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Commission Public Hearing
Part 2

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Référence du Projet de transparence nucléaire

À l'égard de

Ontario Power Generation

Demande concernant la réfection de la centrale nucléaire de Pickering et le renouvellement de ses permis pour la centrale et l'installation de gestion des déchets

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Expert review for NTP intervention regarding the proposed refurbishment for Pickering B Nuclear Generating Station reactors

EXECUTIVE SUMMARY

This report reviews the proposed Pickering B, Units 5–8 refurbishment from the perspective of water transparency, groundwater pathway control, and long-term source reduction. The groundwater record shows continuing localized tritium variability, including recent high Unit 1 values in Area A and million-Bq/L concentrations in Unit 6 and western IFB-B in Area B. The central concern is therefore not public exposure alone, but whether the refurbishment plan provides enough pathway-specific evidence that tritiated groundwater will be correctly classified, monitored, routed, and controlled during shutdown, dewatering, heavy-water handling, sump operation, construction, and restart.

The report is structured in two parts. Part 1 gives a concise list of recommended clarifications and licence-review conditions for both radiological and non-radiological water management plans. Part 2 provides the detailed basis for those recommendations. The focus is on why compliance and dilution are not the same as source control: the PERA demonstrates expected compliance but does not yet demonstrate whether refurbishment will reduce avoidable chemical loading to Lake Ontario over the next operating period.

PART 1: CLARIFICATIONS AND CONDITIONS FOR THE REFURBISHMENT LICENCE REVIEW

1. Clarify Area B water pathways and routing decisions

OPG should provide a clear Area B water-pathway plan "**Units 5–8 Tritium Groundwater Pathway Control Plan**" that would include diagrams showing, separately:

- MK sump pathway → RLWMS;
- Unit 5/6 → IFB-B groundwater pathway;
- TAB IAD / inactive drainage pathway;
- CCW intake duct / forebay pathway;

- final discharge route to Lake Ontario.

The licence review should require OPG to define exactly which Area B waters go to RLWMS and which do not, especially where Unit 5/6 groundwater is interpreted as moving beneath IFB-B toward TAB IAD sumps. The key clarification is whether such water is treated as inactive drainage or as radiological liquid waste, and under what conditions the classification changes.

2. Provide pre-dilution monitoring and mass-balance evidence

OPG should provide tritium monitoring data for TAB IAD sump water and inactive drainage before dilution, especially for 2021–2023 when western IFB-B groundtubes were at million-Bq/L levels. It is not enough to state that dilution will occur. The review should require a tritium concentration-balance showing expected concentrations:

- before dilution;
- after CCW intake duct mixing;
- in the forebay;
- at the final lake discharge point.

This should include the evidence supporting the conclusion that the updated CCW / forebay pathway is sufficiently conservative compared with the earlier RLWMS-routing assumption.

3. Define trigger levels and contingency actions

OPG should define numerical trigger levels for elevated tritium in TAB IAD / inactive drainage. The review should require a clear decision rule stating when water is:

- held;
- resampled;
- investigated;
- reported;
- redirected to RLWMS or another radiological-control pathway;
- subject to increased monitoring.

This is especially important for water that may be classified as “inactive drainage” but could receive million-Bq/L tritium contaminated groundwater from the Unit 5/6–IFB-B pathway.

4. Require refurbishment-specific event-based monitoring

Routine annual or quarterly reporting is not enough for the refurbishment phase. The historical leakages from pipes have shown that **potential recurrence of high-concentration zones** must be assumed by the refurbishment activities.

Refurbishment must account for diverse groundwater paths and active control of million-Bq/L contamination.

OPG should implement event-based monitoring during:

- shutdown;

- dewatering;
- heavy-water handling;
- construction near subsurface drainage pathways;
- sump maintenance;
- pump changes;
- restart.

Monitoring should include Unit 5/6 groundtubes, IFB-B groundtubes, TAB IAD sumps, inactive drainage, CCW intake duct water, forebay, and final discharge points where relevant.

5. Separate groundwater zones instead of relying on general averages

OPG should track and report separately:

- shallow groundwater;
- HU 6 / foundation-zone groundwater;
- IFB-B western groundtubes;
- TAB IAD sump water;
- MK sump / RLWMS water.

The review should not rely only on annual averages or broad statements such as "within historical range." Western IFB-B is a known elevated pathway and requires pathway-specific interpretation.

