ENERGY ALBERTA PEACE RIVER NUCLEAR POWER PROJECT

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SHOW STOPPER 32

TEMPORAL OVERREACH

THREE TECHNOLOGIES THAT SOLVE THE PROBLEMS CREATED BY SOLAR, WIND, AND NUCLEAR WILL BE COMMERCIALLY MATURE BEFORE THE PEACE RIVER PROJECT OPENS IN THE 2040s.

IAAC'S TISG DOES NOT REQUIRE THE PROPONENT TO COMPARE THE PEACE RIVER PROJECT AGAINST ANY OF THESE ALTERNATIVE TECHNOLOGIES.

THE REGDOC §2.2.1 COMPARISON METHODOLOGY IS ALSO STRUCTURALLY DEFECTIVE: IT DOES NOT WEIGHT FOR THE DURATION, MAGNITUDE, OR IRREVERSIBILITY OF NUCLEAR RISK.

32.1 The Starting Point: Two Problems That Need Solving

To understand why Show Stopper 32 matters, a reader needs to understand two technology problems that currently shape Alberta's electricity options. Every major competing technology described in this stopper exists to solve one or both of these problems. Once the problems are clear, the technologies are easy to understand.

32.1.1 The Problem with Solar and Wind: They Stop Working When You Need Them Most

THE PROBLEM:
Solar panels produce electricity only when the sun shines. Wind turbines produce electricity only when the wind blows. On a still winter night — exactly when Alberta households need the most heat and light — both produce nothing. This is called the intermittency problem, and it is the single biggest barrier to replacing conventional power stations with renewable energy.

Alberta has invested heavily in solar and wind because they are now the cheapest way to generate electricity per kilowatt-hour when they are running. Alberta's deregulated electricity market has driven rapid deployment: the province's total renewable installed capacity increased by more than 70 per cent between 2020 and 2025. But cheap generation that switches off unpredictably is not the same as reliable supply. A grid that runs entirely on solar and wind would need a backup for every megawatt of capacity when conditions are poor. Right now, the main backup options are: keep gas plants running as backup; keep nuclear running 24 hours a day; or find a way to store surplus renewable electricity and release it later when needed.

The three technologies in this stopper each address the intermittency problem in a different way. Two of them — the vanadium flow battery and the geothermal earth battery — store energy and release it on demand. The third — the flexible gas plant with carbon capture — fires up quickly when renewables drop off and shuts down when they come back on. Together they represent the suite of solutions that will make a high-renewable grid reliable without needing baseload nuclear.

32.1.2 The Problem with Nuclear: It Solves Intermittency but Creates Four New Problems

THE PROBLEM:

Nuclear generation is firm and dispatchable. It runs 24 hours a day regardless of weather. This is exactly what the grid needs when solar and wind are not producing. But nuclear solves the intermittency problem by introducing four new problems that the competing technologies do not.

First, it is very expensive to build. A new large nuclear facility costs on the order of two to four times as much per kilowatt installed as a gas plant and often takes ten to fifteen or more years from decision to operation. The money is committed decades before a single kilowatt-hour is delivered. Energy Alberta's own October 2025 pivot from the MONARK small modular reactor to the Westinghouse AP1000 large reactor illustrates how uncertain technology selection remains even after the environmental assessment is filed — a further reason why the alternatives comparison must be updated at each licensing gate.

Second, it produces radioactive waste that remains hazardous for periods ranging from tens of thousands to hundreds of thousands of years depending on waste class. The Canadian Nuclear Safety Commission has not resolved the question of where to store this waste permanently. It is currently held in temporary storage at reactor sites. The duration of this hazard is not a quantity that any standard risk comparison framework weighs accurately. Section 32.6 of this submission addresses this methodological failure directly.

Third, it creates a continuous radiological hazard around the site. Every nuclear facility requires a formal Emergency Planning Zone where evacuation plans must be maintained for the surrounding population. It emits tritium and other radionuclides into the water and air around the site continuously throughout its operational life. At the Peace River site, effluent enters the Peace River system, which flows northeast into the Peace-Athabasca Delta — a UNESCO World Heritage site and the drinking-water and food-source watershed for multiple Treaty 8 First Nations communities including the Dene Tha', Beaver (Dane-zaa), and downstream communities at Fort Chipewyan.

Fourth, the public bears residual liability that private insurance will not cover. The Nuclear Liability and Compensation Act caps the operator's liability at one billion dollars. If a major release contaminates the Peace River and its downstream watershed — including Lake Athabasca and the Mackenzie River system — losses beyond one billion dollars fall on the public and on Treaty 8 Nations whose FPIC rights are already in dispute.

None of the three competing technologies in this stopper share any of these four characteristics. That categorical difference is the substance of the REGDOC-2.5.2 §2.2.1 mandatory comparison that the current Peace River TISG does not require the proponent to conduct. It is also the substance of the methodological defect addressed in section 32.6: a comparison framework that treats nuclear risk and alternative-technology risk as commensurable without addressing duration, magnitude, and irreversibility asymmetries is not a valid comparator.

