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## **Update from CNSC Staff**

## **Mise à jour du personnel de la CCSN**

Follow up from June 28, 2023  
Commission Meeting

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Suivi de la réunion de la Commission du  
28 juin 2023

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**Update on the Unit 4 Primary Heat  
Transport Purification System Leak at  
the Bruce Nuclear Generating  
Station A**

**Mise à jour sur la fuite d'eau lourde  
provenant du système d'épuration du  
circuit caloporteur de la tranche 4 de  
la centrale nucléaire de Bruce-A**

Signed on / Signé le  
2023-11-28

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Directeur général, Direction de la réglementation des centrales nucléaires

## BRIEFING NOTE FOR THE COMMISSION

### ISSUE OR PURPOSE

The Commission requested that CNSC staff provide the Commission with an update on the compliance activities conducted following the Unit 4 Primary Heat Transport (PHT) Purification system leak at the Bruce Nuclear Generating Station (NGS) A (Bruce A) that occurred on April 25, 2023 and was reported to the Commission via an [Event Initial Report](#)<sup>1</sup>. on June 28, 2023. This briefing note aims to fulfill the Commission's direction documented in paragraph 42 of the June 28, 2023 Commission meeting [minutes](#)<sup>2</sup>.

### BACKGROUND

On April 25, 2023 at 14:07, Bruce Power staff received indication of an increased PHT coolant (heavy water) system leak rate in Bruce A, Unit 4. Efforts to locate and isolate the source of the leak were initially unsuccessful due to a failure of the moisture-detecting beetle located at the leak location. With an estimated leak rate of approximately 600-700 kg/h at 16:43, Bruce Power entered an 8-hour clock for unit shutdown and cooldown, per normal procedures. Actions were subsequently taken to conservatively remove the unit from service as the PHT leak rate continued to increase. Unit shut down started at approximately 19:30. The leak was confirmed to be in the PHT Purification room outside containment at 1:00 on April 26, 2023. Bruce Power declared a radiological incident, mobilized staff to isolate the leak and begin clean-up at approximately 1:10. Isolation of the leak was complete by 1:20. Bruce Power estimated the total amount of contained heavy water that leaked from the Unit 4 PHT system during the event to be 135 Mg. The cause of the leak was determined to be a failed hose on the outlet side of one of the Unit 4 PHT Purification system filters.

In response to the event, Canadian Nuclear Safety Commission (CNSC) staff conducted a series of regulatory activities to assess licensee compliance with regulatory requirements. This briefing summarizes what these compliance activities were as well as any findings.

### CNSC STAFF COMPLIANCE ACTIVITIES RELATED TO THE BRUCE A UNIT 4 HEAVY WATER LEAK EVENT

CNSC staff carried out a series of compliance verification activities in response to the April 25, 2023 event.

#### **Surveillance and Monitoring:**

Upon verbal notification of the event at approximately 7:20 on April 26, 2023, a CNSC site inspector was dispatched to Bruce Power's Emergency Management Centre to monitor Bruce Power's event response. CNSC staff also monitored remotely via Bruce Power's online

emergency management system, which provided online updates regarding the emergency actions implemented by Bruce Power. CNSC staff continued to monitor and assess Bruce Power's response actions over the course of the day.

CNSC staff continued to monitor Bruce Power's spill recovery efforts and short-term actions in the days following the event. CNSC staff also held post-event follow up meetings with Bruce Power on May 9, June 23, July 11, and July 20, 2023 to obtain additional information on the causes of and follow up in response to the event. Through these meetings, CNSC staff gathered information to assess and verify Bruce Power's compliance with regulatory requirements both during and following the event.

## **Inspections**

Based on the information gathered during meetings with Bruce Power and other surveillance and monitoring activities, CNSC staff performed reactive field inspection activities and modified several planned baseline inspections to further verify Bruce Power's compliance with its licence requirements. Inspections focused on the causes of the event as well as Bruce Power's recovery from and follow up after the event.

### May 29, 2023: Baseline Field Inspection - Radiation Protection Bruce A Unit 4 (A2341 Outage)

The event occurred one week prior to the start of the Unit 4 planned outage. During the planned outage, CNSC staff conducted an inspection of areas where the event occurred. Through this inspection CNSC staff observed the establishment and maintenance of contamination control areas, hazard signage, and boundaries to control any residual radiological hazards in the vicinity of the PHT purification room. CNSC staff determined that the inspected radiation protection controls were mostly meeting the requirements. Minor deficiencies included out-of-date signage, removal of temporary catch containment and housekeeping. CNSC staff were satisfied that Bruce Power implemented corrective actions to correct all minor deficiencies found and to ensure compliance with all relevant standards.

