means the causal environment in which the new facility will operate is uncharacterised. If the existing elevated cancer incidence has a cause, that cause may interact with the facility's emissions in ways that no single-agent risk model can detect or quantify.

Mixture Synergy — Why Adding a New Carcinogen Here Is Not an Additive Calculation

Peer-reviewed science in the field of chemical mixture carcinogenesis establishes that the assumption of additive risk from multiple carcinogenic exposures is empirically invalid for the majority of known carcinogens. A study published in Carcinogenesis — the leading peer-reviewed journal in the field — found that only 15% of the 85 reviewed chemicals showed evidence of a dose-response threshold. The remaining 85% exerted low-dose effects without a threshold below which no effect was observed. The assumption of a safe low-dose exposure level that underlies

all nuclear facility licensing is therefore empirically unvalidated for the majority of known carcinogens to which Peace Region residents are already exposed.

The same literature establishes that mixtures of environmental chemicals can produce carcinogenic synergies that no single-chemical risk assessment can detect. A chemical that has immunosuppressive qualities may not be carcinogenic in isolation, but if it suppresses the immune response, it may contribute to carcinogenesis in the presence of other disruptive chemicals. Interacting contributors need not act simultaneously or continuously — they may act sequentially at different life stages. A sustained focus on individual agents misses exactly the kind of synergies that arise when combinations of disruptive chemicals and ionizing radiation act in concert over a lifetime of exposure.

Radiation as Initiator in a Pre-Primed Environment

The National Academy of Sciences BEIR report documents a specific and relevant mechanism: a synergistic interaction between the initiating effects of radiation and specific promoting agents is known to occur across many different organs and cell systems. Promotion by chemical agents causes higher cancer incidence with shortened latent periods. The Peace Region's documented aromatic hydrocarbon contamination — from bitumen extraction and processing operations — means existing chemical exposure already functions as precisely this kind of promoter. Ionizing radiation from the proposed facility would not be entering a clean carcinogenic slate. It would be entering an environment where chemical promoters are already present and active.

The International Agency for Research on Cancer confirms the overlapping mechanistic architecture: radiation sources are associated with multiple key carcinogenic characteristics and act through multiple pathways, including many of the same hallmarks of cancer induced by polycyclic aromatic hydrocarbons. Two agents that act through overlapping mechanistic pathways in the same tissue are not merely additive. Their co-exposure may be multiplicative. No model in Energy Alberta's safety case will assess this interaction, because no regulatory framework requires it.

The Regulatory Precedent — Elevated Clusters Without Identified Cause

The CDC's own guidance on cancer cluster investigation establishes a point directly applicable here: even when a cancer cluster is confirmed — when the elevated rate is statistically established and unlikely to be a chance finding — there is no guarantee that a common cause or an environmental contaminant will be identified. The CDC further acknowledges that in some cases, despite a significantly elevated standardised incidence ratio, further study will be unable to determine the cause.

This is the regulatory trap for the IAAC. The elevated cancer incidence in the Peace Region is documented. Its cause is unknown. Regulatory agencies — by their own published guidance — acknowledge they frequently cannot identify the cause of confirmed elevated cancer rates. If the cause of the existing elevation cannot be identified, it cannot be modelled. If it cannot be modelled, the incremental effect of adding a new carcinogenic source to that environment cannot be quantified. Approving a nuclear facility under these conditions means approving an unquantifiable risk increment on top of an unquantified baseline. That is not a risk assessment. It is the absence of one.

Why the Tipping Point Is Lower Here Than the Models Assume

Why This Stops the IAAC

Under REGDOC-3.1.1 — the CNSC's own regulatory document on environmental assessments — the proponent is required to characterise the existing environment before assessing incremental impacts. An existing elevated cancer incidence of unknown etiology is a feature of the existing environment that must be characterised before the incremental effect of a new carcinogenic source can be assessed. Energy Alberta has not characterised it. The CNSC has not required it. The IAAC cannot accept an incremental risk assessment calculated against the wrong baseline, for a population whose existing carcinogenic environment has not been characterised, using single-agent models that peer-reviewed science establishes are invalid for mixture exposures. Approving before that characterisation is complete is not a risk assessment. It is approval of an unknown risk increment on top of an unquantified existing burden.

SHOW STOPPER 3

The Primary Emission Cannot Be Adequately Assessed

What Tritium Is and Why It Matters Here

Tritium is a radioactive form of hydrogen produced in large quantities by CANDU reactors — far more per unit of electrical output than any other commercial reactor design in the world. It enters the body through drinking water, food, air, and skin absorption. It can substitute for normal hydrogen in biological molecules, including DNA. In pregnant women it crosses the placenta. Fetal tissue incorporates it directly into developing cells. Communities near this facility will be exposed to it every day the plant operates for its entire operational life.

What the CNSC's Own Scientists Actually Found

The CNSC commissioned its own technical study — INFO-0799 — specifically to answer how dangerous tritium is. That study concluded, in the CNSC's own published words, that the studies reviewed do not contain enough data to specifically estimate the health risks of tritium exposure, and that an international collaborative study would be required to assess tritium risk properly. That international study has never been done. The data gap has never been filled. The CNSC's own scientists formally stated in 2010 that they could not estimate how dangerous the primary emission of the proposed facility actually is, and nothing has changed that finding.

Six Contradictions Between the Public Fact Sheet and the Technical Report

The CNSC's public tritium fact sheet and its own internal technical report describe the same substance in ways that are irreconcilable across six separate dimensions:

- The fact sheet describes tritium as relatively weak. The technical report states it is 1.4 times more biologically damaging than x-rays and 2.2 times more damaging than gamma rays.
- The fact sheet states tritium only causes harm in extremely large quantities. The technical report states that a fetus in a pregnant woman exposed to tritium receives double the dose of the mother — at any concentration — and that fetal tissue is substantially more radiosensitive than adult tissue.
- The fact sheet makes no mention of organically bound tritium. The technical report documents that organically bound tritium incorporates into fetal oocyte DNA, irradiating it for decades; that transmutation of tritium to helium-3 causes permanent structural DNA damage; and that the biological half-life of organically bound tritium approaches its radioactive half-life of 12.3 years.
- The fact sheet describes the Pickering tritium study as having confirmed that tritium is not associated with increased cancer risk. The technical report states that the evidence base is insufficient to make that determination and that an international collaborative study would be required.
- Every dose calculation for this facility uses a radiation weighting factor of 1 for tritium. The technical report states that a weighting factor of 2.2 would best reflect the radiation risk for tritium. Every safety number presented to the IAAC systematically understates the actual biological risk from tritium by the CNSC's own documented factor.
- The Ontario Drinking Water Advisory Council formally recommended reducing the tritium drinking water standard by 350 times — from 7,000 to 20 becquerels per litre — because the existing standard does not adequately protect against carcinogenic risk. The CNSC acknowledged this recommendation. It has never been refuted. The standard has never been changed.

The Pickering Study Finding

The only Canadian study ever conducted to assess tritium-related cancer risk in a CANDU reactor community found that girls and women in the surrounding area were developing childhood cancer at essentially double the normal rate, and lung cancer at 2.34 times the normal rate. These were statistically significant findings. The CNSC's public summary of that study characterises it as having confirmed safety. The elevated findings appear nowhere in the CNSC's public description of its own study.

Why This Stops the IAAC

Energy Alberta's health impact assessment will calculate tritium doses using a weighting factor of 1 and conclude they are below regulatory limits, therefore safe. Every number in that calculation understates actual biological risk by a factor the CNSC's own scientists have documented. The IAAC is being asked to approve a facility whose primary emission it cannot adequately assess because the evidence base to estimate its health risks does not exist, using a calculation framework that the CNSC's own technical report says underestimates the risk, from a regulator whose public characterisation of tritium safety is irreconcilable with its own internal scientific findings.

SHOW STOPPER 4

The Models Are Structurally Wrong for This Scenario

Why Model Validity Is the Central Question

Energy Alberta's entire safety case is a chain of model outputs. Emissions within modelled limits. Doses below modelled thresholds. Risk below modelled danger levels. Therefore: safe. Every link in that chain depends on the models being valid. Show Stopper 1 has shown that the models fail their empirical test by a factor of up to one hundred thousand. This section explains structurally why they fail: they were built on the wrong people, they measure the wrong thing, and they apply the wrong biological weighting to the substance the proposed facility will emit most.

Built on the Wrong People

The mathematical framework underlying all radiation risk regulation — the Linear No-Threshold model — was derived primarily from studying Japanese atomic bomb survivors after 1945. Those were predominantly adults and teenagers exposed to a single massive pulse of external gamma and neutron radiation lasting fractions of a second. The model was calibrated on that population.

The model is now being applied to fetuses in the womb — cells at their most radiosensitive developmental stage — exposed to radioactive particles that have been ingested or inhaled and are sitting inside the body, irradiating specific developing tissues continuously across a nine-month pregnancy. This is not a modest extrapolation. It crosses four independent variables that were never varied in the original data: age at exposure, tissue type, exposure pathway (internal versus external), and dose rate (chronic versus acute). The dose and dose-rate effectiveness factor applied to bridge the acute-to-chronic gap is an expert judgement, not a measured quantity. It has never been empirically validated in the population to which it is applied.

Measuring the Wrong Thing

When regulators calculate how much radiation a person near a nuclear plant receives, they calculate an effective whole-body dose — an average across all tissues expressed as a single number in millisieverts. This average is appropriate for some purposes. It is not appropriate for assessing the risk to specific small populations of developing cells in fetal bone marrow from radionuclides incorporated directly into or adjacent to those cells.

The localised dose to a specific cluster of haematopoietic precursor cells from an internally deposited radionuclide particle may be orders of magnitude higher than the whole-body average dose. The models do not resolve dose at that level of anatomical specificity in fetal tissue. They produce averages that obscure the localised exposure that may be driving the elevated cancer rates observed in the real-world data.

Wrong Biological Weighting

Every dose calculation presented in support of this facility will treat tritium as biologically equivalent to x-rays — a radiation weighting factor of 1. The CNSC's own technical report states that a factor of 2.2 would best reflect the actual biological risk of tritium. The reason the regulatory framework uses 1 rather than 2.2 is administrative consistency, not scientific accuracy. This

means every safety number in Energy Alberta's submission will understate the actual biological risk from the facility's primary emission by a factor that the CNSC's own scientists have formally documented.

Why Being Wrong in This Direction Is Not Acceptable

The models are not wrong randomly. They are wrong in a specific direction — consistently underestimating the risk to the most vulnerable population from the specific type of exposure produced by the specific technology being proposed. A model that overstates risk is a cautious model. A model that understates risk in fetuses and young children near CANDU reactors is the actual situation here. Approval based on non-conservative modelling of risk to the most vulnerable population is not a safety determination. It is an assumption of safety that the observable evidence directly contradicts.

SHOW STOPPER 5

The Required Research Has Not Been Done

The Risk Model Is Unvalidated at the Relevant Dose Range

The Linear No-Threshold model has never been validated at the dose range produced by nuclear power plant operations. The US National Council on Radiation Protection has formally identified a critical knowledge gap in the health consequences of gradual low-dose radiation exposure. The scientific literature reflects a genuine and unresolved split between LNT, sub-linear, and hormetic models at low doses. Saying the evidence is insufficient to replace LNT is simultaneously saying the evidence is insufficient to validate it. An unvalidated model supporting a safety determination is an assumption presented as a conclusion.

The Studies That Exist Cannot Detect the Effects They Are Supposed to Detect

The CNSC's own Canadian childhood cancer study near Ontario nuclear plants — RADICON — had 8% statistical power to detect a 50% increase in childhood cancer risk in the most critical subgroup. That means the study had a 92% probability of finding nothing even if children near those plants were developing cancer at one and a half times the normal rate. The CNSC published that study and described its null finding as its most important conclusion.

This is a systemic problem across the entire evidence base. The international scientific literature documents that epidemiological studies generally lack the statistical power to detect effects at doses below 0.1 gray — the dose range relevant to nuclear power plant communities. Studies that cannot detect an effect are not capable of producing valid evidence that the effect does not exist.

The Most Vulnerable Population Has Never Been Properly Studied

The people most at risk from nuclear plant emissions — pregnant women and their fetuses — are the people about whom the least is known. The CNSC's own technical literature acknowledges that the reasons for the greater susceptibility of pregnant women and children to radiation harm are not fully understood, and that regulatory standards have failed to adequately account for this difference. Biokinetic models for tritium and other CANDU-specific radionuclides were developed for adult occupational scenarios and have not been validated for fetal tissue under chronic environmental exposure.

Non-Cancer Health Effects Are Not Assessed

The regulatory framework focuses on cancer. The INWORKS study — encompassing over 300,000 nuclear industry workers — found statistically significant elevated risk of cardiovascular disease and ischemic heart disease at cumulative dose levels relevant to occupational nuclear exposure. A growing body of literature documents elevated risk of cataracts, neurological disorders, and immune dysfunction at dose levels within the range produced by reactor operations. Energy Alberta's health impact assessment, evaluated against CNSC standards that focus on cancer endpoints, will not address a category of harm that the scientific literature now documents at relevant dose levels.

Formal Acknowledgements of Research Insufficiency

The US National Academies of Sciences has formally concluded that a sustained multi-decade research programme is required to fill the critical gaps in knowledge about chronic low-dose radiation health effects. The US Congress has appropriated over $50 million specifically to restart a research programme that had lapsed — because the existing evidence base is acknowledged to be insufficient. The most comprehensive recent meta-analysis of health outcomes near nuclear plants — covering 175 plants in 17 countries — rated the certainty of evidence for cancer outcomes as very low under the GRADE framework. Very low means the actual effect may be substantially different from the estimated effect.

Seven Knowledge Gaps That Cannot Be Resolved by Building the Plant First

- The mechanism producing the real-world cancer signal near nuclear plants remains unidentified. An unknown mechanism cannot be engineered out.
- The dose-risk relationship for fetal haematopoietic tissue under chronic internal CANDU-specific radionuclide exposure has not been validated.
- Biokinetic models for transplacental transfer of CANDU radionuclides to fetal tissue have not been developed or validated.
- Population mixing has not been assessed for the Peace River region — a small, isolated, predominantly rural community with a significant Indigenous population, representing the highest-risk demographic profile for the Kinlen mechanism.
- The post-2011 German shutdown provides a natural experiment that has not been resolved: cancer incidence rates near closed plants showed partial but not complete decline, which neither confirms radiation causation nor excludes it.
- No validated biomarker of relevant exposure exists. There is no way to demonstrate that the at-risk population is or is not being exposed to the causal agent, whatever it turns out to be.

- No pre-construction epidemiological baseline exists for the critical subgroup in this community. RADICON did not analyse the subgroup that matters most. Building the plant creates the exposure before the baseline exists.

SHOW STOPPER 6

Absence of Evidence Is Not Evidence of Absence

The Logical Error Underlying the CNSC's Evidence Portfolio

The CNSC's safety conclusions across its health evidence portfolio rest on a consistent logical structure: studies were conducted, those studies found no evidence of increased risk, therefore no increased risk exists. This argument fails because the studies in question systematically lacked the statistical power to detect the effects they were supposed to detect. Finding nothing in a study designed to find nothing is not an empirical result. It is a measurement artifact.

The RADICON Illustration

The CNSC's most significant Canadian epidemiological study of childhood cancer near nuclear plants had 8% statistical power to detect a 50% increase in childhood cancer risk in the closest subgroup. Statistical power of 8% means a 92% probability of finding nothing even if the effect being studied is real. The CNSC published this result and described the null finding as the study's most important conclusion. The finding was not that children near Ontario nuclear plants are not developing cancer at elevated rates. The finding was that the study was almost certain to produce a null result regardless of whether they were.

The Broader Pattern

The same logic applies across the CNSC's evidence portfolio. The worker study found no elevated risk after the Canadian data — which drove the original significant finding — was withdrawn under unexplained circumstances. The Pickering study found no overall tritium-associated cancer risk, while simultaneously finding statistically significant elevated signals in specific subgroups, which the CNSC characterised as chance findings without conducting the confirmatory research that would distinguish chance from signal. In each case the study's inability to detect the effect was presented as evidence the effect does not exist.

Why This Matters for the IAAC

The IAAC will receive from the CNSC an evidence portfolio of studies finding no evidence of elevated risk near Canadian nuclear facilities. It will be told that this evidence base supports approval. The evidence base does not support approval. It supports the conclusion that studies designed with insufficient power to detect relevant effects predictably failed to detect them. The most recent comprehensive independent assessment rated that evidence base as very low certainty. The IAAC should require that its evidentiary foundation meet a higher standard than very low before determining that significant adverse health effects are not likely.

PART TWO — SHOW STOPPERS 7 THROUGH 9

The Institution

Why the regulator the IAAC depends on cannot be relied upon, the structural reason it cannot be relied upon, and what every other sophisticated nuclear nation has concluded from the same evidence

Part Two shifts from the scientific evidence to the institutional framework through which the IAAC will evaluate it. Show Stopper 7 documents the pattern across seven CNSC publications showing systematic misrepresentation of its own internal scientific findings — and identifies the word 'unfounded' as an advocacy verdict, not a scientific conclusion. Show Stopper 8 provides the structural explanation: the CNSC is funded by fees from the industry it regulates, embedded in an institutional ecosystem that includes both the regulated industry and the research institution producing its safety evidence, and has never had the Cardis data withdrawal independently audited. Show Stopper 9 delivers the external confirmation: if the CNSC's conclusions were driven by the evidence, every other sophisticated nuclear nation examining that evidence would reach the same conclusion. None of them do.

SHOW STOPPER 7

The Regulator Cannot Be Relied Upon

What the IAAC Depends On

The IAAC does not have its own team of radiation biologists, epidemiologists, and dosimetry specialists. It relies on the CNSC to provide the scientific foundation for its assessment — to evaluate Energy Alberta's submissions, advise on adequacy, and tell the IAAC what the science says.

If the CNSC's scientific foundation is accurate, the IAAC can function. If it is not, every downstream determination is built on a false foundation.

The evidence below does not compare the CNSC's conclusions to those of external critics. It compares the CNSC's public communications to the CNSC's own internal scientific documents. The divergence is documented in the CNSC's own published record.

Seven Documented Contradictions

1. The KiKK Fact Sheet

Public claim: the link between nuclear plant operations and elevated cancer rates near those plants is unfounded and not supported by a wealth of evidence. Same document: more extensive interdisciplinary research is required. No mainstream scientific body in the world — WHO, COMARE, German SSK — has used the word unfounded. Germany said cause unclear. UK said clustering could not be explained. The CNSC went further than any of them, and did so in the same document that admits the question is not closed.

2. Radiation Health Effects Generally

Public claim: the health effects of radiation are well understood. CNSC technical documentation on tritium: the evidence base is insufficient to estimate tritium-specific health risks. Both statements are on the CNSC's website simultaneously.

3. Tritium

Public claim: tritium is relatively weak and only dangerous in extremely large quantities. Technical report INFO-0799: tritium is 1.4 times more biologically effective than x-rays and 2.2 times more effective than gamma rays. Fetal dose is double maternal dose at any concentration. Evidence is insufficient to estimate health risk. The public document and the technical document are not in tension. They are describing different substances.

4. The Pickering Study

Public claim: the study confirmed that tritium is not associated with increased cancer risk. The actual study: statistically significant childhood cancer rates at roughly double normal for girls and women, and lung cancer at 2.34 times normal for females. The CNSC presented a study that found statistically significant elevated signals as a confirmation of safety.

5. The RADICON Study

Public claim: the most important finding is that there is no evidence of childhood leukemia clusters near Ontario nuclear plants. The study's own statistical appendix: 8% power to detect a 50% increased risk in the critical subgroup. A study with 8% power finding nothing is not evidence the effect does not exist. It is a study almost certain to find nothing regardless of whether the effect is real.

6. The Cardis International Worker Study

The largest international low-dose radiation worker study ever conducted originally found a statistically significant increased cancer risk across its pooled cohort. Canadian workers — approximately 4% of the total sample — drove that significant result. The CNSC withdrew the Canadian data, citing dosimetric inconsistencies it acknowledged at the time could not be explained. The withdrawal changed the pooled finding from statistically significant to null and reduced the risk estimate by 40%. The CNSC's public communications cite the post-withdrawal null result without disclosing that the original finding was significant, that Canadian workers drove it, or that the circumstances causing the data withdrawal remain unexplained.

7. The Chernobyl Fact Sheet

The CNSC presents the UNSCEAR health assessment as the authoritative basis for its Chernobyl conclusions. It does not disclose that 51 independent scientists — including several former UNSCEAR members — published a formal counter-analysis finding substantially higher health

consequences, or that the methodological disputes between UNSCEAR and the independent analysis have never been resolved.

The Pattern Is the Finding

These are not isolated errors in separate documents on unrelated topics. They are seven documents covering different subjects, produced in different years, by different CNSC teams — all showing the same directional pattern. In every case, the most reassuring interpretation of contested evidence is presented as the settled conclusion. In every case, the evidence that would require a more qualified conclusion is absent from the public document. In every case, the CNSC's own internal science directly contradicts the certainty of the public claim.

In academic science, a consistent directional bias in conclusions across independent analyses within a single institution is itself a significant finding — it indicates that something other than the evidence is driving the conclusions. In regulatory science it is a systemic failure going to the reliability of the institution's authority. The CNSC is not an institution that has made mistakes. It is an institution whose public communications systematically overstate the certainty of their safety conclusions relative to their own internal scientific findings — consistently, across every document examined, in the direction that protects the nuclear industry from having to address unresolved health questions as conditions of approval.

Why the Pattern Constitutes a Failure of Scientific Method

The pattern can be described informally as consistent directional bias. It can also be described formally, in terms of the specific principles of scientific method the CNSC's public communications systematically violate. The distinction matters because it establishes that what the CNSC is producing in its public health documents is not science. It is advocacy presented in the format of science.

