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## Event Initial Report

## Rapport initial d'événement

### **Orano Canada Inc., McClean Lake Operation**

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Elevated Hydrogen Level in Leach  
Tank

### **Orano Canada Inc., installation de McClean Lake**

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Niveau d'hydrogène élevé dans le  
réservoir de lixiviation

Commission Meeting

Réunion de la Commission

January 21, 2021

Le 21 janvier 2021

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# EVENT INITIAL REPORT (EIR)

e-Docs #6452126

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|---|---|
| <b>EIR: Elevated Hydrogen Level in Leach Tank - Niveau d'hydrogène élevé dans le réservoir de lixiviation</b>   |   |
| <b>Prepared by:</b> Directorate of Nuclear Cycle and Facilities Regulation – Uranium Mines and Mills Division   |   |
| <b>Licensee:</b> Orano Canada Inc. (Orano)  | <b>Location:</b> McClean Lake Operation - Saskatchewan  |
| <b>Date Event was Discovered:</b> 2020-12-15  | <b>Have Regulatory Reporting Requirements been met?</b><br>Yes <input checked="" type="checkbox"/> No <input type="checkbox"/><br><br><b>Proactive Disclosure:</b><br>Licensee: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> CNSC: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> |
| <b>Overview</b>   |   |
| <b>Reporting Criteria:</b> Elevated Hydrogen Level in Leach Tank  |   |
| <b>Description:</b><br><br><u><b>System Overview</b></u><br><br>The ore slurry received from Cameco's Cigar Lake Operation is mixed with acid and other reagents in the Leaching Circuit at the McClean Lake Operation to extract the uranium from the ore in the milling process. The Leaching Circuit used at McClean Lake is Leaching Circuit No. 2, which is comprised of seven secondary leach tanks and may be operated in series or in parallel (See Figure 1 for a schematic of one tank in Leaching Circuit No. 2). Leaching Circuit No. 1 has not been used since 2014.<br><br>The liquid output from the Leaching Circuit undergoes further separation and refinement in the same mill complex to produce the final calcined yellowcake product that is shipped to a refinery.<br><br><u><b>Changes to the Leaching Circuit</b></u><br><br>The McClean Lake mill is currently only processing ore slurry that is transported from Cameco's Cigar Lake Operation. During the laboratory testing of the Cigar Lake ore, Orano found that the process of acid leaching released significant hydrogen; something that had not been previously encountered with other ore bodies. The hydrogen accumulated in the ore as a result of radiation hydrolysis of groundwater with the hydrogen being trapped in the clay encapsulating the mineralization along with the uranium. When the ore slurry is exposed to the acid in the Leaching Circuit, the hydrogen is released as a gas.<br><br>Once this potential hazard had been identified and before processing ore from Cigar Lake, Orano took steps to mitigate the hydrogen risk by modifying the Leaching Circuit No. 2 (figure 1). Orano used a defence-in-depth strategy to ensure that hydrogen did not accumulate in the headspace of leaching tanks. Orano installed a sweep air system (figure 2), using air moving along the surface of the liquid in the tank to keep the hydrogen from accumulating; then safely releasing it outside the building to the atmosphere. In addition, Orano also installed a nitrogen purge system which brings the system to a safe state by blanketing the Leach Vessel headspace with inert nitrogen in case of a sweep air system failure or when significant levels of hydrogen are detected. Finally, each tank is designed to maximize explosion-proofing, minimizing sources of ignition.<br><br><u><b>Control</b></u><br><br>Each tank contains two hydrogen analysers which measure the level of hydrogen under the cover of each tank. These monitors typically record low level values of 0.1 to 1.0 percent hydrogen as it is being swept away. The system is set to alarm at a 2 percent hydrogen concentration level and again at the next threshold of 2.4 percent hydrogen concentration (figure 3). It is at this point where a nitrogen purge system is triggered, flooding the tank with inert nitrogen (figure 4). For reference, hydrogen has a lower explosive limit (LEL) of 4 percent and an upper explosive limit of 75 percent, a very wide range for any potentially explosive gas. By comparison, propane - which is widely used at the site as an energy source - has an explosive range from 2.1 percent to 10.1 percent. The nitrogen safety system is designed to trigger at 2.4 percent, well below the LEL for hydrogen (4%). Orano reported that the systems have worked well to date and the sweep air system has always been able to prevent hydrogen accumulation. Each tank has its own independent sweep air system, comprised of feed air and exhaust system for each tank and independent hydrogen analysers.<br><br><u><b>Event</b></u><br><br>On the evening of December 14, 2020, the Secondary Leach Tank (SLT) #7 agitator tripped out on high amperage numerous times over a two-hour period. As a result, SLT #7 was bypassed to troubleshoot the issues with the agitator. SLT #7 was not drained as the agitator electrical motor is external to the tank, therefore no personnel were required to enter the tank. At approximately 23:00, the sweep air system, a safeguard which mitigates hydrogen accumulation in each tank, was mistakenly bypassed, leading to a potential unsafe condition. Workers had conducted a full bypass of the tank, comprising both liquid and sweep air bypass, when only the liquid bypass was required. |   |