6. Define "historical range" numerically

For western IFB-B groundtubes, OPG should define "historical range" with actual numerical values and dates. The term should distinguish between:

- background or low-level groundwater;
- routine operational ranges;
- known contaminated pathway ranges;
- event-related elevated values.

This is necessary because the reviewed data show that "historical range" for western IFB-B can include million-Bq/L tritium concentrations.

7. Demonstrate that refurbishment will not alter groundwater pathways

OPG should provide evidence supporting the conclusion that refurbishment will not change groundwater capture and migration pathways. This should address whether shutdown, dewatering, construction, pump/sump changes, or heavy-water work could affect the Unit 5/6 → IFB-B → TAB IAD pathway.

A key question for the licence review is whether the 2022 PEA Addendum considered the later 2022–2023 IFB-B million-Bq/L data, or whether the routing update was based on earlier assumptions.

8. Classification and control of million-Bq/L groundwater

Can OPG demonstrate, with pathway-specific monitoring and pre-dilution data, that tritium-impacted groundwater from the Unit 5/6–IFB-B pathway will be properly classified, monitored, and controlled during refurbishment if it enters TAB IAD / inactive drainage rather than RLWMS?

9. Distinction between compliance and source control

The reviewed reports support a low public-exposure conclusion, because predicted doses are far below the public dose limit and downgradient/end-use impacts are not identified. However, compliance at off-site receptors is not the same as proof of on-site source control. Local groundwater near Unit 1, Unit 6, and western IFB-B has shown persistent million-Bq/L tritium levels and variability, indicating that source-side conditions, engineered drainage pathways, and operational events remain important.

10. Non-radiological water control: missed source-reduction opportunities

The PERA demonstrates expected compliance, but it does not sufficiently demonstrate source reduction of non-radiological water control. For a major refurbishment intended to support decades of continued operation, OPG should be required to evaluate whether non-chemical or lower-chemical water-conditioning alternatives can reduce routine chemical loading to Lake Ontario while maintaining corrosion control, biofouling control, and operational safety.

1) What are the expected annual mass loads of all conditioning and biofouling chemicals for the next 30 years, and is their impact evaluated as cumulative loading to Lake Ontario or only as final discharge concentrations?

2) Has OPG conducted, or will it conduct before final refurbishment approval, a documented Best-Available-Alternatives review of lower-chemical and non-chemical water-conditioning options, including electromagnetic, electrochemical, advanced oxidation, physical filtration, automated monitoring/control, and hybrid systems for scaling, corrosion, and biofouling control? If not, why not, given that peer-reviewed studies and industrial deployments show these options are sufficiently mature to warrant screening, even if site-specific pilot validation would still be required?

PART 2:
DETAILED REVIEW

1. What was analyzed

This review examined whether the Predictive Environmental Risk Assessment (PERA) and supporting groundwater reports provide sufficient transparency for the proposed refurbishment of Pickering B. Particular attention was given to Area A, Units 1–4, where recent Unit 1 leaks created high localized tritium concentrations, and Area B, Units 5–8, where Unit 5, Unit 6, IFB-B, TAB IAD sumps, and downgradient wells define the main refurbishment-relevant groundwater pathway.

The review also examined the distinction between two different water-management pathways: reactor-building foundation drainage sumps that are described as pumping to the Radioactive Liquid Waste Management System (RLWMS), and TAB IAD / inactive drainage pathways that the updated PERA indicates will not be re-routed to RLWMS but will discharge to CCW intake ducts with dilution before final discharge. This distinction is central because western IFB-B and Unit 6 have shown **million-Bq/L tritium** concentrations, while the PERA relies on low predicted off-site dose and updated drainage assumptions.

The review further examined whether the PERA's non-radiological water assessment is limited to concentration compliance or whether it also addresses source reduction of routine water-conditioning chemicals over the proposed post-refurbishment operating period. The proposed extension of the Best-Available-Alternatives screening is based on the review of scientific literature and available industrial experience with lower-chemical and non-chemical water-conditioning approaches, including electromagnetic, electrochemical, advanced oxidation, filtration, and automated control systems.

2. Historical trends and latest observations of Area A, Units 1–4

Area A, Pickering Units 1–4, began operation between 1971 and 1973. Units 2 and 3 were already shut down earlier and placed in safe storage, while Unit 1 was permanently shut down on October 1, 2024 and Unit 4 on December 31, 2024.

