



UNPROTECTED/NON PROTÉGÉ

ORIGINAL/ORIGINAL

CMD: 23-M37

Date signed/Signé le : 12 SEPTEMBER 2023

Reference CMD(s)/CMD(s) de référence : **22-M36**

Annual Program Report

Rapport annuel sur les programmes

**Regulatory Oversight
Report for Uranium Mines
and Mills in Canada: 2022**

**Rapport de surveillance
réglementaire des mines
et usines de concentration
d'uranium au Canada :
2022**

Public Meeting

Réunion publique

Scheduled for:

December 13 to 14, 2023

Prévue pour :

Les 13 et 14 décembre 2023

Submitted by:

CNSC Staff

Soumise par :

Le personnel de la CCSN

Summary

This Commission member document (CMD) is on the *Regulatory Oversight Report for Uranium Mines and Mills in Canada, 2022*.

This CMD addresses the Commission's action outlined in the minutes of the CNSC meeting on CMD 22-M35, CMD 22-M36, CMD22-M37, and CMD 22-M43 to CMD 22-M46 held on December 15 and 16, 2022 for CNSC staff to provide an update to the Commission on the CNSC order by an inspector under subsection 35(1) of the *Nuclear Safety and Control Act*. This order was issued to Cameco Corporation for exceedance of approved volume of waste rock, and for lack of compliance with conditions of the Cigar Lake Operation's UML-MINE-CIGAR.00/2031 licence, as well as with the *Nuclear Safety and Control Act*, and the *General Nuclear Safety and Control Regulations*.

This CMD addresses the Commission's action outlined in the minutes of the CNSC meeting on CMD 22-M29 to CMD 22-M34, CMD22-M37, and CMD 22-M40 to CMD 22-M42, held on November 1, 2, and 3, 2022. This action directed CNSC staff to work towards the transparent resolution of intervenor recommendations. Where comments and recommendations were made by Indigenous Nations and communities, the Commission expects CNSC staff to provide an update to the Commission on whether and how such recommendations have been or will be addressed, including where there are disagreements.

Résumé

Le présent document à l'intention des commissaires (CMD) porte sur le *Rapport de surveillance réglementaire des mines et usines de concentration d'uranium au Canada : 2022*.

Ce CMD traite de la mesure prise par la Commission décrite dans le procès-verbal de la réunion de la Commission dans les CMD 22-M35, CMD 22-M36, CMD 22-M37 et CMD 22-M43 à CMD 22-M46 tenue les 15 et 16 décembre 2022 pour le personnel de la CCSN de fournir une mise à jour à la Commission en ce qui concerne l'ordre de la CCSN émis par un inspecteur en vertu du paragraphe 35(1) de *la Loi sur la sûreté et la réglementation nucléaires*. Cet ordre a été délivré à Cameco Corporation pour le dépassement du volume approuvé de stériles et pour la non-conformité aux conditions du permis UML-MINE-CIGAR.00/2031 de l'établissement de Cigar Lake, ainsi qu'à *la Loi sur la sûreté et la réglementation nucléaires* et au Règlement général sur la sûreté et la réglementation nucléaires.

Ce CMD traite de l'action de la Commission décrite dans le procès-verbal de la réunion de la Commission de la CCSN sur les CMD 22-M29 à CMD 22-M34, CMD 22-M37, et CMD 22-M40 à CMD 22-M42, tenue les 1, 2 et 3 novembre 2022. Cette mesure demandait au personnel de la CCSN de travailler à la résolution transparente des recommandations des intervenants. Lorsque des commentaires et des recommandations ont été formulés par des nations et des communautés autochtones, la Commission s'attend à ce que le personnel de la CCSN lui fournisse une mise à jour sur la façon dont ces recommandations ont été ou seront prises en compte, y compris en cas de désaccord.

Signed/signé le

12 September 2023

 Digitally signed by Murthy, Kavita
DN: cn=CA, o=GC, ou=CNSC-CCSN, cn="Murthy, Kavita"
Reason: I am approving this document
Location: Ottawa, Ontario, Canada
Date: 2023.09.12 13:33:44-04'00'
Foxit PDF Editor Version: 12.1.2

Kavita Murthy

Director General

Directorate of Nuclear Cycle and Facilities Regulation

Directeur général

Direction de la réglementation du cycle et des installations nucléaires

This page was intentionally left blank.

TABLE OF CONTENTS

| | |
|---|-----------|
| PLAIN LANGUAGE SUMMARY | 1 |
| 1 INTRODUCTION..... | 3 |
| 1.1 Background..... | 3 |
| 1.2 CNSC Regulatory Efforts | 4 |
| 1.2.1 Licensing..... | 4 |
| 1.2.2 Regulatory developments..... | 4 |
| 1.2.3 Compliance | 7 |
| 1.2.4 Safety and control area framework | 8 |
| 1.2.5 Independent Environmental Monitoring Program | 9 |
| 1.2.6 Environmental Protection Review Reports..... | 10 |
| 1.3 Public Information and Indigenous Consultation and Engagement | 10 |
| 1.3.1 Public information and disclosure programs | 11 |
| 2 OVERVIEW | 17 |
| 2.1 Performance | 19 |
| 2.2 Radiation Protection..... | 21 |
| 2.3 Environmental Protection | 25 |
| 2.3.1 Environmental management system | 26 |
| 2.3.2 Effluent and emissions control..... | 26 |
| 2.3.3 Assessment and monitoring | 37 |
| 2.3.4 Environmental risk assessment..... | 37 |
| 2.3.5 Protection of people | 38 |
| 2.4 Conventional Health and Safety | 40 |
| 3 CIGAR LAKE OPERATION..... | 45 |
| 3.1 Performance | 46 |
| 3.2 Radiation Protection..... | 47 |
| 3.3 Environmental Protection | 50 |
| 3.4 Conventional Health and Safety | 56 |
| 3.5 Additional SCAs | 58 |
| 3.5.1 Management system..... | 58 |
| 3.5.2 Human performance management | 59 |
| 3.5.3 Operating performance | 59 |
| 3.5.4 Safety analysis | 59 |
| 3.5.5 Physical design..... | 59 |
| 3.5.6 Fitness for service | 60 |
| 3.5.7 Emergency management and fire protection | 60 |
| 3.5.8 Waste management | 61 |
| 3.5.9 Security | 61 |
| 3.5.10 Safeguards and non-proliferation..... | 61 |
| 3.5.11 Packaging and transport..... | 61 |
| 4 MCARTHUR RIVER OPERATION..... | 63 |
| 4.1 Performance | 64 |

| | | |
|----------|--|-----------|
| 4.2 | Radiation Protection..... | 64 |
| 4.3 | Environmental Protection | 67 |
| 4.4 | Conventional Health and Safety | 72 |
| 4.5 | Additional SCAs | 74 |
| 4.5.1 | Management system..... | 74 |
| 4.5.2 | Human performance management | 75 |
| 4.5.3 | Operating performance | 75 |
| 4.5.4 | Safety analysis | 75 |
| 4.5.5 | Physical design..... | 76 |
| 4.5.6 | Fitness for service | 76 |
| 4.5.7 | Emergency management and fire protection | 76 |
| 4.5.8 | Waste management | 76 |
| 4.5.9 | Security | 77 |
| 4.5.10 | Safeguards and non-proliferation..... | 77 |
| 4.5.11 | Packaging and transport..... | 77 |
| 5 | RABBIT LAKE OPERATION..... | 78 |
| 5.1 | Performance | 79 |
| 5.2 | Radiation Protection..... | 80 |
| 5.3 | Environmental Protection | 82 |
| 5.4 | Conventional Health and Safety | 88 |
| 5.5 | Additional SCAs | 89 |
| 5.5.1 | Management system..... | 89 |
| 5.5.2 | Human performance management | 90 |
| 5.5.3 | Operating performance | 90 |
| 5.5.4 | Safety analysis | 90 |
| 5.5.5 | Physical design..... | 90 |
| 5.5.6 | Fitness for service | 91 |
| 5.5.7 | Emergency management and fire protection | 91 |
| 5.5.8 | Waste management | 91 |
| 5.5.9 | Security | 92 |
| 5.5.10 | Safeguards and non-proliferation..... | 92 |
| 5.5.11 | Packaging and transport..... | 92 |
| 6 | KEY LAKE OPERATION..... | 93 |
| 6.1 | Performance | 95 |
| 6.2 | Radiation Protection..... | 95 |
| 6.3 | Environmental Protection | 98 |
| 6.4 | Conventional Health and Safety | 107 |
| 6.5 | Additional SCAs | 108 |
| 6.5.1 | Management system..... | 108 |
| 6.5.2 | Human performance management | 108 |
| 6.5.3 | Operating performance | 109 |
| 6.5.4 | Safety analysis | 109 |
| 6.5.5 | Physical design..... | 109 |
| 6.5.6 | Fitness for service | 109 |
| 6.5.7 | Emergency management and fire protection | 110 |