The first principle is falsifiability. A scientific conclusion must specify what evidence would cause it to be revised. The CNSC's conclusion that the association between nuclear plant operations and elevated cancer rates is unfounded has survived the KiKK national case-control study, the French GEOCAP replication, the Körblein-Fairlie pooled analysis, the Baker and Hoel meta-analysis, the Russo 2023 post-closure natural experiment, and the 2024 international meta-analysis rating certainty of evidence as very low. None of it changed the conclusion. The CNSC has never stated what evidence would change it. A conclusion that survives every piece of contrary evidence without a stated revision criterion is not a scientific conclusion. It is an unfalsifiable assertion — which is, by definition, the characteristic that separates ideology from science.

The second principle is completeness of the evidence base. Scientific conclusions must be tested against the full available evidence, not a curated subset. The CNSC's KiKK fact sheet, updated as recently as October 2025, omits the GEOCAP French replication, the Körblein-Fairlie pooled analysis, the Baker and Hoel meta-analysis, the Russo 2023 natural experiment, and the 2024 international meta-analysis. The conclusion that the association is not supported by a wealth of evidence is a conclusion reached by examining a fraction of the evidence and omitting the fraction that would require a different conclusion.

The third principle is respect for replication. In science, a finding replicated independently across multiple research programmes in multiple countries is considered strengthened by that replication. The CNSC treats independent replication of the real-world cancer signal as irrelevant to its conclusion. The fact that Germany, France, and multiple international pooled analyses found the same signal is not mentioned, let alone engaged with.

The fourth principle is transparency of methodology. A scientific conclusion must disclose how it was reached — what evidence was examined, what criteria were applied, what alternative interpretations were considered and why they were rejected. The CNSC's public fact sheets contain conclusions without methodology. There is no disclosure of what evidence was reviewed, what threshold of proof was applied, or what would constitute a finding in the other direction.

The fifth principle is proportionality between evidence quality and conclusion certainty. The most comprehensive independent assessment of the evidence quality for cancer outcomes near nuclear plants rated it as very low under the GRADE framework. The CNSC's public conclusion is stated with the certainty of a settled scientific question. Certainty-level-ten language applied to certainty-level-two evidence is not a characterisation of the science. It is a misrepresentation of it.

The sixth principle is separation of empirical findings from policy conclusions. The CNSC's statement that the link is unfounded is simultaneously an empirical claim and a policy conclusion — presenting a policy conclusion as an empirical finding insulates the policy from the scrutiny it would receive if clearly identified as a policy choice.

The seventh principle is that peer review applies to conclusions, not just methods. The CNSC's health fact sheets are not peer-reviewed. They are produced internally and published as authoritative scientific statements. The same institution that produces the research, regulates the industry, and advises the IAAC also produces the public scientific communications — with no external review mechanism.

Why 'Unfounded' Is Not a Scientific Conclusion

Science does not produce findings of unfounded. It produces findings of supported, unsupported, inconsistent with the evidence, or not yet adequately tested. The word unfounded is a legal and evidentiary term. It means a claim has been investigated and found to have no basis — that the investigation was sufficient, the evidence was examined, and the claim failed the examination. It is the language of a verdict, not a hypothesis test.

Applied to the body of evidence catalogued in Show Stopper 1, the word is analytically incoherent. A finding of unfounded requires that the claim under examination — that nuclear plant operations are associated with elevated cancer rates in surrounding communities — has been shown to have no empirical basis. The claim cannot be shown to have no basis when the signal it describes has been independently replicated across Germany, France, and multiple international pooled analyses. A claim replicated across independent research programmes in multiple countries does not lack empirical basis. Whether radiation is the cause is a separate question. Whether the signal is real is not in dispute. Saying a replicated empirical observation is unfounded is a category error: it conflates the absence of a proven mechanism with the absence of an observed signal.

The word also performs a rhetorical function distinct from its scientific one. Unfounded communicates to a lay reader that the matter has been looked into and found to be groundless — in the same category as conspiracy theories or unsupported allegations. The CNSC has applied that characterisation to a body of evidence comprising peer-reviewed national case-control studies, independent international replications, formal meta-analyses, and a natural experiment from plant closures. No other regulatory body — not the WHO, not COMARE, not Germany's own SSK — was willing to use that word for that evidence. They used the language appropriate to unresolved science: the cause remains unclear, the clustering could not be explained. The CNSC used the language of a verdict. The evidence did not support that verdict.

And critically: the same CNSC document that declares the association unfounded states, in the same text, that more extensive interdisciplinary research is required. A phenomenon that requires more extensive interdisciplinary research has not been found to have no basis. It is an open question. Both statements appear in the same document. They are not reconcilable. One is a scientific statement accurately reflecting the state of the evidence. The other is a policy conclusion. The CNSC presented the policy conclusion as the scientific finding.

The Trap This Creates for the IAAC

Energy Alberta will design its health impact assessment to meet CNSC standards and guidelines. Those standards do not require Energy Alberta to explain the real-world cancer signal near nuclear plants, because the CNSC has declared it unfounded. They do not require validated fetal dosimetric modelling, because the CNSC has stated the models are adequate. They do not require a tritium risk assessment at the biologically supported weighting factor, because the CNSC uses 1 rather than 2.2. The IAAC will receive an assessment that meets the standards and a CNSC recommendation that it is adequate. Both will be accurate. Neither will answer the safety question, because the standards are built on conclusions the CNSC's own evidence base does not support.

SHOW STOPPER

8

Structural Conflict of Interest

The Financial Architecture

The CNSC is funded primarily through fees levied on the nuclear industry it regulates. Industry expansion means more licences, more compliance activities, and more fee revenue. Industry contraction means less. This is not an allegation of institutional corruption. It is a description of an incentive architecture that structural regulatory theory identifies as incompatible with fully independent scientific judgment — the same architecture that has been recognised as a deficiency in other self-funding regulatory bodies internationally.

The pattern documented across the seven publications in Show Stopper 7 is precisely what institutional incentive theory predicts from a fee-funded regulator: conclusions consistently resolving scientific uncertainty in the direction that protects continued industry operation, across independent analyses, over an extended period. This structural explanation does not require proof of any individual's intent. It requires only that the incentive architecture exists and that the observable output is consistent with what it predicts.

The Research Triangle

The CNSC regulates Canadian Nuclear Laboratories — the successor organisation to Atomic Energy of Canada Limited, which was the primary source of Canadian nuclear industry research for decades. The regulator, the regulated industry, and the institution producing much of the safety

research the regulator relies on are part of the same institutional ecosystem. The Cardis worker data withdrawal — in which Canadian data from AECL-era dosimetry changed the world's largest low-dose worker study from a significant to a null finding under circumstances the CNSC acknowledged it could not explain — sits at exactly this intersection. An unexplained data withdrawal, by a data custodian within the regulatory ecosystem, that produced a null result from a previously significant finding, has never been independently audited or resolved.

Why This Matters for the IAAC

The IAAC relies on the CNSC for scientific authority in a process where the CNSC is also the regulator of the proponent's technology. The structural conflict does not disqualify the CNSC from participating. It does require the IAAC to treat the CNSC's scientific conclusions with the degree of independent scrutiny that any institution with a documented financial interest in one outcome would normally receive in a quasi-judicial proceeding. The IAAC has no mechanism to provide that independent scrutiny without engaging external scientific authority not embedded in the same institutional ecosystem.

SHOW STOPPER
9

International Regulatory Divergence

What Other Jurisdictions Have Concluded from the Same Evidence

The CNSC does not operate in an information vacuum. The forty-year evidence catalogue documented in Show Stopper 1, the tritium evidence base, the worker studies — all of this is available to regulators in every nuclear-operating country. What other sophisticated jurisdictions have concluded from it is directly relevant to assessing whether the CNSC's conclusions are driven by the evidence or by something else.

Germany's radiological protection commission examined the KiKK evidence and concluded the cause remains unclear. The UK's Committee on Medical Aspects of Radiation in the Environment examined comparable clustering evidence at Krümmel and stated it could not be explained. The World Health Organisation has not declared the association between nuclear plant proximity and childhood cancer unfounded. None of these bodies reached the CNSC's conclusion.

Germany closed all of its nuclear power plants. Austria has maintained a constitutional prohibition on nuclear power. Switzerland voted to phase out. These are not countries with unsophisticated regulatory systems. They are countries whose regulatory and political processes, having examined the same evidence the CNSC has examined, concluded that the unresolved uncertainties were a reason for caution rather than confidence.

The Significance of the Divergence

International regulatory divergence is not binding on the IAAC. Canada is entitled to make its own regulatory decisions. But systematic divergence — in which Canada's regulator reaches more confident safety conclusions than every other sophisticated nuclear nation that has examined the same evidence — is itself evidence that warrants explanation. The IAAC should ask why the CNSC's assessment of the same data produces a conclusion that no other mainstream regulatory body has been willing to reach, and whether that divergence is explained by Canada-specific evidence or by something structural about how the CNSC assesses evidence.

The answer this submission documents is structural. The CNSC is funded by industry fees. Its conclusions consistently resolve uncertainty in the direction of continued industry operation. Its public documents overstate certainty relative to its own internal scientific findings across every document examined. The international divergence is not evidence that other countries are being overly cautious about the same settled science. It is evidence that other countries are being appropriately cautious about genuinely unsettled science, and that the CNSC is being anomalously confident about it.

PART THREE — SHOW STOPPERS 10 THROUGH 13

The Law

The statutory obligations that are triggered, the constitutional defect in consent, and the irreversibility that makes everything unreviewable after the fact

Part Three translates the evidence of Parts One and Two into the legal framework within which the IAAC must operate. Show Stopper 10 establishes that the precautionary principle — a positive statutory obligation under section 6 of the Impact Assessment Act — is triggered by every documented uncertainty in this submission, and that the burden of proof the CNSC has systematically inverted sits by law with the proponent, not with those opposing the project. Show Stopper 11 establishes that Free, Prior, and Informed Consent under UNDRIP and Bill C-15 cannot be valid when the scientific foundation on which it rests has been shown to be inaccurate — a substantive constitutional defect, not a procedural one. Show Stopper 12 establishes that if harm occurs in the Peace River community at the levels documented near other nuclear plants, it will never be statistically detectable, never correctable, and never legally provable. Show Stopper 13 closes Part Three with the most comprehensive indictment of all: the CNSC has known about every deficiency documented in this submission, possessed the statutory authority and the budget to remedy each of them, was told by its own scientists what was required, and chose across decades not to act — making the IAAC the only remaining mechanism in the Canadian regulatory system through which these deficiencies can be compelled before this facility is built.

SHOW STOPPER 10

The Precautionary Principle Is a Positive Legal Obligation

The Statutory Requirement

Section 6 of the Impact Assessment Act requires the IAAC to apply the precautionary principle in its assessment. This is not a soft policy preference. It is a substantive statutory obligation embedded in the Act under which this entire process operates.

The Rio Declaration on Environment and Development — which Canada has formally endorsed — states that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. Under the precautionary principle, uncertainty is a reason for protection, not a reason for approval.

How the CNSC Inverts the Principle

The CNSC's consistent analytical approach treats the absence of proven harm as a justification for approval. It cites studies that found no evidence of elevated risk as positive evidence of safety. It cites the absence of a proven causal mechanism for the real-world cancer signal as grounds for declaring the association unfounded. This is the inverse of the precautionary principle. Under the actual precautionary principle, unresolved scientific uncertainty about a threat of serious harm is a reason to require resolution before approval — not a reason to approve while research continues.

The Burden of Proof That Flows From the Principle

The precautionary principle resolves a prior question: who bears the burden of proof, and of what? Under the Impact Assessment Act, the burden sits with the proponent. Energy Alberta must demonstrate that significant adverse health effects are not likely. Intervenors are not required to prove harm. The IAAC is not required to find harm proven before withholding approval. The proponent is required to demonstrate safety before receiving it.

The CNSC's analytical framework systematically inverts this. It treats the absence of proven causation as a basis for approval. The body of evidence catalogued in Show Stopper 1 has not been shown to be caused by radiation from plant emissions — therefore the association is unfounded — therefore no regulatory action is warranted. That syllogism places the burden of establishing causation on those opposing the project, and treats the proponent's failure to rebut an unproven causal claim as a positive safety demonstration. It is not. It is the absence of a safety demonstration dressed as one.

The inversion matters most when the three analytically distinct questions the CNSC conflates are separated. The first question is whether radiation from nuclear plant emissions has been proven to cause the elevated cancer rates documented across the international body of evidence. The answer is no. This is the only question the CNSC addresses, and it addresses it by finding the causal hypothesis unproven. The second question is whether the elevated cancer rates documented across that body of evidence have been explained by any alternative mechanism. The answer is also no. The cause remains formally unresolved under any mechanism. The third

question is whether Energy Alberta has demonstrated that this specific facility will not contribute to whichever mechanism — identified or not — is responsible for the signal documented in the international evidence. This question has never been asked. Under correct burden allocation, it is the operative one.

The tobacco analogy is instructive. Decades of industry argument that causation between tobacco smoke and lung cancer had not been definitively proven did not shift the regulatory burden to patients to establish it. The failure to prove causation was never treated as a sufficient basis for continued unrestricted approval while the causal question remained open. The question was always what the producer could demonstrate about safety — not what critics could prove about harm. The CNSC applies to nuclear power plant health assessment a burden structure that would not be accepted in any other regulatory domain where an unexplained real-world signal of potential harm had persisted for thirty years across multiple independent replications.

The Documented Uncertainties That Trigger the Principle

The following documented uncertainties — each established by the CNSC's own publications — individually and collectively trigger the statutory precautionary principle obligation:

- The dose-risk relationship for the most relevant subgroup (fetuses and children under five) under the most relevant exposure conditions (chronic internal emitter from CANDU-specific radionuclides) is not validated.
- The real-world cancer data near nuclear plants shows elevated rates the models cannot account for, and the cause of that gap has not been identified.
- The CNSC's own scientists have formally stated that the evidence base is insufficient to estimate the health risks of tritium — the primary emission of the proposed facility.
- The most comprehensive independent meta-analysis of health outcomes near nuclear plants rates the certainty of evidence as very low under the GRADE framework.
- Non-cancer health effects of chronic low-dose exposure are not incorporated into the regulatory assessment framework despite emerging evidence at relevant dose levels.
- The radiation weighting factor applied to tritium in all regulatory calculations understates actual biological risk by a factor the CNSC's own technical report documents.

What the IAAC Must Address

The IAAC is required by statute to explain how it has applied the precautionary principle to each of these documented uncertainties. An approval decision that does not address them is not merely scientifically insufficient — it is a failure to comply with a substantive statutory obligation. A decision that cites compliance with CNSC standards as the basis for satisfying section 6 of the Act is a decision that uses a standard built on inadequate evidence as a proxy for the independent precautionary analysis the Act requires. The Act does not provide for that substitution.

SHOW STOPPER
11

The UNDRIP Informed Consent Defect

The Legal Obligation

Bill C-15, enacted in 2021, incorporated the United Nations Declaration on the Rights of Indigenous Peoples into Canadian law. UNDRIP requires Free, Prior, and Informed Consent from affected Indigenous peoples before the approval of any project affecting their lands, territories, and health. First Nations and Métis communities in the Peace River region will live within the zone of elevated cancer risk documented in the real-world data near nuclear plants and will be exposed to the tritium emissions the CNSC's own scientists have acknowledged they cannot adequately assess. FPIC is a mandatory precondition to approval, not a procedural formality.

Why Informed Consent Is Structurally Impossible on the Current Information Base

Free, Prior, and Informed Consent requires that the communities giving consent be accurately informed about the risks they are consenting to accept. The health information provided to Indigenous communities during this consultation process will be drawn primarily from CNSC publications. This submission has documented that those publications systematically misrepresent the CNSC's own scientific findings — describing tritium as relatively weak when the technical report says it is more damaging than x-rays; describing the real-world cancer signal near nuclear plants as unfounded when the same document says more research is required; presenting a study that found doubled cancer rates as confirmation of safety.

Consent obtained on the basis of health information that has been shown — through the CNSC's own documents — to be an inaccurate representation of the available scientific evidence is not informed consent. It is manufactured consent. The constitutional defect is not procedural. Consultation meetings may have been held. Notices may have been given. The defect is substantive: the scientific foundation on which consent was sought does not accurately represent what the CNSC's own scientists have found. FPIC obtained on a demonstrably inaccurate scientific foundation is not valid consent under C-15.

The defect is independently grounded in section 35 of the Constitution Act, 1982. The Supreme Court of Canada established in Haida Nation v. British Columbia (Minister of Forests), 2004 SCC 73, that the duty to consult is constitutionally grounded and requires that consultation be meaningful — that affected Indigenous communities have access to the information necessary to meaningfully assess the impacts on their rights. C-15 supplements the Haida Nation framework with an explicit accuracy requirement for the information provided. A consent process in which the primary scientific authority provided to Indigenous communities has been shown — through that authority's own internal documents — to misrepresent the available evidence does not meet either the constitutional standard or the C-15 standard. The two grounds are cumulative, not alternative.

Why This Cannot Be Corrected After Approval

Approval of the project forecloses the option of the affected Indigenous communities making a genuinely informed consent decision. Once construction begins, the economic, political, and legal landscape for any subsequent challenge to consent validity changes entirely. The informed consent obligation under C-15 is a pre-condition to approval, not a condition attached to it. It cannot be satisfied retroactively.

SHOW STOPPER 12

Irreversibility and the Absence of Any Self-Correction Mechanism

Why This Approval Cannot Be Undone

Every other major approval decision carries some capacity for error correction. If infrastructure fails, the failure is observable. If a pharmaceutical causes harm, pharmacovigilance systems can detect patterns and trigger regulatory response. Nuclear plant health effects near a facility of this type, in a community of this size, have no comparable detection and correction mechanism.

Why Harm Here Cannot Be Detected

The Peace River region has a small residential population. Childhood leukemia in children under five is a rare disease. To detect a doubling of childhood leukemia risk in this community with confidence intervals narrow enough to be actionable would require a study enrolling a population far larger than the community exposed, with follow-up periods measured in decades, and a pre-construction baseline for the specific age and distance subgroup that matters most. That baseline does not currently exist. The CNSC has never required it. RADICON — the most recent Canadian epidemiological study of this type — did not analyse the 5-kilometre subgroup at all.

If this facility causes harm at the level documented in real-world data near other nuclear plants, it may never be possible to prove it in this community. The statistical noise will exceed the detectable signal. Any monitoring programme the CNSC attaches as an approval condition will produce inconclusive results — not because no harm is occurring, but because the community is too small to detect it. Those inconclusive results will then be cited as further evidence of safety. This is not speculation. It is what RADICON already demonstrated is the Canadian approach to nuclear plant epidemiology.

Why Conditions and Monitoring Cannot Substitute for Prior Validation

The IAAC process typically addresses uncertainty by attaching conditions — requiring ongoing monitoring, adaptive management, and regulatory review. That approach is not available here, because the thing that would trigger adaptive management response cannot be detected. Attaching a monitoring condition to an approval where the harm can never be statistically demonstrated is not a safeguard. It is a mechanism for generating reassuring null findings from

underpowered studies in a small population — findings that provide institutional cover while providing no actual protection.

The harm, if it occurs, is therefore effectively permanent, population-specific, and unreviewable within any realistic regulatory timeframe. The irreversibility of this specific harm in this specific community is a qualitatively different consideration from the monitoring-amenable harms that conditions and adaptive management are designed to address.

SHOW STOPPER 13

Regulatory Abdication — The CNSC Knew, Had the Power to Act, Had the Resources, and Chose Not To

The Argument in One Paragraph

Every scientific deficiency documented in Show Stoppers 1 through 12 was known to the CNSC. Each was documented in the CNSC's own published materials. Each was identified by the CNSC's own scientists as requiring resolution before adequate safety determinations could be made. The CNSC possessed, and continues to possess, the statutory authority under the Nuclear Safety and Control Act to impose research requirements as conditions on any licence it issues. It has an annual operating budget of over $350 million, funded by the nuclear industry it regulates. It has had decades to act. It has acted on none of them. The IAAC is now asked to approve a new nuclear facility on an evidence base every major deficiency of which the regulator responsible for remedying it documented, acknowledged, and left unaddressed. This is not a record of scientific uncertainty pending resolution. It is a record of regulatory abdication that the IAAC has the statutory authority — and the obligation — to end.

What the CNSC Knew and When It Knew It

The CNSC's knowledge of the specific deficiencies documented in this submission is not inferred. It is recorded in the CNSC's own publications, each of which is cited in the main submission with its URL and publication date.

INFO-0799 — the CNSC's own technical report on tritium health effects, published in 2010 and still publicly available — states explicitly that the CNSC's scientists do not have sufficient evidence to estimate the health effects of tritium. It states that the weighting factor used for regulatory calculations understates the actual biological effectiveness of tritium. It documents the ODWAC recommendation for a 350-fold reduction in the drinking water standard. It identifies the need for an international collaborative study to resolve the inadequacies in the existing evidence base. Every one of these admissions was published by the CNSC in 2010. Fifteen years have passed. The international collaborative study has not been conducted. The weighting factor has not been revised. The drinking water standard has not been changed.

The KiKK fact sheet — last updated October 2025 — contains the statement that more extensive interdisciplinary research is required to understand the association between nuclear plant proximity and childhood cancer. That sentence is an admission, published by the CNSC in its own name, that the evidence base on which it approves nuclear facilities is acknowledged as insufficient and that research it has not conducted is required. It appears in the same document that declares the association unfounded. The CNSC simultaneously declares the science settled and acknowledges that the required research has not been done.

RADICON — the CNSC's most recent community epidemiology study — was published with a statistical power of 8% for the critical subgroup. The CNSC's own scientists designed and conducted a study so underpowered that it had a 92% probability of finding nothing regardless of whether harm was occurring. The CNSC published that study and cited its null result as evidence of safety. It has not designed or funded a replacement study with adequate statistical power. It has not required Energy Alberta to fund one as a pre-construction condition.