Area A has documented historical tritium issues. However, the last operating years of Area A, especially 2018–2023, were significant for groundwater tritium contamination around Unit 1. Therefore, I summarize and update the status of Area A for an overall understanding.

There have been a series of recent releases to local groundwater below several of Pickering's units. The high Area A events discussed in the groundwater reports consulted for this review occurred in 2018, 2020, and 2023. Moreover, over the last years, Area B also had significant localized events, especially Unit 6 and IFB-B.

Before 2020, tritium concentrations in groundwater reached 3 million Bq/L, but in 2020, a malfunction of pipes in Unit 1 caused contamination beyond 300 million Bq/L.

September 2020: heavy water leak (main event >370M Bq/L)

- A heavy-water leak was identified in the Unit 1 Heat Transport purification room. The 2020 report attributes the cause to a leaking pipe in the Heat Transport system. The water likely entered groundwater through foundation joints, causing a major increase in Unit 1 reactor-building groundtubes. The highest reported value was U1-RBFD-1 = 377,400,000 Bq/L. The leak was isolated/investigated, corrective actions were taken, and monitoring frequency was increased.

- Although the leak was isolated immediately, the 2020 plume/migration signal remained visible through years. For example, in 2022, Unit 1-related locations were still in the tens of millions Bq/L, including U1-RBFD-1 up to 26,529,000 Bq/L.

October 2023 and November 2023 (faulty pump gaskets)

- New leaks added to the legacy contamination leading to tritium levels in the range 20-30M Bq/L (2023 U1-RBFD-2: **29,822,000 Bq/L**, 2023 U1-RBFD-1: **26,344,000 Bq/L**).

Discussion:
This created a local Area A legacy around Unit 1, VBRS, TAB drains, and IFB-A, which is located close to Area B. Therefore, the next question that I investigated was whether this contamination could pose an environmental risk by migrating into Area B (Units 5–8) during refurbishment.

3. Is there a connection between Area A and Area B?

I analyzed tritium data over years and space and conclude that **there is no direct groundwater flow from Area A into Area B.**

The documented Area A pathway is Unit 1 toward VBRS, TAB, and IFB-A. The documented Area B pathway is Unit 5/6 toward IFB-B and TAB. Both areas are influenced by TAB drainage, which is a controlled engineered capture/common-discharge system, not a passive flow and connection to Area B.

I did not identify a potential risk of legacy Unit 1 groundwater contamination migrating into Area B under the current documented flow interpretation. The Area B concern is its own Unit 5/6/IFB-B pathway and whether refurbishment changes capture conditions.

4. Historical ranges in Area B

Area B has its own tritium history and should not be treated as clean background. Moreover, the reports use confusing language referring to the levels “within historical range” for Units 5-6. The issue is that for western IFB-B groundtubes, the historical range itself includes million-Bq/L groundwater tritium concentrations. Whereas, the reader may anticipate “historical – low levels” instead of millions.

Especially, after they actually refer to low-level historical values within the same paragraph but referring to a different context.

Report	OPG Proprietary		
	Document Number: P-REP-10120-10052		Usage Classification: N/A
	Sheet Number: N/A	Revision Number: R000	Page: 43 of 77
Title: 2023 PICKERING NUCLEAR GROUNDWATER MONITORING PROGRAM RESULTS			

IFB-B

The groundwater results collected from sampling locations in the Irradiated Fuel Bay area located between Units 6 and 7 (IFB-B) are described below.

In 2023, tritium concentrations in the western groundtubes (IFBB-GT-1B, IFBB-GT-2B, and IFBB-GT-3B) decreased relative to 2022. Monitoring wells MW-171-15 and MW-172-25 located further south of Units 5-8 continued to show tritium concentrations within historical ranges reflective of routine operations. In addition, tritium concentrations in each of the eastern groundtubes (IFBB-GT-4B, IFBB-GT-5B, and IFBB-GT-6B) demonstrate decreasing or stable trends. A review of the available groundwater flow conditions suggests groundwater moves from Unit 6, beneath the IFB-B area and ultimately towards the TAB inactive drainage (IAD) sumps. The recent increases in tritium concentrations in the western groundtubes within the IFB-B area are likely related to the elevated concentrations observed in Unit 5 and 6 groundtubes. However, the tritium concentrations within the western IFB-B groundtubes are still within historical range. Groundwater quality in this area will continue to be monitored.