### June 9, 2023: Reactive Field Inspection - Environmental Protection Event Follow-Up

Verifications performed during this field inspection were to confirm that Bruce Power's spill maps and flowsheets were aligned with the field configuration of each of the drains in the vicinity of the PHT leak. CNSC staff observed discrepancies with the flowsheets and spill maps in three instances from nearby drains. In response to the observed non-compliance with its documentation, Bruce Power implemented corrective actions for each of the three discrepancies. CNSC staff concluded that Bruce Power's corrective actions for the above non-compliance were acceptable.

### June 21 to July 7, 2023: Reactive Field Inspection – Radiation Protection Response to PHT Leak

CNSC staff interviewed Bruce Power staff participating in the response to the event as well as several staff involved in Bruce Power's event investigations. The discussions and document reviews showed that,

- Bruce Power’s roles and responsibilities were well defined
- Bruce Power sufficiently used its event response, and problem identification and resolution processes
- Bruce Power staff responding to the event had the required qualifications
- Contamination control areas, barriers, signage and radiation instruments were effectively used to minimize dose and contamination of personnel responding to the event.

This inspection also showed that Bruce Power adequately self-identified deficiencies with procedure adequacy, procedure usage, records, radiation personal protective equipment, use of extremity dosimetry, and spill kit adequacy. Bruce Power implemented appropriate corrective actions through the Root Cause and Learning Team Investigations.

October 16-20, 2023: Baseline Type II Inspection – Maintenance Planning and Scheduling  
 CNSC staff included in its October 2023 planned inspection on maintenance planning and scheduling the verification of changes Bruce Power made to preventive maintenance strategies for purification system hoses and moisture detection beetles. The inspection report is currently in progress. However, the preliminary results of this inspection demonstrate that Bruce Power met all regulatory requirements to ensure the safety of the workers, the public and the environment throughout the event and during the clean-up phase.

Overall <sup>3</sup>, CNSC staff concluded that corrective actions were either completed or are in progress with additional oversight from Bruce A senior leadership to address 6 non-compliances related to procedure and flowsheet adequacy, procedure adherence, PPE availability and readiness, use of dosimetry, and spill response management. Bruce Power was advised of these non-compliances as each inspection was conducted and had completed or begun the implementation of corrective actions in their managed system. As a result, no notices of non-compliance, nor any enforcement actions were required. CNSC staff will continue to monitor the associated Safety Control Areas (SCAs) through its regular field inspections to assess compliance and trends.

### **Review of Bruce Power Submissions Related to the Event**

As required by *REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants* <sup>4</sup>, Bruce Power submitted a *Preliminary Event Report* <sup>5</sup> on May 3, 2023 and a *Detailed Event Report* <sup>6</sup> (DER) on August 23, 2023. CNSC staff reviewed both reports and further follow up was sought from Bruce Power to understand the assigned radiological dose impact to workers who responded to the event. An amended version of the *DER* <sup>7</sup> with this additional information was subsequently submitted by Bruce Power on September 1, 2023. Of the 176 Nuclear Energy Worker staff involved in the initial spill response and subsequent clean-up and mitigation efforts, Bruce Power reported that plant Nuclear Energy Worker (NEW) staff were assigned 20 mSv (2 rem) in total for this event with the greatest dose to an individual being 1.98 mSv (0.198 rem). All results were below the radiological effective dose limits for a NEW which are 50 mSv (5 rem) in a 1-year period and up to 100 mSv (10 rem) for 5-year period per the Radiation Protection Regulations <sup>8</sup>. Bruce Power reported that post-incident investigations revealed the release of approximately 25 curies of tritium which does not

result in any adverse environmental impact or risk to the public.

In the DER, Bruce Power reported that it had leveraged its problem identification and resolution program to learn from the event and improve its event response. Bruce Power's actions included the completion of an event review board where immediate response to the event was evaluated and a root cause investigation generated corrective actions intended to prevent or minimize the likelihood of recurrence. The DER also provided information about Bruce Power's Learning Team investigation through which Bruce Power workers involved in the event response proposed corrective actions. Each investigation had oversight from Bruce A's Senior Leadership Team and all corrective actions were captured in Bruce Power's corrective action system.

CNSC staff reviewed the output of each completed investigation to verify whether Bruce Power followed regulatory requirements and its internal processes. Of the 23 key actions listed in the DER, 17 have since been completed with the remaining six on track to be completed by their scheduled completion dates. Of note, Bruce Power:

- has adjusted its preventive maintenance strategy to replace all non-metallic pressure boundary hoses every six months
- has shared lessons learned from its investigations to the broader nuclear industry
- has implemented interim actions to address performance and reliability issues with existing moisture detecting beetles
- has increased surveillance of the beetles until a new and enhanced moisture detecting beetle design is implemented across all Bruce Power unit locations (429), currently planned to be completed in January 2030. CNSC staff plan to monitor progress of this through its planned field inspections
- has conducted anonymous post-event nuclear safety culture surveys with Bruce Power workers staff to understand strengths and areas for improvement. The output is expected to be delivered as part of a case study to site leaders and staff starting in December 2023.