The US National Academies of Sciences formally identified the validation of radiation risk models for fetal tissue under CANDU-specific internal emitter conditions as a critical knowledge gap requiring a sustained, multi-decade research programme. The US Congress appropriated over $50 million for related research through the National Institute of Environmental Health Sciences. Canada has appropriated nothing. The CNSC has not required any licensee to fund this research. The critical knowledge gap the US National Academies identified as requiring resolution before safety determinations can be made with confidence remains open.

What the Nuclear Safety and Control Act Authorised the CNSC to Do

Section 24 of the Nuclear Safety and Control Act grants the CNSC broad authority to attach conditions to any licence it issues. The Act does not restrict these conditions to operational or technical requirements. The CNSC may impose, as a condition of any nuclear facility licence, a requirement that the licensee fund, conduct, or participate in specified research programmes. This is not a novel or untested power. The CNSC imposes research and monitoring conditions on licensees routinely — requiring environmental monitoring programmes, worker dose tracking, and operational data reporting as standard licence conditions.

The power to impose a research funding condition is therefore not in question. The CNSC could have required, as a condition of any CANDU operating licence issued since 2010, that the licensee fund the international collaborative tritium study its own technical report identified as necessary. It could have required a pre-construction baseline epidemiological study for children under five within five kilometres as a condition of any new site licence. It could have required validation of the fetal dosimetry models for CANDU-specific internal emitter conditions before approving any new CANDU facility. It could have required an etiological investigation of the elevated cancer burden in any community proposed as a nuclear facility site before accepting an incremental risk assessment for that site.

It has done none of these things. The power existed. The knowledge existed. The budget existed. The action did not follow.

The Budget

The CNSC's annual operating budget has exceeded $350 million for over a decade, funded almost entirely by fees levied on nuclear facility licensees. The international collaborative tritium study recommended in INFO-0799 — involving collection and analysis of biological samples from CANDU communities across multiple countries — would cost a fraction of one year's operating budget. A properly powered pre-construction baseline epidemiological study for a proposed site

community would cost less than one tenth of one percent of the CNSC's annual revenue. The fetal dosimetry validation programme the US National Academies identified as critical, funded by the US Congress at $50 million over multiple years, is within one year's operating budget of an institution that spends over $350 million annually.

The CNSC has not allocated meaningful funding to any of these programmes. It has not required licensees to fund them. It has published documents acknowledging the deficiencies, described the research required to remedy them, watched the US fund equivalent programmes, and redirected its own budget to operational functions that do not include resolving the evidentiary inadequacies its own scientists documented. This is not a resource constraint. It is a priority allocation that has consistently chosen not to fund the research that would test whether the CNSC's safety conclusions are correct.

Why the Research Has Not Been Done — The Structural Explanation

The structural explanation for the CNSC's failure to fund or require the necessary research is the same explanation documented in Show Stoppers 7, 8, and in Annexure 1. An institution whose revenue depends on licensed facilities remaining in operation has an institutional interest in maintaining the evidence base that permits licensing to continue. An institution that commissions research that validates its existing safety conclusions receives confirmation. An institution that commissions research that contradicts its existing safety conclusions faces the consequences of that contradiction — the need to revise its standards, potentially to halt operating licences pending new assessments, and to acknowledge publicly that its previous safety determinations were made on an insufficient evidentiary foundation.

The CNSC does not need to have made a deliberate decision to avoid the research. The structural incentive produces the same outcome without any explicit institutional decision. An institution that is simultaneously responsible for promoting the development of nuclear energy, funded by the nuclear operators it licenses, and accountable for safety determinations made on the existing evidence base does not need to suppress research explicitly. It simply does not prioritise the research that would most directly test whether its safety conclusions are correct. The result — sixteen years of acknowledged deficiency, documented in its own publications, unaddressed by its own budget or its own regulatory powers — speaks for itself.

What This Means for the Approval Decision

The IAAC is being asked to approve a new nuclear facility. The regulatory system assigns the CNSC the role of providing the scientific foundation for that approval. The CNSC will tell the IAAC that the facility is safe within the limits of current scientific understanding. This submission has documented that the CNSC's own scientists told it in 2010 that the current scientific understanding is not adequate to make that determination for this type of facility — and documented the specific research required to make it adequate. Fifteen years later, with that research unfinished and unfunded, the CNSC proposes to make the same determination on the same deficient basis it acknowledged in 2010.

This is not a situation in which the science is uncertain and the regulator is making a good-faith judgment under uncertainty. This is a situation in which the regulator's own scientists identified the uncertainty, described the research required to resolve it, estimated what it would cost, and the institution did nothing with that information for sixteen years except continue to issue licences and declare the science adequate. The IAAC cannot rely on a scientific foundation that the scientists who produced it formally documented as insufficient.

The IAAC as the Circuit Breaker

The CNSC has had decades to fix the evidentiary deficiencies it acknowledged in its own publications. It has not fixed them. There is no mechanism within the CNSC's own institutional structure — given what Annexures 1 and 2 document about how that institution functions — through which it will fix them voluntarily. Every mechanism that could have compelled the CNSC to fund the required research — Parliamentary scrutiny, independent audit, peer review — has been available and has produced no remedial action.

The IAAC is the only body in the approval chain for this specific project with the statutory authority, the independence from the nuclear regulatory ecosystem, and the mandate to require that deficiencies be remedied before approval proceeds. Section 22 of the Impact Assessment Act requires the IAAC to consider health effects. Section 6 requires it to apply the precautionary principle. Section 63 requires it to be satisfied that significant adverse effects are unlikely or to make an explicit public interest finding. None of these statutory obligations can be satisfied on an evidence base the regulator responsible for producing it has formally documented as insufficient.

The IAAC's authority to impose conditions on an approval — including conditions requiring research, baseline characterisation, and evidentiary validation before construction commences — is the statutory mechanism through which the deficiencies documented in this submission can be compelled. If the IAAC approves this facility without requiring those conditions, the deficiencies will remain permanently unaddressed for the life of this facility. The CNSC will cite the IAAC's approval as confirmation that the evidence base was adequate. The research that would test that conclusion will never be funded. The community that lives adjacent to the facility will be exposed to emissions whose health effects the regulator's own scientists said in 2010 they could not adequately assess — and that admission will be buried in a technical report that no subsequent regulatory process will be required to revisit.

Show Stopper 13 is therefore not merely an additional ground for refusal. It is the explanation for why every other show stopper in this submission exists. The evidentiary failures of Show Stoppers 1 through 6 exist because the CNSC did not fund the research to fix them. The institutional failures of Show Stoppers 7 through 9 exist because the CNSC's structure ensures that it will not fund that research. The legal failures of Show Stoppers 10 through 12 exist because the precautionary principle, UNDRIP, and irreversibility are triggered by deficiencies the CNSC could have addressed and chose not to. The IAAC has before it not just a deficient application but the accumulated consequence of decades of regulatory inaction by the institution responsible for making the application adequate. The question for the IAAC is whether it will use the authority the statute gives it to end that inaction, or whether it will approve the facility and allow the inaction to continue permanently.

Why All Thirteen Show Stoppers Are Worse Together

Each show stopper is serious independently. Together they form a closed logical structure that cannot be resolved within the current state of knowledge or the current regulatory architecture. They are organised into three movements for a reason — each movement amplifies the ones before it.

Part One establishes the empirical foundation. Show Stopper 1 documents that the models fail their real-world empirical test by a factor of ten thousand to one hundred thousand across forty years of independent international evidence. Show Stopper 2 shows that the Peace River population compounds this failure — it already carries an elevated cancer burden in a chemical environment that amplifies radiation risk, making the incremental calculation wrong not just generally but specifically and materially at this site. Show Stoppers 3 and 4 explain structurally why the models fail: wrong population, wrong measurement unit, wrong biological weight for the facility's primary emission. Show Stopper 5 establishes that the research to fix them has not been done — formally acknowledged by the US National Academies, funded but not completed by Congress, and rated as very low certainty by the most comprehensive independent meta-analysis ever conducted. Show Stopper 6 closes the empirical argument by demonstrating that the null studies the CNSC will cite as counter-evidence are almost certain to find nothing regardless of whether harm exists.

Part Two provides the institutional explanation. Show Stopper 7 documents that the institution responsible for telling the IAAC what the science says has been shown through its own published documents to systematically misrepresent its own internal science — and specifically that its most consequential public conclusion, that the forty-year replicated signal is unfounded, is not a scientific finding but an unfalsifiable advocacy verdict that violates seven principles of scientific method simultaneously. Show Stopper 8 provides the structural explanation for why an institution would maintain false certainty in the face of its own contrary evidence: fee funding by the industry it regulates, an institutional ecosystem that includes both the regulated industry and the research institution producing its safety evidence, and an unexplained data withdrawal that changed the world's largest low-dose worker study from significant to null. Show Stopper 9 delivers the external confirmation: every other sophisticated nuclear nation examining the same evidence has reached a more qualified conclusion than Canada's own regulator, and that divergence is not explained by Canada-specific science.

Part Three establishes the legal consequences and the regulatory accountability. Show Stopper 10 translates every documented uncertainty in Parts One and Two into a positive statutory obligation under the Impact Assessment Act — the precautionary principle is triggered by each of six documented uncertainties individually, and the burden of proof the CNSC inverts sits by law with the proponent. Show Stopper 11 establishes the constitutional defect: FPIC under C-15 cannot be valid when the information on which consent was sought is demonstrably inaccurate based on the CNSC's own documents. Show Stopper 12 establishes that if harm occurs in this community, it can never be detected, corrected, or proven — the irreversibility is not a monitoring problem, it is the permanent consequence of approval. Show Stopper 13 closes the submission with the most comprehensive indictment: the CNSC knew about every deficiency in Show Stoppers 1 through 12, had the statutory power to remedy them, had the budget to fund the required research, was told by its own scientists what was needed, and chose across sixteen years not to act. The IAAC is the last available mechanism through which those deficiencies can be compelled before this community is permanently committed to living adjacent to a facility whose primary emission the CNSC's own scientists said they could not adequately assess.

The loop cannot be broken from inside the current process. The models cannot be validated without the research Show Stopper 5 shows has not been done — and Show Stopper 13 shows the CNSC had the power to fund and chose not to. The tritium risk cannot be assessed without the international collaborative study Show Stopper 3 shows was recommended in 2010 and never conducted — and Show Stopper 13 shows the CNSC acknowledged this in writing and took no action. The real-world cancer signal cannot be resolved without identifying a mechanism Show Stopper 1 shows has been studied for forty years without explanation — and Show Stopper 13 shows the CNSC simultaneously declared the matter settled and acknowledged more research was required, in the same document. None of this can be addressed within the current process because Show Stopper 7 documents that the institution responsible for raising these requirements has a consistent pattern of not raising them, Show Stopper 8 shows why, and Show Stopper 13 shows that sixteen years of documented inaction is the result.

STATUTORY OBLIGATIONS OF THE IAAC UPON RECEIPT OF THIS SUBMISSION

This section sets out the legal obligations the IAAC is required to discharge in response to this submission. These are not requests. They are statutory and common law obligations that exist independently of whether the IAAC finds this submission persuasive. They are set out here so that the record is clear as to what the IAAC was formally advised of, and so that any subsequent decision can be evaluated against them.

Section 22 of the Impact Assessment Act — Mandatory Factors

Section 22 of the Impact Assessment Act specifies the factors the IAAC Panel is required to consider in conducting its assessment. These are not discretionary considerations that the Panel may address if it chooses. They are mandatory. Among the factors listed in section 22 are: the health effects of the project, including the intersection of health effects with gender and cultural identity; the implementation of the United Nations Declaration on the Rights of Indigenous Peoples; and the extent to which the effects of the project are reversible or irreversible.

This submission has documented that: the health effects of this project on the Peace River region population cannot be adequately assessed because the existing cancer burden in that population has not been characterised and the incremental risk models are structurally invalid for this population; the information provided to Indigenous communities as the basis for FPIC is demonstrably inaccurate based on the CNSC's own published documents; and if the project causes health harm to the Peace River community, that harm cannot be detected epidemiologically in a population of this size using the tools the CNSC has shown it deploys. The irreversibility factor under section 22 is therefore not academic — it is the defining characteristic of the harm this submission documents.

The IAAC is required to demonstrate in its reasons that each of these mandatory factors was genuinely addressed. A decision that cites regulatory compliance as the basis for satisfying these factors is a decision that substitutes a proxy for the substantive analysis the statute requires. Section 22 does not provide for that substitution.

Section 63 — The Approval Gate

Section 63 of the Impact Assessment Act establishes the approval gate. The IAAC must be satisfied either that the project is not likely to cause significant adverse effects, or that significant adverse effects are likely but are in the public interest. This is a binary determination. It cannot be satisfied by demonstrating that the project complies with standards that this submission has shown are built on inadequate evidentiary foundations.

This submission has documented that the evidentiary foundation on which the CNSC's safety standards rest has been independently rated as very low certainty under the GRADE framework. A determination under section 63 that significant adverse effects are not likely, made on an evidentiary foundation rated as very low certainty, is a determination that the statutory standard has been met on evidence that the international scientific community has formally assessed as insufficient to support confident conclusions. The IAAC must explain in its reasons how that determination was reached on that evidence base.

If the IAAC instead determines that significant adverse effects are likely but are in the public interest, that determination must be made explicitly — it must identify the significant adverse effects it has found to be likely, characterise their nature and magnitude, and explain why the public interest justification overrides them. A determination that significant adverse effects are not likely, made to avoid the public interest analysis, in the face of a forty-year international evidence record of elevated cancer rates near nuclear plants, is a determination whose adequacy of reasoning is directly reviewable.

Section 6 — The Precautionary Principle as a Statutory Obligation

Section 6 of the Impact Assessment Act establishes the precautionary principle as an operative principle of the Act. It is a principle the IAAC is required to apply in conducting its assessment. Under the precautionary principle, where there are threats of serious or irreversible damage, lack of full scientific certainty is not a reason to postpone protective measures.

This submission has documented the following specific scientific uncertainties, each established by the CNSC's own published documents: the dose-risk relationship for the most vulnerable population under the most relevant exposure conditions is unvalidated; the evidence base is insufficient to estimate the health risks of the plant's primary emission; the most comprehensive independent assessment of evidence quality rates it as very low; the models used to demonstrate safety fail their empirical test by a factor of up to one hundred thousand; and the existing cancer burden in the Peace River population has not been characterised. Each is a documented scientific uncertainty about a potential serious and irreversible harm.

The IAAC is required to explain in its reasons how it applied the precautionary principle to each of these documented uncertainties. A decision that approves the project without addressing each uncertainty individually and explaining why the precautionary principle did not require protective measures in response to it is a decision that is silent on a specific statutory obligation. Silence on a statutory obligation is judicially reviewable as an error of law.

REGDOC-3.1.1 — The CNSC's Own Environmental Assessment Standard

REGDOC-3.1.1 is the CNSC's own regulatory document governing environmental assessments. It requires the proponent to characterise the existing environment — including existing health conditions in the affected population — before assessing the incremental impacts of the proposed project. An incremental risk assessment cannot be validly conducted without an accurate baseline against which the increment is measured.

This submission has documented that the Peace River region carries a documented elevated cancer incidence of unknown etiology, that no etiological investigation of that elevation has been conducted, and that Energy Alberta has not characterised the existing carcinogenic environment in the Peace River region before presenting its incremental risk assessment. The CNSC's own regulatory standard for environmental characterisation has not been satisfied. The IAAC cannot accept an incremental risk assessment as complete under a regulatory standard whose own author has not applied it.

The Common Law Duty to Provide Adequate Reasons

The IAAC Panel is a quasi-judicial decision-maker whose decisions affect legal rights — including the health and property rights of Peace River region residents and the treaty and constitutional rights of Indigenous communities in the region. Quasi-judicial decision-makers in Canada have a common law duty, confirmed by the Supreme Court of Canada, to provide adequate reasons for decisions. Adequacy of reasons requires that the decision-maker address the evidence and argument placed before it, explain the basis for its conclusions, and demonstrate that the statutory factors were genuinely considered.

The Supreme Court of Canada confirmed in Canada (Minister of Citizenship and Immigration) v. Vavilov, 2019 SCC 65, that reasonableness review requires an administrative decision-maker to have genuinely grappled with the evidence and argument placed before it. A decision whose reasons do not address the specific evidentiary and legal grounds formally documented in a submission does not meet this standard. The test is not whether the decision-maker mentioned the evidence. It is whether the reasons demonstrate that the evidence was actually engaged with in a manner that shows it was understood and assessed.

This submission constitutes formal notice to the IAAC of the specific evidentiary and legal grounds on which this project cannot be approved without addressing the issues it raises. The submission will form part of the evidentiary record against which the adequacy of the IAAC Panel's reasons will be assessed in any subsequent judicial review. A decision that does not address the specific grounds documented in this submission — the model failure evidence, the tritium admissions, the CNSC pattern of misrepresentation, the precautionary principle triggers, the UNDRIP consent defect, the irreversibility finding, and the compromised Peace Region baseline — is a decision whose reasons will be inadequate as a matter of law, regardless of what conclusion those reasons reach.

The Duty of Procedural Fairness

Where a decision-maker receives evidence that affected parties' rights may be harmed in a way not anticipated by the standard assessment process, the duty of procedural fairness requires that the decision-maker address that evidence rather than proceeding as if it had not been received. The issues documented in this submission — particularly the structural invalidity of the models for the Peace River population, the UNDRIP consent defect, and the irreversibility of potential harm — are not issues that the standard IAAC process was designed to address. They require specific procedural accommodation.

At minimum, procedural fairness requires that the IAAC: provide affected parties with an opportunity to respond to Energy Alberta's health impact assessment with reference to the specific scientific grounds documented in this submission; require the CNSC to disclose the full basis for its scientific conclusions rather than relying on its public fact sheets as authoritative; and ensure that Indigenous communities have access to the full scientific record — including the CNSC's internal technical documents — before being asked to confirm or qualify their consent decisions.

What a Decision That Ignores This Submission Creates

If the IAAC approves this project without addressing the statutory obligations set out in this section, it will have produced a decision that: failed to apply mandatory section 22 factors to documented facts; satisfied the section 63 approval gate on evidence rated as very low certainty without explaining how; failed to apply the section 6 precautionary principle to six specific documented uncertainties; accepted a health impact assessment that does not meet the CNSC's own REGDOC-3.1.1 standard; and provided reasons that do not address the specific evidentiary grounds formally placed before it.

Such a decision would be judicially reviewable in the Federal Court on multiple independent grounds. The grounds would include: error of law in the application of mandatory statutory factors; failure to apply the precautionary principle; breach of the duty of procedural fairness; and inadequacy of reasons. The strength of each of those grounds is directly proportional to how specifically this submission has documented the underlying facts — which is why this submission has been structured to document them with precision.

This is not a threat of litigation. It is a description of the legal consequences that flow from the IAAC's statutory obligations and the evidence before it. Those consequences exist whether or not this submission mentions them. They are set out here because the IAAC is entitled to know the legal framework within which its decision will be evaluated, and because the affected communities whose health is at stake are entitled to know what legal protections apply to the process being conducted on their behalf.

NINE REQUESTS TO THE IAAC

The foregoing analysis supports the following specific requests:

- Require that before approval, Energy Alberta identify — or formally demonstrate the absence of — the mechanism responsible for the elevated cancer rates documented in the real-world data near nuclear plants, and demonstrate that mechanism will not operate at the proposed site. This is not a request to prove radiation is not the cause. It is a request to demonstrate that whatever the cause is, it has been excluded at this site.
- Require Energy Alberta to characterise the existing cancer burden and its potential causes in the Peace River region before any incremental risk assessment is accepted — including a mixture exposure assessment addressing the interaction between existing aromatic hydrocarbon contamination and ionizing radiation from the proposed facility — as a condition precedent to the health impact assessment being considered complete under REGDOC-3.1.1.
- Require that Energy Alberta's health impact assessment use fetal-tissue-specific dosimetric models validated for CANDU-specific radionuclide exposure under chronic internal conditions, not adult proxy models derived from external acute exposure scenarios.
- Require Energy Alberta's tritium health impact assessment to be conducted using both the regulatory weighting factor of 1 and the scientifically supported factor of 2.2 documented in the CNSC's own technical report, with explicit comparison of results and explanation of the difference.

- Require assessment of non-cancer health endpoints — cardiovascular, neurological, immune, and ophthalmic — at dose levels documented in the emerging scientific literature to be associated with elevated risk.
- Require a population mixing assessment for the Peace River region as a pre-construction condition, addressing the Kinlen mechanism with the specificity of the community demographic profile.
- Require a pre-construction baseline epidemiological study for children under five within five kilometres of the proposed facility, using the age and distance stratification demonstrated to be the critical subgroup in the international literature, before any construction activities that would alter the baseline community profile.
- Require the CNSC to correct the KiKK fact sheet — specifically to include the full body of replication literature, the post-2012 international evidence, the Russo 2023 post-shutdown natural experiment findings, and the biological mechanism literature — before that document is admitted as an evidentiary foundation in this process.
- Appoint an independent scientific review panel, with disclosed and screened conflicts of interest, not embedded in the CNSC institutional ecosystem, to review the scientific adequacy of Energy Alberta's health impact assessment before the IAAC Panel considers the question of approval.

Plain Language Summary for the Record

The IAAC cannot approve this project for thirteen independent reasons, organised in three parts.

PART ONE: THE EVIDENCE

The mathematical models used to show the plant is safe do not predict what actually happens near nuclear plants in the real world. A forty-year, multi-country body of independently replicated evidence shows this consistently: Sellafield UK at ten times the national average in 1984; COMARE confirmed 20% excess leukemia within 5km across UK nuclear sites through the 1990s; Krümmel Germany at five to six times the expected rate through the 1990s and 2000s; KiKK Germany found 119% excess leukemia and 61% excess all-cancer risk in 2008; GEOCAP France independently found 90% excess leukemia in 2012; pooled analyses confirmed 61% excess all cancers and 119% excess leukemia within 5km; and a 2025 Harvard study found 20% elevated cancer mortality near US plants after controlling for poverty, smoking, obesity, race, and healthcare access. The gap between what the models predict — effectively zero — and what is consistently observed is between ten thousand and one hundred thousand times. No one has explained it after forty years.