Tritium concentrations over time for the IFB-B groundtubes and monitoring wells are presented in Graphs 31 to 36. The 2023 tritium sample results are presented in Table A-3 (Appendix A). Figure 13 also displays tritium distributions of the Unit 5 to 8 IFBs in HU 6.

Source: Ontario Power Generation. 2023 Pickering Nuclear Groundwater Monitoring Program Results. Document No. P-REP-10120-10052, Revision R000, April 2, 2024. Section 3.1.1.3 Irradiated Fuel Bay Areas, IFB-B, report page 43 of 77.

In the 2023 report, page 43, OPG uses the phrase "historical range" for different groundwater settings with very different concentration magnitudes. I reviewed the 2020 graphs to estimate what the "historical ranges" could mean for different areas and context over time.

My rough estimates of the difference:

- **Routine shallow wells (the first mentioning of the "historical ranges"):** ~10^4 Bq/L
- **Western IFB-B pathway:** ~10^5–10^6 Bq/L

That means western IFB-B is about **one to two orders of magnitude higher** than the shallow "routine operations" wells. The report wording is defensible for OPG since it does not call western IFB-B "routine operations." But it still should define the numerical range, because "historical range" alone hides that the western IFB-B historical level is a much higher contaminated-pathway level.

Recommendation:

The reports should define the historical range numerically and distinguish routine operational fluctuation from a persistent contaminated pathway.

5. Unit 6 and contamination legacy of Area B

Unit 6 and western IFB-B groundwater reached million-Bq/L tritium levels during the 2018–2023 period and are identified in the Area B migration pathway.

Area B has a real tritium source history.

1) 2016: Unit 5

- Unit 5 had a 2016 issue related to degraded construction joints in the moderator room floor. Repairs were done in 2017, and by 2020 the report says Unit 5 groundwater tritium had declined and remained stable.

2) 2018: elevated Unit 6 groundwater and construction-joint repairs.

- The 2020 report says elevated concentrations were identified in the Unit 6 area in 2018 and that construction-joint repairs were undertaken. Based on the graph 14 (page 19), the peak contamination was about 30 million Bq/L (RBU6-GT-3).

3) 2020: Unit 6 Moderator Purification System valve leak.

- In Q4 2020, an emerging Unit 6 issue was traced to a leaking valve in the Unit 6 Moderator Purification System. OPG says actions were taken to stop the leak, the repair was completed, groundwater tritium increased in Unit 6 reactor-building foundation drainage groundtubes and the U6 MK30 sump, and monitoring frequency at the Unit 6 groundtubes and surrounding monitoring wells was increased. The peak reported value was RBU6-GT-2 = 62 million Bq/L.

- The 2020 peak was roughly 2 times higher than that of 2018 in tens of million range.
- The 2020 peak was roughly 1,500–6,000 times higher than shallow-well water of units 5-8 (depending on which shallow-well value use for comparison, from 10,000 to 40,000 Bq/L).

In 2023, tritium levels remained elevated in the millions of Bq/L, although they were generally about 6-10 times lower (depending on the well location) than the 2020 Unit 6 peak.

These estimates are based on my detailed review and interpretation of the reported data and graphs. The reports provide the underlying numerical results, but their narrative interpretation often describes these values more generally as being within “historical ranges,” rather than clearly defining those ranges in the text.

6. IFB-B (Irradiated Fuel Bay B, spent-fuel storage)

IFB-B is a spent-fuel storage bay located between Units 6 and 7 and the major groundwater contamination area is observed beneath it. But important difference, the reports do not say IFB-B itself is leaking, it is interpreted as movement of contaminated groundwater from other sources, especially Unit 6.

The most important concern is whether refurbishment could alter the existing Area B legacy contamination.

7. Groundwater hydrological-control options

There are two different groundwater-management pathways that matter for this review. Not all groundwater near Area B reactors goes to RLWMS (waste management system).

Option 1: Radioactive Liquid Waste Management System, RLWMS.

- For Units 5–8, the reactor-building foundation drainage sumps, U5 MK26, U6 MK30, U7 MK36, and U8 MK42, are described as collecting groundwater from foundation drainage rings around the reactor buildings and pumping it to the RLWMS. This pathway gives more explicit radiological classification, accounting, monitoring, and operational control.