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At approximately 07:30 on the morning of December 15, 2020, members of the incoming shift observed in the control room that the hydrogen levels in SLT #7 were elevated, but had not exceeded alarm threshold levels. The sweep air system for SLT #7 was returned to service and the resulting movement of sweep air into the tank caused a hydrogen analyser to register a level of 4.25%. Since this was well above the second alarm threshold of 2.4%, the system automatically activated the nitrogen purge system to place the tank into a safe state, as per design.

Orano undertook an internal investigation and classified the incident as having a high potential for serious consequences. As such, the Saskatchewan Ministry of Labour Relations and Workplace Safety (LRWS) Mines Inspector was contacted by Orano on December 17, 2020 to further discuss the event and the event was considered a dangerous occurrence by LRWS.

Orano is required to report high potential events as Dangerous Occurrences under *Saskatchewan Occupational Health and Safety Regulations*.

The CNSC Duty Officer and Project Officer were also called on December 17, 2020.

It should be noted that at no time was any hydrogen analyser in this circuit inoperable; the safety systems worked as designed, triggering the nitrogen purge system and the alarm as measured levels exceeded the 2.4% upper threshold.

### Cause(s):

Orano's investigation identified the following causes to this event:

- Inadequate training and/or awareness of the workers involved in the leach tank bypass contributed significantly to the situation.

The ability to bypass a Leach Tank is a new feature in the Leaching Circuit which Orano implemented in September 2020. Although the tank-bypass system has only been used a few times, Orano recognizes that it is deficient on completion of training on this modification.

## Impact of the Event

### On People:

How many workers have been (or may be) affected?

- No workers were affected.

How many members of the public have been (or may be) affected by the event?

- No members of the public were affected.

How were they affected?

Although workers and members of the public were not affected, the event had a high potential risk for a serious injury or fatality because an important safety system had been mistakenly bypassed.

### On the Environment:

- There were no actual or anticipated effects on the environment.

### Other Implications:

- There is the potential that similar events could occur at other uranium mills, if common designs are in place, when processing ore that contains a significant quantity of entrapped hydrogen.

## Licensee Actions

### Taken or in Progress:

- The tank was returned to a safe state by reactivating the sweep air system and the nitrogen purge system.
- The sweep air control valves to physically bypass the sweep air system were locked open on all seven secondary leach tanks. The locks can now only be removed by a Mill Operations General Supervisor.

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- After Orano's consultation with the Saskatchewan Ministry's (LRWS) Mine Inspector, the CNSC Duty Officer was notified on December 17, 2020 (e-Doc 6449987). Orano provided an initial written notification on December 18, 2020 (e-Doc 6449892) and a follow-up report on December 24, 2020 (e-Doc 6452691) under Section 29(2) of the *General Nuclear Safety and Control Regulations*.

### Planned:

- An additional barrier will be implemented through the digital control system (DCS) in order to bypass the sweep air critical control (e.g., password controlled, pop-up on DCS screen). The anticipated completion date is January 15, 2021.
- Improvements will be made to the following work instructions and subsequent training will take place on both work instructions by March 2021:
  - 501-13 Leaching SLT Bypass
  - 580-28 Control Bypass.
- This event and subsequent investigation will continue to be presented to the Mill Operations and Maintenance Groups with focus on the lessons learned.

## CNSC Actions

### Taken or in Progress:

- CNSC staff completed an initial review of the incident and held teleconference discussions and assessment of the cause with Orano on December 18, 2020.
- CNSC staff have also separately talked to the Chief Mines Inspector for the Province of Saskatchewan who reviewed the steps to be taken following a dangerous occurrence under their legislation:
  - The occupational health and safety committee at McClean Lake and the company itself will conduct investigations as to the cause and prepare a report on the matter.
  - Orano submitted a follow-up report on December 24, 2020 (e-Doc 6452691) to the CNSC and the Province with corrective actions, which was duly signed by the employer and the worker representatives of the occupational health and safety committee.
  - The Province will review the report and make a determination if any regulations have been contravened; the appropriate actions will be taken by the Province.
  - CNSC staff have agreed to cooperate and collaborate with the Province on this matter.
- CNSC staff have reviewed Orano's initial incident report (e-Doc 6449892) and the follow-up report (e-Doc 6452691) and are satisfied with the corrective actions taken or in progress.
- CNSC staff are satisfied that Orano has taken appropriate actions to avoid similar incidents in the future.
- CNSC staff will continue to review additional information, if any, as submitted by Orano.