| | | |
|----------|--|------------|
| 6.5.8 | Waste management | 110 |
| 6.5.9 | Security | 110 |
| 6.5.10 | Safeguards and non-proliferation..... | 111 |
| 6.5.11 | Packaging and transport..... | 111 |
| 7 | MCCLEAN LAKE OPERATION..... | 112 |
| 7.1 | Performance | 114 |
| 7.2 | Radiation Protection..... | 114 |
| 7.3 | Environmental Protection | 117 |
| 7.4 | Conventional Health and Safety | 125 |
| 7.5 | Additional SCAs | 127 |
| 7.5.1 | Management system..... | 127 |
| 7.5.2 | Human performance management | 127 |
| 7.5.3 | Operating performance | 127 |
| 7.5.4 | Safety analysis | 127 |
| 7.5.5 | Physical design..... | 128 |
| 7.5.6 | Fitness for service | 128 |
| 7.5.7 | Emergency management and fire protection | 128 |
| 7.5.8 | Waste management | 128 |
| 7.5.9 | Security | 129 |
| 7.5.10 | Safeguards and non-proliferation..... | 129 |
| 7.5.11 | Packaging and transport..... | 130 |
| | GLOSSARY..... | 131 |
| | A. FACILITY LICENSING INFORMATION..... | 132 |
| | B. LIST OF INSPECTIONS | 133 |
| | C. SAFETY AND CONTROL AREA DEFINITIONS | 137 |
| | D. SAFETY AND CONTROL AREA RATING METHODOLOGY | 141 |
| | E. SAFETY AND CONTROL AREA RATINGS..... | 143 |
| | F. FINANCIAL GUARANTEES..... | 146 |
| | G. WORKER DOSE DATA..... | 147 |
| | H. RADIOLOGICAL ACTION LEVEL EXCEEDANCES REPORTED TO THE CNSC..... | 150 |
| | I. REPORTABLE RELEASES TO THE ENVIRONMENT (SPILLS)..... | 153 |
| | J. ENVIRONMENTAL ACTION LEVEL AND REGULATORY LIMIT EXCEEDANCES REPORTED TO THE CNSC | 158 |
| | K. LOST-TIME INJURIES | 163 |

| | |
|--|------------|
| L. ANNUAL RELEASES OF RADIONUCLIDES TO THE ENVIRONMENT ... | 166 |
| M. LIST OF INDIGENOUS NATIONS AND COMMUNITIES | 167 |
| O. REGULATORY OVERSIGHT REPORT OUTREACH..... | 169 |
| P. REGULATORY OVERSIGHT REPORT 2021 DASHBOARD | 171 |
| Q. LINKS TO WEBSITES | 172 |
| R. ACRONYMS | 173 |
| S. SUMMARY OF ENGAGEMENT IN RELATION TO CNSC'S TERMS OF REFERENCE FOR LONG-TERM ENGAGEMENT AND ASSOCIATED WORKPLANS IN 2022 | 176 |
| T. SUMMARY TABLE OF THE STATUS OF ISSUES, CONCERNS AND REQUESTS FROM INDIGENOUS INTERVENORS IN THE 2021 UMM ROR | 179 |

This page was intentionally left blank.

PLAIN LANGUAGE SUMMARY

The *Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2022* provides information about the work of the Canadian Nuclear Safety Commission (CNSC) to verify the safety and protection of people and the environment around all operating uranium mines and mills in Canada. These mines and mills are located in northern Saskatchewan and continued to operate safely in 2022. Monitoring continues to show that the country foods and water surrounding the mines and mills remain safe to eat and drink. There were no releases that could have harmed human health or the environment.

This report provides information on the 5 uranium mines and mills that were licensed to operate in Canada in 2022:

- Cameco's Cigar Lake – uranium mine (operated throughout 2022)
- Cameco's McArthur River – uranium mine (resumed commercial operation in late 2022)
- Cameco's Rabbit Lake – uranium mine and mill (in care and maintenance throughout 2022)
- Cameco's Key Lake – uranium mill (resumed commercial operation in late 2022)
- Orano's McClean Lake – uranium mine and mill (operated throughout 2022)

CNSC staff would like to acknowledge that the uranium mine and mill facilities within this report are located on Treaty 10 territory, the Homeland of the Métis, and are within the traditional territories of the Dene, Cree, and the Métis peoples.

When a mine or mill is in a state of care and maintenance, uranium ore is not being mined nor is uranium ore being milled into uranium ore concentrate (yellowcake). Facilities in care and maintenance still have sufficient staff onsite to complete maintenance, to operate water treatment systems, and to conduct environmental monitoring programs for the protection of workers, the public and the environment.

Each year, CNSC inspectors conduct inspections at uranium mines and mills. The number and focus of these inspections depend on facility performance and operating status.

From March 2020 until the end of the first quarter of 2022, the CNSC adapted its inspections to COVID-19 pandemic conditions. Most inspections of uranium mines and mills were conducted remotely during this time. CNSC inspectors used a combination of video conferencing, email, and document/photograph reviews to conduct these remote inspections. Since COVID-19 pandemic restrictions were lifted, the CNSC has moved to a hybrid model where remote inspection practices can be used as part of in-person meetings and onsite inspections. This practice began in the second quarter of 2022 and has continued since then.

In 2022, CNSC staff performed a total of 25 inspections across the 5 operating mines and mills addressed in this report. As a result of these inspections, CNSC staff found 79 instances of lack of compliance. One order was also issued to Cameco's Cigar Lake

Operation. The operators were required to correct their lack of compliance and are addressing all the concerns raised during the inspections.

The CNSC evaluates operating nuclear facilities across 14 safety and control areas. However, this report focuses on the following 3 areas:

- **Radiation protection:** In 2022, the maximum individual radiation dose to a worker at any of the 5 uranium mine and mill facilities covered in this report was 14.28% of the annual regulatory limit. No workers exceeded their regulatory dose limit.
- **Environmental protection:** Each mine and mill facility uses water as part of operations, and all water must be treated before being discharged back into the environment. In 2022, all discharged water (i.e., authorized releases) met the federal and provincial discharge requirements, ensuring the safety of people and the environment near the facilities. Licensees also conduct air sampling and vegetation sampling around their sites. All results for 2022 were well below the limits set by the environmental quality guidelines. In addition, CNSC licensees are required to report any unauthorized release of hazardous substances or nuclear substances to the environment, such as spills. In 2022, unauthorized releases were reported. While the releases were not authorized, the amounts were within the normal range of releases for uranium mines and mills. All releases were corrected by the mine or mill operators and no lasting impacts to the environment resulted from these releases.
- **Conventional health and safety:** Licensees of all mining and milling operations must report any lost-time, workplace-related injuries to the CNSC and provincial agencies. In 2022, 5 injuries required reporting. This is consistent with previous years and injury data from other mining sectors.

As an agent of the Government of Canada, the CNSC recognizes and understands the importance of building relationships with Indigenous peoples. In 2022, CNSC staff worked in support of this ongoing commitment to Indigenous consultation and engagement and continued building relationships with Indigenous peoples with interests in Canada's uranium mines and mills. As in previous years, CNSC staff met with Indigenous Nations and communities to provide information and to seek opportunities for improvement for regulatory oversight reports.

In summary, for the 2022 calendar year, CNSC staff confirm that:

- workers at each facility were safe and properly protected from radiation hazards and from conventional health and safety hazards
- there were no releases to air or to water that could harm the environment or the health and safety of people
- country foods continued to be safe to eat
- COVID-19 did not affect the CNSC's ability to verify the safety of uranium mines and mills

1 INTRODUCTION

1.1 Background

The Canadian Nuclear Safety Commission (CNSC) regulates Canada's uranium mines and mills to protect health, safety, security, and the environment; to implement Canada's international commitments on the peaceful use of nuclear energy; and to disseminate objective scientific, technical, and regulatory information to the public. This mandate is derived from the [Nuclear Safety and Control Act](#) (NSCA). Licensees must comply with the NSCA, the regulations made under it, any licence conditions imposed by the Commission as well as their licensing basis.

CNSC staff would like to acknowledge that the uranium mine and mill facilities included within this report are located on Treaty 10 territory, the Homeland of the Métis, and are within the traditional territories of the Dene, Cree, and the Métis peoples.

Each year the CNSC produces a regulatory oversight report on the operating performance of Canada's uranium mine and mill licensees and their licensed facilities. This report includes data for the 2022 calendar year for uranium mine and mill sites. Data for historic and decommissioned sites was last presented in the [Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2021, CMD 22-M36](#), and is presented every 3 years.

This report:

- describes the CNSC's regulatory efforts, public information, Indigenous and community engagement activities, and the Independent Environmental Monitoring Program (IEMP)
- includes information on licensee operation, licence changes, major developments at licensed facilities, as well as any significant events
- presents the performance rating for each safety and control area (SCA) for each of the uranium mine and mill facilities
- presents performance data on the radiation protection, environmental protection and conventional health and safety SCAs for each of the uranium mine and mill facilities

This report summarizes CNSC staff's assessment of the following regulated uranium mine and mill facilities:

- [Cameco's Cigar Lake Operation](#)
- [Cameco's McArthur River Operation](#)
- [Cameco's Rabbit Lake Operation](#)
- [Cameco's Key Lake Operation](#)
- [Orano's McClean Lake Operation](#)

Throughout the review period, CNSC staff continued to conduct compliance verification activities, including inspections, technical assessments, reviews of reports submitted by licensees, event and incident reviews, and ongoing exchanges of information with the licensees of all uranium mine and mill facilities.

1.2 CNSC Regulatory Efforts

1.2.1 Licensing

The CNSC regulates each uranium mine and mill under a separate licence. A licence granted by the Commission defines the licence period, licensed activities, and licence conditions. Tables summarizing the uranium mine and mill licences can be found in Appendix A. Each uranium mine and/or mill licence issued by the Commission is accompanied by a licence conditions handbook (LCH) which contains compliance verification criteria (CVC) used by CNSC staff to determine compliance with the conditions set out in the licence. All changes to the LCHs made to date during the licence term are also provided in Appendix A.