The Peace River region does not have the healthy baseline population the models assume. It already carries an elevated cancer burden of unknown cause, in an environment with documented chemical promoters that interact synergistically with ionizing radiation. Peer-reviewed mixture carcinogenesis science establishes that the incremental risk from adding this facility is not the additive calculation the models will present. It may be multiplicative. The models are being applied to the wrong population.

The plant's primary emission is tritium. The CNSC's own scientists formally stated in 2010 they do not have enough evidence to estimate how dangerous tritium is. Every dose calculation presented to the IAAC will use a biological weighting factor the CNSC's own technical report says understates the actual risk by a factor of 2.2. The only Canadian study of tritium cancer risk in a CANDU community found doubled cancer rates in girls and women. The CNSC described that as confirmation of safety.

The models were built on the wrong people, measure the wrong thing, and apply the wrong biological weight to the substance the plant will emit most. They have never been validated for fetuses exposed to CANDU emissions.

The research that would fix the models and characterise the actual risk has not been done. The US National Academies called it a critical knowledge gap. The most comprehensive independent meta-analysis rated the certainty of evidence as very low. Safety conclusions made before the required research exists are assumptions presented as science.

The null studies the CNSC will cite as evidence of safety were designed with so little statistical power they were almost certain to find nothing regardless of whether harm existed. A study with 8% power finding nothing is not a safety finding. It is a measurement failure presented as a conclusion.

PART TWO: THE INSTITUTION

The regulator the IAAC relies on has been shown — through its own published documents — to systematically overstate certainty relative to its own internal science, consistently in the direction that protects the nuclear industry from having to address unresolved questions. Its most consequential public conclusion — that the forty-year replicated international signal is unfounded — is not a scientific finding. It is an unfalsifiable advocacy verdict that violates seven principles of scientific method simultaneously and applies a word no other major scientific body was willing to use for this evidence. That institution is funded by fees from the industry it regulates, embedded in an institutional ecosystem that includes both the regulated industry and the research institution producing its safety evidence, and has never had its most consequential data withdrawal independently audited.

Every other sophisticated nuclear jurisdiction — Germany, France, the UK, Austria, Switzerland — that has examined this evidence has reached a more qualified conclusion.

That divergence is not explained by Canada-specific science. It is explained by the structural incentives documented in this submission.

PART THREE: THE LAW

The precautionary principle is a statutory obligation under the Impact Assessment Act. The burden of proof sits with the proponent. Three questions must all be answered before approval: has the real-world cancer signal been explained, has an alternative mechanism been excluded at this site, and has Energy Alberta demonstrated this facility will not contribute to whichever mechanism is responsible. None of those questions has been answered. The CNSC declared the first closed without answering it. The second and third have never been asked.

Indigenous communities who will live near this facility cannot give free, prior, and informed consent when the health information underlying that consent has been shown — through the CNSC's own documents — to be inaccurate. That is a substantive constitutional defect, not a procedural one. It cannot be corrected after approval.

If harm occurs it cannot be detected in a community this small with the epidemiological tools the CNSC has shown it deploys. Monitoring conditions attached to this approval will produce reassuring null results from studies with no power to detect the relevant effect. The harm, if it occurs, will be permanent, population-specific, and unreviewable.

The CNSC knew about every one of these deficiencies. Its own scientists named them in its own publications, described the research required to fix them, and the CNSC took no action across sixteen years. It had the statutory authority under the Nuclear Safety and Control Act to impose research requirements as licence conditions. It had a budget exceeding $350 million annually. It chose to continue issuing approvals on the deficient evidence base it had acknowledged was insufficient. The IAAC is the last point in the approval chain where those deficiencies can be compelled before a community is permanently committed to living beside a facility whose primary emission the CNSC's own scientists said in 2010 they could not adequately assess. If the IAAC does not require those deficiencies to be remedied before this project proceeds, there is no mechanism in the Canadian regulatory system through which they will ever be addressed.

A safety determination made on this foundation is not a finding that the project is safe. It is a finding that the project complies with standards whose own evidentiary basis has been rated as very low certainty — standards set by an institution whose public conclusions are not an accurate representation of its own scientific findings, applied to a community whose existing carcinogenic environment has never been characterised, whose consent was obtained on demonstrably inaccurate information, whose size makes the consequences of error permanent and undetectable, and whose regulator had the power to remedy every one of these deficiencies and chose not to.

Guide to the Annexures

The main submission makes thirteen independent arguments for why the IAAC cannot approve this project. The three annexures that follow provide the supporting material for those arguments. Each annexure stands independently and each addresses a different dimension of the case. An independent scientific reviewer, legal counsel, or IAAC Panel member may read any one of them without the others and find it complete on its own terms.

Annexure 1 — The Institutional Record

Annexure 1 documents the history of the CNSC and its predecessor body, the Atomic Energy Control Board, as institutions. It does not rely on any of the scientific disputes addressed in the main submission. Its evidence is drawn entirely from Parliamentary testimony, Royal Commission findings, IAEA assessment mission reports, government-commissioned independent reviews, and the CNSC's own founding legislation. It establishes ten documented institutional findings: that the CNSC's founding legislation assigns it both a protective and a promotional mandate that have never been structurally separated; that its predecessor body was found by two Royal Commissions to have knowingly maintained inadequate health standards for uranium miners over decades; that its fee-funding mechanism creates institutional incentives structurally incompatible with independent public health protection; that its leadership appointment structure was demonstrated in 2008 to be subject to political override when safety determinations conflicted with commercial interests; that Port Hope, Chalk River, Elliot Lake, and the Cardis data withdrawal each independently confirm the directional bias toward industry protection that the main submission documents across seven CNSC publications; and that Canada is the only major nuclear nation that conducted a post-Fukushima regulatory review and made no structural changes to its regulator's independence architecture. The purpose of Annexure 1 is to foreclose the CNSC's anticipated defence that the pattern of misrepresentation documented in Show Stopper 7 represents a collection of isolated errors. An institution with this institutional history does not make errors that are all isolated and all in the same direction.

Annexure 2 — The Hidden Science

Annexure 2 documents eighteen independent categories of peer-reviewed radiation health science that the CNSC's public health communications systematically exclude. None of the eighteen is KiKK or tritium — both of which are addressed in the main submission. The eighteen cover: nuclear worker studies in the BMJ and Lancet confirming dose-response at occupational dose levels; non-cancer health endpoints including cardiovascular disease and cataracts that the regulatory framework does not assess; the Petkau Effect — a Canadian discovery at a Canadian government laboratory that directly undermines the dose-rate assumption the CNSC applies; parallel community health studies in the United States finding the same elevated childhood leukaemia signal near nuclear plants as the European evidence the CNSC dismisses; Alice Stewart's foundational work on fetal radiosensitivity and the fifteen-year institutional resistance to her correct findings; the Fukushima thyroid cancer dispute and the active unresolved methodological controversy the CNSC presents as settled science; the European Committee on Radiation Risk alternative risk models that produce estimates orders of magnitude higher than ICRP for the specific substances CANDU reactors emit; the Mayak plutonium worker data showing internal alpha emitter cancer risk exceeds model predictions; the Marshall Islands dose reconstruction failure; the US government's $2.5 billion downwinder compensation programme; strontium-90 in baby teeth near nuclear plants; carbon-14 as a hidden long-lived CANDU

emission; radiation-induced genomic instability across thirty years of peer-reviewed literature; La Hague as a third independent community study; the BEIR VII age-at-exposure coefficients the CNSC cites but does not apply; infant mortality as an excluded endpoint; and Hanford as the North American precedent for both deliberate concealment and model failure. The purpose of Annexure 2 is to make unavailable the CNSC's anticipated defence that KiKK is an outlier insufficiently replicated to disturb the scientific consensus. There is no consensus. There is a curated subset of science selected for consistency with a predetermined conclusion.

Annexure 3 — The Model Failures

Annexure 3 is the technical annexure. It explains, in plain language accessible to a non-specialist reader, exactly what the regulatory dose-risk models were designed to do, where they came from, the seven independent dimensions on which they fail when applied to a CANDU community scenario, what the CNSC's own cited scientific authorities — the ICRP and BEIR VII — acknowledge about their limitations in their own publications, the ten specific parameters that a valid model for the Peace River application would need to incorporate, and the approximate numerical effect of applying those parameters to the CNSC's own published dose estimates. The seven extrapolation failures are: acute to chronic dose rate, with the correction applied in the wrong direction; external radiation to internal emitter exposure; adult tissue to fetal and infant tissue; whole-body effective dose to localised cell dose; the Japanese 1945 reference population to the Peace River 2025 population; gamma and neutron radiation to tritium, carbon-14, and strontium-90; and the dose-rate effectiveness factor. The ten missing parameters are identified with their specific published sources so that an independent scientific reviewer can verify each one directly. The numerical section takes the CNSC's own published dose estimates as its starting point and shows that quantifiable corrections alone produce risk estimates ten to thirty times higher for the most at-risk subgroup — before accounting for the parameter failures that cannot yet be precisely quantified. The purpose of Annexure 3 is to give the IAAC the precise technical basis for conditions requiring Energy Alberta to provide supplementary dosimetric modelling incorporating the missing parameters before any approval proceeds.

ANNEXURE 1

The Institutional Record

Further evidence of the CNSC's systematic failure to execute its mandate, independent of and predating the publications analysed in the main submission

Purpose and Standard of Evidence

The main submission documents a pattern of institutional misrepresentation through analysis of seven specific CNSC publications. The pattern is consistent, directional, and statistically improbable as a collection of independent errors. This annexure provides the institutional context that explains why that pattern exists and why it should be understood not as a collection of failures but as the predictable and documented output of a structurally compromised institution.

The evidence assembled here is drawn from Parliamentary testimony, Royal Commission findings, government-commissioned independent reports, IAEA assessment mission reports, published academic analysis of regulatory capture in the nuclear sector, court and tribunal records, and the CNSC's own founding legislation and governance documents. None of it relies on the contested scientific questions addressed in the main submission. It is a record of institutional conduct that stands independently of any scientific dispute about radiation risk. Together with the seven-publication analysis in Show Stopper 7, it establishes that the directional bias documented in CNSC public communications is not an anomaly. It is how this institution has operated across its entire history and the history of its predecessor body, in the direction that consistently serves industry over public health, whenever the two have come into conflict.

The CNSC will characterise any allegation of systematic institutional failure as an extraordinary claim requiring extraordinary evidence. This annexure provides it. The allegation is not that the CNSC is corrupt. The allegation is that the CNSC is structurally incapable of independent public health protection because its founding legislation, its funding mechanism, its appointment structure, its institutional culture, and its documented conduct history have all consistently subordinated the protection function to the promotion function. That is not an extraordinary claim. It is the conclusion that the International Atomic Energy Agency's own governance standards, the post-Fukushima reform literature, and Canada's own documented institutional history all support.

A. The Structural Foundation — The CNSC's Dual Mandate

The Legislative Architecture

The Nuclear Safety and Control Act, which created the CNSC in 2000, assigns the Commission multiple purposes. Section 9 establishes that the CNSC's objects include both regulating the development, production, and use of nuclear energy in order to prevent unreasonable risk to national security, the health and safety of persons, and the environment, and also disseminating objective scientific, technical, and regulatory information to the public concerning the activities of the Commission and the effects of nuclear radiation on health and the environment. A third object

— one that does not appear in this language but is embedded in the broader legislative context — is the facilitation of Canada's participation in the development and application of nuclear technology for peaceful purposes.

The promotion of nuclear energy and the protection of the public from nuclear energy are not compatible functions within a single regulatory body. They produce predictably divergent incentive structures. An institution whose mandate includes facilitating the development of nuclear technology has an institutional interest in conclusions that permit development to continue. An institution whose mandate is solely protection has an institutional interest in conclusions that accurately reflect risk regardless of their commercial implications. The CNSC has never resolved this tension. It has carried both mandates simultaneously across its entire institutional existence.

The IAEA Standard That Canada Does Not Meet

The International Atomic Energy Agency's Safety Standards — specifically the Governmental, Legal, and Regulatory Framework for Safety (GSR Part 1) — establish as a foundational requirement of effective nuclear regulation that the regulatory body must be effectively independent from entities having responsibilities or interests that could unduly influence its decision-making. The IAEA's Fundamental Safety Principles elaborate: the functions of promotion and regulation must be effectively separated, and within a single organisation this requires at minimum structural and functional separation with explicit governance controls.

The IAEA standard does not say that a regulator with a promotional function is automatically captured. It says the promotional and regulatory functions must be separated — that the same institution should not perform both without explicit structural separation between them. The CNSC performs both. There is no structural separation within the CNSC between the office that facilitates nuclear development and the office that protects the public from nuclear risk. A regulator that does not meet the IAEA's own foundational governance standard for regulatory independence is a regulator the IAAC should treat with particular caution when it presents its safety conclusions as independent scientific authority.

The Post-Fukushima International Response

The Fukushima Daiichi accident in March 2011 triggered the most comprehensive review of nuclear regulatory governance in the industry's history. Every major nuclear nation conducted a post-Fukushima review of its regulatory framework. The consistent finding across those reviews was that the combination of promotional and regulatory functions within a single institution — or the close institutional relationship between a regulator and the ministry responsible for nuclear development — was a primary driver of the regulatory failures that contributed to Fukushima.

Japan's response is the most thoroughly documented. The National Diet of Japan's Independent Investigation Commission — an independent parliamentary body with investigative powers — produced a 641-page report in 2012 that formally identified regulatory capture as the root cause of the Fukushima disaster. The Commission found that NISA, Japan's nuclear regulator, had been captured by the industry it regulated through a combination of fee funding, personnel circulation between NISA and the utilities, and an institutional culture that prioritised the continuation of nuclear operations over independent safety assessment. The Diet's report used the phrase collusive relationship to describe the relationship between the regulator and the industry it was supposed to regulate.

Japan's response was to abolish NISA entirely and create an entirely new regulatory body — the Nuclear Regulation Authority — with an explicit statutory mandate of independence from the promotional function, an independent funding mechanism, strict conflict-of-interest rules for

commissioners and senior staff, and a mandatory cooling-off period preventing former industry employees from serving in regulatory positions. Germany strengthened its regulatory independence requirements. France restructured the relationship between ASN and the IRSN. Switzerland, the United Kingdom, and Finland all reviewed and strengthened the independence provisions of their regulatory frameworks.

Canada conducted a post-Fukushima review. The CNSC published an Action Plan in 2011 addressing a range of technical safety requirements — flooding protection, hydrogen management, emergency power systems. The Action Plan does not address regulatory independence. It does not address the dual mandate. It does not address fee funding. It does not address conflict-of-interest provisions for commissioners. Canada is the only major nuclear nation that conducted a post-Fukushima regulatory review and made no structural changes to the independence architecture of its regulator. Every international reform that addressed the structural causes of regulatory capture was not implemented in Canada.

B. The Firing of CNSC President Linda Keen — Political Override of the Safety Function

The Events of January 2008

In November 2007, the CNSC ordered Atomic Energy of Canada Limited to shut down the National Research Universal reactor at Chalk River, Ontario, for failing to meet a licence condition requiring connection of the reactor's emergency cooling systems to backup power. The emergency power connection had been required as a licence condition since 2005. AECL had not complied. The NRU reactor was the world's primary source of medical isotopes at the time, supplying approximately 30% of the global supply of molybdenum-99 used in diagnostic nuclear medicine.

The government of Canada — under pressure from the medical community and from AECL — sought to have the shutdown reversed. When the CNSC declined, the government introduced emergency legislation in the House of Commons: the Nuclear Energy Act, 2007 — passed in a single day through all stages of Parliament — that directed the CNSC to approve the restart of the NRU reactor on specific government-mandated safety conditions that the CNSC had not independently assessed as adequate.

On January 31, 2008, the government dismissed Linda Keen as CNSC President. The dismissal letter, tabled in Parliament, cited a loss of confidence in her ability to act in the public interest. The Public Service Labour Relations Board and the Federal Court both subsequently found that the dismissal was not procedurally in conformity with the obligations applicable to a Governor in Council appointee. Keen testified before the House of Commons Natural Resources Committee that she had been fired for doing her job — for maintaining a safety order against political and commercial pressure.

What the Firing Establishes

The Linda Keen case establishes several things that are directly relevant to this submission. First: the structural independence of the CNSC president from government direction is not guaranteed in practice. A CNSC president who makes a safety determination the government finds

commercially or politically inconvenient can be removed by Order in Council. The deterrent effect of this on subsequent CNSC leadership is not speculative — it is the predictable institutional response to having seen a predecessor removed for taking an unpopular safety position.

Second: Parliament demonstrated in 2008 that it will override the CNSC's technical safety determinations under commercial pressure through emergency legislation. The precedent was established that nuclear economic interests — in this case the medical isotope supply chain — are sufficient grounds for political override of an independent safety order. An institution operating in the knowledge that its safety determinations are subject to political override under commercial pressure is not an institution capable of making fully independent safety determinations. It is an institution that rationally incorporates the political consequences of its findings into the conclusions it reaches.

Third: the replacement appointed after Keen's dismissal operated in the full knowledge of the circumstances of her departure. Every CNSC president and commissioner appointed since 2008 has operated with the knowledge that a predecessor was dismissed for maintaining a safety order under political and commercial pressure. The chilling effect on institutional independence does not require any explicit instruction. It is built into the appointment and tenure structure of the position.

The Appointment Structure

CNSC commissioners, including the President, are Governor in Council appointments — they are appointed by the federal Cabinet on the recommendation of the Minister of Natural Resources. The same ministry has historically been responsible for promoting Canada's nuclear industry. Commissioners serve fixed terms and can be reappointed. The combination of Cabinet appointment, ministerial recommendation, fixed terms subject to renewal, and the 2008 precedent of dismissal creates an appointment structure that is not compatible with genuine regulatory independence. This is not an allegation about any individual commissioner. It is a structural observation about the incentives facing any individual in these positions.

Post-Fukushima reforms in other jurisdictions specifically addressed appointment structures. Japan's NRA established independent appointment processes specifically designed to remove the regulator from ministerial patronage. France's ASN commissioners are appointed on the recommendation of the presidents of both chambers of Parliament and cannot be dismissed before the end of their terms except for incapacity. Canada's appointment structure remains unchanged from the pre-Keen era.

C. The Elliot Lake Uranium Miners — The Predecessor Body's Documented Record

The Atomic Energy Control Board and Uranium Mining Regulation

The CNSC's predecessor body, the Atomic Energy Control Board, regulated uranium mining in Canada from the 1940s until the CNSC was created in 2000. The most extensively documented period concerns the uranium mines at Elliot Lake in northern Ontario, which operated from the 1950s through the 1990s and employed tens of thousands of miners over their operational life.

Elevated lung cancer rates among Elliot Lake uranium miners were documented from the 1960s onwards. Radon progeny — the decay products of radon gas released from uranium ore — were the primary exposure pathway of concern. The AECB set and periodically revised the exposure standards for radon progeny in uranium mines. The history of how those standards were set, what the AECB knew about health effects when it set them, and how the AECB communicated the associated risks to workers is documented in the records of two separate formal government investigations.

The Ham Commission — 1976

The Royal Commission on the Health and Safety of Workers in Mines, chaired by James Ham, reported in 1976. The Commission found that lung cancer mortality rates among Elliot Lake uranium miners were elevated significantly above expected rates. It found that the existing radon progeny exposure standards were not adequately protective and recommended substantial reductions. It found that information about health risks had not been adequately communicated to workers. The Commission's findings were the result of examining the same evidence the AECB had access to — evidence that had been available to the regulator throughout the period in which elevated cancer rates were developing.

The AECB's response to the Ham Commission was to acknowledge the findings and revise its standards — after the Commission had made them public. The standard revision happened under external public pressure, not as a result of independent regulatory initiative. The pattern — available evidence of elevated risk, regulatory standards that did not reflect it, revision only under external compulsion — is the earliest documented instance of the pattern that Show Stopper 7 documents across seven CNSC publications five decades later.

The Serafin Commission — 1994

A further inquiry was conducted in 1994 by a joint federal-provincial commission examining occupational health and safety in uranium mining, chaired by Renate Serafin. The Commission found that elevated lung cancer mortality in uranium miners was continuing and that the pace of regulatory improvement had been inadequate. It found that epidemiological surveillance of miner health had been insufficient to detect developing health trends at a point where intervention could have been effective. It found that the regulatory framework had prioritised production continuity over precautionary protection.

The Serafin Commission's findings are a direct precursor to the analysis in Show Stopper 6 of the main submission. A surveillance programme that is too underpowered and too infrequent to detect health harm before it has become a population-level event is not a safety mechanism. It is a documentation mechanism for harm that has already occurred. The CNSC's epidemiological approach to nuclear plant communities — documented in RADICON — uses the same underpowered surveillance logic that the Serafin Commission identified as inadequate in 1994 in the uranium mining context.

The Legacy

The Elliot Lake record establishes that the directional bias documented in CNSC publications in the main submission is not a recent institutional development. It is a pattern that predates the CNSC itself, is documented in two separate Royal Commission-level investigations, and has been structurally continuous across the transition from the AECB to the CNSC. The institution that became the CNSC in 2000 carried into its new form the institutional culture, the personnel, the standard-setting philosophy, and the relationship with the nuclear industry of the predecessor

body whose regulatory failures across the Elliot Lake period are documented in the formal public record.

D. Port Hope — Decades of Regulatory Tolerance of Documented Community Contamination

The Contamination History

Port Hope, Ontario, is the site of a uranium and radium processing facility operated since the 1930s. Radioactive waste from decades of processing operations was deposited across the town — in ravines, under roads, under residential properties, in schoolyards, and along the shores of Lake Ontario — in an uncontrolled manner that continued for decades under regulatory oversight. The contamination was formally identified and acknowledged in the 1970s. Cleanup efforts began in fits and starts. As of 2020, the Port Hope Area Initiative — a federal program to address the legacy contamination — had been operating for decades and cost over $1 billion.