32.2 The Three Technologies and How They Work

TECHNOLOGY 1: VANADIUM FLOW BATTERY STORAGE — stores the surplus; releases it on demand

THE PROBLEM:

Solar and wind produce surplus electricity at some times and none at others. Without a way to store the surplus, it is wasted or sold cheaply to neighbouring grids. The grid then has to fall back on gas or nuclear when renewables drop off.

A vanadium redox flow battery is a very large rechargeable battery. It stores electricity by pumping a liquid chemical solution — vanadium dissolved in sulphuric acid — through electrochemical cells. When the battery is charging, surplus renewable electricity drives a chemical reaction that stores energy in the liquid. When the battery is discharging, the reaction runs in reverse and releases the stored energy as electricity on demand.

The key difference from the lithium-ion batteries in phones and laptops is scale and duration. Because the energy is stored in tanks of liquid, a vanadium flow battery can be made as large as needed simply by building bigger tanks. A system storing four hours of output is the same technology as one storing twelve hours — just with larger tanks. And unlike a lithium-ion battery, the vanadium electrolyte does not wear out under normal operating conditions. The same liquid can be recharged and discharged tens of thousands of times over a 25-year life without losing capacity.

HOW IT SOLVES IT:
Store surplus solar and wind electricity in tanks of vanadium electrolyte. Release it as firm dispatchable electricity on demand — at night, on still days, in winter peaks. Scale the tanks to match the storage duration needed. No fuel, no emissions, no radioactive waste, no Emergency Planning Zone, no Nuclear Liability and Compensation Act cap.

World's largest operating VRFB — Rongke Power, Dalian, China — Phase I commercially operating at 100 MW / 400 MWh since 2022, with planned build-out to the full 200 MW / 800 MWh scale. This is a commercially operating grid-scale installation demonstrating the technology at the scale required for serious grid applications.

Cost trajectory — BloombergNEF 2025 — BloombergNEF's 2025 benchmark for a four-hour battery project is approximately 78 USD/MWh levelised cost of storage. NREL ATB mid-case projections for long-duration storage are directionally consistent with LCOS in the 80–150 USD/MWh range for 8–12 hour systems further out; these are scenario-based projections, not guaranteed outcomes, but they are the same figures AESO uses in its long-term adequacy planning.

Alberta market confirmation — AESO's 2024 Long-Term Adequacy Report identifies large-scale battery energy storage as a viable capacity resource for Alberta grid reliability. AESO's storage procurement pilots issued in 2024–2025 include grid-scale battery systems. Alberta's deregulated merchant market provides revenue streams — energy arbitrage, ancillary services, capacity — that make the VRFB business case directly applicable to the Peace River region.

Alberta vanadium supply chain — Canada is a producer of vanadium through domestic mining operations. The Peace River region's proximity to Alberta's oil sands — which produce vanadium-rich petroleum coke as a by-product — creates a potential domestic electrolyte supply chain that does not exist for lithium-ion or nuclear fuel. This is an Alberta-specific advantage that the TISG's alternatives analysis has not addressed.

What this means for Peace River — By the time the Peace River Nuclear Power Project enters operation, grid-scale vanadium flow battery storage will be commercially mature, widely deployed, and cost-competitive with new nuclear under mid-case scenario projections. A 2026 Impact Statement that does not compare the Peace River project against this technology is structurally incomplete as a REGDOC-2.5.2 §2.2.1 mandatory comparison.

TECHNOLOGY 2: FLEXIBLE GAS WITH CARBON CAPTURE — PEAK-ONLY OPERATION — fires up when renewables drop; shuts down when they come back

THE PROBLEM:

Solar and wind do not produce power on still winter evenings. Someone has to supply electricity at those moments. A battery storage system covers hours. But what about the days when there is a prolonged period of low wind across Alberta and the batteries are depleted? A firm dispatchable generator is needed as the last-resort backup.

The key word here is flexible. A flexible gas plant is fundamentally different from a conventional gas plant or from a nuclear plant. A nuclear plant must run at full output 24 hours a day, 7 days a week, every day of the year. It cannot be switched off cheaply. Its entire economic model depends on running continuously.

A flexible gas plant is the opposite. It is specifically designed to start up quickly, run at high output when demand peaks, and shut down again when demand falls. In a grid with high renewable penetration, a flexible gas plant might run at full output for only 1,000 to 2,000 hours per year — out of 8,760 hours in a year. For the remaining 6,000 to 7,000 hours, it is idle. This has two critical consequences.

The first consequence is that a flexible gas plant produces far less carbon dioxide per year than a plant running 24/7. Because it only fires during peak demand, its total annual fuel consumption — and therefore its total annual CO2 output — is a fraction of a baseload plant. On a 2,000-hour-per-year operating schedule, a flexible gas plant produces roughly one-quarter of the annual emissions of the same plant running at full output all year.

The second consequence is that carbon capture and storage (CCS) becomes far more economical for a flexible gas plant than for a baseload plant. CCS captures the CO2 from the exhaust stream before it reaches the atmosphere. The smaller the volume of exhaust gas, the cheaper and more effective the capture system. A peak-only gas plant with CCS running 2,000 hours per year has a much smaller CCS system to size, fund, and operate than a baseload plant running 8,760 hours per year.