1.2.2 Regulatory developments

CNSC staff continue to modernize the regulatory framework with the CNSC's series of regulatory documents. CNSC staff have an effective process in place to implement new regulatory documents once they are approved by the Commission. Licensees continue to be in compliance with the regulatory documents or applicable standards identified in their LCHs during the transition process. For CNSC regulatory documents which have not yet been implemented, uranium mine and mill licensees are on track for meeting all agreed implementation deadlines. CNSC staff continue to monitor progress through regular licensing meetings.

Table 1.1 lists updates made to the CNSC regulatory documents since 2021 including the implementation status up to the date of this ROR, that apply to the uranium mine and mill licensees.

Table 1.1 - Regulatory documents applicable to uranium mine and mill facilities

| Regulatory document | Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|--|-------------------|--|--------------------|-----------------|-----------------------|
| REGDOC-2.10.1, <i>Nuclear Emergency Preparedness and Response</i> , Version 2 February 2017 | Implemented | Implemented as part of 2023 LCH update | Implemented | Implemented | Implemented |
| REGDOC-2.9.1, <i>Environmental Protection: Environmental Principles, Assessments and Protection Measures</i> , Version 1.1, April 2017 | Implemented | Implemented as part of 2023 LCH update | Implemented | Implemented | Implemented |
| REGDOC-2.13.1, <i>Safeguards and Nuclear Material Accountancy</i> February 2018 | Implemented | Implemented as part of 2023 LCH update | Implemented | Implemented | Implemented |
| REGDOC-2.1.2, <i>Safety Culture</i> April 2018 | Implemented | Implemented | Implemented | Implemented | Implemented |
| REGDOC-3.2.1, <i>Public Information and Disclosures</i> May 2018 | Implemented | Implemented as part of 2023 LCH update | Implemented | Implemented | Implemented |
| REGDOC-2.11.1, <i>Waste Management, Volume III: Assessing the Long-Term Safety of Radioactive Waste Management</i> May 2018 | Not applicable | Not applicable | Not applicable | Not applicable | Implemented |

| Regulatory document | Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|---|--|--|--|--|-----------------------|
| REGDOC-2.11.1, <i>Waste Management, Volume II: Management of Uranium Mine Waste Rock and Mill Tailings</i> November 2018 | Implemented | Implemented as part of 2023 LCH update | Implemented | Implemented | Implemented |
| REGDOC-2.11.1, <i>Waste Management, Volume I: Management of Radioactive Waste</i> January 2021 | Implemented as part of next update of the LCH. | Implemented as part of 2023 LCH update. | Implemented as part of 2023 update | Implemented as part of 2023 update | Implemented |
| REGDOC-2.11.2, <i>Decommissioning</i> January 2021 | Implementation plan submitted August 2022 | Implemented |
| REGDOC-3.3.1, <i>Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities</i> January 2021 | Implementation plan submitted August 2022 | Implemented |
| CSA N294:19, <i>Decommissioning of facilities containing nuclear substances</i> 2019 | Implemented in next regular PDP and PDCE update. | Implemented in next regular PDP and PDCE update. | Implemented in next regular PDP and PDCE update. | Implemented in next regular PDP and PDCE update. | Implemented |
| CSA 393, <i>Fire protection for facilities that process, handle or store nuclear substances</i> | Implementation by December 31, 2023 | Implemented |

1.2.3 Compliance

The CNSC determines whether licensees are in compliance with requirements through verification, enforcement and reporting activities. CNSC staff develop compliance plans for each facility commensurate with their associated risk and implement these plans by conducting regulatory activities which include onsite and remote inspections, and technical assessments of licensee programs, processes, and reports. Adjustments to compliance plans are made as needed in response to operational status, events, facility modifications and changes in licensee performance.

The CNSC uses a risk-informed approach when planning for on-site work; from March 2020 until the second quarter of 2022, the CNSC adapted its workplace practices to meet CNSC and licensee COVID-19 pandemic protocols. Most inspections of uranium mines and mills were conducted remotely during this time. CNSC inspectors used a combination of video conferencing, email and document/photograph review to conduct these remote inspections. Since COVID-19 pandemic restrictions were lifted, CNSC staff have moved to a hybrid model where remote inspection practices can be integrated into in-person meetings and on-site inspections. This practice began in the 2nd quarter of 2022 and has continued since that time.

Table 1.2 presents data on CNSC staff inspections conducted at uranium mines and mills since the calendar year 2018. Instances of non-compliance noted during these inspections were provided to the licensees in detailed inspection reports and recorded in the CNSC Regulatory Information Bank (RIB) to ensure that corrective actions were tracked to completion. Examples of non-compliances include failure to wear radiation monitoring equipment Canada, failure to follow procedures, additional personnel training needs identified, and incorrect or incomplete labelling or signage.

Table 1.2: Inspections at uranium mines

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|------------------------------------|------|------|------|------|--------------|
| Number of inspections | 26 | 20 | 17 | 18 | 25 |
| Instances of non-compliance | 31 | 23 | 11 | 19 | 79 + 1 order |

All instances of non-compliance identified were of low risk and low safety significance with the exception of one non-compliance related to the licensee's Emergency Management Program and one non-compliance related to the licensee's Radiation Protection Program, both of which were identified as medium risk with low safety significance, as described in s. 3.1. Safety significance is determined based on comparison to criteria developed and used in the CNSC RIB. Examples of the criteria are included in the appendices to this report in tables Table **H-2**, Table **I-2**, Table **J-2** and Table **K-2**. Additional details on the inspections covered in this reporting period can be found in Appendix B.

CNSC staff assessed the licensees' corrective actions taken in response to the identified instances of non-compliance and verified that these actions were appropriate and acceptable. All instances of non-compliance are being addressed by the licensees to meet all regulatory requirements and have been closed by CNSC staff.

One inspector's order was issued to the Cigar Lake Operation due to the amount of potentially acid generating material on Stockpile "C" exceeding the limit as identified in the Cigar Lake Waste Management Program. The details of the order are further discussed in section 3.1.

Other regulatory bodies that conduct inspections at uranium mine and mill facilities include the Saskatchewan Ministry of Environment, the Saskatchewan Ministry of Labour Relations and Workplace Safety, and Environment and Climate Change Canada (ECCC).

These regulatory bodies focus primarily on the areas of conventional health and safety and environmental protection. CNSC staff consider the findings from these regulatory bodies when assessing licensees' performance. When logistically reasonable, joint inspections are conducted with other federal or provincial regulatory agencies. No joint inspections at operating facilities occurred in 2022.

1.2.4 Safety and control area framework

SCAs are the technical topics that CNSC staff use across all regulated facilities and activities to assess, evaluate, review, verify and report on regulatory requirements and performance. The CNSC's SCA framework, which staff use to evaluate licensee safety performance, includes 14 SCAs. Each SCA is subdivided into specific areas that define its key components. Appendix C provides definitions of these SCAs and their specific areas.

CNSC staff use the following 3 ratings, defined in Appendix D, to grade licensee performance in each applicable SCA:

- satisfactory (SA)
- below expectations (BE)
- unacceptable (UA)

This report contains CNSC staff's performance ratings for all applicable SCAs, with a focus on 3 SCAs that cover many of the key performance indicators for mining and milling operations: radiation protection, environmental protection, and conventional health and safety.

For 2022, all SCA performance ratings for uranium mines and mills were rated satisfactory (SA), with the exception of the Management System and Radiation Protection SCAs at Cameco's Cigar Lake operation which were rated below expectations (BE).

CNSC staff concluded, based on the results of regulatory oversight activities, uranium mine and mill facilities met the following requirements:

- as low as reasonably achievable (ALARA) principle, which considers social and economic factors, as a result:
 - no worker doses exceeded regulatory effective dose limits
 - where action level exceedances occurred, they were reported and investigated to determine the causes, and corrective actions were identified by the licensee and verified by CNSC staff
- environmental protection programs were effective, and as a result, emissions and effluents remained well below regulatory limits:
 - where action level exceedances occurred, they were reported and investigated, and corrective measures were implemented by the licensee and verified by CNSC staff
- conventional health and safety programs continued to protect workers:
 - where a lost-time injury (LTI) was reported, corrective measures were implemented by the licensee and verified by CNSC staff

As such, CNSC staff confirmed that workers at each facility were safe and properly protected; and the health and safety of people near these facilities and the surrounding environment continued to be protected. Appendix E provides the uranium mines and mills SCA performance ratings for the previous 5 years, from 2018 to 2022.

1.2.5 Independent Environmental Monitoring Program

The Independent Environmental Monitoring Program (IEMP) is an independent from licensee, technical environmental sampling program conducted by CNSC staff in publicly accessible areas around nuclear facilities, while using CNSC resources effectively and efficiently. The CNSC continues to strive to build Indigenous and public trust in the CNSC's regulation of the nuclear industry, by broadening awareness of the IEMP and promoting more involvement in the planning and sampling activities by Indigenous communities and the public. The IEMP is a regulatory tool that complements and informs the CNSC's ongoing compliance verification program. The IEMP does not rely on licensees to provide samples. CNSC staff or independent contractors obtain samples from publicly accessible areas around nuclear facilities, then measure and report the amounts of radiological and hazardous substances present in these samples to the Commission, Indigenous Nations and communities, and the public.

In 2022, CNSC staff conducted independent environmental monitoring around the Rabbit Lake Operation in northern Saskatchewan and worked with Ya'thi Néné Lands and Resource Office (YNLR) in gathering the samples. The results are available on the [CNSC IEMP: Rabbit Lake Operation Website](#). There were no results of concern. In addition, these results are consistent with sampling results submitted by the licensee. The IEMP results add to the body of evidence and supports CNSC staff's assessment that persons and the environment in the vicinity of the uranium mines and mills facilities are protected and that the

licensees' environmental protection programs are effective. Results from previous IEMP sampling campaigns are available on [CNSC's IEMP Website](#).

