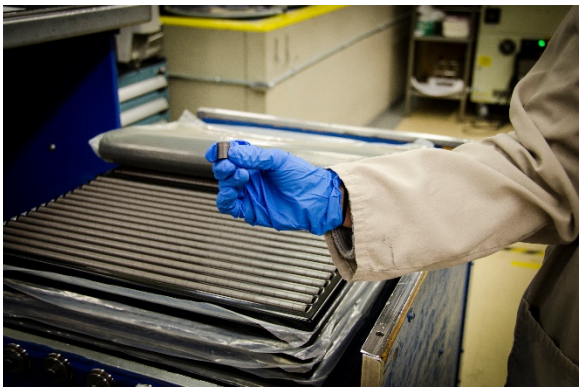
BWXT Nuclear Energy Canada Inc.

Toronto Nuclear Fuel Pellet Operations Safety Analysis Report Summary

The BWXT Nuclear Energy Canada Inc.'s (BWXT NEC) Toronto operation processes ceramic grade uranium dioxide (UO_2) powder to industry-grade natural uranium fuel pellets. The Toronto operation is licensed for a maximum monthly production rate of 150 Megagrams (150 tonnes) of uranium pellets under Nuclear Fuel Facility Operating Licence FFOL-3620.01/2020.

The facility processes both natural and depleted ceramic grade UO_2 powder to industry-grade uranium fuel pellets for use primarily in CANDU (Canadian Deuterium Uranium) reactor fuel bundles.



The Facility

Ceramic grade UO_2 powder is received in Type IP-1 steel drums from the Cameco Port Hope Facility or alternate supplier. This powder is pressed into pellet-shape and sintered in hydrogen atmosphere furnaces at high temperature. The sintered pellets are hard and ceramic. Sintered pellets are ground to the required diameter, inspected and wrapped for shipment to Peterborough. In Peterborough, the pellets are loaded into zirconium sheaths and assembled into bundles.

The Toronto facility is located on the east side of Lansdowne Avenue, north of Dupont Street in Toronto, Ontario at 1025 Lansdowne Avenue. Toronto, Ontario.

Safety at the Toronto Operation

The President, management team and employees of BWXT NEC are committed to ensuring that a strong, positive nuclear safety and security culture is established, fostered, and actively monitored for our nuclear facilities and activities. A nuclear safety and security culture is defined as the core values and behaviors resulting from a collective commitment which is instilled in organizations by leaders and individuals that emphasize nuclear safety and security over competing goals to ensure protection of people and the environment.

BWXT NEC EHS Mission Statement:

It is a business priority to continuously improve our EHS systems to protect fellow employees, the environment, and our communities against environmental, health and safety hazards.

Defence in Depth

The defence in depth concept is applied to all safety related activities, whether organizational, behavioural, design and operational related, particularly those dealing with chemical/ radiological hazards.

The concept of defence in depth involves the implementation of a number of consecutive and independent levels of protection that would have to fail before harmful effects could be caused to people or to the environment. In other words, the idea is that if one level of protection or barrier were to fail, the subsequent level or barrier would be available. In brief, the idea of multiple levels of protection is the central feature of defence in depth.

At BWXT NEC, the defence in depth approach combines the following:

- An effective management system with a strong management commitment to safety and a strong safety culture. The BWXT NEC Environmental, Health and Safety (EHS) Mission Statement notes that the President, management team and employees of BWXT NEC are committed to ensuring that a strong, positive nuclear safety and security culture is established, fostered, and actively monitored for our nuclear facilities and activities.
- The incorporation of strong design and engineering features providing safety margins, diversity and redundancy, mainly using:
    - Design, technology and materials of high quality and reliability, particularly through developing procedures for Critical to Safety Systems, Structures, and Components; and
    - Control, limiting and protection systems (particularly fire safety) and surveillance features.
- Comprehensive operational procedures and practices as well as accident management procedures through development of numerous EHS and operational procedures and emergency preparedness and response plans (see next section).

The Safety Analysis

Our Safety Analysis Report (SAR) was completed in compliance with safety analysis requirements specified in the Canadian Nuclear Safety Commission's Class I Nuclear Facilities Regulations.

The SAR is an important part of the licensing basis for the Toronto operations. The fundamental objective of the safety assessment is to protect the people and the environment from any potential harm arising from the licensed activity. More specifically, the conduct of safety analysis demonstrates that BWXT NEC in Toronto is operated:

- To ensure control over exposure of people and the environment from hazards arising from the licensed activity through any Postulated Initiating Event;
- To ensure control over safety for a broad range of facility states or operating conditions and restrict the likelihood of such events that might lead to a loss of control over the safety of the licensed facility and its activities; and

- To mitigate the consequences of such events if they were to occur through defence in depth.