HOW IT SOLVES IT:

Provide firm dispatchable backup power only during the hours when solar, wind, and storage cannot meet demand. Capture the carbon dioxide from those limited operating hours before it is released. The result is a backup generator that runs infrequently, emits a small total volume of CO2, and captures most of that through CCS — all without any radiological hazard, radioactive waste, Emergency Planning Zone, or statutory liability cap.

Canadian commercial CCS reference — SaskPower Boundary Dam, Saskatchewan — Post-combustion carbon capture retrofitted to a coal-fired power station. Realised capture rate 85–90 per cent. Over 4 million tonnes of CO2 captured since commissioning. This is a demonstrated Canadian industrial fact. CCS works in Canada.

Alberta commercial CCS reference — Shell Quest CCS, Fort Saskatchewan, Alberta — Pre-combustion carbon capture from hydrogen production at Shell's Scotford Upgrader. Realised capture rates around 80–90 per cent; cumulative storage exceeding 8 million tonnes since 2015. Shell Quest demonstrates that large-scale CCS is achievable in Alberta industrial conditions — in the same regulatory and geological environment as the Peace River Nuclear Power Project. This is an Alberta benchmark, not a foreign technology reference.

Where CCS is heading — pilot scale 2026 — Pilot projects and studies are targeting 98–99 per cent carbon capture for commercial deployment in the 2030s. If these targets are achieved — and they are not yet guaranteed — a peak-only plant running 2,000 hours per year would have very low net annual emissions, comparable to nuclear's lifecycle greenhouse gas intensity of approximately 6–15 gCO2e/kWh (IPCC AR6 lifecycle range).

The critical difference from nuclear — Nuclear runs 24/7 and produces continuous radiological emissions into the Peace River watershed, requires a permanent Emergency Planning Zone across Treaty 8 territory, and generates radioactive waste hazardous for tens to hundreds of thousands of years. A flexible peak-only gas plant with CCS runs for approximately 1,000 to 2,000 hours per year, produces no radioactive emissions, requires no Emergency Planning Zone, and leaves no long-lived radioactive waste. The two technologies are not comparable in their risk profiles. The REGDOC-2.5.2 §2.2.1 mandatory comparison must address this difference — and the methodology used to make that comparison must not treat the 100,000-year waste tail as equivalent to zero, as section 32.6 of this submission addresses.

What this means for Peace River — By the early 2040s, flexible peak-only gas plants with CCS approaching high capture rates will be commercially deployed under mid-case scenario projections. Running on a peak-only schedule in combination with solar, wind, and storage, their annual net CO2 footprint may be comparable to nuclear on a lifecycle basis if pilot capture targets are met. They will cost approximately one-third of the Peace River Nuclear Power Project to build and take approximately one-quarter of the time.

TECHNOLOGY 3: CLOSED-LOOP GEOTHERMAL — THE EARTH AS A RECHARGEABLE BATTERY — stores heat underground; releases firm clean electricity on demand

THE PROBLEM:

Both battery storage and flexible gas solve the intermittency problem from the output side — they respond to the grid when needed. But what if there were a technology that provided firm, continuous, zero-emission baseload electricity from the earth itself, available 24 hours a day without fuel, without emissions, and without the problems of nuclear?

Traditional geothermal energy has always been limited by geography. You need to be near a natural hot spring or volcanic zone to tap underground heat. Iceland and parts of the western United States can use conventional geothermal. Most of Alberta cannot — or could not, until recently.

The Eavor-Loop, developed by Eavor Technologies of Calgary, Alberta, changes this. It uses directional drilling technology borrowed from the oil and gas industry — the same industry whose workforce and equipment base is concentrated precisely in northern Alberta — to create a sealed underground loop, like a giant underground radiator. A specially formulated working fluid is circulated through a network of wellbores drilled several kilometres deep, where the natural heat of the earth warms it. The hot fluid rises to the surface through a process called thermosiphon — hot fluid is lighter and rises naturally, so no pumps are needed. At the surface, the heat drives an Organic Rankine Cycle turbine to generate electricity. The cooled fluid flows back down the other well and the cycle repeats continuously.

Crucially, the loop is completely sealed. No underground water is extracted. No fracking is required. No underground aquifer is needed. No tectonic activity is required. The system works in geologically ordinary rock at drilling-accessible depths — which means it can be deployed almost anywhere, including the Peace River region of northern Alberta.

The geothermal aspect makes it firm baseload. But the rechargeable battery aspect makes it dispatchable. The flow of fluid through the loop can be slowed or stopped, allowing the fluid to stay near the heat source underground and absorb more heat. This charges the fluid with additional thermal energy. That stored heat can then be dispatched rapidly when electricity demand peaks — exactly like discharging a battery. The earth itself becomes the thermal reservoir.

HOW IT SOLVES IT:

Use the natural heat of the earth as a giant rechargeable battery. Circulate working fluid through sealed underground wellbores to generate continuous firm electricity from geothermal heat. Slow the flow to charge — store more heat underground. Speed the flow to discharge — release electricity on demand during peak hours. Zero emissions. No fuel. No radioactive waste. No Emergency Planning Zone. Deployable on Alberta geology. Built using Alberta oil and gas drilling expertise.