1.2.6 Environmental Protection Review Reports

CNSC staff conduct environmental protection reviews (EPRs) for all licence applications for facilities with potential environmental interactions, in accordance with CNSC's mandate under the NSCA and associated regulations. An EPR is a science-based environmental technical assessment conducted by CNSC staff.

Starting in 2021, the CNSC began a new approach for publishing EPR reports online and separate from a specific licensing decision to allow interested Indigenous Nations and communities and members of the public additional time to review information related to environmental protection and engage with CNSC staff on any areas of interest or concern. All available EPR reports can be found on the [CNSC website](#). EPR reports are typically conducted to align with the facility's ERA cycle, which is approximately every five years or whenever there is a major change to the facility. CNSC staff have posted the following five EPR reports for UMMs:

- [EPR report: Cigar Lake \(2021\)](#)
- [EPR report: Cluff Lake Project \(2022\)](#)
- [EPR report: Rabbit Lake Operation \(2023\)](#)
- [EPR report: Key Lake Operation \(2023\)](#)
- [EPR report: McArthur River Operation \(2023\)](#)

The information in EPR reports support staff's recommendations to the Commission for related licensing and regulatory decisions on whether a proposal provides adequate protection of the environment and the health and safety of people.

1.3 Public Information and Indigenous Consultation and Engagement

All uranium mines and mills are required to maintain and implement public information and disclosure programs (PIDPs), in accordance with [REGDOC-3.2.1, Public Information and Disclosure](#). CNSC's REGDOC-3.2.1 sets out the requirements for public information and disclosure. The primary goal of the program is to ensure that information related to the health, safety and security of persons and the environment, and other issues associated with the lifecycle of nuclear facilities is shared with the public in a format relevant to the audience. The program includes a commitment and protocol for ongoing, timely dissemination of information related to the licensed facility. As the operating mine and mill sites are located in northern Saskatchewan, an area with a predominantly Indigenous population, this dissemination of information frequently includes and is accompanied by Indigenous engagement activities.

CNSC staff fulfill this mandate in a variety of ways, including the publishing of RORs and through project specific outreach sessions. CNSC staff also seek out other opportunities to engage with the public and Indigenous Nations and

communities, often participating in meetings or events in communities with interest in nuclear sites. These events allow CNSC staff to answer questions about the CNSC's mandate and role in regulating the nuclear industry, and to listen to and discuss concerns raised by community members. CNSC staff have responded to or provided CNSC staff's path forward to meaningfully address and close out specific requests, concerns and comments raised by Indigenous Nations or communities and key intervenors where possible. See Table A in Appendix T for more details. In 2022, CNSC staff worked with the public within northern Saskatchewan to identify opportunities for formalized and regular engagement throughout the lifecycle of these sites, including meetings and facilitated workshops. Some of these engagements included:

- Participation in the Northern Saskatchewan Environmental Quality Committee ([EQC](#)) meeting that took place in June 2022 in La Ronge
- Attending the Saskatchewan Mining Association ([SMA](#)) Minerals and Products ([MAP](#)) event located in Beauval. This allowed CNSC staff members to engage with middle school students regarding the safety of uranium mines and mills located in northern Saskatchewan
- Organizing an Indigenous information and discussion session in Saskatoon in September 2022

As an agent of the Government of Canada, the CNSC recognizes and understands the importance of consulting and building relationships with Indigenous peoples in Canada. CNSC staff are committed to building long-term relationships with Indigenous Nations and communities who express an interest in CNSC-regulated facilities within their traditional and/or treaty territories. By pursuing informative and collaborative ongoing interactions, the CNSC's goal is to build partnerships and trust.

The CNSC's Indigenous engagement practices are consistent with the principles of upholding the honour of the Crown and reconciliation. These practices include information sharing and funding support through the CNSC Participant Funding Program ([CNSC PFP](#)) to assist Indigenous peoples to meaningfully participate in Commission proceedings and ongoing regulatory activities.

A list of Indigenous Nations and communities whose traditional and/or treaty territories are in proximity to operating uranium mine and mill sites are available in Appendix M.

1.3.1 Public information and disclosure programs

CNSC staff monitor licensee implementation of the PIDPs to ensure communication with target audiences is regular and meaningful. CNSC staff also review yearly program updates to verify licensees are taking public feedback into consideration and making program adjustments accordingly. All uranium mines and mills (UMM) have PIDPs which have been accepted by CNSC staff.

The COVID-19 pandemic challenged licensees to adapt their engagement activities to a virtual and/or hybrid setting. Even though some of the uranium mines and mills were in care and maintenance during 2022, licensees were still

required to maintain their public information and disclosure program and disclose important information to the public.

Upon review, CNSC staff determined that the PIDPs implemented by Cameco Corporation (Cameco) and Orano Canada Inc. (Orano) complied with [REGDOC-3.2.1](#), and that they provided regular information and engagement opportunities on the status of their facilities to key audiences by adapting to a virtual environment. In 2022, licensees began to reintroduce in-person engagement, while maintaining digital communication tools to reach their audience via multiple methods. These included:

- Website and social media updates
- Conventional media, newsletters, magazines, newspapers
- Social media presence and updates to communities on information that they need or have expressed interest in
- Responding to public inquiries, meetings with community leadership and members
- Incorporating visual aids with videos and tours (virtual or in person)
- In-person and virtual/hybrid events and sponsorship.

1.3.2 Indigenous consultation and engagement

The CNSC is committed to building long-term relationships and conducting ongoing engagement with Indigenous Nations and communities who have an interest in CNSC-regulated facilities within their traditional and/or treaty territories. The CNSC's ongoing Indigenous engagement practices include:

- Sharing information and discussing topics of interest with Indigenous Nations and communities
- Seeking feedback and input on CNSC processes
- Responding to issues and concerns
- Creating and maintaining the conditions for collaboration and two-way dialogue on an ongoing basis
- Collaborating on drafting relevant sections of CNSC reports
- Providing opportunities to participate in environmental monitoring through the [CNSC IEMP](#)
- Supporting participation in Commission proceedings and ongoing regulatory activities via funding opportunities through the [CNSC PFP](#)

The operating uranium mines and mills in Canada fall within the traditional and treaty territories of many Indigenous Nations and communities, as listed in Appendix M.

In 2022, CNSC staff worked with Indigenous Nations and communities in northern Saskatchewan with an interest in operating uranium mines and mills to

identify opportunities for formalized and regular engagement throughout the lifecycle of these sites, including meetings and facilitated workshops. The majority of engagement and consultation with Indigenous groups in northern Saskatchewan in 2022 occurred via a hybrid model allowing for in-person and virtual participation.

As a result of recommendations from the Commission, CNSC staff continue to hold an annual ROR engagement meeting with Indigenous Nations and communities in northern Saskatchewan in September before the public consultation period for the ROR, to provide updated information on, and seek opportunities for improvement of, the ROR such as the plain language summary that is now included. Indigenous Nations and communities with an interest in Canada's uranium mines and mills are also provided a copy of the ROR for review each year.

CNSC Engagement Efforts

In 2022, CNSC staff engagement efforts in relation to UMM sites were largely focused on consultation activities linked to the renewal of Cameco's McArthur River, Key Lake and Rabbit Lake Operations, as well as ongoing environmental assessments (EAs) under the *Canadian Environmental Assessment Act, 2012* ([CEAA 2012](#)) and licensing processes for the proposed NexGen Energy Ltd.'s (NexGen) Rook I Project and the Denison Mine's (Denison) Wheeler River Project, which are outside the scope of this ROR.

In September of 2022, CNSC staff hosted a hybrid ROR engagement meeting with Indigenous Nations and communities with interests in the uranium mine and mill sites in northern Saskatchewan to discuss topics such as: Beaverlodge Project (Cameco), McArthur River Operation (Cameco), Cigar Lake Operation (Cameco), Rabbit Lake Operation (Cameco), Key Lake Operation (Cameco), Cluff Lake Project (Orano), McClean Lake Operation (Orano) as well as the Gunnar legacy uranium mine (SRC) and the former Lorado mill site (SRC). CNSC staff also provided updates on proposed uranium mines and mill sites including: NexGen Rook I and Denison Wheeler River Projects.

In addition, in 2022 CNSC staff also carried out a number of engagement activities with Indigenous Nations and communities in northern Saskatchewan and Alberta, which included:

- Providing updates and held meetings directly with a number of Indigenous Nations and communities on Cameco's McArthur River Operation, Key Lake Operation and Rabbit Lake Operation licence renewal. These in-person engagement events included two community tours in November 2022. One tour visited Patuanak, La Ronge and Pinehouse while the other tour visited Uranium City, Black Lake, Fond du Lac, Stony Rapids and Wollaston/Hatchet Lake.
- Providing updates and held meetings directly with a number of Indigenous Nations and communities on Orano's Cluff Lake Operation licence revocation.