In addition to the 23 corrective actions listed in the DER, each of the remaining corrective actions from the Root Cause and Learning Team investigations are subject to Bruce A Senior Leadership quality and timeliness review.

CNSC staff also assessed the emergency response actions taken by Bruce Power during the April 25, 2023 event. In June 2023, CNSC staff requested via a letter and an action item<sup>9</sup> that Bruce Power assess the adequacy of its emergency response program and develop an associated action plan. This was based upon CNSC findings where it was believed the declaration of a station emergency, entry into its abnormal incidents manual, and notification to the CNSC Duty Officer could have been initiated sooner than what occurred. A Bruce Power letter<sup>10</sup> detailed the corrective actions that Bruce Power intends to take by December 31, 2023 to address these findings and improve its emergency response program documentation. CNSC staff plans to review the completion of these corrective actions following Bruce Power's submission to the CNSC planned for January 31, 2024.

CNSC have determined that Bruce Power’s submissions related to this event have been adequate. CNSC staff plan to continue verifying submissions provided by Bruce Power to ensure it is implementing all remaining corrective actions.

## CONCLUSION

Results of surveillance and monitoring, submission reviews, and inspections conducted by CNSC staff for this event confirmed that Bruce Power is taking appropriate actions to address non-compliances found with procedure and flowsheet adequacy, procedure adherence, PPE availability and readiness, use of dosimetry, spill response management, and its emergency response program. Bruce Power is on the right path to meeting regulatory requirements such that the safety of workers, the public and the environment continues to be protected.

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**Reviewed by:** *Kimberly Hazelton, Acting Director General, DPRR*

**Approved by:** *Karen Owen-Whitred, Acting Executive Vice-President, ROB*

**Date:** November 28, 2023

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## REFERENCES:

<sup>1</sup> [CMD 23-M20](#), Event Initial Report, “Bruce A Unit 4 Heat Transport Purification System Heavy Water Leak”, presented at the Commission meeting on June 28, 2023, e-Doc 7066144.

<sup>2</sup> “Minutes of the Canadian Nuclear Safety Commission (CNSC) Meeting held on June 28, 2023”, September 11, 2023, e-Doc 7123934.

<sup>3</sup> Inspection Report, “BRPD-A-2023-19095 – Inspection Report – Unit 4 PHT Leak Summary Report”, e-Doc 7123934.

<sup>4</sup> REGDOC-3.1.1, Version 2, “Reporting Requirements for Nuclear Power Plants”, April 2016, [https://nuclearsafety.gc.ca/pubs\\_catalogue/uploads/REGDOC-3-1-1-v2-Reporting-Requirements-for-Nuclear-Power-Plants-eng.pdf](https://nuclearsafety.gc.ca/pubs_catalogue/uploads/REGDOC-3-1-1-v2-Reporting-Requirements-for-Nuclear-Power-Plants-eng.pdf)

<sup>5</sup> Preliminary Event Report, “REGDOC-3.1.1-B-2023-263308-PER-Unit 4 Leak in Heat Transport Purification System”, May 4, 2023, e-Doc 7033842

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<sup>6</sup> Detailed Event Report, “REGDOC-3.1.1-B-2023-263308-DR-Unit 4 Leak in Heat Transport Purification System”, August 23, 2023, e-Doc 7113421

<sup>7</sup> Detailed Event Report Addendum, “REGDOC-3.1.1-B-2023-263308-DR-Unit 4 Leak in Heat Transport Purification System A0”, September 1, 2023, e-Doc 7123262

<sup>8</sup> Radiation Protection Regulations, SOR/2000-203, Current to October 31, 2023, <https://laws.justice.gc.ca/PDF/SOR-2000-203.pdf>

<sup>9</sup> Letter, M. Hornof to M. Burton, “Bruce A Unit 4 Primary Heat Transport Purification Leak Event, April 25, 2023 – Emergency Response Actions – New Action Item 2023-07-27907”, June 23, 2023, e-Doc 7059959, BP-CORR-00531-04286.

<sup>10</sup> Letter, M. Burton to M. Hornof, “Response to Primary Heat Transport Purification Leak Event, Emergency Response Actions, Action Item 2023-07-27907”, August 31, 2023, e-Doc 7119107, BP-CORR-00531-04317.