First commercial deployment — Geretsried, Bavaria, Germany — Eavor-Loop commercial plant with Turboden Organic Rankine Cycle system from MHI group company. Capacity of 8.2 megawatts electric at full operation across four loops. Provides approximately 44,000 tCO2e greenhouse gas emissions avoided per year including heat output. The first commercial implementation of closed-loop geothermal technology anywhere in the world.

Alberta demonstration — Eavor-Loop pilot, Rocky Mountain House, Alberta — Eavor Technologies commissioned its field demonstration facility at Rocky Mountain House, Alberta. The demonstration confirmed thermosiphon operation, sealed-loop integrity, and the viability of the technology in Alberta sedimentary basin geology. This is a Canadian result in Alberta. The technology works in Alberta rock.

Alberta competitive advantage — workforce and supply chain — Eavor Technologies is headquartered in Calgary. The drilling contractors, engineers, and oilfield service companies required to scale the Eavor-Loop are concentrated in Alberta's existing oil and gas workforce. A multi-gigawatt Eavor-Loop deployment in Alberta would use the same directional drilling rigs, the same wellbore casing suppliers, and the same trained workforce already present in the province. No equivalent supply chain exists for nuclear construction in northern Alberta. This asymmetry is not reflected anywhere in the TISG's alternatives analysis.

Scalability — engineering potential based on modular loops — Scalability to multi-gigawatt installations is an engineering potential based on the modular loop architecture and the demonstrated availability of directional drilling technology, not an existing project pipeline. Each additional loop adds capacity using the same technology as the first. Eavor and its investors — including bp and Chevron — have identified multi-GW scalability as a medium-term commercial target.

LCOE projection — IEA geothermal analyses and Eavor's own projections suggest that at commercial scale, closed-loop geothermal could reach LCOEs in the 60–100 USD/MWh range. These are scenario-based and technology-projection figures, not currently realised costs; they are included as mid-case forward projections using the same methodology as NREL ATB and IEA WEO scenario analysis.

What this means for Peace River — By the early 2040s, closed-loop geothermal will have moved from the first commercial plant in Bavaria to multi-hundred-megawatt installations in North America under plausible mid-case trajectories. Alberta's geology is compatible, its workforce is ready, and the technology is headquartered in Calgary. The 2026 IS will be unable to assess this technology at commercial scale because the commercial cost data does not yet exist. By 2035 it will exist. By the time the Peace River project operates, a multi-GW Eavor-Loop installation is a plausible Alberta alternative that the assessment never considered.

32.3 The Temporal Gap: Why a 2026 Assessment Cannot Cover a 2042 Competitive World

The Peace River Nuclear Power Project Impact Statement will be filed in 2026 or 2027. The facility will not enter commercial operation until the early 2040s. That is a gap of fifteen to eighteen years between assessment and operation.

IAA section 22(1)(f) requires consideration of alternatives to the designated project. IAA section 22(1)(i) requires consideration of alternative means of carrying out the project. REGDOC-2.5.2 §2.2.1 requires that societal risks from reactor operation shall be comparable to or less than the risks of generating electricity by viable competing technologies. Each obligation requires a comparison against alternatives that are actually viable when the decision has its effect — the period 2042 to 2100, not the filing year 2026. Critically, REGDOC-2.5.2 §2.2.1 applies at each licensing stage, not only at the IS stage. An EA that is silent on these competing technologies pre-commits the CNSC to a licensing decision on structurally incomplete information.

Ignoring documented technology development trajectories is equivalent to ignoring an environmental baseline. A section 63 public interest determination that rests on a 2026 alternatives snapshot applied to a 2042–2100 operational period cannot meet Vavilov's requirements of justification, transparency, and intelligibility. IAAC is not being asked to predict the future — it is being asked to require the same scenario-based analysis, using NREL ATB and IEA WEO figures, that AESO already treats as authoritative for Alberta's long-term planning.

A further aggravating factor applies specifically to the Peace River project. Energy Alberta's October 2025 announcement of a pivot from the MONARK small modular reactor design to the Westinghouse AP1000 large reactor means that the project's own technology selection was not settled at the time the TISG was issued. The TISG was drafted against a project that no longer exists in its original form. A TISG alternatives analysis that was inadequate for the MONARK design is doubly inadequate for the AP1000 design, which has a larger footprint, a larger Emergency Planning Zone, and a larger capital commitment.

The gap table below quantifies what the 2026 IS will miss for each of the three competing technologies. The table distinguishes between current documented status and projected mid-case scenario figures, using the same sources AESO relies on for its own long-term adequacy planning.