The SAR is a high-level summary of the Toronto operations' safety analysis program and associated controls and safeguards. In brief, the SAR:

- Summarizes the key characteristics of the Toronto operations;
- Summarizes the results of the Facility Safety Analysis (FSA), identified hazards, selection and classification of events to be analyzed, acceptance criteria, methods and associated documentation; and
- Documents the results of the Safety Assessment.

The focus of the FSA is on offsite consequences to the public and the environment. Worker safety hazards are identified, and worker safety is primarily addressed through the Toronto operations' Health & Safety Manual and Radiation Protection Manual.

The FSA was completed in two steps. The first step involved the completion of a HAZOP (Hazard and Operability Study) of licensed activities. A HAZOP of the hydrogen tank system was completed by the supplier for that system. All other activities were included in a facility HAZOP, which systematically identified possible hazards at the Toronto facility by investigating each process and identifying where variations could present a danger. These variations were then qualitatively screened based on a qualitative assessment of likelihood and consequences to determine their level of risk as High, Intermediate or Low.

The sources of hazards considered were:

- Radioactive material;
  - UO_2 powder;
  - UO_2 pellets;
- Contaminated waste (e.g., used filter media);
- Compressed gases, hydrogen and natural gas;
- Nearby rail tracks;
- Air traffic over and airport movements in the vicinity of the site; and
- External fires.

For all hazard scenarios, existing safeguards resulted in Low or Intermediate Risk. No high-risk scenarios were identified. Key safeguards were identified, with these key safeguards considered in determining critical to safety systems, structures, and components.

The HAZOPs identified several potentially intermediate fire risks and structural failure scenarios that were selected for further quantitative risk assessment (QRA). While the hydrogen tank HAZOP confirmed the existence and suitability of safeguards and resulted in a low risk, adopting a precautionary approach, several large-scale fire and explosion scenarios involving the hydrogen tank system were carried forward to QRA.

The second step involved conducting QRA. A QRA is a more quantitative assessment of risks based on accident data and numerical modelling to predict the consequences of events.

For the HAZOP, the frequency, or likelihood, of an accident or malfunction was estimated.

In the QRA, the frequency, or likelihood estimations were more robust and were based on industry accident statistics and, as appropriate, fault tree analysis to determine the likelihood of multiple events occurring concurrently or consecutively.

Consequences were assessed against emergency exposure guidelines for exposure to airborne uranium and to thermal and overpressure hazards associated with gaseous fires and explosions.

Conclusions of the Facility Safety Assessment

The FSA demonstrated that engineering and administrative controls and safeguards implemented by the BXWT NEC Toronto operation provide an adequate level of protection over a broad range of operating conditions:

- To restrict the likelihood of events that might lead to a loss of control over the safety of the licensed facility; and
- To adequately protect the public and the environment from any potential harm arising from the licensed activity.

Specifically, the FSA (HAZOPs and QRA) determined that with implementation of existing safeguards, that facility risks are all Low or Very Low, except for extremely unlikely incidents involving the hydrogen storage tank, which are of Medium risk.

From the QRA, there were no radiological release events that exceeded the Provincial Nuclear Emergency Response Plan for public intervention (sheltering or evacuation[1]).

From the hydrogen tank analysis, there were no accident scenarios resulting in;

- Release of radioactivity from the site; or,
- Structural damage to offsite buildings or injury to persons from a “blast” overpressure.

Although exceptionally unlikely, there is potential for hydrogen fire from a hydrogen spill, which could expose individuals outdoors and in the immediate vicinity to the heat from the fire. These hazards are consistent with any industrial use of liquid hydrogen. Appropriate engineering and administrative controls, as identified in the hydrogen system HAZOP, have been established to reduce these conventional industry risks to As Low As Reasonably Achievable.

The results of the FSA were used to confirm the adequacy of Toronto operation’s safety program, which is summarized in the SAR. BWXT NEC’s safety program is based on the defence in depth concept. The implementation of defence in depth is the primary means of preventing accidents and mitigating the consequences of accidents if they do occur.

The strategy for defence in depth is twofold: first, to prevent accidents, and second, if prevention fails, to minimize the potential radiological and chemical consequences and to prevent evolution to more serious conditions. BWXT NEC’s Toronto operation applies the defence in depth concept to all safety related activities, whether organizational, behavioural, design related, or operational related, particularly those dealing with chemical/radiological hazards.

[1] Generic Criteria – 10 mSv Sheltering, 100 mSv Evacuation https://www.emergencymanagementontario.ca/sites/default/files/content/emo/docs/PNERP%20Master%20Plan%202017.pdf

Our Safety Analysis Report and supporting documentation will be periodically updated throughout the lifecycle of the facility as required by the Licence Condition Handbook, and, at a minimum, not less than every five years. The SAR will also be updated if a significant event impacts the safety of the facility and/or ongoing site evaluation identifies new information indicating an update is warranted.

Contact Us

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