Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 26-M13.B

Date: 2026-06-12

Supplementary Information

Written submission from CNSC Staff in response to undertaking #1 to provide clarification or additional information

In the matter of the

Mid-term update from BWXT Nuclear Energy Canada Inc. on licensed activities at its Toronto and Peterborough facilities

Commission Meeting

May 27-28, 2026

Renseignements supplémentaires

Mémoire du personnel de la CCSN en réponse à l'engagement no 1 de fournir des précisions ou des renseignements supplémentaires

À l'égard de la

Mise à jour de mi-parcours sur les activités autorisées de BWXT Nuclear Energy Canada Inc. à ses installations de Toronto et de Peterborough

Réunion de la Commission

27-28 mai 2026

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Canada

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

MEMORANDUM **NOTE DE SERVICE**

To
Candace Salmon
Commission Registrar

c.c.: Ramzi Jammal, Dana Beaton

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From
Kim Campbell,
Director General
Directorate of Nuclear Cycle and Facilities Regulation

De

Campbell, Kimberley A
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Subject
Objet

Technical information on the fate of beryllium following inhalation exposures and potential human health effects

Introduction

On 27 May 2026, during the Commission public proceedings on BWXT Nuclear Energy Canada, Inc.'s (BWXT NEC's) mid-term update, a question was raised by Commission Member Dr. Alexander McEwan regarding the fate of beryllium in the lungs once inhaled. On 28 May 2026, at the start of the day's proceedings, CNSC staff requested to submit an undertaking to provide a more fulsome written response to address the Commission Member's question. This memorandum provides additional technical information to address this undertaking. It is important to note that CNSC staff have on-going regulatory oversight of the facility, and have concluded that the risks of adverse effects to human health due to beryllium exposure via air emissions from the BWXT NEC Peterborough facility are negligible.

Discussion

Brief Background on Beryllium

Beryllium (Be) is a steel-grey, brittle metal that occurs naturally in the environment, including in rocks, coal, oil, soil and volcanic dust [1]. It has a melting point of 1,287°C and a boiling point of 2,468°C. In Canada, it is naturally found at low levels in areas with igneous bedrock, mostly in northern British

Columbia and the Northwest Territories [2]. The primary anthropogenic sources of beryllium emissions into the environment are from industrial processes such as combustion of fossil fuels. At the BWXT NEC facility in Peterborough, beryllium is used as the brazing agent in the assembly of nuclear fuel bundles.

Presented in this table are the reported background concentrations of beryllium in air as well as the relevant Ontario Ambient Air Quality Criteria (AAQC).

Media	Reported background concentrations [2]	Relevant quality criteria/guideline [3]
Air	0.000013 µg/m^3 (range=0 to 0.000087 µg/m^3)	0.01 µg/m^3 (24-hr)

Toxicological Profile of Beryllium

According to the US Agency for Toxic Substances and Disease Registry (ATSDR), the primary route of exposure to beryllium is via inhalation of dust, fumes or aerosols, and this is predominantly in occupational settings. Beryllium is absorbed in the lungs and slowly cleared from the lungs with reported clearance half-lives ranging from days to years in animal studies. With respect to oral exposure, based on animal studies, 99% of beryllium is excreted in feces and <1% is excreted in urine. The accumulation of beryllium after absorption through the lungs or gastrointestinal tract is duration specific and absorbed beryllium can distribute throughout the body, depending on the beryllium species, particle size, and solubility [4].

As the lungs and respiratory tract are the primary target sites of inhalation exposure to beryllium, the most commonly documented health effects associated with overexposure to beryllium in the workplace include: beryllium sensitization and acute beryllium disease (ABD), chronic beryllium disease (CBD or "berylliosis"), and potentially lung cancer. Note that CNSC staff had previously addressed many health-related questions regarding exposure to beryllium raised by intervenors at the BWXT NEC 2020 license renewal. These have been presented in CMD 20-H2.B (Comments 12, 14, 15, 16, & 17).

In terms of acute exposures (≤ 14 days), ABD has been reported to be dose-dependent and associated with exposures to high concentrations ≥100 µg/m^3 [5]. However, occurrence of ABD is now considered rare in occupational settings that control worker exposure to beryllium [6]. Determination of threshold exposure levels of CBD following chronic exposure (≥ 15 days) has not yet been clearly defined, as CBD is an immune disease, and only a small percentage of the population appears to be susceptible. The US Environmental Protection Agency (EPA)'s Integrated Risk Information System (IRIS)'s 1998 *Toxicological Review of Beryllium and Compounds* report makes reference to a 1949 community study that investigated exposure levels at continuous sampling stations at set distances from a beryllium production plant. That study reported a No Observed Adverse Effect Level (NOAEL) Human Equivalent Concentration (HEC[1]) range of 0.01 to 0.1 µg/m^3 for the development of CBD in a population exposed to beryllium in ambient air [7].

Other potential routes of exposure to beryllium include ingestion and dermal contact. However, as the focus of this memo is to address health effects specific to inhalation, further details regarding these other exposure pathways have not been presented here in this memo.

[1] The United States Environmental Protection Agency's Human Equivalent Concentration (HEC) approach is designed to adjust the dose in an animal inhalation experiment to the dose that a human would receive at the same air concentration. The adjustment is based on some of the physiological differences between humans and animals.