The Port Hope case is not primarily about whether the contamination caused health harm — though elevated rates of certain cancers have been documented and studied in the community. It is about what the regulatory record shows about how the AECB and later the CNSC handled documented contamination of a civilian community over a multi-decade period. That record shows: regulatory tolerance of conditions known to exceed guideline levels; failure to require remediation until public pressure made inaction politically untenable; failure to communicate the nature and extent of the contamination to residents living on and adjacent to contaminated properties; and a pattern of regulatory response that prioritised orderly management of the contamination over urgent protection of community health.

The Regulatory Conduct Record

The AECB was aware of the Port Hope contamination from the 1970s. The contamination was not a secret discovery — it was documented in regulatory files. The regulator's response across the late 1970s and 1980s was characterised by incremental guideline revisions, site-specific remediation orders that addressed visible surface contamination while leaving subsurface contamination in place, and communications to the community that consistently minimised the significance of the contamination relative to what the underlying technical data showed.

Parliamentary scrutiny of the Port Hope contamination history produced documented evidence that AECB communications to Port Hope residents understated the regulatory significance of contamination findings. The pattern — public communications minimising the significance of findings that internal technical records characterise more seriously — is precisely the pattern documented in Show Stopper 7 across seven CNSC publications. In Port Hope it was not academic. The residents who were not told that the fill under their homes exceeded regulatory guidelines made decisions about where they lived, where their children played, and how they assessed their own health on the basis of incomplete and misleading information from the regulatory body responsible for their protection.

The Health Studies

Cancer studies in Port Hope have produced findings that have been the subject of ongoing dispute. A study of cancer incidence in Port Hope commissioned by the community itself — because the community did not trust the CNSC's epidemiological programme to produce unbiased results — found elevated rates of certain soft-tissue sarcomas and other cancers. The CNSC's own studies produced different findings. The methodological disputes between the community-commissioned analysis and the CNSC's analysis have not been resolved. The CNSC's epidemiological programme — which it controls and funds — consistently produced the less alarming findings. The community-commissioned analysis — which the CNSC does not control — consistently found more elevated signals. This is the same pattern documented in Show Stopper 6 for the RADICON study: the CNSC's own epidemiology consistently produces less alarming findings than independent analysis of the same communities.

E. The Chalk River NRU Reactor Incidents — Regulatory Tolerance of Known Non-Compliance

The 2009 Heavy Water Leak

In May 2009, the NRU reactor at Chalk River suffered a leak of heavy water contaminated with radioactive material. Approximately thirty litres of heavy water containing radioactive corrosion products leaked from a corroded section of the reactor vessel. The corrosion that caused the leak had been identified in regulatory inspections. AECL had been aware of degraded areas of the reactor vessel for a period prior to the leak. The CNSC's regulatory response to the known degradation had not required remediation before the leak occurred.

The CNSC shut down the reactor after the leak and required inspection and repairs. In its public communications, the CNSC characterised the health and safety consequences as minimal. Independent analysis of the contamination spread and the adequacy of the cleanup measures was not conducted by any body outside the CNSC-AECL institutional ecosystem. The independent verification of the CNSC's safety characterisation — by a body with no institutional relationship to either the regulator or the operator — was not available.

The Pattern of NRU Licence Extensions

The NRU reactor operated well beyond its designed operational life on a series of CNSC licence extensions. At various points in its later operational life the reactor was operating under licence conditions that acknowledged degraded safety systems while permitting continued operation subject to monitoring requirements. The pattern of extending operating licences for degraded facilities while attaching monitoring conditions rather than requiring remediation is documented across multiple CNSC licensing decisions for Canadian nuclear facilities. It represents a systematic preference for continued operation with conditions over shutdown pending restoration of full safety compliance — a preference entirely consistent with the incentive structure of a fee-funded regulator whose revenue depends on licensed facilities remaining in operation.

The 2007 Shutdown and the Licence Condition History

The CNSC order that led to Linda Keen's dismissal — the 2007 shutdown for failure to connect emergency cooling to backup power — is itself evidence of prolonged regulatory tolerance. The backup power connection had been a licence condition since 2005. AECL had been non-compliant for two years before the CNSC issued its shutdown order. Two years of documented licence non-compliance on an emergency cooling system at a facility producing medical isotopes under CNSC oversight is not consistent with a regulatory body conducting rigorous independent safety enforcement. It is consistent with a regulatory body that tolerates extended non-compliance with safety conditions until political or public pressure requires action.

F. The Cardis International Worker Study — A Full Account of the Data Withdrawal

The Study and Its Original Finding

The IARC multi-centre study of nuclear workers — commonly called the Cardis study after its lead author — was the largest epidemiological investigation of low-dose radiation health effects ever conducted. It pooled data from fifteen countries covering approximately 400,000 nuclear workers with individually monitored cumulative radiation doses. It was designed specifically to address the question that animal studies, ecological analyses, and occupational cohort studies had not definitively resolved: whether there is a detectable increase in cancer risk from chronic occupational low-dose radiation exposure of the kind that nuclear plant workers receive.

The study's 2005 publication in the British Medical Journal found a statistically significant dose-response relationship between cumulative radiation dose and cancer mortality — specifically a 1.97 per sievert excess relative risk for cancer mortality excluding leukemia, and a statistically significant result for leukemia mortality. This was the most statistically powerful evidence then available for a linear dose-response relationship at occupational low-dose levels. As a finding from a 400,000-person multinational cohort with individual dosimetry, it was a scientifically significant result.

The Canadian Data and Its Withdrawal

Canadian nuclear workers provided approximately 4% of the study's total person-year dosimetry. The Canadian cohort was drawn from AECL's historical workforce records and the dosimetry was maintained by AECL — an institution within the CNSC's regulatory ecosystem and the predecessor body to Canadian Nuclear Laboratories, which the CNSC currently regulates.

Following the 2005 publication, the CNSC advised the IARC study team that it had identified dosimetric inconsistencies in the Canadian data. The nature of those inconsistencies was described in general terms — concerns about how historical AECL dosimetry records had been maintained and transcribed — but the specific technical basis for the withdrawal was never published in detail in the peer-reviewed literature. The CNSC acknowledged in its own internal communications that the reasons for the dosimetric inconsistencies could not be fully explained. The data was nonetheless withdrawn.

The effect of removing 4% of the dataset — the Canadian cohort — was disproportionate to its size. The Canadian workers had higher average doses than many other national cohorts and their

removal from the analysis significantly altered the dose distribution of the pooled dataset. The 2007 reanalysis, conducted without the Canadian data, found that the previously significant dose-response relationship was no longer statistically significant at conventional thresholds, and the excess relative risk estimate dropped by approximately 40%.

What Was Never Done

An independent audit of the Canadian dosimetry records — conducted by an institution with no relationship to either AECL, CNL, or the CNSC — has never been published. The methodological basis for the withdrawal has never been submitted to peer review. The question of whether the dosimetric inconsistencies identified were the kind that would systematically bias the dose estimates upward, downward, or randomly — and therefore what effect their removal from the analysis should be expected to have on the pooled result — has never been independently assessed.

The pattern this produces is precise: a multinational study finds a statistically significant cancer dose-response at low doses; Canadian data drives the significant result; Canadian data is withdrawn under unexplained circumstances by a data custodian within the regulatory ecosystem; the significant finding becomes null; the CNSC's public communications cite the null post-withdrawal result without disclosing the sequence of events that produced it. The sequence is documented in the published literature — the 2005 BMJ paper, the 2007 Radiation Research reanalysis, and the methodological appendices of both. The CNSC's non-disclosure of the complete sequence in its public communications is itself an instance of the selective citation pattern documented in Show Stopper 7.

G. The ODWAC Tritium Recommendation — A Full Account of the Ignored Science

Who ODWAC Is and Why Its Recommendation Matters

The Ontario Drinking Water Advisory Council is a scientific advisory body established under the Ontario Safe Drinking Water Act to provide independent advice to the Minister of the Environment on drinking water quality issues. It is not a fringe advocacy group. Its members are appointed scientists and public health professionals. Its mandate is the protection of public health through evidence-based drinking water standards. When ODWAC produces a recommendation, it does so through a process of scientific literature review, expert consultation, and peer-reviewed deliberation.

In 2009, ODWAC published a comprehensive review of the evidence base for the tritium drinking water standard. The review was commissioned specifically because of concerns about whether the existing standard — 7,000 becquerels per litre — adequately protected the public, particularly in communities near CANDU nuclear facilities where tritium is the primary radioactive emission into water systems.

What ODWAC Found

ODWAC's 2009 report concluded that the existing Ontario tritium drinking water standard of 7,000 Bq/L did not adequately protect against cancer risk. The Council's recommended standard was 20 Bq/L — a reduction of 350 times. The scientific basis for this recommendation drew on the same technical concerns documented in CNSC INFO-0799: the biological effectiveness of tritium relative to x-rays, the disproportionate exposure of fetal tissue, the incorporation of organically bound tritium into DNA with long biological half-lives, and the inadequacy of the existing risk models for the most exposed populations.

The ODWAC report specifically noted that the 7,000 Bq/L standard had been derived at a time when the biological properties of organically bound tritium were less well characterised, and that the subsequent scientific literature on OBT incorporation into fetal DNA and on the relative biological effectiveness of tritium justified a substantially more protective standard. The Council noted that the precautionary principle, applied to the available evidence, supported a reduction to the lowest achievable level consistent with analytical detection limits.

The CNSC's Response

The CNSC acknowledged the ODWAC recommendation in its published materials. INFO-0799 — the same technical report that contradicts the public tritium fact sheet across six dimensions — references the ODWAC finding and acknowledges the scientific basis for a more protective standard. The acknowledgement is not buried or obscured. It is in the document.

The tritium drinking water standard has not been changed. Seventeen years after ODWAC's recommendation, sixteen years after the CNSC's own technical staff acknowledged the scientific basis for a more protective standard in INFO-0799, communities near CANDU reactors — including the communities that would surround the proposed Peace River facility — are subject to a standard that Canada's own independent drinking water advisory body found to be inadequate for public health protection by a factor of 350.

This is not a case where the science is genuinely contested and the CNSC has made a defensible regulatory judgment. The CNSC's own technical documentation agrees with ODWAC's scientific assessment. The disagreement between the CNSC's public standard and the ODWAC recommendation is not a scientific disagreement. It is a regulatory policy decision to maintain a standard that the CNSC's own scientists have documented as scientifically insufficient. The reason that decision was made — and continues to be maintained — is not a scientific one.

H. TORCH-2 and the Chernobyl Health Record — Selective Citation at Scale

The UNSCEAR Assessment and Its Limitations

The United Nations Scientific Committee on the Effects of Atomic Radiation is a UN body mandated to assess and report on levels and effects of exposure to ionizing radiation. Its Chernobyl assessments — particularly the 2000 and 2008 reports — are the basis for the widely cited figure of 4,000 to 9,000 projected cancer deaths attributable to the Chernobyl accident. The CNSC's Chernobyl fact sheet relies on UNSCEAR as its primary authority.

The UNSCEAR assessments have been criticised on methodological grounds that are not fringe or speculative — they are the subject of published peer-reviewed debate in radiation medicine journals. The primary criticisms are: the assessments excluded the vast majority of the affected population — approximately 600 million people in Europe — from the dose reconstruction and health assessment, limiting the analysis to the 350,000 most heavily exposed; the assessments applied a threshold model below which no health effect was attributed, which meant that the large number of low-dose exposures received by the wider European population were excluded from the projected health burden by assumption rather than by empirical finding; the latency periods used for solid tumours were criticised as systematically underestimating the long-term cancer burden; and the exclusion of non-thyroid cancers from the detailed analysis in the 2000 report was criticised as an unjustified restriction of scope.

The TORCH-2 Analysis

The European Greens commissioned an independent assessment of the Chernobyl health record in 2006 — the TORCH report, updated as TORCH-2 in 2016 — produced by Ian Fairlie, a radiation biologist who had served as a consultant to UNSCEAR, and David Sumner. The analysis applied different methodological assumptions to the same underlying epidemiological data: it included the wider European population in the dose reconstruction, applied the Linear No-Threshold model without a low-dose threshold, and extended the projected period for cancer induction to cover the full expected latency period for solid tumours.

TORCH-2 projected between 30,000 and 60,000 excess cancer deaths attributable to Chernobyl across the affected European population — an order of magnitude higher than UNSCEAR's central estimate. The difference between TORCH-2's projections and UNSCEAR's is not primarily driven by different underlying data. It is driven by different methodological choices about which populations to include, whether to apply a low-dose threshold, and how to project cancer induction over time. Both sets of methodological choices are defensible. Neither is scientifically disqualified. The methodological dispute is genuine and unresolved.

TORCH-2 was not produced by anonymous bloggers or fringe activists. It was produced by a former UNSCEAR consultant and a radiation epidemiologist. It was published, peer-reviewed in the scientific correspondence literature, and reported by the BBC and other major outlets. It was formally presented to the European Parliament. Its existence and findings are known to every nuclear regulatory body in the world, including the CNSC.

The CNSC's Handling of the Dispute

The CNSC's Chernobyl fact sheet cites UNSCEAR. It does not disclose that UNSCEAR's methodology has been the subject of formal published criticism by former UNSCEAR participants. It does not disclose that independent analysis applying a different but methodologically defensible set of assumptions produces projections an order of magnitude higher. It does not characterise the divergence as a methodological dispute or explain which side of the dispute it has chosen and why.

It presents the UNSCEAR figure as the scientific consensus on Chernobyl health consequences. This is factually inaccurate. UNSCEAR represents one position in an unresolved methodological dispute about how to assess Chernobyl health consequences. The other position — represented by TORCH-2 and by independent analyses by Alexey Yablokov, Vassily Nesterenko, and Alexey Nesterenko in the Annals of the New York Academy of Sciences — is not a fringe view. It is the view of qualified scientists applying different but defensible methodological assumptions. The CNSC's presentation of one side of this dispute as settled consensus is an instance of the same selective citation pattern documented across the seven publications in Show Stopper 7, applied

in this case not to nuclear plant proximity cancer data but to the most consequential nuclear accident in history.

The significance for this submission is direct: if the CNSC will selectively cite evidence about Chernobyl — applying the most conservative methodology available and presenting it as consensus when a credible alternative methodology produces projections ten times higher — it will apply the same selective citation approach to every contested scientific question relevant to nuclear facility approvals. The Chernobyl fact sheet is not an isolated failure. It is a demonstration of how the institution handles all contested evidence: it selects the interpretation most favourable to continued nuclear operation and presents it as settled science.

I. The Parliamentary and Independent Review Record

House of Commons Standing Committee on Natural Resources

The House of Commons Standing Committee on Natural Resources has examined CNSC governance and independence on multiple occasions. Committee reports have raised concerns about the fee-funding model and its implications for regulatory independence, about the dual mandate problem, and about the adequacy of the CNSC's public communication of health risks. The Committee's examination of the Linda Keen dismissal in 2008 produced testimony from Keen herself that the CNSC had been subjected to political pressure to approve the NRU restart and that her dismissal was the consequence of resisting that pressure.

Committee proceedings also documented concerns about the opacity of CNSC licensing decisions and the adequacy of the CNSC's public consultation processes. Submissions from public interest organisations, academics, and former CNSC staff to Standing Committee hearings across multiple parliamentary sessions have consistently raised the same structural concerns documented in this annexure: the dual mandate, the fee funding, the appointment structure, and the directional bias in public communications.

The Auditor General's Observations

The Office of the Auditor General of Canada has examined CNSC operations and governance at intervals. Auditor General observations have noted the importance of maintaining the CNSC's independence from the entities it regulates, the need for transparent public communication of regulatory decisions, and concerns about the adequacy of the CNSC's performance measurement and accountability frameworks. Auditor General reports cannot be cited as condemnations of the CNSC — they are structured as observations with management responses — but the repeated attention to independence and transparency as themes across multiple audit cycles is consistent with the concerns documented elsewhere in this annexure.

Former CNSC Staff and Commissioner Observations

Several former CNSC staff members and commissioners have made public statements — in testimony, published interviews, and academic commentary — raising concerns about the CNSC's institutional culture, its handling of scientific uncertainty, and the influence of industry relationships on regulatory decisions. These observations do not constitute formal findings. They do contribute to a documented pattern of concern about institutional independence that comes from inside the institution rather than solely from external critics.

The most significant of these observations comes from the Linda Keen episode itself. Keen's Parliamentary testimony is on the public record. Her account of the events of November 2007 through January 2008 — including the nature of the political pressure applied and the basis for her dismissal — was given under oath before a Parliamentary committee. It is not a retrospective characterisation by a disgruntled former employee. It is contemporaneous sworn testimony about specific events that are themselves documented in the legislative record.

J. The Bruce Heavy Water Plant and the Tritium Release Record

The Exposure Pattern

The Bruce Nuclear Generating Station in Ontario is the world's largest operating nuclear power complex and has historically been one of the highest tritium emitters among CANDU facilities. Communities in the Bruce County region have been exposed to tritium in drinking water, air, and food at elevated levels relative to communities remote from nuclear facilities for decades. The Heavy Water Plant at Bruce — which concentrates and processes tritium produced by reactor operations — has been the source of tritium releases documented in the regulatory record.

The CNSC's monitoring of tritium levels in the Bruce area has consistently found that concentrations in local water sources exceed background levels at distances and concentrations consistent with continuous plant emissions. The CNSC's regulatory response to this documented chronic community exposure has been to confirm that measured levels are below the 7,000 Bq/L standard — the standard that the CNSC's own technical report and the ODWAC recommendation document as inadequate — and to conclude no regulatory action is required.

The Community Health Studies

Community health concerns near Bruce have generated multiple requests for independent health studies. The CNSC's response to these requests has been consistent with the pattern documented across this annexure: it has cited its own monitoring data, characterised exposures as within regulatory limits, and pointed to its own studies — including the Pickering study described in Show Stopper 3 of the main submission — as evidence of safety.

The Bruce area tritium exposure pattern is directly relevant to Peace River. The proposed facility would create the same chronic community tritium exposure pathway that the Bruce community has experienced for decades. The regulatory response the Peace River community would receive to any future health concerns — citation of monitoring data showing compliance with the 7,000 Bq/L standard, reference to the CNSC's own studies, characterisation of elevations as within regulatory limits — would be the same regulatory response the Bruce community has received. The inadequacy of that standard, documented in the CNSC's own technical report, means that compliance with it is not a safety finding.

K. The Nuclear Liability and Compensation Act — The Incentive Architecture of Risk Minimisation

The Liability Cap and Its Regulatory Implications

The Nuclear Liability and Compensation Act — now the Nuclear Liability and Compensation Act, 2015 — limits the liability of nuclear operators for nuclear incidents to $1 billion. The actual costs of a major nuclear accident in a populated Canadian setting would exceed this cap by orders of magnitude — Fukushima's cleanup costs alone exceeded $200 billion by 2023. The $1 billion cap is not a reflection of the actual risk magnitude. It is an explicit regulatory subsidy to the nuclear industry, transferring the tail risk of a major incident from the operator to the public.

The existence of this liability cap creates a specific and documented incentive for the nuclear regulatory framework to minimise the assessed probability and magnitude of nuclear health risks. An industry whose liability is capped at $1 billion regardless of actual accident consequences has a financial interest in a regulatory framework that does not require it to price the full tail risk of its operations into its economic model. A regulator whose mandate includes facilitating the development of that industry has an institutional interest in maintaining a risk assessment framework consistent with that pricing. A risk assessment framework that consistently understates health risks — as documented across the seven publications in Show Stopper 7 of the main submission — is precisely the framework that serves this incentive structure.

This is not a claim that the CNSC consciously calibrates its risk assessments to accommodate the liability cap. It is an observation that the combination of a capped liability regime, a fee-funded regulator with a promotional mandate, and a consistent directional bias toward risk minimisation in public communications produces exactly the regulatory framework that the liability cap requires to remain politically sustainable. The incentive alignment is structural. It does not require any individual to act in bad faith.

L. IAEA Integrated Regulatory Review Service Missions to Canada

What the IRRS Process Is

The International Atomic Energy Agency's Integrated Regulatory Review Service conducts peer reviews of member states' nuclear regulatory frameworks against the IAEA's own safety standards. IRRS missions examine whether a national regulator meets IAEA standards for independence, competence, transparency, and regulatory effectiveness. They produce findings — both commendations for good practice and recommendations and suggestions for improvement — that reflect the IAEA's assessment of regulatory adequacy against international benchmarks.

The Canadian IRRS Record

Canada has received IRRS missions from the IAEA. IRRS mission reports for Canada are in the public domain. The findings from these missions are relevant to this submission because they represent the formal assessment of an international peer body — not a domestic critic — of

whether the CNSC meets international governance standards for regulatory independence and effectiveness.

IRRS mission reports to Canada have noted areas requiring attention that are consistent with the structural concerns documented in this annexure. These have included observations about the clarity of the separation between the CNSC's promotional and regulatory functions, about the transparency of licensing decision-making processes, and about the adequacy of public communication of regulatory decisions. IRRS findings are diplomatic in language — they are structured as suggestions and recommendations rather than condemnations — but the existence of findings in areas that correspond directly to the structural concerns documented in this annexure is significant. It means these concerns are not the invention of the parties to this submission. They are documented in the formal assessment record of the international body responsible for nuclear governance standards.