Technology	2026 — IS preparation year	2040s — Project operational date	What the 2026 IS gets wrong
Vanadium Flow Battery	***Current status (documented):*** Phase I of Dalian project commercially operating at 100 MW / 400 MWh; planned build-out to 200 MW / 800 MWh (Rongke	Commercially mature at GWh scale. NREL ATB mid-case long-duration storage ranges consistent with LCOS achieving further reductions from	2026 IS assesses VRFB at an early commercial stage. By 2040 it is a dominant grid storage technology. The IS overstates its cost and understates its deployment. The REGDOC

	Power, 2022). BloombergNEF 2025: four-hour battery LCOS benchmark ~78 USD/MWh. AESO storage procurement pilots 2024–2025. ***Projected mid-case (scenario-based):*** NREL ATB mid-case long-duration storage ranges consistent with 80–150 USD/MWh LCOS for 8–12 hour systems. Standard Alberta grid resource category.	2026 baseline. Standard Alberta adequacy resource.	mandatory comparison is skipped entirely.
Flexible Peak-Only Gas with CCS	***Current status (documented):*** Boundary Dam: 85–90% capture, 4+ Mt captured. Shell Quest (Fort Saskatchewan, Alberta): 80–90% realised capture, 8+ Mt stored since 2015. Peak-only gas runs ~2,000 hours/year in high-renewable grid. ***Projected mid-case (scenario-based):*** Pilot systems targeting 98–99% capture for commercial deployment in the 2030s. If achieved, peak-only operation means annual net CO2 comparable to nuclear lifecycle median of ~6–15 gCO2e/kWh. Capital cost one-third of nuclear; lead time one-quarter.	98–99% CCS capture targeted for commercial deployment. Peak-only operation means annual net CO2 footprint comparable to or less than nuclear on a lifecycle basis if capture targets met. Capital cost and lead-time advantage unchanged.	2026 IS treats carbon gap between gas and nuclear as fixed and large. By 2040 it is near zero for a peak-only CCS plant if pilot capture targets are achieved. The IS fails to model flex gas running only 1,000–2,000 hours/year.
Closed-Loop Geothermal (Eavor-Loop)	***Current status (documented):*** First commercial plant operating in Geretsried, Bavaria (8.2 MWe, 4 loops; EU Innovation Fund, bp and Chevron investors). Alberta field demonstration at Rocky Mountain House confirmed thermosiphon and sealed-loop operation. Eavor Technologies	Multi-hundred-MW commercial installations in North America. Scalable to multi-GW range in principle using directional drilling. Alberta geology and oilfield workforce confirmed compatible. Firm baseload, zero emissions, dispatchable.	Cannot be assessed as full comparator in 2026 IS because commercial cost data at Alberta scale does not yet exist. Will be fully assessable by 2035. By the time the project operates, a multi-GW Eavor-Loop installation is a plausible Alberta alternative the 2026 assessment never considered.

	headquartered in Calgary. ***Projected mid-case (scenario-based):*** IEA geothermal analyses and Eavor's own projections suggest LCOEs in the 60–100 USD/MWh range at commercial scale. Multi-hundred-MW installations in North America plausible by 2040s using Alberta oil-and-gas drilling workforce.		

Across all three technologies, NREL ATB and IEA WEO mid-case scenarios imply a further 30 to 50 per cent cost reduction from 2026 to 2040. This is of the same order as the documented declines already observed over the previous decade. It is not speculation — it is scenario-based extrapolation of measured manufacturing learning curves that AESO already uses in its long-range adequacy planning. Solar and battery system costs have fallen by approximately 80–90 per cent over the past 20–25 years, and by over 99 per cent compared to the 1970s; the 30–50 per cent projected reduction over the next 15 years is conservative relative to historical experience.

32.4 The Three Available Options and the Required TISG Amendment

IAAC has three available responses to the temporal overreach. The current TISG chooses none. All three require a TISG amendment.

Option 1 — Provisional Approval with Mandatory Reassessment at Each Licensing Gate

Any section 64 approval is conditional. Before each subsequent licensing stage — Licence to Prepare Site, Licence to Construct, Licence to Operate — the proponent must update the REGDOC-2.5.2 §2.2.1 comparison against all three competing technologies using the latest NREL ATB, IEA WEO, and AESO Long-Term Adequacy Report data. A mandatory update is triggered when any competing technology reaches 100 MW of commercial operation in Canada or a directly interconnected US jurisdiction, when AESO issues a long-term adequacy or capacity contract for it, or when a new NREL ATB or IEA WEO is published that materially changes its cost trajectory.

Each update must state explicitly whether the Peace River Nuclear Power Project is in one of four positions relative to each competing technology: lower-cost and lower-risk; lower-cost but higher-risk; higher-cost but lower-risk; or higher-cost and higher-risk. If higher-cost and higher-risk under any IEA or NREL scenario that those bodies treat as plausible, IAAC and the CNSC shall consider not issuing the next licence without a further public interest justification.

Option 2 — Probabilistic Scenario Assessment

The proponent conducts the REGDOC-2.5.2 §2.2.1 comparison under the full IEA WEO 2024 Stated Policies, Announced Pledges, and Net Zero scenario bands; NREL ATB 2025 conservative, moderate, and advanced cases; and AESO low, reference, and high demand scenarios. For each scenario band, for each competing technology, the proponent states the four-position classification and whether the REGDOC 'shall' requirement is met. If higher-cost and higher-risk under any plausible scenario, the Review Panel must address this on the record in its section 63 determination.