Occupational Exposure Limits and BWXT NEC's Controls for Worker Exposures

In Canada, occupational exposure to beryllium is regulated by both federal and provincial regulatory bodies via Occupational Exposure Limits (OELs). In Ontario, occupational exposure to beryllium should be controlled to levels as low as possible and, as best practice, below the time-weighted average exposure limit of 0.05 µg/m^3 (inhalable fraction). The CNSC requires licensees to use the most stringent values among applicable regulatory requirements as its OEL. BWXT NEC's current operating licence stipulates an OEL of 0.05 µg/m^3 to control hazards associated with beryllium particulates present in the air. To note, OELs are applicable to worker exposures within a facility and are not to be confused with release limits for emissions and effluents from a facility.

As mentioned in CMD 20-H2.B (Comment 14), epidemiological studies have been performed on cohorts of workers exposed to various forms of beryllium in different industries. Evidence of the health effects of beryllium exposure have informed the tolerable concentration for non-cancer health effects of beryllium and informed the limits that are set for workers today.

At BWXT NEC's Peterborough facility, personal air samplers are worn by workers handling beryllium to measure potential beryllium exposure not accounting for protective measures. However, occupational exposures to beryllium are controlled by a number of measures, including engineered controls, safe work procedures, protective clothing and the use of full-face respirators as personal protective equipment (PPE) such as Powered Air Purifying Respirators (PAPRs). This ensures that worker exposures remain as low as reasonably achievable and below the OELs.

Exposure by Members of the Public to Beryllium via Atmospheric Releases

At the BWXT NEC Peterborough facility, continuous in-stack monitoring is conducted for the three beryllium air emission points at this facility. BWXT NEC has consistently reported extremely low atmospheric emissions of beryllium. Results of their annual compliance reports are available publicly at: Regulatory Compliance - | People Strong. Innovation Driven. The reported maximum in-stack concentrations ranged from 0.001 to 0.003 µg/m^3 over the 2021–2025 period, prior to any environmental dilution. These values are well below the beryllium AAQC of 0.01 µg/m^3. All Independent Environmental Monitoring Program (IEMP) samples collected by CNSC staff surrounding this facility have been below detection limits, with the exception of one sample in 2014, measured at 0.000077 µg/m^3. This measurement is within the reported background range for beryllium in ambient air [2]. Since 2018, detection limits for the triennial IEMP sampling campaigns have been set well below the AAQC, confirming that all samples are well below the applicable health-based criterion. IEMP sample results for the BWXT NEC Peterborough facility are available online at: Independent Environmental Monitoring Program: BWXT Nuclear Energy Canada Inc. - Peterborough.

It should also be mentioned that in 2022, CNSC staff carried out extended ambient air monitoring for beryllium near the BWXT NEC Peterborough facility to further verify that levels of beryllium in air are protective of human health and the environment. The levels were measured were well below the AAQC. Based on the low levels measured, CNSC staff concluded that there is negligible risk to the environment or to human health from beryllium in locations surrounding the BWXT NEC Peterborough facility. This report is available publicly online at: Extended Ambient Air Sampling.

Concluding Remarks

The intent of this memo was for CNSC staff to provide additional details regarding the background and air quality screening levels of beryllium in air along with its toxicological profile, highlighting the fate of this metal following inhalation exposures and potential human health effects. In addition, CNSC staff provided an overview of the occupational exposure limits. To reiterate, CNSC staff had previously addressed key concerns and issues regarding beryllium exposure in air and in soil raised in interventions received for the public hearing on the BWXT NEC 2020 relicensing application. These have been provided in supplemental CMD 20-H2.B.

To reaffirm, the CNSC requires that licensees have a robust environmental protection program. As part of that program, licensees must ensure releases are being controlled, air emission monitoring and environmental monitoring are being conducted, and that risks are being assessed and mitigation measures applied, as required. In addition, licensees must implement continuous improvement initiatives in accordance with their environmental management system requirements. Based on the information to date, the risks of adverse effects to human health due to beryllium exposure via air emissions from the BWXT NEC Peterborough facility are negligible. These observations remain consistent with CNSC staff's previous discussions on beryllium exposures and human health, as presented in the supplemental CMDs referenced above.

References

[1] World Health Organization. 1990. International Programme on Chemical Safety, Environmental Health Criteria 106. Geneva.

[2] Canadian Council of Ministers of the Environment (CCME). 2015. Scientific Criteria Document for Canadian Soil Quality Guidelines for the Protection of Human Health: Beryllium. PN 1535, ISBN 978-1-77202-017-5 PDF. Winnipeg.

[3] Human Toxicology and Air Standards Section, Technical Assessment and Standards Development Branch, Ontario Ministry of the Environment, Conservation and Parks (MECP). 2020. Ontario's Ambient Air Quality Criteria. MECP, Toronto, ON, Canada.

[4] Agency for Toxic Substances and Disease Registry (ATSDR). 2023. Toxicological Profile for Beryllium. Atlanta, GA, US.

[5] U.S. Department of Labor, Occupational Safety and Health Administration. Beryllium: Health Effects. Accessed online 02 June 2026.

[6] Canadian Centre for Occupational Health and Safety. [Updated 2023 Apr 03]. Beryllium – Health Effects. Accessed online 02 June 2026.

[7] US EPA. 1998. Toxicological Review of Beryllium and Compounds (CAS No. 7440-41-7). EPA/635/R-98/008. Research Triangle Park, NC, US.