- Providing updates on the 2021 Key Lake and McArthur River IEMP results to verify that the public, Indigenous Nations and communities, and the environment around nuclear facilities are safe. In 2022, CNSC staff worked directly with English River First Nation (ERFN) to communicate the results to their respective leadership and community members, including collaboration on easy-to-read results cards that were shared with ERFN community members.
- Engaging with Indigenous Nations and communities and collaborated directly with the YNLR regarding the 2022 IEMP at the Rabbit Lake Operation to ensure that IEMP sampling reflects Indigenous Knowledge, land use, and values, where possible. A community land technician from the YNLR joined CNSC staff for weeklong sampling program. CNSC staff also met with the Métis Nation – Saskatchewan on the 2022 IEMP.
- Providing updates to Indigenous Nations and communities on the [Canadian Uranium Workers Study](#) and informed communities of how they may become involved in the study, if interested.
- Continued engagement and consultation activities with several Indigenous Nations and communities on NexGen’s Rook I and Denison’s Wheeler River Project EAs, both ongoing in northern Saskatchewan. This included three community tours: one taking place in northwestern Saskatchewan regarding the NexGen Rook I Project in June 2022 and the other two taking place in Patuanak and Pinehouse area regarding the Denison Wheeler River Project in May and September 2022.
- Conducting regular meetings with the YNLR, Clearwater River Dene Nation, the Métis Nation-Saskatchewan, ERFN, and Kineepik Métis Local (KLM) that focused on the operating mines and mills in Saskatchewan.
- Signing a long-term relationship Terms of Reference (ToR) with YNLR in June 2022 and held the first quarterly meeting in September 2022 with the YNLR working group.
- Providing updates and held meetings directly with Indigenous Nations and communities on CNSC’s new [Indigenous and Stakeholder Capacity Fund](#) that was officially launched in May 2023.
- Attending public meetings and site tours in both the spring and fall to Cameco’s Beaverlodge properties in Uranium City. The meetings provided an opportunity for Cameco to engage directly with Indigenous Nations and communities and local residents to provide feedback and ask questions to Cameco and the regulators.
- Attending Orano’s Cluff Lake Operation site tour in September 2022 alongside a member of Clearwater River Dene Nation.

CNSC Communications with Indigenous Nations and Communities

In addition to the outreach and engagement sessions, CNSC staff ensure that all interested Indigenous Nations and communities are made aware of the opportunities to review the ROR and submit interventions to the Commission,

including the opportunity to intervene orally, as well as opportunities to receive funding through the [CNSC PFP](#) to support their participation in the process. In 2022, CNSC staff followed up with each Indigenous Nation and community who intervened with regards to the 2021 UMM ROR and offered to have specific meetings and discussions to address the concerns, comments and recommendations that they made.

Finally, under the ToR between YNLR and CNSC staff, CNSC staff collaboratively drafted engagement updates in this ROR with YNLR. More information on the ToR engagement summary with YNLR, is found in Appendix S.

Tracking of ROR Issues, Concerns and Recommendations

In order to effectively track and respond to requests and recommendations made by Indigenous Nations and communities on past RORs, CNSC staff has established an issue tracking process to capture the requests, concerns and comments included in Indigenous interventions on each ROR, or other Commission proceedings as appropriate, from each Indigenous Nation and community. The tracking tables also include CNSC staff's responses and proposed actions as appropriate.

Therefore, in response to the Commission's request for information on issues and concerns tracking, from interventions received specifically in relation to the RORs, CNSC staff have included an additional Appendix T in this year's ROR. The appendix provides key information about the number of issues, concerns and recommendations submitted by each Indigenous Nation and community in relation to the 2021 UMM ROR. In addition, the appendix presents the number of issues and concerns that the CNSC has responded to or provided an approach to meaningfully address and close out specific requests, concerns and comments, where possible.

CNSC staff have reached out to all Indigenous Nations and communities who intervened in the 2021 ROR, offering to meet and discuss the requests, concerns, and comments from their interventions. For Indigenous Nations and communities that have a ToR with CNSC, requests, concerns and comments raised in the ROR will be further discussed in agreed-upon regular meetings, and CNSC staff will work with the Indigenous Nation or community to share and verify the data in their respective issues tracking table.

Overall, the interventions in relation to the 2021 ROR were categorized into 12 different themes including consultation and engagement, improvements to ROR process and ROR content, and CNSC oversight activities.

Cameco and Orano's Engagement Activities

In 2022, CNSC staff continued to monitor the engagement work conducted by Cameco and Orano to ensure that there was active engagement and communication with Indigenous Nations and communities interested in their UMM facilities, and that there were also activities in relation to relevant licensing and Commission hearing processes that occurred in 2022.

CNSC staff confirmed that Cameco and Orano continued to meet, engage, and share information with interested Indigenous Nations and communities throughout 2022. Cameco and Orano staff also participated in cultural awareness activities, provided capacity funding to support engagement activities, and invited Indigenous community members to in-person events.

Many of Cameco and Orano engagement activities in 2022 focused on licence applications related to the Beaverlodge, Cluff Lake, McArthur River, Key Lake, and Rabbit Lake Operations. However, discussions and activities have also addressed concerns about and interest in Cigar Lake and McLean Lake.

CNSC staff encourage Cameco and Orano to continue to develop relationships and engage with Indigenous Nations and communities who have expressed an interest in their operations and activities.

2 OVERVIEW

This report focuses on the regulatory performance of the 5 operating uranium mines and mills in Canada in 2022. During this time frame, 1 of 5 of these facilities was in a state of care and maintenance and 2 facilities, McArthur River and Key Lake, transitioned from a state of care and maintenance to resumed commercial operation. The facilities listed are located within the Athabasca Basin of northern Saskatchewan and are shown in Figure 2.1.

- [Cigar Lake Operation](#) (mine)
- [McArthur River Operation](#) (mine – resumed commercial operation late 2022)
- [Rabbit Lake Operation](#) (mine and mill – care and maintenance throughout 2022)
- [Key Lake Operation](#) (mill – resumed commercial operation late 2022)
- [McClellan Lake Operation](#) (mine and mill)

Figure 2.1: Location of uranium mines and mills in Saskatchewan



The Cigar Lake, McArthur River, Key Lake and Rabbit Lake facilities are operated by Cameco, while the McClellan Lake facility is operated by Orano.

In 2016, Cameco entered the Rabbit Lake mine and mill into a state of care and maintenance and that facility has remained so since that time. In 2018, Cameco entered Key Lake and McArthur River operations into a state of care and maintenance, and both remained in that state until late 2022. CNSC inspectors have confirmed the safe restart of mining and milling, and that workers performed all expected functions during this period of transition from care and maintenance.

In 2022, CNSC staff continued routine compliance verification inspections at all facilities to determine whether the licensee continued to meet regulatory requirements. The 2022 uranium production data for uranium mine and mill facilities are shown in Table 2.1. CNSC staff concluded that all facilities operated within their authorized annual production limits in 2022.

Table 2.1: Uranium mines and mills, mining and milling production data, 2022

| Production data | Cigar Lake | McArthur River¹ | Rabbit Lake² | Key Lake¹ | McClellan Lake³ |
|--|-------------------|-----------------------------------|--------------------------------|-----------------------------|-----------------------------------|
| Mining – ore tonnage (Mkg/year) | 53.7 | 3.53 | 0 | N/A | N/A |
| Mining – average ore grade mined (%U) | 15.8 | 8.3 | N/A | N/A | N/A |
| Mining – U mined (Mkg U/year) | 7.17 | 0.25 | N/A | N/A | N/A |
| Milling – mill ore feed (Mkg/year) | N/A | N/A | 0 | 10.0 | 52.3 |
| Milling – average mill feed grade (%U) | N/A | N/A | N/A | 0.83 | 13.4 |
| Milling – mill recovery (%U) | N/A | N/A | N/A | 98.86 | 98.86 |
| Milling – U concentrate produced (Mkg U/year) | N/A | N/A | 0 | 0.44 | 6.94 |
| Authorized annual production (Mkg U/year) | 9.25 | 9.6 | 4.25 | 9.60 | 10.9 |

¹ McArthur River and Key Lake transitioned from a state of care and maintenance to commercial production throughout 2022.

² Rabbit Lake was in a state of care and maintenance throughout 2022.

³ McClellan Lake mill processing ore from Cigar Lake.

N/A = Not applicable.

Mkg = 1,000,000 kg

Licenses are required to develop and update preliminary decommissioning plans throughout the entire lifecycle of the facility and are required to provide associated financial guarantees as described on the [CNSC Financial Guarantees Website](#). Financial guarantees ensure that sufficient financial resources are available to fund all approved decommissioning and waste management activities should the licensee not be able to fulfill its obligation. Financial guarantee values for the mine and mill facilities range from approximately C\$42 million at the McArthur River Operation to C\$223 million at the Key Lake Operation. The values of the financial guarantees for each uranium mine and mill are listed in Appendix F. Financial guarantees cover all costs necessary to fully decommission and remediate a uranium mine and/or mill to ensure the protection of people and the environment. The financial guarantees for Cigar Lake and McArthur River are lower relative to the other facilities because of the absence of tailings management facilities at those sites.

2.1 Performance

CNSC staff use expert professional judgement to rate SCA performance at uranium mine and mill facilities. Ratings are based on the review of key performance indicators (e.g., accident/event occurrences, responses to accidents/events, desktop review of reports, dose information, environmental monitoring results) and the results of compliance activities, such as inspections and technical assessments.

The performance ratings are compared across the 5 operating uranium mines and mills and to the rating definitions in Appendix D to ensure that consistent ratings are assigned. The 2022 SCA performance ratings for the mine and mill facilities are presented in Table 2.2; the SCA ratings for each facility from 2018 to 2022 are in Appendix E.