Option 3 — Technology-Neutral Upper Bound

The proponent defines the maximum societal risk the Peace River Nuclear Power Project can impose while remaining comparable to the best-case 2040 alternative across all plausible scenarios, including the optimistic case where geothermal is at 60 USD/MWh, vanadium storage is at 80 USD/MWh, and peak-only gas CCS has achieved high capture rates. Demonstrates via PSA that the Project stays within that bound. A monitoring clause requires the proponent to file a public interest justification if observed alternative costs fall below the bound during operations.

The Minimum Required TISG Amendment

NEW TISG REQUIREMENT — TECHNOLOGY HORIZON ANALYSIS (THA)

(a) Identification. The proponent must prepare a THA identifying three categories of viable competing technology: (i) grid-scale long-duration battery storage including vanadium redox flow battery technology; (ii) flexible peak-only natural gas generation with carbon capture and storage — noting that flex gas operates only during demand peaks and not 24/7, so its total annual emissions and carbon capture system scale are a fraction of a baseload gas plant; and (iii) closed-loop geothermal systems including Eavor-Loop technology, with specific reference to the first commercial plant in Geretsried, Bavaria, Germany, to the Alberta demonstration plant, and to Eavor Technologies' Calgary headquarters, and to scalability to multi-gigawatt installations using directional drilling at commercially accessible depths applicable to Alberta geology. The THA must explain in plain terms what each technology is, what electricity problem it solves, and why it is a viable competing technology for meeting the same Alberta electricity need as the Peace River Nuclear Power Project.

(b) Quantification. For each technology, the proponent must quantify at the Project's projected in-service date the probability-weighted levelised cost and societal risk profile using NREL ATB 2025, IEA WEO 2024, and AESO Long-Term Adequacy Report scenario publications as inputs. All cost calculations must use NREL's published LCOE methodology with disclosed input assumptions to allow independent replication. Each cost figure must be labelled as either 'current documented cost' or 'projected mid-case (scenario-based)' with the source scenario identified.

(c) Comparative assessment. For each IEA scenario band and NREL cost case, the proponent must state whether the Peace River Nuclear Power Project is in position (i) lower-cost and lower-risk, (ii) lower-cost but higher-risk, (iii) higher-cost but lower-risk, or

(iv) higher-cost and higher-risk than each competing technology. This comparison must be cross-walked to the REGDOC-2.5.2 §2.2.1 'shall' obligation.

(d) Risk weighting methodology. The comparative assessment must explicitly address duration asymmetry, magnitude asymmetry, and irreversibility asymmetry in the societal risk comparison as required by the methodological objection set out in section 32.6. A comparison that applies a single expected-value framework without weighting for consequence duration, catastrophic magnitude, or irreversibility cannot satisfy the REGDOC §2.2.1 'shall' standard.

(e) Update triggers. The THA must be updated before each licensing stage and additionally when any competing technology reaches 100 MW of commercial deployment in Canada or a directly interconnected US jurisdiction, when AESO issues a long-term adequacy or capacity contract for it, or when a new NREL ATB or IEA WEO materially changes its cost trajectory.

(f) Consequence. If the updated THA places the Peace River Nuclear Power Project in position (iv) under any plausible scenario, the proponent must file a supplementary submission explaining how REGDOC-2.5.2 §2.2.1 is satisfied before the next licensing stage is authorised.

32.5 Anticipated IAAC Responses

IAAC: "We cannot predict the future — we cannot base an assessment on speculative technology projections"

RESPONSE: You are not being asked to predict the future. The SaskPower Boundary Dam CCS plant is operating in Saskatchewan right now. The Shell Quest CCS facility is operating in Alberta right now, four hundred kilometres from the Peace River project site. Phase I of the Dalian vanadium flow battery is operating in China right now. The Eavor-Loop commercial plant is operating in Bavaria right now with bp and Chevron as investors. The Eavor-Loop field demonstration operated in Rocky Mountain House, Alberta. Eavor Technologies is headquartered in Calgary. AESO has already assessed grid-scale battery storage in its 2024 Long-Term Adequacy Report. None of this is speculative. The cost projections used in this submission are the same NREL ATB and IEA WEO scenario figures that AESO uses to plan Alberta's electricity system at exactly this timescale. If they are adequate for AESO infrastructure planning, they are adequate for this assessment. The table in section 32.3 distinguishes clearly between current documented facts and projected scenario-based figures.

IAAC: "Updating the alternatives assessment at every licensing gate is burdensome"

RESPONSE: Nuclear projects already undergo multiple licensing phases. An updated cost comparison at each gate adds a modest analytical burden relative to the overall costs of each phase. NREL and IEA publish updated scenario data on annual and biennial schedules specifically for long-term infrastructure planning. The methodology is published, the input assumptions are disclosed, and the process is straightforward. More importantly, the magnitude of the cost shifts involved justifies the burden: a 30 to

50 per cent cost reduction in competing technologies over the construction period of a sixty-year facility is not a minor adjustment under NREL and IEA mid-case scenarios. It is the difference between a facility that satisfies REGDOC-2.5.2 §2.2.1 at the IS stage and one that may not satisfy it when it seeks a Licence to Operate. The public — and Treaty 8 Nations whose territories will host the Emergency Planning Zone for the duration of the licence — have a right to know which it is before the concrete is poured.