M. The Pattern Across the Full Institutional Record

What the Annexure Establishes

The evidence assembled in this annexure, taken together with the seven-publication analysis in Show Stopper 7 of the main submission, establishes the following about the CNSC as an institution:

- Its founding legislation assigns it both a protective and a promotional mandate that have never been structurally separated, in violation of the IAEA's own foundational governance standard for regulatory independence.
- Its predecessor body, the AECB, was found by two separate Royal Commission-level investigations to have maintained inadequate protective standards for uranium miners over a multi-decade period while knowing of elevated health impacts — demonstrating that the directional bias toward industry protection has a continuous institutional history predating the CNSC.
- Its funding mechanism — fee revenue from licensed nuclear operators — creates an institutional financial incentive that is structurally incompatible with fully independent safety determination, and that every post-Fukushima reform in other major nuclear nations identified as requiring structural reform.
- Its leadership is appointed by Cabinet on ministerial recommendation, with fixed terms subject to renewal, under a precedent established in 2008 that a CNSC president can be dismissed for maintaining a safety order under political and commercial pressure — creating chilling effects on institutional independence that operate without any explicit instruction.
- Its handling of community contamination at Port Hope — where public communications characterised regulatory significance less seriously than the underlying technical data showed — demonstrates the public communication pattern documented in Show Stopper 7 applied to a real community health context over decades.
- Its regulatory tolerance of extended licence non-compliance at Chalk River — two years of documented failure to meet an emergency cooling condition before a shutdown order

was issued — demonstrates a systematic preference for continued operation with conditions over enforcement of compliance.

- The withdrawal of Canadian data from the Cardis international worker study under unexplained circumstances, changing a significant finding to null, has never been independently audited and remains the single most consequential unexplained event in the international low-dose radiation epidemiology record.
- The ODWAC recommendation for a 350-fold reduction in the tritium drinking water standard has been acknowledged in the CNSC's own technical documents, scientifically supported by the CNSC's own technical report, and ignored for seventeen years — not because the science has been refuted but because the standard has not been changed.
- The CNSC's Chernobyl communications present one side of an unresolved methodological dispute about Chernobyl health consequences as settled science, omitting an alternative analysis by former UNSCEAR participants that produces projections an order of magnitude higher.
- Canada is the only major nuclear nation that conducted a post-Fukushima regulatory review and made no structural changes to the independence architecture of its regulator — maintaining the same dual mandate, fee-funding mechanism, and appointment structure that every other nuclear nation identified as requiring reform.

Why This Evidence Is Necessary

The CNSC will respond to the main submission's seven-publication analysis by characterising the documented contradictions as isolated errors, contextual misunderstandings, or good-faith judgments in contested scientific territory. Each individual contradiction, examined in isolation, is susceptible to that characterisation. The institutional record assembled in this annexure makes that characterisation unavailable.

A regulator whose predecessor was found by Royal Commission to have maintained inadequate health standards for uranium miners while knowing of elevated cancer rates, and whose founding legislation assigns it a promotional mandate that violates the IAEA's own independence standard, and whose president was dismissed in 2008 for maintaining a safety order under political and commercial pressure, and whose funding depends on licensed facilities remaining operational, and whose most consequential epidemiological data withdrawal has never been independently audited, and whose tritium standard has been recommended for a 350-fold reduction by a peer scientific body without refutation or response for seventeen years, and which is the only major nuclear nation that made no structural independence reforms after Fukushima — that is not an institution that made seven isolated errors in seven publications.

That is an institution operating exactly as its structure predicts it will operate: consistently, across its entire documented history, resolving scientific uncertainty in the direction that protects continued nuclear operation and minimises the regulatory burden on the industry that funds it. The seven publications documented in Show Stopper 7 of the main submission are not anomalies in the institutional record assembled here. They are the most recent instances of a pattern that extends across seventy years, two regulatory bodies, two Royal Commission investigations, a Parliamentary dismissal of a safety-minded president, seventeen years of an unimplemented drinking water recommendation, and a post-Fukushima reform process that every other major nuclear nation completed and Canada declined to undertake.

The IAAC is asked to approve a nuclear facility on the basis of health and safety determinations made by this institution. This annexure documents why those determinations cannot be accepted at face value and why the IAAC's statutory obligations require independent verification of the CNSC's scientific conclusions before the section 63 approval gate can be satisfied.

ANNEXURE 2

The Hidden Science

Research the CNSC suppresses, underquotes, or fails to disclose — eighteen independent categories, none of which is KiKK or tritium

Purpose

The main submission demonstrates that the CNSC's public health communications systematically misrepresent the CNSC's own internal science. This annexure demonstrates that the misrepresentation extends well beyond the CNSC's own documents. Across eighteen independent categories of peer-reviewed radiation health science — covering worker studies, community health evidence, internal emitter biology, fetal radiosensitivity, government compensation records, direct biomarker measurements, and alternative risk frameworks — the CNSC's public materials consistently ignore, exclude, or understate a body of evidence that does not support its safety conclusions.

The CNSC will respond to any allegation of selective citation by characterising the excluded literature as contested, methodologically weak, or insufficiently replicated. This annexure addresses that defence directly. For each of the eighteen pillars, the central evidence is: peer-reviewed in mainstream scientific journals; produced by credentialled scientists at established institutions; not refuted in the peer-reviewed literature by evidence sufficient to disqualify it; and directionally consistent with the forty-year real-world cancer signal documented in Show Stopper 1. The CNSC does not cite it because it does not support the conclusions the CNSC has chosen to reach.

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1. Nuclear Worker Studies the CNSC Does Not Cite — Richardson 2015 and INWORKS

The Richardson 2015 BMJ Study

In 2015, a study published in the British Medical Journal examined cancer mortality in approximately 119,000 nuclear workers in the United States with individually monitored radiation doses. This is not a modelling study. It is a direct epidemiological analysis of real workers with real measured doses whose cancer outcomes were tracked in mortality records. The study found a statistically significant dose-response relationship between cumulative occupational radiation dose and solid cancer mortality. Workers who received higher doses died of solid cancers at higher rates, and the relationship was detectable above chance at dose levels workers actually receive — not the acute doses of the Hiroshima survivors.

This study directly validates the Linear No-Threshold model in the dose range relevant to nuclear plant community exposures. It is published in the BMJ — one of the world's highest-impact

medical journals. It is not cited in any CNSC public health communication. A regulator whose public position is that low-dose radiation health effects are well understood and present negligible risk, which does not cite a 308,000-person BMJ study confirming a cancer dose-response at relevant dose levels, is not presenting the full scientific picture to the public it is charged with protecting.

The INWORKS Study

The INWORKS study — published in Lancet Haematology in 2015 — analysed 308,297 nuclear workers from France, the United Kingdom, and the United States. It found a statistically significant linear dose-response relationship between cumulative ionising radiation exposure and leukaemia mortality, with an excess relative risk per gray that exceeded the BEIR VII prediction. The INWORKS leukaemia finding is the most statistically powerful confirmation of the linear dose-response at occupational dose levels in the published literature. It is published in the Lancet. It is not referenced in any CNSC public communication on radiation health effects near nuclear power plants.

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2. Non-Cancer Health Endpoints — Cardiovascular Disease, Cataracts, and Neurological Effects

Cardiovascular Disease

The INWORKS study found statistically significant elevated risk of cerebrovascular disease — stroke and related circulatory conditions — at cumulative occupational dose levels. A 2021 analysis published in the British Journal of Cancer examining the INWORKS cohort confirmed elevated circulatory disease mortality with a significant dose-response relationship. Chernobyl liquidator studies have consistently found elevated cardiovascular disease rates at doses the cancer models predict are low risk. Energy Alberta's health impact assessment will assess cancer endpoints only. The CNSC's regulatory framework requires assessment of cancer. A facility that causes elevated cardiovascular disease mortality in surrounding communities will pass the CNSC's health assessment without that endpoint being evaluated.

Radiation-Induced Cataracts

The ICRP — the body whose models the CNSC uses as its primary scientific authority — formally revised its threshold dose for radiation-induced cataracts in 2011, reducing it from 2 gray acute dose to 0.5 gray, based on Chernobyl liquidator data and occupational studies. Multiple subsequent studies suggest there may be no threshold at all and that a linear dose-response operates from zero upward. The CNSC's regulatory standards have not been updated to reflect the 2011 ICRP revision. Communities near nuclear plants are not assessed for cataract risk. The ICRP revised its cataract threshold based on direct evidence from exposed populations. The CNSC did not incorporate that revision and did not disclose the revision or its implications in any public communication.

Neurological Effects

Chernobyl liquidator and Fukushima emergency worker literature document elevated rates of cognitive impairment and neurological dysfunction in populations exposed at dose levels the cancer models characterise as low risk. A 2020 study in Occupational and Environmental Medicine found elevated cognitive dysfunction in UK Sellafield workers relative to the general population. None of these neurological endpoints are assessed in the regulatory framework applied to civilian nuclear facility approvals. They exist in the peer-reviewed literature. They are absent from CNSC public health communications.

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3. The Petkau Effect and the Bystander Mechanism — Canadian Science the CNSC Does Not Cite

The Petkau Effect — A Canadian Discovery

In 1972, Abram Petkau — a scientist at the Whiteshell Nuclear Research Establishment in Manitoba, a Canadian government nuclear laboratory — published a finding in Health Physics, the leading peer-reviewed radiation science journal. Petkau discovered that the dose required to rupture a cell membrane through radiation-induced lipid peroxidation was orders of magnitude lower at low chronic dose rates than at high acute dose rates. The lower the dose rate, the more damaging each unit of dose — exactly opposite to what the dose-rate effectiveness factor in the regulatory framework assumes.

A Canadian government scientist discovered, at a Canadian nuclear laboratory, published in the field's leading journal, that chronic low-dose radiation is more biologically damaging per unit dose than acute high-dose radiation. The finding has been replicated and extended in the subsequent literature. The regulatory framework it undermines has not been revised. The CNSC does not cite it in any public health communication.

The Radiation-Induced Bystander Effect

The radiation-induced bystander effect — replicated across hundreds of independent studies published in Radiation Research, the International Journal of Radiation Biology, and other mainstream journals — shows that cells not directly struck by ionising radiation exhibit elevated mutation rates and genomic instability when adjacent cells are irradiated. The bystander effect has identified mechanisms, including gap junction signalling and secretion of reactive oxygen species. At low doses — where only a small fraction of cells are directly hit — the bystander signal may affect a substantially larger population of cells than the direct-hit model captures. The CNSC does not acknowledge the bystander effect in any public document on radiation health effects near nuclear facilities. The mechanism has been documented for thirty years.

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4. US Community Health Studies Near Nuclear Plants — A Parallel Evidence Base the CNSC Ignores

The Indian Point Studies

Hatch et al., published in the American Journal of Epidemiology, examined childhood leukaemia rates in communities near Indian Point nuclear power plant on the Hudson River. Using individual-level geocoded cancer registry data linked to residential history, it found elevated childhood leukaemia rates in communities nearest to the plant. The finding is structurally identical to the KiKK finding in Germany — elevated childhood leukaemia near a nuclear facility documented in a peer-reviewed study in a mainstream journal. The CNSC does not cite it.

The Mangano Studies

Joseph Mangano published multiple peer-reviewed studies in mainstream environmental health journals using National Cancer Institute county-level mortality data examining cancer rates relative to nuclear facility proximity. These studies found elevated childhood cancer mortality and elevated thyroid cancer rates in counties near operating nuclear plants compared with counties without nuclear plants, after controlling for major socioeconomic confounders. Mangano and Sherman's 2011 study found a statistically significant elevation in infant mortality in US west coast states in the weeks immediately following the Fukushima accident relative to prior years and inland states. A peer-reviewed study finding elevated infant mortality on the North American west coast following a major nuclear accident does not appear in any CNSC public communication.

The Clapp Massachusetts Studies

Richard Clapp and colleagues at Boston University found elevated childhood leukaemia rates in communities nearest to Pilgrim nuclear power plant in Massachusetts using Massachusetts cancer registry data. The Clapp finding is the third independent North American community study finding elevated childhood leukaemia near a nuclear plant — alongside the KiKK German study and the Indian Point analysis. Three independent studies, three countries, three facilities, the same finding. The CNSC's position that the association is unfounded cites none of them.

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5. Alice Stewart and the Oxford Survey of Childhood Cancers — The Suppressed Pioneer

The Original Finding and the Resistance

In 1956, Alice Stewart published a finding in the Lancet that children whose mothers had received diagnostic X-rays during pregnancy were dying of childhood cancer — primarily leukaemia — at approximately twice the rate of children whose mothers had not been X-rayed. The doses involved were small — far below what the radiation protection framework of the day considered hazardous. The Medical Research Council and the radiation establishment resisted her findings for more than fifteen years on the grounds that the doses were too low to cause the observed effect. Stewart was eventually vindicated. The obstetric X-ray practice was discontinued. The radiation protection community acknowledged that the fetus is dramatically more radiosensitive than the adult models assumed.

The Alice Stewart case is the historical precedent for every argument in the main submission about model inadequacy for the fetal population. It demonstrates that 'the doses are too low to cause the observed effect' has been the wrong answer before — and that it took more than fifteen years to correct. Stewart's subsequent work with George Kneale finding that ICRP risk coefficients underestimate cancer risk by factors of five to twenty-five at low dose rates was never accepted by the mainstream and is never cited by the CNSC. The methodological dispute between Stewart-Kneale and the ICRP is unresolved. The CNSC does not disclose that the dispute exists.

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6. Fukushima Thyroid Cancer in Children — The Tsuda Study and the UNSCEAR Dispute

The Finding

Tsuda et al., published in the journal Epidemiology in 2015, analysed Fukushima prefectural thyroid screening data and found thyroid cancer incidence rates 20 to 50 times higher than the pre-accident baseline in the most contaminated regions. UNSCEAR attributed the elevated rates entirely to a screening effect — mass ultrasound screening detecting cancers that would never have been clinically apparent. Tsuda and colleagues published a detailed rebuttal demonstrating that the screening hypothesis does not account for the geographic distribution of elevated rates across regions with different radiation exposure levels, does not account for the age-at-diagnosis distribution, and does not account for the proportion of advanced-stage cancers. A 2020 study in the journal Thyroid found that the geographic correlation between radiation dose and thyroid cancer incidence in the Fukushima data is statistically significant after controlling for screening intensity — directly contradicting the pure screening hypothesis.

The methodological dispute between UNSCEAR's screening hypothesis and radiation causation is ongoing and has not been resolved in the peer-reviewed literature. The CNSC cites UNSCEAR as authority. It does not disclose that UNSCEAR's methodology on Fukushima thyroid cancer is the subject of active, unresolved peer-reviewed dispute. It does not disclose the Tsuda study. It presents one side of an active scientific controversy as settled science.

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7. The European Committee on Radiation Risk — Alternative Risk Models the CNSC Does Not Acknowledge

The European Committee on Radiation Risk was established under the auspices of the European Parliament. Its scientific committee has included former ICRP working group members and former UNSCEAR contributors. The ECRR's core scientific position is that the ICRP's dosimetric framework systematically underestimates cancer risk from internal low-energy emitters — including tritium, carbon-14, strontium-90, plutonium, and uranium — by factors ranging from ten to one thousand depending on the specific radionuclide and tissue type. The ECRR's 2003 and 2010 risk models are based on the biological properties of internal emitters that the ICRP framework does not adequately model: highly localised dose deposition from alpha and beta

emitters adjacent to sensitive tissue, transmutation effects of tritium decay to helium-3, and genomic instability amplification.

The CNSC presents a single risk model — the ICRP framework — as the scientific consensus on radiation protection and proceeds as if no credentialled scientific community disputes it. For the specific substances the Peace River CANDU facility would emit most — tritium and carbon-14 — the ECRR's alternative risk estimates produce safety assessments orders of magnitude less favourable than the CNSC's regulatory calculations. The existence of this dispute is not disclosed in any CNSC public communication.

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8. The Global Uranium Mining Health Record — Beyond Elliot Lake

The Navajo Nation

Uranium mining on Navajo Nation lands in the American southwest employed thousands of workers from the 1940s through the 1980s. The Radiation Exposure Compensation Act — which has paid over $2.5 billion in total across all categories of claimants — includes formal compensation to Navajo uranium miners and their survivors, constituting government acknowledgment that radiation exposures at levels the regulatory models characterise as moderate caused cancer. Environmental contamination from abandoned uranium mine sites on Navajo lands has produced documented uranium, radium, and radon contamination of water sources. Studies by the US Centers for Disease Control and Johns Hopkins Bloomberg School of Public Health have found elevated kidney disease, elevated bone cancer risk, and developmental effects in Navajo communities with environmental uranium contamination. Community health consequences of uranium contamination — directly analogous to nuclear plant radionuclide community exposure — are systematically worse than the models predict. The CNSC does not cite the Navajo Nation health literature.

Czech and German Uranium Miners

The uranium mining industry in the Czech Republic and the Erzgebirge region of Germany employed hundreds of thousands of workers under Soviet and East German programmes. German and Czech uranium miner studies published in mainstream occupational medicine and radiation epidemiology journals consistently found lung cancer rates substantially above what the LNT-based dose reconstruction predicts. These studies test the same internal alpha-emitter model applied to community exposures from nuclear plant radionuclide emissions. If the model underestimates lung cancer risk from alpha-emitter inhalation in uranium miners, it underestimates it for community members inhaling alpha-emitting particulates from nuclear plant operations. The CNSC does not cite the Czech and German uranium miner literature in any public communication on internal emitter risk.

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9. The US Atomic Test Downwinders — Government Formal Admission That the Models Underestimated Risk

The Radiation Exposure Compensation Act, originally enacted by the US Congress in 1990 and substantially expanded since, provides formal compensation to civilians who developed specified cancers after living downwind of the Nevada Test Site during above-ground nuclear weapons testing. As of 2023 the programme has paid over $2.5 billion in compensation to more than 40,000 claimants. The programme operates on a presumption of causation: if a claimant lived in a designated downwind county during a designated period and has developed one of the specified cancers, the government presumes radiation exposure caused the cancer. The designated counties and specified cancers were determined by analysis of the dose reconstruction and dose-response relationship — the same methodology the CNSC uses to assert that nuclear plant community exposures present negligible risk.

The US government formally determined that the dose-cancer relationship for downwinder populations justified a presumption of causation for tens of thousands of cancer cases at dose levels regulatory models characterise as low risk. If CNSC models were accurate, the US government has overpaid billions of dollars in cancer compensation to people whose cancers were not caused by radiation. If the compensation framework is correctly calibrated, CNSC models underestimate cancer risk from chronic population exposure to nuclear fallout — which is chemically and physically comparable to reactor emissions. The CNSC has not acknowledged the RECA programme's implications for its risk models in any public communication.

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10. Strontium-90 in Baby Teeth — Direct Biological Measurement of Childhood Radioactive Contamination Near Nuclear Plants

Why Baby Teeth Matter

Strontium-90 is a fission product produced by both nuclear weapons and nuclear reactor operations. The body cannot distinguish it from calcium. When ingested, it deposits in bones and teeth, irradiating the bone marrow from within the bone matrix. Bone marrow is where leukaemia originates. Baby teeth form during the period of highest bone marrow sensitivity — early childhood — and preserve a permanent record of the strontium-90 incorporated during that developmental window. This is not a modelled estimate. It is a direct physical measurement of radioactive contamination actually incorporated into the bodies of children near nuclear facilities.

The Tooth Fairy Project

The Tooth Fairy Project, conducted by Jay Gould and Joseph Mangano from 1998 onwards, collected baby teeth from children near operating nuclear plants and from control communities, measured strontium-90 concentrations, and compared them. The results, published in peer-reviewed environmental health journals, found statistically significant elevated strontium-90 concentrations in the teeth of children near operating nuclear facilities compared with children in control communities. The CNSC's regulatory framework calculates modelled strontium-90 doses to surrounding communities and concludes they are within acceptable limits. The Tooth Fairy

Project found that actual strontium-90 accumulation in children's bone tissue near nuclear plants exceeds what background comparison shows. A regulator that ignores direct biological measurements of radioactive contamination in children's bones in favour of modelled estimates is a regulator that has chosen its models over its measurements. The CNSC does not cite the Tooth Fairy Project literature.

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11. Carbon-14 from CANDU Reactors — The Hidden Long-Lived Emission

The Biological Hazard

Carbon-14 is produced in CANDU reactors through neutron activation of nitrogen in heavy water — in substantially larger quantities per unit of electrical output than light water reactors. Carbon is the elemental building block of all organic molecules including DNA. Carbon-14 incorporates into DNA through the same biochemical pathways that incorporate stable carbon-12. Its radioactive half-life is 5,730 years. Its biological half-life in organically bound form approaches its radioactive half-life. Once incorporated into DNA, carbon-14 remains there, irradiating from within the molecular structure of the DNA helix, for the life of the organism.

Transmutation Damage

When carbon-14 decays, it transmutes to nitrogen-14. A carbon atom in a DNA molecule that becomes nitrogen is no longer chemically compatible with the molecular structure of which it was part — the covalent bond breaks, severing the DNA strand at that point regardless of whether the emitted beta particle causes further damage. Transmutation damage is irreparable by normal cellular repair mechanisms because the damage is not a broken bond that can be reconnected — it is a change in the atomic identity of a molecular component. The CNSC's public communications about CANDU reactor emissions focus almost entirely on tritium. Carbon-14 receives no meaningful discussion in any CNSC public health communication despite being produced in large quantities by CANDU operations, having a half-life 450 times longer than tritium, incorporating directly into DNA, and causing irreparable transmutation damage that cellular repair cannot address.

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12. Radiation-Induced Genomic Instability — Three Decades of Peer-Reviewed Science the CNSC Does Not Acknowledge

Radiation-induced genomic instability — replicated across hundreds of independent experiments published in Radiation Research, the International Journal of Radiation Biology, and Carcinogenesis — is the phenomenon by which ionising radiation causes elevated mutation rates not only in the directly irradiated cell but in its descendants across multiple subsequent generations of cell division. A cell that is irradiated passes on a state of genomic instability to its daughter cells, producing elevated spontaneous mutation rates in a clone of cells tracing its lineage to the originally irradiated cell. The instability persists across dozens of cell generations

and has been demonstrated in vitro, in vivo in animal models, and in epidemiological studies of radiation-exposed populations.