Table 2.2: Uranium mines and mills, SCA performance ratings, 2022

| Safety and control area | Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|---|-------------------|-----------------------|--------------------|-----------------|-----------------------|
| Management system | BE | SA | SA | SA | SA |
| Human performance management | SA | SA | SA | SA | SA |
| Operating performance | SA | SA | SA | SA | SA |
| Safety analysis | SA | SA | SA | SA | SA |
| Physical design | SA | SA | SA | SA | SA |
| Fitness for service | SA | SA | SA | SA | SA |
| Radiation protection | BE | SA | SA | SA | SA |
| Conventional health and safety | SA | SA | SA | SA | SA |
| Environmental protection | SA | SA | SA | SA | SA |
| Emergency management and fire protection | SA | SA | SA | SA | SA |
| Waste management | SA | SA | SA | SA | SA |
| Security | SA | SA | SA | SA | SA |
| Safeguards and non-proliferation | SA | SA | SA | SA | SA |
| Packaging and transport | SA | SA | SA | SA | SA |

SA = satisfactory

This report provides detailed information about 3 SCAs that cover many of the key performance indicators for these facilities. These SCAs are radiation protection, environmental protection, and conventional health and safety. Additional SCAs are covered in each operating site's respective section of this report.

Licensees are required to develop and maintain management systems that include integrated links to all 14 SCAs. Management systems are the framework that establish the processes and programs required to determine that an organization achieves its safety objectives, continuously monitors performance, identifies inadequacies, fosters a healthy safety culture and continually improves that culture. Throughout 2022, CNSC staff reviewed and assessed program performance and key performance indicators through regular compliance verification activities.

For 2022, CNSC staff concluded that the overall performance of the operating uranium mines and mills was satisfactory with the exception of Management Systems and Radiation Protection SCAs for the Cigar Lake operation.

2.2 Radiation Protection

Uranium mine and mill licensees in Canada are required to implement and maintain radiation protection programs. Each program must ensure that contamination levels and radiation dose received by individuals are monitored, controlled, maintained below regulatory limits and are kept consistent with the ALARA principle, considering economic and social factors.

With the exception of Cameco's Cigar Lake Operation, CNSC staff rated the 2022 performance of the operating uranium mine and mill facilities for the radiation protection SCA as satisfactory; the Cigar Lake Operation's performance was rated as below expectations. Further information on the Cigar Lake Operation's performance rating can be found in section 3.2.

Table 2.3: Uranium mines and mills radiation protection ratings, 2022

| Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|------------|----------------|-------------|----------|----------------|
| BE | SA | SA | SA | SA |

SA= satisfactory

Radiological hazard control

Sources of radiation exposure at uranium mines and mills include:

- gamma radiation
- long-lived radioactive dust (LLRD)
- radon progeny (RnP)
- radon gas (RnG)

CNSC staff's compliance activities confirmed these hazards were controlled by the licensees' radiation protection programs, including practices such as the effective use of time, distance and shielding, source control, ventilation, contamination control, and personal protective equipment.

Radiation protection program performance

During 2022, CNSC staff conducted regulatory oversight activities for the radiation protection SCA for all 5 facilities. These activities were carried out to verify that licensees were complying with regulatory requirements for the implementation of radiation protection programs.

Radiation protection programs include codes of practice that outline licensee administrative levels and action levels for exposures and dose of radiation. Action levels and administrative levels are identified for all radiological hazard types, applied to normal operating conditions, and are followed to ensure optimal conditions for workers. Licensees are responsible for identifying the parameters for their programs that represent timely indicators of potential losses of control. For this reason, action and administrative levels are licensee-specific and may change over time, depending on operational and radiological conditions. If an action level is reached, it may indicate the loss of control of part of a licensee's radiation protection program. The licensee is then required to establish the cause, notify the CNSC and if applicable, restore the effectiveness of the radiation protection program.

Administrative levels include a list of specific actions to be taken by the licensee based on radiological monitoring in the workplace. Exceedances of these levels are not reportable to the CNSC, if required by each licensee's Radiation Code of Practice. The radiation protection programs include actions to be taken under specific conditions, for example:

- continue to work while monitoring or investigating a parameter
- leave the area and initiate an investigation
- report to regulatory authority

As radiation levels or worker exposure levels increase, the required protective actions become more stringent, which is consistent with a risk-informed approach.

The 5 operating uranium mines and mills currently have the same individual nuclear energy worker (NEW) radiation dose action level of 1 millisievert (mSv) per week and 5 mSv per quarter of a given year.

CNSC staff confirmed that during the reporting period, the radiation protection programs and practices at the McArthur River Operation, Rabbit Lake Operation, Key Lake Operation and McClean Lake Operation remained effective at controlling radiological exposure to workers. While the Cigar Lake Operation was below expectation, radiological exposure was controlled.

Application of ALARA

The radiation protection programs implemented by uranium mine and mill licensees include responsibilities and processes for ensuring that exposures to workers are consistent with the ALARA principle.

Through compliance verification activities and desktop reviews, CNSC staff verified that key elements of these ALARA programs (e.g., management control over work practices, personnel qualification and training, control of occupational

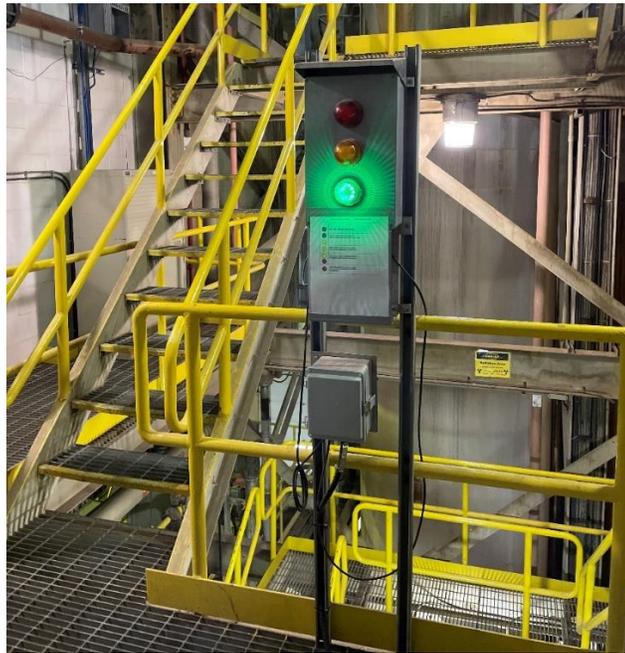
and public exposure to radiation planning for unusual situations) were effectively implemented by most uranium mine and mill facilities in 2022.

This report includes the reporting of annual collective dose values for NEWs for each mine and mill (see sections 3.2, 4.2, 5.2, 6.2 and 7.2). The collective dose value is the sum of the effective doses received by all NEWs at a given site over a calendar year. Collective dose is a radiation protection performance indicator that provides the total exposures associated with each operation. It supplements other performance statistics, like average dose, which have been affected by factors including changes in the number of workers or workers who receive radiation exposures over very short periods of time. Collective dose shows the effect of increased or reduced facility activities, for example, due to care and maintenance status or as a response to the COVID-19 pandemic.

Worker dose control

In accordance with the [Radiation Protection Regulations](#), uranium mine and mill licensees' radiation protection programs include processes and criteria to provide assurance that all individuals identified as NEWs under section 2 of the [NSCA](#) are appropriately designated and trained. This includes licensees' employees and contractors. Radiation exposures are ascertained through approved dosimetry methods and workers are notified of the results.

Figure 2.2: Continuous air monitor located at the Key Lake Operation



Source: CNSC

At all operating uranium mines and mills, NEWs are issued optically stimulated luminescence dosimeters (OSLD) that measure external gamma radiation exposure. Where required, workers also wear personal alpha dosimeters (PADs) to measure internal alpha radiation exposure from radon progeny and LLRD.

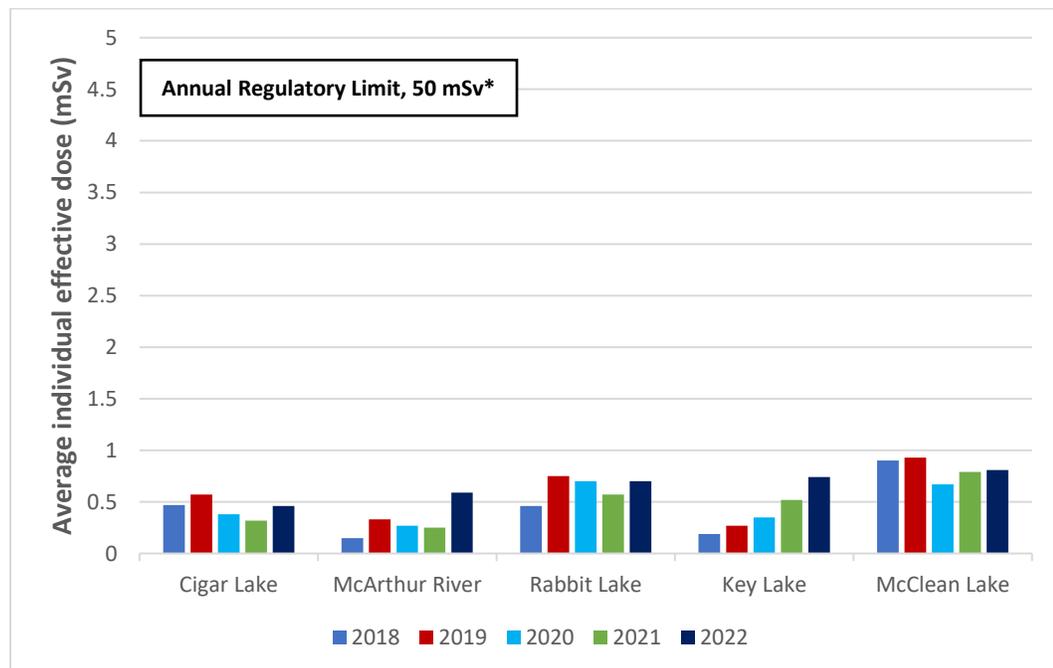
OSLD and PAD readings are measured by CNSC-licensed dosimetry service

providers. Where direct monitoring through dosimeters is not warranted or practical, dose estimation methods authorized under the [Radiation Protection Regulations](#) (such as area/group monitoring and time cards) are used in keeping with CNSC regulatory guidance. CNSC staff confirmed that all licensees for the facilities discussed in this section of the report met the regulatory requirements for the use of licensed dosimetry during the reporting period.