### Planned:

- CNSC staff will verify the corrective and preventive actions taken and planned by Orano during an upcoming remote compliance inspection of the McClean Lake site scheduled for January 25 to 29, 2021. This remote inspection is focused on the Human Performance Management (Training) safety and control area.

### Additional reporting to the Commission Members anticipated:

Yes

No

If Yes, provide method of reporting: N/A

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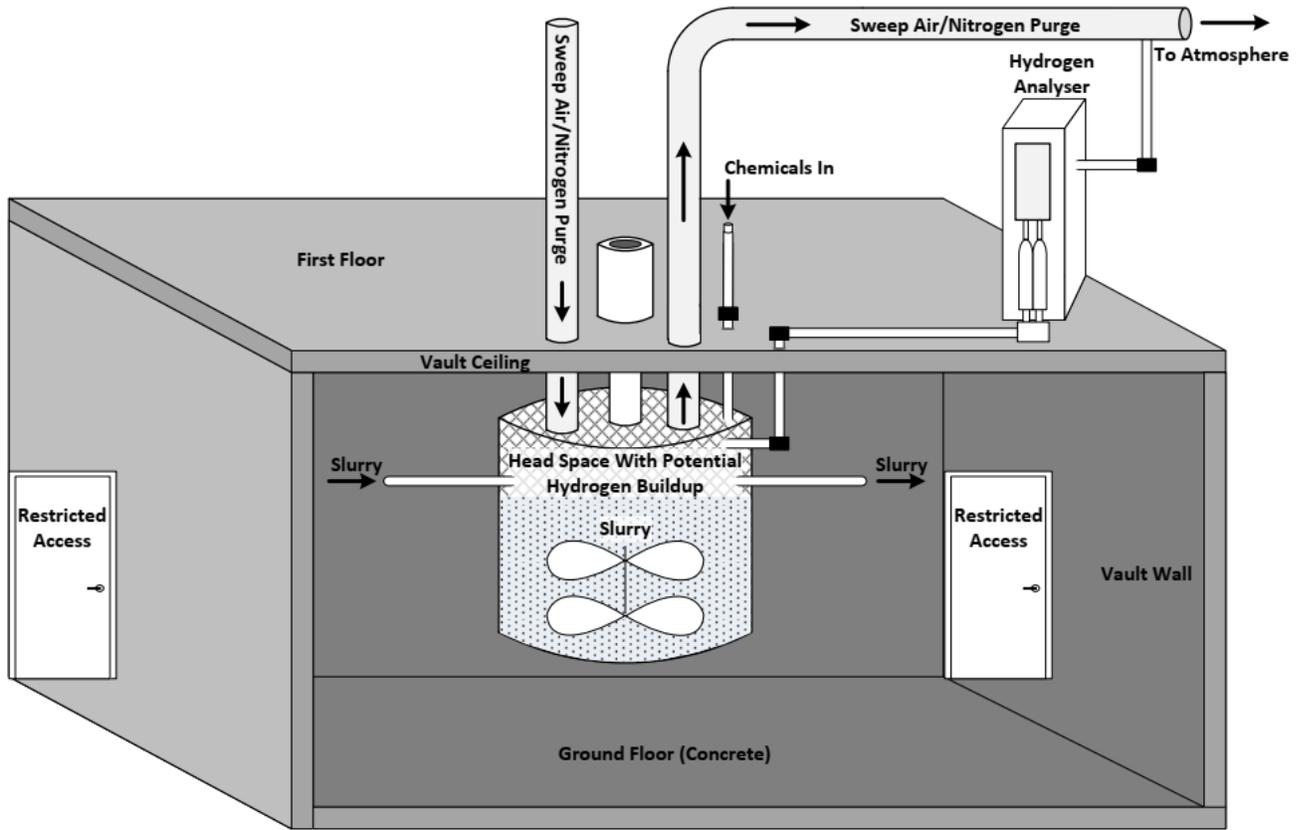
**EIR: Elevated Hydrogen Level in Leach Tank - Niveau d'hydrogène élevé dans le réservoir de lixiviation**

| Name and Title  | Signature  |
|---|--|
| <p><b>Kavita Murthy</b></p> <p>Directorate of Nuclear Cycle and Facilities Regulation</p> | <p style="text-align: right;">1/12/2021</p> <p><b>X</b> </p> <hr/> <p>K. Murthy<br/>Director-General, DNCFR<br/>Signed by: Murthy, Kavita</p> <hr/> <p>Director General <span style="float: right;">Date</span></p> |

**APPENDIX A**

**Figures**

# EVENT INITIAL REPORT (EIR)



**Figure 1:** 3D view of Leaching Circuit  
(Source: Orano)

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**Figure 2:** Sweep air system  
(Source: Orano)



**Figure 3:** Hydrogen gas analyser  
(Source: Orano)

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**Figure 4:** Nitrogen tanks  
(Source: Orano)