Units 5–8 (reactor-building foundation) → RLWMS → monitored liquid effluent discharge → Lake Ontario

Option 2: Inactive drainage / TAB IAD / CCW intake duct / forebay pathway.

- This is a different pathway. TAB (Turbine Auxiliary Bay) foundation drains collect groundwater and terminate in TAB IAD (Inactive Drainage) sumps. The updated PERA pathway states that inactive drainage will not be re-routed to RLWMS, RBSW, or the Units 5–8 discharge channel. Instead, it will discharge to the relevant CCW (Condenser Cooling Water) intake duct, with dilution before final discharge.

Unit 5/6 (groundwater) → **beneath** IFB-B → toward **TAB IAD sumps via TAB foundation-drain influence** → CCW (Condenser Cooling Water) intake duct → **Forebay** → Lake Ontario

Difference between the hydrological controls:

- Option 1 (RLWMS) does not necessarily remove tritium, but it provides clearer radiological waste control via radiological classification, accounting, possible hold-up, sampling, and discharge control.

- Option 2 (inactive drainage) also relies on monitoring and dilution, but the concern is whether high-tritium groundwater in area B is being classified, sampled, and controlled strongly enough before dilution. Million-Bq/L contamination needs stronger proof that pre-dilution sampling and trigger rules are adequate.

8. No practical tritium removal is available

Tritium in groundwater is generally present as tritiated water, commonly HTO, where tritium substitutes for ordinary hydrogen in the water molecule. Therefore, it not practically removed from large volumes of dilute groundwater by conventional water treatment. In the absence of practical contaminated groundwater remediation, core management is mainly:

a) Source repair,
b) Capture,
c) Sampling,
d) Controlled discharge,
e) Dilution,
f) Decay,
g) Dose control.

Therefore, the difference between RLWMS and inactive drainage is not “treatment versus no treatment”, but difference is **control and transparency before dilution**.

Transparency concerns:

1. If there is no active tritium removal, then the only real environmental protection tools are **source prevention, hydraulic control, pathway-specific monitoring, early warning, and transparent reporting**. However, the refurbishment budget and scale do not provide clarity on million-Bq/L tritium levels management (discussed in detail below).

2. Because tritium is not removed through conventional chemical or filtration treatment, the wording in the PERA in section 4.2.2 may be misleading for a general audience:

> *“All effluent collected through drainage systems is analyzed by OPG (and treated if necessary) to ensure it meets radiological and non-radiological limits prior to discharge to Lake Ontario.”*

4.2.2 Water and Sediment Quality

4.2.2.1 Water Quality

PNGS currently interacts with the surface water quality of Lake Ontario as all liquid effluent (except for sewage, which goes to into the Regional Municipality of Durham sewage mains) and some stormwater drainage is discharged into the CCW discharge duct, the outfall structures or the forebay. All effluent collected through drainage systems is analyzed by OPG (and treated if necessary) to ensure it meets radiological and non-radiological limits prior to discharge to Lake Ontario.

This statement is not necessarily incorrect, because some effluent may require treatment for non-radiological parameters or other contaminants. However, it could lead readers to assume that million-

Bq/L tritiated groundwater undergoes an active radiological treatment process before discharge. While tritium management appears to rely primarily on source control and dilution, rather than removal of tritium from the water.

9. The safe envelope and the later amendment

2017 Safe Storage PEA:

- The PERA reports that the 2017 Safe Storage PEA assumed discharges from **TAB foundation drains and VBRS** would be routed to **RLWMS**.

2022 PEA Addendum:

- The assumption changed. The 2022 PEA Addendum assessed continued discharge of groundwater from **TAB foundation drains and VBRS** to **CCW intake ducts**, eventually reaching the **forebay**, instead of routing them to RLWMS.

2025 PERA for refurbishment:

- The PERA says that during Units 5–8 refurbishment, drainage systems will remain operational, additional flow may go to RLWMS during system draining, but **inactive drainage will not be re-routed to RLWMS**. The revised strategy is discharge to the respective **CCW intake duct**, with dilution before discharge.

Conclusion:

- The 2017 assumption appears more conservative with respect to radiological routing, while the 2022 Addendum relies more explicitly on CCW dilution and intake-duct routing.
- The 2025 PERA says inactive drainage will not be re-routed to RLWMS and will discharge to CCW intake ducts, with greater CCW flow reducing predicted concentrations.