Figure 2.3 and Figure 2.4 show the average individual effective dose and maximum individual effective dose during the 5-year period from 2018 to 2022 for the

5 facilities. In 2022, no worker at any facility exceeded the individual effective dose limit of 50 mSv in 1 year, or 100 mSv in a 5-year dosimetry period.

Figure 2.3: Uranium mines and mills, average individual effective dose to nuclear energy workers, 2018–22

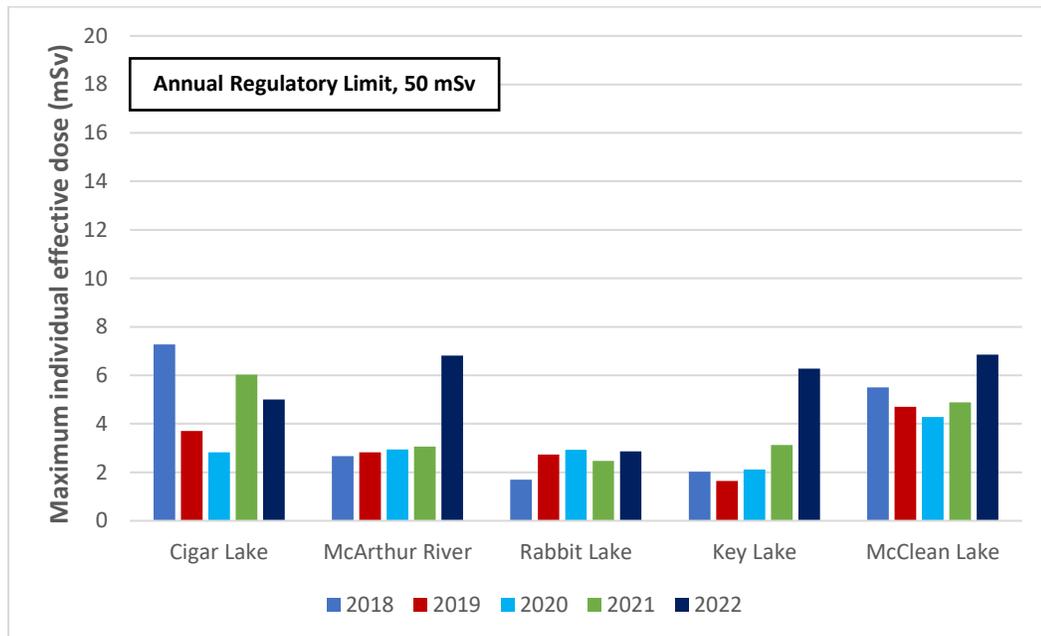


| | Cigar Lake (mSv) | McArthur River (mSv) | Rabbit Lake (mSv) | Key Lake (mSv) | McClean Lake (mSv) |
|------|------------------|----------------------|-------------------|----------------|--------------------|
| 2018 | 0.47 | 0.15 | 0.46 | 0.19 | 0.9 |
| 2019 | 0.57 | 0.33 | 0.75 | 0.27 | 0.93 |
| 2020 | 0.38 | 0.27 | 0.7 | 0.35 | 0.67 |
| 2021 | 0.32 | 0.25 | 0.57 | 0.52 | 0.79 |
| 2022 | 0.46 | 0.59 | 0.70 | 0.75 | 0.81 |

*No regulatory limits exist for average dose to NEWs, annual dose limit used for reference

Increases and decreases over time in the effective dose to NEWs are explained in the facility-specific sections of this report, under the subsection on worker dose control.

Figure 2.4: Uranium mines and mills, maximum individual effective dose to nuclear energy workers, 2018–22



| | Cigar Lake (mSv) | McArthur River (mSv) | Rabbit Lake (mSv) | Key Lake (mSv) | McClean Lake (mSv) |
|-------------|-------------------------|-----------------------------|--------------------------|-----------------------|---------------------------|
| 2018 | 7.28 | 2.67 | 1.7 | 2.02 | 5.5 |
| 2019 | 3.7 | 2.82 | 2.73 | 1.64 | 4.7 |
| 2020 | 2.82 | 2.94 | 2.93 | 2.11 | 4.28 |
| 2021 | 6.03 | 3.06 | 2.47 | 3.13 | 4.89 |
| 2022 | 5.00 | 7.14 | 2.86 | 6.46 | 6.86 |

The highest maximum individual effective dose to a worker at a uranium mine or mill in 2022 occurred at the McArthur River Operation. The worker at McArthur River was assigned a dose of 7.14 mSv; a value that is 14.28 % of the annual dose limit of 50 mSv.

Appendix G displays the number of NEWs with the corresponding average individual effective dose and maximum individual effective dose for each facility from 2018 to 2022.

2.3 Environmental Protection

Uranium mine and mill licensees in Canada are required to implement and maintain environmental protection programs, which include a set of action levels. Each program must ensure to identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities.

Further to this, the CNSC requires that each nuclear facility licensee develops, implements, and maintains an environmental monitoring program to demonstrate

that persons and the environment are protected from any releases to the environment related to the facility's licensed activities. CNSC staff evaluate and assess the results of these monitoring programs to determine compliance with the applicable requirements and limits, as set out in the regulations that govern Canada's nuclear industry.

Based on regulatory oversight activities, CNSC staff rated the 2022 performance of all 5 operating uranium mine and mill facilities for the environmental protection SCA as satisfactory. CNSC staff concluded the licensees' environmental protection programs were effectively implemented and are protective of the environment and people.

Environmental Protection Ratings

| Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|-------------------|-----------------------|--------------------|-----------------|-----------------------|
| SA | SA | SA | SA | SA |

2.3.1 Environmental management system

As part of an effective environmental protection program, the CNSC requires licensees to develop and maintain environmental management systems that provide a framework for integrated activities related to environmental protection at their operation. Environmental management systems include activities such as establishing annual environmental objectives, goals and targets. The licensees conduct internal audits of their programs as identified in their CNSC-accepted management system program. CNSC staff confirmed the licensees' objectives, goals and targets through regular compliance verification activities. Facility-specific details are provided in sections 3.3, 4.3, 5.3, 6.3 and 7.3 of this report.

2.3.2 Effluent and emissions control

Effluent and emissions control programs are associated with an environmental code of practice that sets out administrative levels and action levels for select contaminants of potential concern (COPC) with the potential for adverse environmental effects. An administrative level represents the upper range of design specifications for a specific parameter. Reaching an administrative level, triggers an internal review of the controls in place by the licensee. Exceedance of an action level indicates a potential loss of control of the environmental protection program, which is based on the approved facility design envelope; such an exceedance triggers notification to the CNSC, an immediate investigation by the licensee, and subsequent corrective actions and preventive measures taken to restore the effectiveness of the environmental protection program. It is important to recognize that an exceedance of an action level does not imply a potential risk to the environment but is an early warning signal that identifies that the operating parameter may be outside the facility design envelope. Facility action levels are determined using actual operating data and by following the methodology described in Canadian Standards Association (CSA) Group standard CSA N288.8-

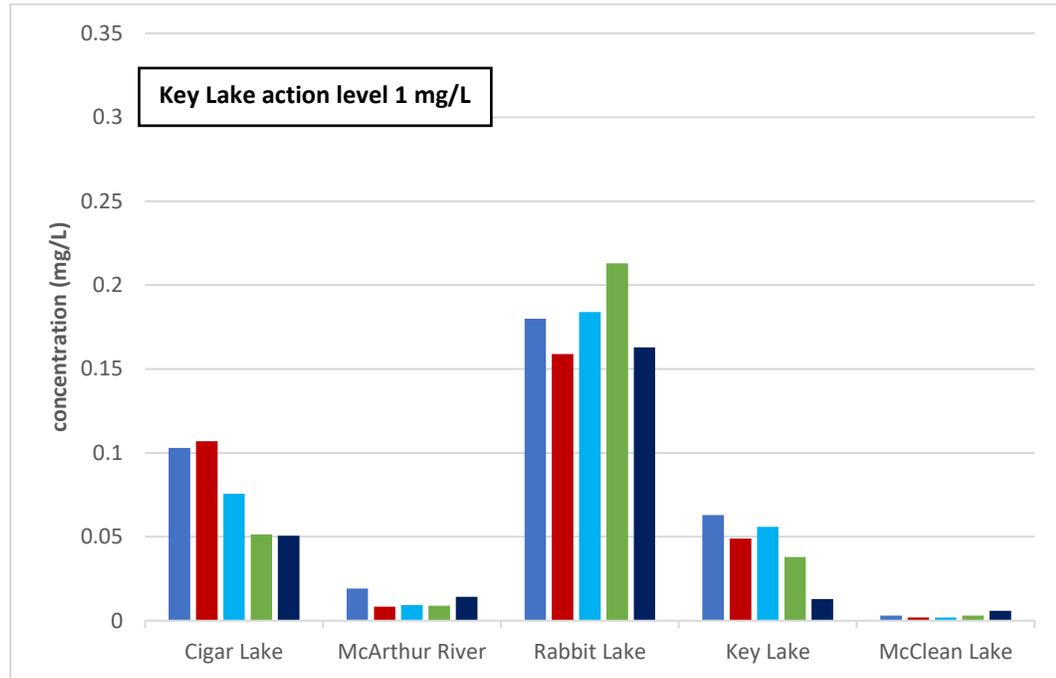
17, Establishing and Implementing Action Levels for Releases to the Environment from Nuclear Facilities, ([CSA N288.8-17](#)).