IAAC: "The Eavor-Loop is too small today to be a meaningful comparator"

RESPONSE: The same objection would have applied to solar in 2009 and wind in 2005. The REGDOC-2.5.2 §2.2.1 requirement is that societal risks be compared against viable competing technologies. Viable does not mean currently deployed at the same scale as the proposed project. It means demonstrably on a trajectory to commercial viability within the assessment horizon. The Eavor-Loop has secured investment from two of the world's largest energy companies, operates a commercial plant in Europe, has conducted a field demonstration in Alberta, and is headquartered in Calgary. The question is not whether it is viable today at multi-GW scale. The question is whether, by 2042, it will be. On current trajectories the answer is plausible. The 2026 IS cannot answer that question honestly if it does not attempt the analysis. That is why the THA is required.

32.6 The Structural Defect in the Comparison Framework

Sections 32.1 through 32.5 address what the TISG omits: the three competing technologies. This section addresses something different and more fundamental: even if the TISG were amended to require comparison against all three technologies, the comparison methodology itself is structurally defective. It does not compare apples with apples. It applies a single expected-value framework — probability multiplied by consequence — that systematically misrepresents nuclear risk relative to the alternatives because it does not weight for three asymmetries that are unique to nuclear energy: duration, magnitude, and irreversibility.

32.6.1 Duration Asymmetry

The three competing technologies produce no long-duration hazardous waste. A vanadium flow battery reaches end of useful life and the electrolyte is recoverable. A gas plant, even one operating for decades, produces combustion products that disperse and decay on timescales of years to decades. A closed-loop geothermal system leaves a network of sealed wellbores that present no ongoing hazard after decommissioning.

The Peace River Nuclear Power Project will produce radioactive waste that remains hazardous for periods ranging from hundreds of years for low-level waste to tens of thousands to hundreds of thousands of years for high-level waste and spent fuel. The Canadian Nuclear Safety Commission has not resolved where this waste will be permanently stored. It is currently accumulating in temporary storage at reactor sites across Canada.

METHODOLOGICAL OBJECTION:

A societal risk comparison that applies the same expected-value framework to a 100,000-year hazard tail and a zero-year hazard tail without explicit durational weighting is not a valid comparison. It converts a qualitative difference of kind — perpetual obligation versus none — into a quantitative figure that obscures that difference entirely.

REGDOC-2.5.2 §2.2.1 requires that societal risks be 'comparable to or less than' the risks of viable competing technologies. A comparison methodology that assigns no differential weight to duration cannot produce a finding that meets the 'shall' standard. The TISG must require the proponent to state, explicitly and separately, the durational profile of each technology's societal risk — not just the annualised expected value.

32.6.2 Magnitude and Irreversibility Asymmetry

Standard risk comparison frameworks compute expected harm as probability multiplied by consequence. This methodology performs well when consequences are bounded and recoverable — when a dam fails, the valley floods and then is restored; when a battery installation catches fire, the fire is extinguished and the equipment replaced. The expected-value framework is appropriate for these events because the consequence, however severe in the short term, is finite and bounded.

A nuclear release at the Peace River site is not bounded and recoverable in the same sense. The Peace River flows northeast from the project site into the Peace-Athabasca Delta — a UNESCO World Heritage site, a Ramsar Convention wetland, and the drinking-water and food-source ecosystem for multiple Treaty 8 First Nations communities including downstream communities at Fort Chipewyan. Contamination of this system would be geographically extensive and, depending on the isotopes released, effectively permanent on human timescales. The affected communities could not be restored to their pre-contamination condition by any remediation currently available.

IAA section 6 — the precautionary principle — exists precisely for this category of risk. It provides that where a project may cause serious or irreversible harm, lack of full scientific certainty is not a reason to postpone protective measures. The precautionary principle is not a tiebreaker or a policy aspiration in the IAA framework — it is a listed factor in section 6 that the Minister and Review Panel must apply in the public interest determination under section 63.

METHODOLOGICAL OBJECTION:

An expected-value comparison that assigns the same methodological weight to a recoverable gas leak and a potentially irreversible contamination of the Peace-Athabasca UNESCO World Heritage watershed does not satisfy IAA section 6. It converts the precautionary principle into a nullity by treating irreversible consequences as quantitatively equivalent to recoverable ones.

The TISG must require the proponent to apply a consequence-severity weighting that gives differential weight to outcomes that are: (a) geographically extensive; (b) long-duration; and (c) not remediable by currently available technology. A Peace River nuclear release that contaminates the Peace-Athabasca Delta meets all three criteria. None of the three competing technologies present any consequence that meets any of these criteria.

32.6.3 Intergenerational Equity and UNDRIP Article 29

The two asymmetries above — duration and irreversibility — have a third dimension that is specific to the Treaty 8 context: intergenerational equity and the ongoing obligation of Free, Prior, and Informed Consent under UNDRIP.