10. Compliance is not the same as source control

The reviewed reports support a low public-exposure conclusion, but that should be separated from the question of whether the on-site source and migration pathways are fully controlled.

A high tritium value in a reactor-building groundtube, foundation drain, or IFB-B groundtube reflects local groundwater contamination near a source area or engineered capture pathway. This groundwater is not used directly as drinking water. Public exposure is assessed after collection, routing, dilution, environmental dispersion, and receptor modelling. The PERA dose estimates are low, about 0.999–1.24 µSv/year, roughly 0.1% of the 1,000 µSv/year public dose limit, which supports a compliance conclusion for public exposure.

However, low off-site dose does not prove that the source is fully controlled. The groundwater reports often emphasize that downgradient or perimeter results are below criteria, that there is no identified end-use impact, and that water is managed through sumps or monitored pathways. This is important, but it mainly demonstrates containment and exposure control, not necessarily source elimination or active reduction of the on-site plume.

This distinction matters because the reviewed data show continuing on-site variability: Unit 6 and western IFB-B remained at million-Bq/L levels in 2022–2023, while Area A Unit 1 also showed persistent elevated values after the 2020 leak and new 2023 leaks. These patterns are not consistent with a simple story of old contamination passively decaying away. They suggest that local pathways, drainage systems, source-side conditions, and operational events still matter.

Therefore, the licence review should not rely only on the statement that there is no off-site impact. It should also require evidence of source control, pathway control, event-based monitoring, and transparent routing decisions, especially where tritiated groundwater may enter TAB IAD / inactive drainage rather than RLWMS.

11. Non-radiological water control: compliance is not the same as chemical source reduction

With non-radiological water control, the concern is the routine chemical burden associated with cooling-water, service-water, corrosion-control, and biofouling-control systems. The PERA appears to rely on existing compliance and dilution logic, without examining whether refurbishment should reduce chemical dependence at source. Such large refurbishment program creates a rare opportunity to move ***from a "monitoring and dilution" model to a "source reduction" model***, especially for chemicals such as sodium hypochlorite, sodium bisulphite, hydrazine, morpholine, ammonia, and sulphuric acid. Since Pickering's once-through cooling-water scale is about 116 m^3/s, or roughly 10,000,000 m^3/day, even small concentrations change can still become large cumulative mass flows to Lake Ontario over next 30 years of operation.

The PERA concludes that non-radiological waterborne emissions during Units 5–8 refurbishment are not expected to create adverse effects because monitored parameters, including ammonia, hydrazine, morpholine, pH, and total residual chlorine, have remained within regulatory limits in recent operating years. PERA also states that morpholine and hydrazine will continue to be used during refurbishment to protect equipment and piping from corrosion, and that hydrazine will continue at current levels. If necessary, CCW flows may be adjusted to keep discharges within ECA limits. This shows a compliance-based approach to water chemistry management.

However, compliance with concentration limits is not the same as reducing the source of chemical loading. Pickering Units 5–8 operate with a once-through lake-water cooling interface at very large flow scale, and the refurbishment is intended to support approximately 30 additional years of operation. In this context, continued reliance on legacy chemical conditioning should be assessed not only by whether final discharge concentrations meet limits, but also by **whether avoidable chemical inputs to Lake Ontario can be reduced at source**. In my analysis, I identified sodium hypochlorite, sodium bisulphite, hydrazine, morpholine, ammonia, and sulphuric acid as chemicals or related parameters relevant to this source-reduction question.

The proposed Deep Water Intake is an important physical modernization measure. PERA states that it is expected to reduce fish impingement and entrainment and may reduce certain biofouling events. However, changing **where** water is taken from does not demonstrate the opportunity of changing **how** water-conditioning chemistry can be modernized. The PERA does not appear to provide a refurbishment-specific alternatives assessment for non-chemical or lower-chemical water conditioning, despite confirming continued hydrazine and morpholine use during refurbishment.

Therefore, the refurbishment review should ask:

- ***Can the refurbishment reduce or eliminate avoidable chemical inputs to Lake Ontario over the next 30 years?***

This is an important distinction, because compliance protects against unacceptable concentrations. Whereas, source reduction reduces total chemical loading, operational hazard, storage/handling risk, and long-term dependency on dilution.