The Linear No-Threshold model counts cancer risk by counting initial ionisation events — DNA hits. RIGI means that a single DNA hit can initiate an expanding clone of genomically unstable cells, each at elevated cancer risk. The cancer risk from a given dose is therefore not simply proportional to the number of initial hits — it includes the amplified risk from the instability cascade initiated by each hit. A risk framework that does not incorporate RIGI systematically underestimates cancer risk at low doses. The CNSC's public health communications on radiation risk near nuclear power plants do not mention RIGI. Three decades of documented, replicated, peer-reviewed science. Not one citation in any CNSC public document.

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13. La Hague — A Third Independent Study Finding Elevated Childhood Leukaemia Near a Nuclear Facility

The La Hague nuclear fuel reprocessing facility in Normandy, France, is the world's largest nuclear reprocessing plant. In 1997, Pobel and Viel published a case-control study in the British Medical Journal finding that children who had played on local beaches where radioactive discharges from La Hague could be contacted had a substantially elevated risk of childhood leukaemia compared with children who had not. The dose estimates from the beach exposure, calculated using standard regulatory models, predicted negligible risk. The real-world finding contradicted the model prediction in the same direction and with the same magnitude as KiKK and GEOCAP.

The CNSC's position that the association between nuclear facility proximity and elevated childhood leukaemia is unfounded requires dismissing KiKK Germany, GEOCAP France, the La Hague BMJ study, the Indian Point finding, and the Clapp Massachusetts finding — five independent studies, three countries. The CNSC cites none of them except KiKK, which it dismisses. The La Hague BMJ study does not appear in any CNSC public document.

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14. The Mayak Plutonium Workers — Real-World Internal Alpha Emitter Cancer Risk Exceeds Model Predictions

The Mayak Production Association in the southern Urals was the Soviet Union's first plutonium production complex. Workers were exposed to plutonium — an internal alpha emitter — across a range of doses, and their health outcomes have been tracked for decades by the Southern Urals Biophysics Institute in collaboration with western researchers. Findings published in Radiation Research, the British Journal of Cancer, and the International Journal of Epidemiology are consistent: lung cancer, liver cancer, and bone cancer risks observed in workers with documented plutonium body burdens are substantially higher than the ICRP's internal dosimetry model predicts — by factors of between two and ten depending on the tissue and the study.

The model that predicts negligible risk from internal alpha emitter contamination at low body burdens is the same model applied to assess health risk to CANDU communities from internal alpha emitter exposure. The Mayak data is the most direct available test of whether that model is accurate in real human populations. It consistently shows the model underestimates cancer risk. The CNSC does not cite the Mayak alpha-emitter carcinogenesis literature in any public communication on internal emitter risk from CANDU operations.

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15. The Marshall Islands — A Government Dose Reconstruction That Failed Its Empirical Test

The United States conducted 67 nuclear weapons tests in the Marshall Islands between 1946 and 1958. The US government conducted detailed dose reconstructions for affected populations using the same dosimetric methodology applied in regulatory nuclear facility assessments. Those reconstructions predicted health outcomes. The actual outcomes — documented by the US National Cancer Institute and the Republic of the Marshall Islands Nuclear Claims Tribunal — significantly exceeded the predictions. Thyroid cancer rates in Rongelap atoll residents substantially exceeded predicted rates. Leukaemia rates exceeded predictions. Solid tumour excess was broader and larger than predicted. The Marshall Islands Nuclear Claims Tribunal found that the US government's own dose reconstruction underestimated the health consequences of the testing programme and awarded compensation exceeding what the dose-based liability estimates had projected.

The Marshall Islands is a controlled natural experiment in dose reconstruction validity at a population scale: the US government conducted a dose reconstruction, predicted health outcomes, and the real outcomes were worse. The failure of dose reconstruction to predict real-world outcomes in the Marshall Islands is the most direct available evidence that the dosimetric methodology underlying the CNSC's safety assessments underestimates real-world health consequences. The CNSC does not cite the Marshall Islands dose reconstruction failure in any public document on radiation risk assessment.

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16. Children's Radiosensitivity — What BEIR VII and UNSCEAR Actually Say and What the CNSC Applies

The CNSC cites BEIR VII as a primary scientific authority. BEIR VII itself provides age-at-exposure risk coefficients showing that radiation exposure in the first decade of life carries cancer risk two to ten times higher than the same dose received in adulthood, depending on tissue type. For leukaemia — the cancer most consistently elevated in children near nuclear plants across the forty-year evidence record — BEIR VII's age-at-exposure multipliers are among the largest. UNSCEAR's 2006 report provides similar coefficients. Both reports acknowledge that children are substantially more radiosensitive than adults and that this difference is large enough to be of regulatory significance.

The CNSC's community dose assessments calculate effective dose using population-average risk coefficients. They do not apply BEIR VII's age-at-exposure multipliers to the subgroup most at risk — children under ten within five kilometres. The health impact assessment Energy Alberta will present to the IAAC will use population-average risk coefficients that the CNSC's own cited authorities document as substantially underestimating the risk to the population group the forty-year real-world evidence record identifies as the primary risk group. A regulator that cites BEIR VII while not requiring application of BEIR VII's own age-at-exposure coefficients to the most exposed age group is not fully applying the science it claims as its foundation.

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17. Infant Mortality Near Nuclear Plants — A Health Endpoint the Regulatory Framework Does Not Assess

Mangano and Sherman's peer-reviewed studies in environmental health journals found elevated post-neonatal mortality rates in US counties near operating nuclear plants compared with matched control counties after controlling for socioeconomic predictors, and elevated infant mortality on the US west coast in the weeks immediately following the Fukushima accident relative to prior years and to inland states. The studies have been critiqued on methodological grounds — the ecological study design and multiple comparisons problem are legitimate limitations. They have not been retracted. A peer-reviewed finding of elevated infant mortality near nuclear plants and following nuclear accident fallout is a finding that exists in the scientific literature. The CNSC's regulatory framework does not assess infant mortality as a health endpoint at all. The first year of life — the period of highest vulnerability to environmental exposures of any post-birth developmental stage — is entirely excluded from the protection analysis applied to nuclear facility approvals. The literature documenting potential elevated infant mortality near nuclear plants does not appear in any CNSC public health communication.

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18. The Hanford Downwinders — Deliberate Releases, Suppressed Data, and a Health Record That Exceeded Predictions

The Green Run and the Declassification Record

In December 1949, the US Army conducted a deliberate release of approximately 5,500 to 8,000 curies of radioactive iodine-131 from the Hanford Site in Washington State as part of a classified experiment. The release was classified Top Secret. Communities downwind — including Spokane, Walla Walla, and the Yakima Valley — received fallout without warning or disclosure. The Green Run experiment was declassified following Freedom of Information Act litigation in the 1980s. Declassified documents showed that Hanford management had conducted the release knowing that downwind communities would receive significant doses, and had prioritised the weapons intelligence value of the experiment over the health of the downwind civilian population. The decision was deliberate. The concealment lasted four decades.

The Health Record and the Model Failure

Independent health studies of Hanford downwinder communities by the Fred Hutchinson Cancer Research Center found elevated thyroid disease rates in communities with the highest documented iodine-131 fallout exposure. The CDC's Hanford Thyroid Disease Study conducted a dose reconstruction and predicted thyroid disease rates. The actual thyroid disease rates documented in downwinder communities exceeded the CDC's predictions — the same pattern of real-world health outcomes exceeding dose-reconstruction predictions documented in the Marshall Islands, near nuclear plants in KiKK and GEOCAP, and in the Mayak worker cohort. The CNSC's public communications do not mention Hanford. They do not discuss the Green Run. They do not acknowledge that a North American nuclear facility deliberately exposed civilian communities to iodine-131 fallout and concealed it for four decades, and that the health outcomes exceeded the model predictions. A regulatory body presenting nuclear facility health assessment as settled and trustworthy science while never acknowledging the most significant deliberate civilian radiation exposure event in North American history is not giving the IAAC the full picture.

Summary: What Eighteen Pillars Establish

The eighteen pillars documented in this annexure establish a single, simple conclusion: the CNSC's public health communications do not reflect the full body of peer-reviewed radiation health science. They reflect a curated subset — selected for consistency with the safety conclusions the CNSC has chosen to maintain, and excluding every significant body of evidence that would require those conclusions to be qualified.

The excluded literature is not fringe science. It includes studies published in the BMJ, the Lancet, Lancet Haematology, Epidemiology, the American Journal of Epidemiology, Radiation Research, the International Journal of Radiation Biology, Carcinogenesis, Nature Communications, the British Journal of Cancer, and Thyroid. It includes findings replicated independently in Germany, France, the United Kingdom, the United States, Russia, Japan, and the Marshall Islands. It includes the formal compensation programmes of the United States government paying over $2.5 billion for cancers caused by radiation exposures the regulatory models characterise as low risk. It includes direct biological measurements of radioactive contamination in children's bones near nuclear plants. It includes a Canadian scientific discovery — the Petkau Effect — made at a Canadian government nuclear laboratory, published in the field's leading journal, that directly undermines a key assumption in the CNSC's regulatory framework.

The CNSC's response will be that each piece of excluded evidence is individually contested or methodologically limited. For some of the eighteen pillars, that critique has partial validity. For none of them does it justify complete exclusion from public health communications about nuclear facility risks. A regulator whose public health communications exclude the Richardson BMJ study, the INWORKS Lancet study, the BEIR VII age-at-exposure coefficients, the Tooth Fairy strontium-90 measurements, the La Hague BMJ case-control study, the Mayak alpha-emitter dose-response, the Marshall Islands dose reconstruction failure, the Petkau Effect, the genomic instability literature, and the US government's formal downwinder compensation framework — while maintaining that the association between nuclear plant proximity and elevated childhood cancer is unfounded — is not producing an evidence-based public health assessment. It is producing an institutional advocacy document in the format of a scientific communication.

The IAAC cannot approve the Peace River nuclear facility on the basis of health and safety determinations produced by an institution that selectively excludes from its public scientific communications every significant body of peer-reviewed evidence that does not support its conclusions. That is not what the section 63 approval gate requires. It requires a genuine safety determination. This annexure documents why the determinations the CNSC will present do not meet that standard.

ANNEXURE 3

The Model Failures

A technical account of where the regulatory dose-risk models came from, what they were designed to do, every dimension on which they fail for this application, and the parameters that would be required to make them valid

Purpose and Structure

The main submission establishes that the regulatory models fail their real-world empirical test — that the gap between what they predict and what forty years of international evidence observes is between ten thousand and one hundred thousand times. This annexure explains the technical reasons for that failure. It is structured in five sections. Section A documents where the models came from and what they were designed to do. Section B identifies the seven independent dimensions on which those models fail when applied to a CANDU community scenario. Section C presents the ICRP's own published acknowledgments of model limitations that the CNSC does not disclose. Section D specifies the parameters that a valid model for the Peace River application would need to incorporate. Section E translates the model failures into approximate numerical terms — showing what changes in the risk calculation if the missing parameters are applied.

This annexure is written for a reader without specialist radiation physics training. Every technical concept is explained in plain language before the evidence for it is presented. The scientific sources are identified by publication and author so that an independent scientific reviewer appointed by the IAAC can verify each claim directly. The purpose is not to produce a rival dose assessment — it is to demonstrate with precision what is absent from the assessments the CNSC will present, and to give the IAAC the technical basis for requiring those absences to be remedied before approval proceeds.

A. Where the Models Came From — The Hiroshima and Nagasaki Foundation

The Life Span Study

The dose-risk models used in every nuclear facility health impact assessment in Canada — including the assessment Energy Alberta will present for the Peace River facility — descend from a single source: the Life Span Study of survivors of the atomic bombings of Hiroshima and Nagasaki in August 1945. The study, conducted by the Atomic Bomb Casualty Commission from 1950 and continued by the Radiation Effects Research Foundation from 1975, tracked approximately 120,000 survivors and their descendants over more than seven decades. It is the largest and longest-running study of radiation health effects ever conducted and has produced most of what the international radiation protection community formally accepts as the quantitative basis for radiation risk estimation.

The Life Span Study is an extraordinary scientific achievement. It is also a dataset with very specific characteristics that define both what it can tell us and what it cannot. Understanding those characteristics is essential to understanding why the models derived from it are not valid for the specific scenario this submission concerns.

The Characteristics of the Hiroshima and Nagasaki Dataset

The Hiroshima and Nagasaki survivors were exposed in August 1945. The exposure was instantaneous — a matter of seconds for the direct radiation from the detonation. It was external — radiation striking the body from outside, not radionuclides taken into the body through breathing, eating, or drinking. It was primarily gamma radiation and neutrons — high-energy, penetrating radiation that deposits dose relatively uniformly across the body. The dose was acute — the entire lifetime dose received in a single brief exposure. The survivors were overwhelmingly adults — the median age of the study population at the time of bombing was approximately 35 years. They were a Japanese population in the 1940s, living through the aftermath of the Second World War, with no pre-exposure cancer registry baseline and a documented healthy survivor bias — those most severely exposed died immediately and are not in the study population.

These characteristics are not incidental features of the dataset. They are its defining properties. Every one of them is different, in a scientifically important way, from the exposure scenario relevant to a community living near a CANDU reactor in the Peace River region of Alberta in the twenty-first century.

B. The Seven Extrapolation Failures — Every Dimension on Which the Models Are Wrong for This Application

Applying the Hiroshima and Nagasaki models to a CANDU community scenario requires making extrapolations across seven independent dimensions simultaneously. Each extrapolation introduces uncertainty. None of them has been validated by direct empirical measurement in the relevant population. All seven operate in the same direction — each one causes the model to underestimate risk relative to what would be observed if the correct population-specific parameters were available. The cumulative effect of seven simultaneous underestimations in the same direction is the ten-thousand to one-hundred-thousand-fold gap between model predictions and real-world observations documented in Show Stopper 1.

Extrapolation Failure 1 — Acute Dose to Chronic Dose

The Hiroshima and Nagasaki survivors received their entire radiation dose in a single instant. The regulatory framework applies a dose-rate effectiveness factor — a mathematical adjustment — to convert the acute-dose risk estimates from the Life Span Study into chronic-dose risk estimates for communities receiving small doses continuously over years and decades. The dose-rate effectiveness factor used by the ICRP and the CNSC is 2 — meaning the models assume that chronic low-dose radiation is half as biologically effective per unit dose as acute high-dose radiation.

This assumption is contradicted by two independent bodies of peer-reviewed science. First, the Petkau Effect — documented at the Whiteshell Nuclear Research Establishment in Manitoba in 1972 and published in Health Physics — demonstrated that low chronic doses of radiation are

more biologically damaging per unit dose to cell membranes than high acute doses through a lipid peroxidation mechanism involving superoxide free radicals. Second, the radiation-induced bystander effect — replicated across hundreds of studies over thirty years — demonstrates that low-dose chronic irradiation produces a disproportionately large biological response relative to the number of direct ionisation events. Both findings suggest the dose-rate correction should operate in the opposite direction to the one the CNSC applies: chronic low-dose exposure may be more dangerous per unit dose than the Life Span Study data predicts, not less. The CNSC applies a factor of 2 reduction. The published science suggests the correction may need to run in the opposite direction by a comparable or larger factor.

Extrapolation Failure 2 — External Radiation to Internal Emitters

The Hiroshima and Nagasaki survivors were exposed to external radiation — gamma rays and neutrons striking the body from outside. A CANDU community's primary radiation exposure pathway is internal: tritium dissolved in drinking water and inhaled from air is absorbed into the body and circulates through blood and tissue; carbon-14 is incorporated directly into organic molecules including DNA; strontium-90 ingested with food deposits in bone adjacent to bone marrow; iodine-131 concentrates in the thyroid gland.

Internal emitters are fundamentally different from external radiation in their biological effects. An external radiation source irradiates tissue from a distance — the dose is distributed across a volume of tissue proportional to the body's cross-section. An internal emitter lodged in or adjacent to a specific tissue irradiates that tissue — and only that tissue — continuously, at very close range, from the point of deposition. The dose to the immediately adjacent cells may be orders of magnitude higher than the whole-body average dose calculation suggests, because the whole-body average calculation distributes the energy of a localised emitter across the entire body mass.

Alpha-emitting internal particles — plutonium, polonium, radium — deposit all their energy within a few cell diameters of the particle itself. The cells immediately adjacent to an alpha-emitting particle receive a very high localised dose while the whole-body average dose calculation may show a negligible number. Strontium-90, a beta emitter that deposits in bone, irradiates the bone marrow cells immediately adjacent to the bone surface — where the haematopoietic stem cells that give rise to leukaemia originate — at a localised dose that the whole-body effective dose calculation does not capture. The CNSC's dose assessments use whole-body effective dose methodology applied to internal emitter exposures. This is not an appropriate methodology for the exposure pathway that CANDU communities experience.

Extrapolation Failure 3 — Adult Tissue to Fetal and Infant Tissue

The Life Span Study population was predominantly adult at the time of exposure. The regulatory risk coefficients derived from that population are applied in CANDU community assessments to estimate risk for all age groups — including fetuses in the womb and infants in the first year of life. This extrapolation is not valid.

The biological basis for age-dependent radiosensitivity is well established. Rapidly dividing cells are more radiosensitive than slowly dividing cells because the DNA replication machinery is more exposed during cell division and because repair mechanisms are less reliable in rapidly dividing cell populations. The fetus in the first trimester — when organogenesis is occurring — has a cell division rate orders of magnitude higher than an adult's resting tissue. Fetal haematopoietic stem cells — the cells in which leukaemia originates — are dividing rapidly throughout the second and third trimester to establish the bone marrow architecture the child will carry for life. The radiosensitivity of these cells is not comparable to adult haematopoietic tissue.

Alice Stewart's Oxford Survey of Childhood Cancers — published in the Lancet in 1956 — demonstrated that prenatal X-ray exposure at doses far below those considered hazardous for adults doubles childhood leukaemia risk. The BEIR VII report provides age-at-exposure risk multipliers showing that exposure in the first decade of life carries cancer risk two to ten times higher than adult exposure depending on tissue type — and for the tissues most relevant to the leukaemia signal observed near nuclear plants, the multipliers are at the high end of this range. The CNSC's community dose assessments do not apply these multipliers. They use population-average risk coefficients that include adults, who are substantially less sensitive than the population group — children under five — that the real-world evidence record identifies as the primary risk group near nuclear plants.

Extrapolation Failure 4 — Whole-Body Effective Dose to Localised Cell Dose

Effective dose is a mathematical construct. It takes the dose absorbed by each organ and tissue in the body, multiplies each by a tissue weighting factor reflecting that tissue's relative contribution to total cancer risk, and sums them to produce a single number representing the whole-body cancer risk equivalent. This construct is useful for comparing the risks of different radiation exposure scenarios that affect different organs — it is the appropriate tool for comparing the risk of a chest X-ray with the risk of a bone scan, for example.

It is not an appropriate tool for assessing the cancer risk from a radionuclide that concentrates in a specific tissue and irradiates the cells of that tissue from within at close range. When strontium-90 deposits in bone and irradiates bone marrow stem cells at a localised dose rate, the relevant quantity for cancer risk assessment is the dose to those specific cells — not the whole-body effective dose, in which the strontium-90's energy is mathematically distributed across the entire body mass including organs and tissues it never reaches. The whole-body effective dose calculation for an internal beta emitter deposited in bone systematically underestimates the dose to the specific cell population at risk of leukaemia by a factor proportional to the ratio of whole-body mass to the mass of the target cell population. For bone marrow stem cells — which represent a tiny fraction of total body mass — that ratio may be very large.

The same argument applies to tritium concentrated in fetal tissue, to carbon-14 incorporated into specific DNA sequences, and to iodine-131 concentrated in the thyroid gland of a child with higher thyroid uptake than an adult. The effective dose framework is being applied to scenarios for which it was not designed and in which it systematically underestimates risk to the cell populations actually at risk.

Extrapolation Failure 5 — The Japanese 1945 Population to the Peace River 2025 Population

The risk coefficients derived from the Life Span Study represent average cancer risk for a Japanese adult population exposed in 1945. Applying those coefficients to the Peace River region population in 2025 requires assuming that the baseline cancer risk, the background carcinogen exposure, the diet, the genetic susceptibility profile, and the pre-existing health conditions of the two populations are comparable. This assumption is not examined in any CNSC document.

The Peace River region carries a documented elevated cancer burden of unknown etiology — documented in the main submission as Show Stopper 2. The Life Span Study population was not carrying a pre-existing elevated cancer burden from an existing carcinogen exposure at the time of their radiation exposure. The Peace River population is. The mixture carcinogenesis literature — published in Carcinogenesis, the leading journal in the field — establishes that eighty-five percent of carcinogens show no dose-response threshold and that mixtures of carcinogens

produce synergistic effects that no single-agent model captures. The BEIR report establishes radiation as a cancer initiator that is amplified by chemical promoters. The Peace River region's documented aromatic hydrocarbon burden from bitumen operations — precisely the class of chemical promoters the BEIR report identifies — means that the incremental cancer risk from adding ionising radiation to this specific population's existing carcinogen exposure is not the additive calculation the Life Span Study-derived models produce. It may be substantially multiplicative.

The specific demographic profile of the Peace River population adds a further extrapolation problem. The region has a significant Indigenous population with a documented history of disproportionate environmental carcinogen exposure, reduced access to early detection and treatment services, and a cultural relationship to the land — including consumption of locally harvested food and water — that produces higher per-capita exposure to any environmental contaminant than the general population average the models assume. The models are not parameterised for this population. They were never intended to be.

Extrapolation Failure 6 — Gamma and Neutron Radiation to Tritium, Carbon-14, and Strontium-90

The Life Span Study population was exposed primarily to gamma radiation and neutrons — the radiation types produced by nuclear weapon detonation. Gamma radiation is high-energy electromagnetic radiation that penetrates the body uniformly. Neutrons are high-energy particles that interact with atomic nuclei. The biological effectiveness of these radiation types is what the ICRP's radiation weighting factors were calibrated to reflect.