Future generations of Treaty 8 Nations will bear the hazard of the Peace River project's radioactive waste and the radiological risk to the Peace-Athabasca watershed without having had any opportunity to consent to that burden. The current generation of rights-holders cannot provide FPIC on behalf of future generations for a risk that extends tens of thousands of years. No nation, no government, and no generation has the authority to bind all future generations to the acceptance of a perpetual hazard of this character.

UNDRIP Article 29 protects the right of Indigenous peoples to the conservation and protection of their environment and productive capacity, including for future generations. A risk comparison framework that is silent on intergenerational distribution — that treats the consent of the current generation as sufficient to authorise a 100,000-year hazard — cannot satisfy UNDRIP Article 29 as an ongoing Crown obligation. The Crown's duty to consult and accommodate is not discharged by a single point-in-time FPIC process when the harm at issue is multigenerational.

METHODOLOGICAL OBJECTION:

The TISG must require the proponent to address the intergenerational dimension of the risk comparison explicitly: what obligation does the project impose on future generations of Treaty 8 Nations; what mechanism provides for future consent or review; and how does the risk comparison satisfy UNDRIP Article 29 when none of the three competing technologies impose any comparable intergenerational obligation.

This is not a request for the impossible. It is a request that the proponent acknowledge the asymmetry and address it, rather than subsume it into an expected-value figure that makes it invisible.

32.6.4 The Required TISG Amendment for Methodology

The structural defect in the comparison framework requires a separate TISG amendment in addition to the Technology Horizon Analysis required in section 32.4. The amendment must require the proponent, in the REGDOC-2.5.2 §2.2.1 societal risk comparison, to:

(a) state separately the durational risk profile of each technology — the period over which each technology imposes a hazard on the surrounding environment and communities — rather than collapsing duration into an annualised expected value;

(b) apply a consequence-severity weighting that gives explicit and documented differential weight to consequences that are geographically extensive, long-duration, and not remediable by currently available technology, consistent with IAA section 6;

(c) address the intergenerational distribution of risk, specifically identifying what obligations the project imposes on future generations of Treaty 8 Nations and how UNDRIP Article 29 is satisfied when none of the three competing technologies impose any comparable obligation; and

(d) state, for each competing technology, whether the societal risk comparison would change if consequence-severity weighting were applied, and if so, by how much and in which direction.

FINDING:

Three technologies — vanadium flow battery storage, flexible peak-only gas generation with carbon capture, and closed-loop geothermal using the earth as a rechargeable battery — are each commercially operating today and are each on documented cost and deployment trajectories that will make them materially more capable and materially cheaper by the time the Peace River Nuclear Power Project enters operation in the early 2040s. All three solve the intermittency problem of solar and wind. None of them produce radioactive waste hazardous for tens of thousands of years, require an Emergency Planning Zone over Treaty 8 territory, impose a statutory liability cap on public losses, or emit radionuclides continuously into the Peace River — the headwater of the UNESCO World Heritage Peace-Athabasca Delta and the drinking-water source for Treaty 8 Nations downstream. The lead Alberta CCS reference is Shell Quest at Fort Saskatchewan, operating in the same regulatory and geological environment as the Peace River project. The lead closed-loop geothermal developer is Eavor Technologies, headquartered in Calgary, with a field demonstration already conducted in Rocky Mountain House, Alberta.

The TISG does not require the proponent to compare the Peace River project against any of these technologies. That omission means the Impact Statement will be structurally silent on the question REGDOC-2.5.2 §2.2.1 makes mandatory. A second and independent defect compounds the first: even if the comparison were required, the methodology applied does not weight for duration asymmetry, magnitude and irreversibility asymmetry, or intergenerational equity under UNDRIP Article 29. A risk comparison that treats a 100,000-year radioactive waste tail as commensurable with a zero-year hazard tail, and that treats a potentially irreversible contamination of the Peace-Athabasca UNESCO watershed as equivalent in kind to a recoverable gas leak, is not a comparison that can satisfy REGDOC §2.2.1 or IAA section 6. IAAC must address both defects — the technology omission and the methodology defect — before the IS phase proceeds.

IAAC TRAP:

IAAC faces a binary choice on two independent grounds.

First, on technology: amend the TISG to require a Technology Horizon Analysis addressing vanadium flow batteries, flexible peak-only gas with CCS anchored in Alberta's own Shell Quest reference, and closed-loop geothermal technology developed by a Calgary company using Alberta oilfield expertise — using NREL ATB and IEA WEO scenario data that AESO already treats as authoritative. Or produce a static 2026 alternatives comparison that ignores three commercially operating technologies and their documented trajectories, and make a section 63 public interest determination that cannot be justified under Vavilov when those technologies are further deployed in the 2030s.

Second, on methodology: require the proponent to apply a comparison framework that weights for duration, magnitude, irreversibility, and intergenerational equity — consistent with IAA section 6 and UNDRIP Article 29. Or make a section 63 determination using an expected-value framework that converts a 100,000-year hazard tail into the same units as a zero-year hazard, and makes invisible the distinction between a recoverable consequence and an irreversible contamination of a UNESCO World Heritage watershed in Treaty 8 territory. The two defects are independent. Fixing one does not fix the other.

Both TISG amendments are required.