The licence review should request a non-radiological water source-reduction assessment. This should include: current and projected annual mass loads and an evaluation of Best-Available-Alternatives for biofouling, mussel control, corrosion support, and automated monitoring; and a clear explanation of why continued chemical use is preferable to lower-chemical or non-chemical options over the refurbishment lifetime.

Questions that require clarification and transparency on non-radiological source reduction:

1. What are the annual mass loads, not only concentrations, of hydrazine, morpholine, ammonia, total residual chlorine, sodium hypochlorite, sodium bisulphite, and pH-control chemicals expected during refurbishment and during the 30-year continued-operation period?
2. Does the PERA or supporting technical documentation evaluate non-chemical alternatives for biofouling and mussel control, or only assess compliance of the existing chemical system?
3. Since PERA states hydrazine and morpholine will continue to be used during refurbishment, what justification is provided for not reducing or replacing these chemicals during a major capital refurbishment?
4. How will DWI affect the need for chemical biofouling control? Will sodium hypochlorite use decrease, remain the same, or increase?
5. Does OPG have a chemical source-reduction target for waterborne non-radiological emissions during the post-refurbishment operating period?
6. If CCW flow is used to maintain discharge concentrations below limits, how is cumulative mass loading to Lake Ontario evaluated?
7. Are effects assessed only at the final discharge concentration, or also in terms of cumulative ecotoxicity load over 30 years?
8. Will OPG commit to a Best-Available-Alternatives review for non-chemical water conditioning before finalizing refurbishment water-system design?

12. Recommendations for the licence review

The PERA should not assume that the Area B groundwater pathway is adequately controlled merely because active radioactive liquid waste goes to RLWMS. The reports identify a separate Unit 5/6 → IFB-B → TAB IAD groundwater pathways, while the PERA states that inactive drainage will not be re-routed to RLWMS but will discharge to CCW intake ducts / forebay. Therefore, the licence review should require a clear pathway-specific tritium monitoring and contingency plan for Area B during refurbishment: “**Units 5–8 Tritium Groundwater Pathway Control Plan**.”

The “historical levels” of tritium groundwater concentration in Area B has shown that:

1. Refurbishment must account for diverse groundwater paths and active control of million-Bq/L contamination.
2. Must assume **potential recurrence of high-concentration zones.**

Therefore, the following questions require clarification and more transparency:

1. What exact water from Units 5–8 goes to RLWMS, and what exact water goes to inactive drainage / CCW intake duct / forebay?
2. If Unit 6 groundwater migrates beneath IFB-B toward TAB IAD sumps, is that water treated as inactive drainage or radiological liquid waste? If tritium-impacted groundwater from the Unit 5/6–IFB-B pathway enters TAB IAD / inactive drainage, what decision rule determines whether it remains in the inactive-drainage pathway or is managed through RLWMS or another radiological-control pathway?
3. What tritium concentrations were measured in TAB IAD sump water during 2021–2023, especially when IFB-B western groundtubes were in the million-Bq/L range?
4. Did the 2022 PEA Addendum consider the 2022–2023 IFB-B western groundtube data, or was the routing update based on earlier assumptions?
5. What numerical trigger requires water to be held, resampled, redirected to RLWMS, reported, or otherwise controlled? What are the trigger levels or contingency actions for water that is classified as “inactive drainage” but may receive tritium-impacted groundwater from a known million-Bq/L pathway.
6. How will refurbishment activities, including shutdown, dewatering, heavy-water handling, sump maintenance, and pumping changes, affect the Unit 5/6 → IFB-B → TAB IAD pathway?
7. Will OPG implement event-based monitoring for Unit 5/6 groundtubes, IFB-B groundtubes, TAB IAD sumps, CCW intake duct water, forebay, and final discharge during refurbishment?
8. How is “historical range” defined numerically for IFB-B western groundtubes?
9. Why is the updated CCW/forebay pathway considered sufficiently conservative compared with the earlier RLWMS routing assumption? Whether the control will be sufficient during and after refurbishment if million-Bq/L tritium groundwater enters TAB IAD / inactive drainage rather than RLWMS.

10. What evidence shows that no groundwater-pathway change will occur during refurbishment?
11. Will OPG commit to a Best-Available-Alternatives review for non-chemical water conditioning before finalizing refurbishment water-system design?