CANDU reactors emit a fundamentally different mixture of radionuclides, each with different radiation types and different biological effectiveness. Tritium emits a low-energy beta particle — an electron travelling a very short distance in tissue, depositing all its energy within a few micrometres. The CNSC assigns tritium a radiation weighting factor of 1, identical to gamma radiation, on the basis that both are low-LET radiation. The CNSC's own technical report INFO-0799 states that a weighting factor of 2.2 would best reflect the actual biological effectiveness of tritium based on the published radiobiological literature. Carbon-14 emits a beta particle and additionally undergoes transmutation to nitrogen upon decay — a chemical change that severs any DNA molecule in which it is incorporated regardless of the radiation dose delivered. Strontium-90 is a beta emitter that chemically mimics calcium and deposits in bone, irradiating bone marrow at close range. Iodine-131 concentrates in the thyroid, delivering a highly localised internal dose to a small, specific tissue.

Each of these radionuclides has a biological behaviour — a route of entry into the body, a tissue distribution pattern, an effective dose rate to the target cell population, and a biological repair context — that is categorically different from the external gamma and neutron exposure on which the Life Span Study risk coefficients are based. Applying the same risk coefficient to all of them, on the basis that they are all low-LET radiation, ignores every dimension of biological behaviour that determines their actual carcinogenic potency.

Extrapolation Failure 7 — The Dose-Rate Effectiveness Factor Applied in the Wrong Direction

The dose-rate effectiveness factor is the most consequential single adjustment applied in translating Life Span Study risk estimates to CANDU community risk assessments. The ICRP uses a factor of 2 to reduce the risk estimate for chronic low-dose exposure relative to the acute-dose Life Span Study finding — the assumption being that cells have more time to repair radiation

damage when dose is delivered slowly, so chronic exposure is less harmful per unit dose than acute exposure.

The peer-reviewed literature contains two independent bodies of evidence suggesting this adjustment is wrong in its direction for the specific scenario of chronic internal low-energy emitter exposure. First, the Petkau Effect demonstrates that the free radical mechanism of low-dose chronic membrane damage is more efficient at low dose rates than at high dose rates — the dose-rate relationship runs in the opposite direction to the ICRP assumption for this specific biological mechanism. Second, the radiation-induced genomic instability literature demonstrates that low-dose chronic exposure produces heritable genomic instability in exposed cell populations — an amplification mechanism that operates independently of direct DNA hits and is not captured in models calibrated to acute-dose data. Third, the bystander effect means that even cells not directly irradiated exhibit elevated mutation rates when adjacent cells receive chronic low-dose irradiation — expanding the effective target cell population beyond what the direct-hit model calculates.

The practical consequence is that the CNSC's DERF-adjusted risk estimates for chronic community exposure near a CANDU reactor may be wrong in two compounding ways: the direction of the dose-rate correction may be reversed for the relevant biological mechanisms, and the effective target population is larger than the direct-hit model assumes. The combination of these two errors, both operating in the direction of underestimating risk, contributes materially to the gap between model predictions and real-world observations.

C. The ICRP's Own Acknowledged Limitations — The CNSC's Cited Authority Against Itself

ICRP Publication 103 — 2007

ICRP Publication 103 is the current foundational document of the international radiation protection framework — the document the CNSC cites as the scientific basis for its regulatory standards. Publication 103 contains the following statement, which the CNSC does not reproduce in any public communication: 'Effective dose is intended for use as a protection quantity and for prospective dose assessment; it is not recommended for epidemiological evaluations, nor should it be used for detailed specific retrospective investigations of individual exposure and risk.' This is the ICRP saying explicitly that effective dose — the quantity used in every CNSC community dose assessment — is not appropriate for the precise purpose the CNSC uses it for: assessing cancer risk to individuals in specific communities.

Publication 103 further acknowledges that tissue weighting factors represent averages over sex and over a reference population with a defined age distribution, and that applying them to specific populations — children, for example, or Indigenous communities with specific dietary patterns — introduces uncertainties the framework does not quantify. It acknowledges that the risk coefficients are derived primarily from Japanese atomic bomb survivors and that the extrapolation to other populations is subject to uncertainty. It acknowledges that the models do not adequately address internal emitter exposures involving particles that deposit dose highly non-uniformly in tissue. Each of these acknowledged limitations is directly applicable to the Peace River CANDU

scenario. None of them is disclosed by the CNSC in its public communications about the safety of nuclear plants.

ICRP Publication 118 — 2012

ICRP Publication 118 revised the threshold dose for radiation-induced cataracts from 2 gray to 0.5 gray, based on Chernobyl liquidator data and occupational radiation studies showing lens opacities at doses substantially below the previous threshold. The publication acknowledges evidence suggesting there may be no threshold at all for cataract induction and that a linear dose-response from zero dose may better fit the available data. This is the ICRP formally revising a threshold downward — toward greater sensitivity and lower dose thresholds — based on real-world evidence from an exposed population showing effects at lower doses than the models predicted. The CNSC's regulatory standards have not been updated to reflect this revision. It is not disclosed in any CNSC public communication on nuclear facility community health effects.

ICRP Publication 60 — 1991 Admission on Internal Emitters

ICRP Publication 60 — the predecessor to Publication 103 — acknowledged that the dosimetric models for internal emitters involving high-LET alpha and beta particles depositing dose in small volumes of tissue are subject to substantial uncertainty because the relevant biological target volumes are small and the dose is highly non-uniform. The ICRP's internal dosimetry task group produced a series of publications through the 1990s acknowledging that the microdosimetric complexities of internal alpha and beta emitters were not adequately captured in the effective dose framework. These acknowledgments predate the CNSC's use of the same framework for CANDU community assessments. They establish that the scientific body whose work the CNSC cites as authority for its safety calculations acknowledged those calculations were inadequate for internal emitter scenarios — before the CNSC used them for precisely that purpose.

BEIR VII — 2006 Admission on Extrapolation Uncertainty

BEIR VII — the National Academies' Biological Effects of Ionising Radiation report that the CNSC also cites — states explicitly that the uncertainty range on its low-dose risk estimates spans approximately a factor of ten in either direction at the lowest doses assessed. It states that the models cannot exclude the possibility that the actual risk is zero at low doses, but equally cannot exclude the possibility that it is substantially higher than the central estimate. It states that the age-at-exposure multipliers documented in the report — showing two to ten times higher risk for childhood exposure — represent genuine biological differences that should be incorporated into assessments of populations with significant proportions of children. The CNSC cites BEIR VII. It does not apply BEIR VII's own uncertainty range to its risk assessments, does not disclose the factor-of-ten uncertainty in either direction, and does not apply BEIR VII's own age-at-exposure multipliers to the most at-risk age group.

D. What Valid Models for This Application Would Need to Include — The Missing Parameters

A dosimetric risk model valid for assessing the health impact of the proposed Peace River CANDU facility on the surrounding community would need to incorporate the following parameters. Each is supported by published peer-reviewed science identified below. None is incorporated in the

regulatory models the CNSC will use. The IAAC can use this section directly as the basis for conditions requiring Energy Alberta to provide supplementary modelling incorporating each parameter before approval is granted.

Parameter 1 — Age-Specific Tissue Weighting Factors for Children Under Ten

The BEIR VII report provides age-at-exposure risk multipliers showing that cancer risk per unit dose for children under ten is substantially higher than the population-average risk coefficient for all cancer types. For leukaemia specifically — the cancer most consistently elevated near nuclear plants in the forty-year real-world evidence record — the childhood multiplier is at the high end of the reported range. A valid risk assessment for the Peace River community would apply these age-specific multipliers to the child population within five kilometres of the facility rather than using population-average coefficients. Source: BEIR VII, Committee on the Biological Effects of Ionising Radiation, National Academies of Sciences, 2006, Table 12-3.

Parameter 2 — Tritium Biological Weighting Factor of 2.2

The CNSC's own technical report INFO-0799 states that a radiation weighting factor of 2.2 for tritium would best reflect the radiation risk for tritium based on the published radiobiological literature. Every current regulatory calculation uses a weighting factor of 1 — the same value used for gamma radiation. Applying the factor the CNSC's own scientists documented as scientifically appropriate would increase all tritium-specific dose and risk estimates by a factor of 2.2. A valid model for this application would present risk estimates using both wR=1 and wR=2.2 with explicit comparison and justification for the chosen value. Source: CNSC INFO-0799, Health Effects, Dosimetry, Regulation and Environmental Transport of Tritium, 2010, Section 3.4.

Parameter 3 — Organically Bound Tritium Biokinetics for Fetal Tissue

Tritium exists in two forms in the body: tissue-free water tritium, which has a biological half-life of approximately ten days and is cleared relatively quickly; and organically bound tritium, which incorporates into organic molecules including DNA and has a biological half-life approaching its radioactive half-life of 12.3 years in stable structures. INFO-0799 documents that OBT incorporates into fetal oocyte DNA — the eggs a female fetus is developing in the second trimester, which she will carry for her entire reproductive life. A valid model for this application would use OBT-specific biokinetic parameters for the fetal population rather than the whole-body tritium biokinetic model, and would explicitly account for the long-term irradiation of the female fetal germ-line from OBT incorporation. Source: CNSC INFO-0799, 2010, Section 4.2; Balonov et al., Journal of Radiological Protection, 1993.

Parameter 4 — Fetal Dose Multiplier for Pregnant Women

INFO-0799 documents that a fetus in a pregnant woman exposed to tritium at any concentration receives approximately double the dose of the mother, because tritium readily crosses the placental barrier and the fetus has a higher tissue water content and a higher metabolic rate than the mother. A valid model for this application would calculate fetal dose separately from maternal dose for all tritium exposure pathways and present fetal dose estimates with the age-specific risk multipliers for the fetal tissue types most at risk. Source: CNSC INFO-0799, 2010, Section 4.1; Harrison and Khursheed, Journal of Radiological Protection, 2002.

Parameter 5 — Carbon-14 Transmutation Damage Modelling

Carbon-14 decay produces transmutation damage — the conversion of a carbon atom in a DNA molecule to nitrogen, severing the molecular bond at that site regardless of whether the emitted beta particle causes further ionisation damage. This damage is not captured in any standard dose-risk calculation because it is not a radiation dose effect — it is a chemical change in a DNA molecule caused by radioactive decay within the molecule itself. A valid model for this application would quantify the carbon-14 transmutation damage rate to DNA in tissues where carbon-14 is incorporated from CANDU emissions, separately from and in addition to the beta dose calculation. Source: Straume and Carsten, Health Physics, 1993; ICRP Publication 38, Radionuclide Transformations, 1983.

Parameter 6 — Strontium-90 Localised Bone Marrow Dose

Strontium-90 deposits in bone at the bone surface, adjacent to the bone marrow compartment where haematopoietic stem cells reside. The relevant dose quantity for leukaemia risk assessment is not the whole-body effective dose from strontium-90 but the localised dose to the bone marrow stem cells in the endosteal layer of bone — the thin layer of cells at the bone-marrow interface. ICRP Publication 70 provides dosimetric models for bone surface and bone marrow dose from radionuclides depositing in bone. A valid model for this application would calculate bone marrow endosteal cell dose from strontium-90 separately from effective dose and apply leukaemia-specific risk coefficients to that localised dose. Source: ICRP Publication 70, Basic Anatomical and Physiological Data for Use in Radiological Protection, 1995.

Parameter 7 — Population Mixing Correction for Peace River

The Kinlen population mixing hypothesis — developed by Leo Kinlen at Oxford and published across multiple peer-reviewed studies from 1988 onwards — proposes that elevated childhood leukaemia near nuclear plants may result from the introduction of a novel infection into an immunologically naive rural population during plant construction and operation, triggering an abnormal immune response that initiates leukaemia in susceptible children. Whether or not this mechanism is ultimately confirmed as the cause of the observed elevations, it is a mechanism that is specifically potentiated by three characteristics: a small, isolated, rural community; a significant proportion of Indigenous residents with limited prior exposure to urban infections; and a large influx of construction workers from outside the region. The Peace River region has all three characteristics. A valid model for this application would include a population mixing assessment quantifying the degree of mixing expected during construction and early operation phases and assessing whether the Peace River community profile meets the high-risk criteria identified in the Kinlen literature. Source: Kinlen, British Medical Journal, 1988; Kinlen et al., British Medical Journal, 1993; Alexander et al., British Journal of Cancer, 1990.

Parameter 8 — Mixture Interaction Factor for Existing Petrochemical Carcinogen Burden

The Peace River region's documented exposure to aromatic hydrocarbons, polycyclic aromatic hydrocarbons, and other petrochemical carcinogens from bitumen operations creates a synergistic risk context for ionising radiation exposure that is not captured in additive dose-risk calculations. The BEIR report's two-stage clonal expansion model of carcinogenesis identifies ionising radiation as a cancer initiator whose effect is amplified by chemical promoters — of which PAHs are a well-documented class. The mixture carcinogenesis literature published in Carcinogenesis documents that eighty-five percent of carcinogens show no dose-response threshold and that carcinogen mixtures produce synergies that exceed the sum of individual effects. A valid model for this application would incorporate a qualitative assessment of the

radiation-promoter interaction at the Peace River site and would present an uncertainty range on the incremental risk estimate that accounts for the possibility of synergistic rather than additive effects. Source: Goodman et al., Carcinogenesis, 1999; BEIR VI, Health Effects of Exposure to Radon, National Academies, 1999.

Parameter 9 — Bystander Effect Amplification at Low Community Doses

The radiation-induced bystander effect — replicated across hundreds of peer-reviewed studies — demonstrates that cells adjacent to directly irradiated cells exhibit elevated mutation rates through signalling mechanisms including gap junctions and extracellular reactive oxygen species. At the low dose levels relevant to nuclear plant community exposures — where only a small fraction of cells receive direct ionisation events — the bystander signal may affect a cell population substantially larger than the directly irradiated population. A valid model for this application would incorporate a bystander effect correction factor for the low-dose chronic exposure scenario, acknowledging that the effective target cell population for cancer initiation is larger than the direct-hit model calculates. Source: Nagasawa and Little, Cancer Research, 1992; Mothersill and Seymour, Radiation Research, 1997; Morgan, Human and Experimental Toxicology, 2003.

Parameter 10 — Pre-Existing Elevated Cancer Burden as Baseline Correction

REGDOC-3.1.1 — the CNSC's own environmental assessment standard — requires characterisation of the existing environment before incremental risk assessment. The existing environment in the Peace River region includes a documented elevated cancer incidence of unknown etiology that has not been characterised etiologically. A valid incremental risk model for this application cannot treat the Peace River region as having a normal baseline cancer incidence. It would need to: document the existing cancer incidence by type, age group, and geographic distribution within the proposed assessment zone; assess the possible etiological contributions of existing environmental carcinogens; and calculate the incremental risk from the proposed facility above the actual elevated baseline rather than above the provincial or national average. An incremental risk assessment that uses the wrong baseline starting point produces a wrong risk estimate regardless of the accuracy of any other parameter.

E. The Numbers — What Changes When the Missing Parameters Are Applied

The Starting Point — The CNSC's Published Dose Estimate

The CNSC's regulatory framework requires nuclear facility operators to demonstrate that the dose to the most exposed member of the public at the facility boundary does not exceed 1 millisievert per year — the public dose limit. In practice, CANDU facilities consistently report calculated doses at the facility boundary of between 0.01 and 0.05 millisieverts per year — one to five percent of the regulatory limit. These figures are presented as the basis for safety conclusions. They appear to be very small compared with background radiation of approximately 1.8 millisieverts per year from natural sources in Canada. The impression conveyed is that the facility adds a negligible increment to existing exposure.

The following analysis takes these published dose estimates as the starting point and applies the missing parameters in sequence to show what the risk estimate changes to when the model is corrected for the specific population most at risk. It is not a full dosimetric assessment — it is an order-of-magnitude illustration of the cumulative effect of the model corrections documented in Section D.

Step 1 — Apply the Age-Specific Risk Multiplier for Children Under Five

The CNSC's published dose-to-risk conversion uses a population-average cancer risk coefficient of approximately 0.05 per sievert — five percent excess cancer risk per sievert of effective dose, averaged across all ages and both sexes. BEIR VII's age-at-exposure multipliers for leukaemia in children under five are approximately three to five times the adult value depending on sex and the specific study. Applying a conservative multiplier of three to the population-average coefficient for the child population most at risk — children under five within five kilometres — changes the risk coefficient from 0.05 to approximately 0.15 per sievert for this subgroup.

Step 2 — Apply the Tritium Weighting Factor of 2.2

Tritium is the primary radionuclide emitted by CANDU reactors. A significant proportion of the calculated effective dose at the facility boundary derives from tritium. Replacing the weighting factor of 1 with the value of 2.2 documented in INFO-0799 as scientifically appropriate increases the tritium-specific dose contribution by a factor of 2.2. If tritium represents, conservatively, half of the effective dose at the facility boundary — a fraction consistent with published CANDU emission profiles — the total effective dose from tritium alone increases by a factor of approximately 1.6 when the corrected weighting factor is applied.

Step 3 — Apply the Fetal Dose Multiplier for Tritium

INFO-0799 documents that the fetal dose from tritium is approximately double the maternal dose at any exposure concentration. A pregnant woman living within five kilometres of the facility who receives the calculated facility boundary dose of 0.03 millisieverts per year carries a fetus receiving approximately 0.06 millisieverts per year from tritium alone — before any other correction is applied. This doubling applies on top of the corrected weighting factor and the age-specific risk multiplier.

Step 4 — Correct for OBT Incorporation into Fetal Germ-Line DNA

The biological half-life of organically bound tritium incorporated into stable molecular structures — including fetal oocyte DNA — approaches the radioactive half-life of 12.3 years. A female fetus whose oocyte DNA incorporates tritium during the second trimester carries the incorporated OBT for decades, irradiating the germ-line cells that will produce her own children. The effective cumulative dose from long-residence OBT in fetal oocyte DNA substantially exceeds what a single-year dose calculation captures. The CNSC's dose calculations use the tissue-free water tritium biological half-life of approximately ten days — the short residence form — and do not separately calculate the long-residence OBT component in fetal germ-line tissue.

Step 5 — Correct for Elevated Baseline

The Peace River region's documented elevated cancer incidence means the incremental risk from the facility is added to an already-elevated baseline. If the existing cancer incidence in the region is, conservatively, twenty percent above the provincial average — consistent with documented elevated rates in comparable northern Alberta communities — the effective risk to the population from an incremental radiation exposure is not calculated against a normal-baseline population.

The incremental fraction of attributable cases that the facility adds to an already-elevated baseline is not the same as the incremental fraction added to a normal baseline, because the synergistic interaction between radiation and existing carcinogens means the combined risk is not simply additive.

The Cumulative Effect

Applying these corrections in sequence — age-specific risk multiplier of three for children under five, tritium weighting factor of 2.2, fetal dose doubling, OBT long-residence germ-line component, and elevated baseline correction — produces a risk estimate for the most exposed subgroup that is between ten and thirty times higher than the CNSC's published whole-population effective dose calculation suggests. This is not the ten-thousand-to-one-hundred-thousand-fold gap documented in Show Stopper 1 — which reflects the gap between model predictions and real-world observed outcomes across the entire forty-year evidence record. It is the gap that results from correcting the most directly quantifiable parameter errors in the model when applied to the most at-risk subgroup.

The residual gap — between the corrected model estimate and the real-world observed outcomes — represents the contribution of the parameters that cannot yet be precisely quantified: the bystander effect amplification, the mixture synergy with existing carcinogens, the population mixing mechanism, the carbon-14 transmutation damage, and the full OBT germ-line dose. The fact that quantifiable corrections alone account for a factor of ten to thirty in risk underestimation, while still leaving a large unexplained residual gap against real-world data, is itself evidence that the model failures are not minor calibration issues. They are structural inadequacies whose cumulative effect is to render the published risk estimates unreliable as a basis for approval decisions.

F. Summary — What the Model Failures Establish and What the IAAC Should Require

The technical analysis in this annexure establishes that the health impact assessment Energy Alberta will present to the IAAC is built on a dosimetric framework that: was derived from a dataset with fundamentally different exposure characteristics from those relevant to this application; applies corrections for chronic dose rate in a direction the published science does not support; uses a biological weighting factor for the primary emission that the CNSC's own scientists documented as understating actual risk; does not apply the age-specific risk multipliers from its own cited authorities to the most at-risk age group; does not separately assess fetal dose for the primary emission; does not account for transmutation damage from carbon-14; does not calculate localised bone marrow dose from strontium-90 separately from whole-body effective dose; does not incorporate a population mixing assessment; and treats the Peace River region as having a normal baseline cancer incidence when it demonstrably does not.

Each of these deficiencies is independently documentable. Each is correctable — not by abandoning the regulatory framework but by supplementing it with the specific parameters the published science identifies as necessary for this scenario. The IAAC should require, as a condition of any further assessment proceeding, that Energy Alberta provide supplementary dosimetric modelling incorporating each of the ten parameters identified in Section D, with

transparent disclosure of the effect of each parameter on the final risk estimate and a comparison between the corrected estimates and the standard model output.

This requirement is not unreasonable or novel. It is the application of science that already exists to a model that has not incorporated it. The cost of producing the supplementary modelling is trivial compared with the cost of constructing the facility. The consequence of not requiring it is that the approval decision will be made on risk estimates that understate the actual risk to the most vulnerable population by a factor that the evidence in this annexure documents as between ten and thirty for the quantifiable corrections alone — and potentially much larger when the non-quantifiable contributions of the remaining parameter failures are considered.

A facility approved on the basis of a risk estimate that is wrong by a factor of ten to thirty for the population group most at risk, in a community too small to detect the resulting harm epidemiologically, adjacent to a region carrying an existing elevated cancer burden in a petrochemical environment that amplifies radiation risk, is not a facility that has been assessed. It is a facility that has been assumed safe because the model used to assess it was not designed for the scenario it was asked to evaluate.