Treated effluent released to the environment

Environmental risk assessments (ERAs) identified releases of molybdenum, selenium, and uranium with the potential for adverse environmental effects at uranium mines and mills. As a result, improved engineering controls and treatment technologies to reduce effluent releases of these contaminants were implemented where required. In 2022, the treatment technologies implemented continued to keep these contaminant concentrations stable at levels below regulatory limits. Figure 2.5 to Figure 2.7 show the 2022 average annual effluent concentrations for molybdenum, selenium and uranium at the 5 mine and mill facilities.

In the absence of federal or provincial effluent discharge limits for molybdenum, the CNSC required licensees to develop facility-specific effluent controls within the codes of practice of their environmental protection programs. The 2018 to 2022 average concentrations of molybdenum in effluent for the 5 facilities were each below the most stringent action level used across the 5 operating facilities. This level is shown in Figure 2.5 for reference only.

Figure 2.5: Annual average concentration of molybdenum in effluent released to the environment, 2018–22

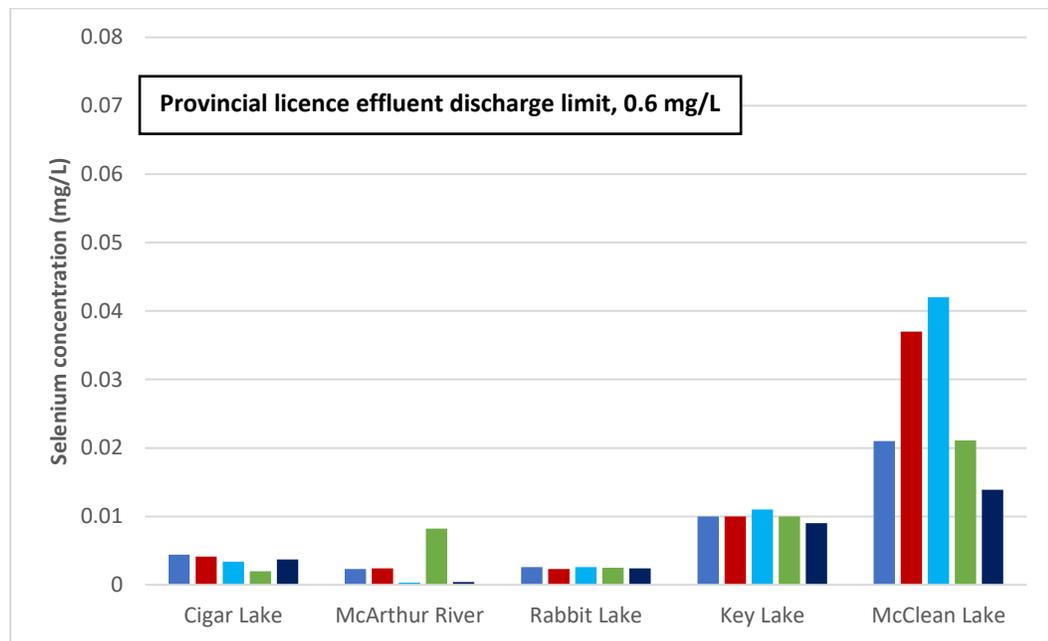


| | Cigar Lake (mg/L) | McArthur River (mg/L) | Rabbit Lake (mg/L) | Key Lake (mg/L) | McClean Lake (mg/L) |
|-------------|------------------------------|--------------------------------------|-----------------------------------|----------------------------|--------------------------------|
| 2018 | 0.103 | 0.0192 | 0.18 | 0.063 | 0.003 |
| 2019 | 0.1069 | 0.0084 | 0.159 | 0.049 | 0.002 |
| 2020 | 0.0756 | 0.0094 | 0.184 | 0.056 | 0.002 |
| 2021 | 0.0515 | 0.0089 | 0.213 | 0.038 | 0.003 |
| 2022 | 0.0506 | 0.0142 | 0.163 | 0.013 | 0.006 |

Figure 2.6 and Figure 2.7 show that concentrations of selenium and uranium in treated effluent released to the environment by mine and mill facilities from 2018 to 2022. As indicated in Figure 2.7, the CNSC identified an interim objective for uranium of 0.1 mg/L. This was derived from the treatment technologies in place at the uranium mines and mills and based on what would be both protective of the environment, and achievable by the uranium metal mining sector. The interim objective was applied to all uranium mine and mill facilities and has been consistently met during the reporting period.

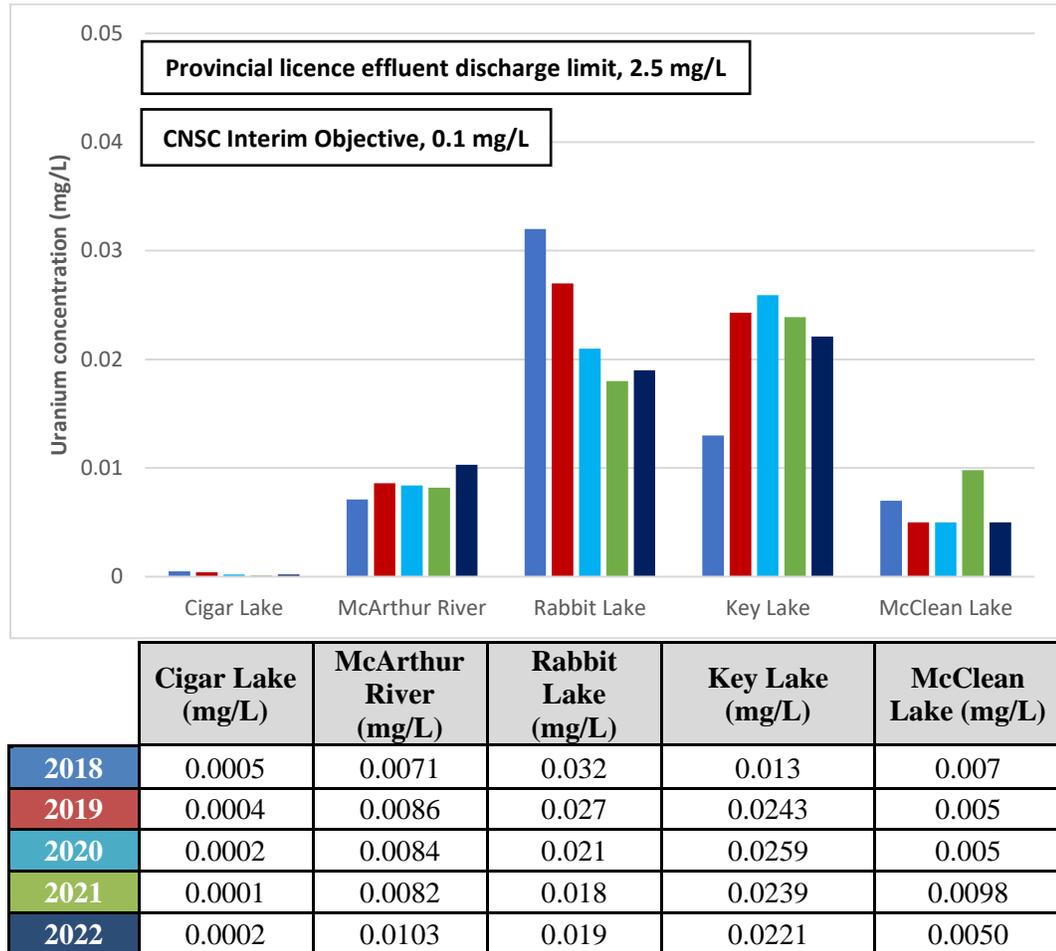
The interim objective for uranium in effluent would be reevaluated if CNSC's [REGDOC-2.9.2, Controlling Releases to the Environment](#), is approved by the Commission and implemented by licensees. CNSC'S draft REGDOC-2.9.2, which was made available for public consultation from May 2021 to July 2021, contains proposed requirements and guidance for establishing and implementing licensed release limits. CNSC staff presented REGDOC-2.9.2 to the Commission in September 2022. The Commission directed CNSC staff to re-engage with licensees to address some items. In 2023, CNSC staff consulted with licensees and have updated REGDOC-2.9.2. Please note that the current draft of REGDOC-2.9.2 on the CNSC website is outdated. CNSC staff are planning to present the updated REGDOC-2.9.2 to the Commission in February 2024. Should it be approved, CNSC staff will implement it via the established process.

Figure 2.6: Annual average concentration of selenium in effluent released to the environment, 2018–22



| | Cigar Lake (mg/L) | McArthur River (mg/L) | Rabbit Lake (mg/L) | Key Lake (mg/L) | McClean Lake (mg/L) |
|------|-------------------|-----------------------|--------------------|-----------------|---------------------|
| 2018 | 0.0044 | 0.0023 | 0.0026 | 0.01 | 0.021 |
| 2019 | 0.0041 | 0.0024 | 0.0023 | 0.01 | 0.037 |
| 2020 | 0.0034 | 0.0003 | 0.0026 | 0.011 | 0.042 |
| 2021 | 0.002 | 0.0003 | 0.0025 | 0.010 | 0.0211 |
| 2022 | 0.0037 | 0.0004 | 0.0024 | 0.009 | 0.0139 |

Figure 2.7: Annual average concentration of uranium in effluent released to the environment, 2018–22

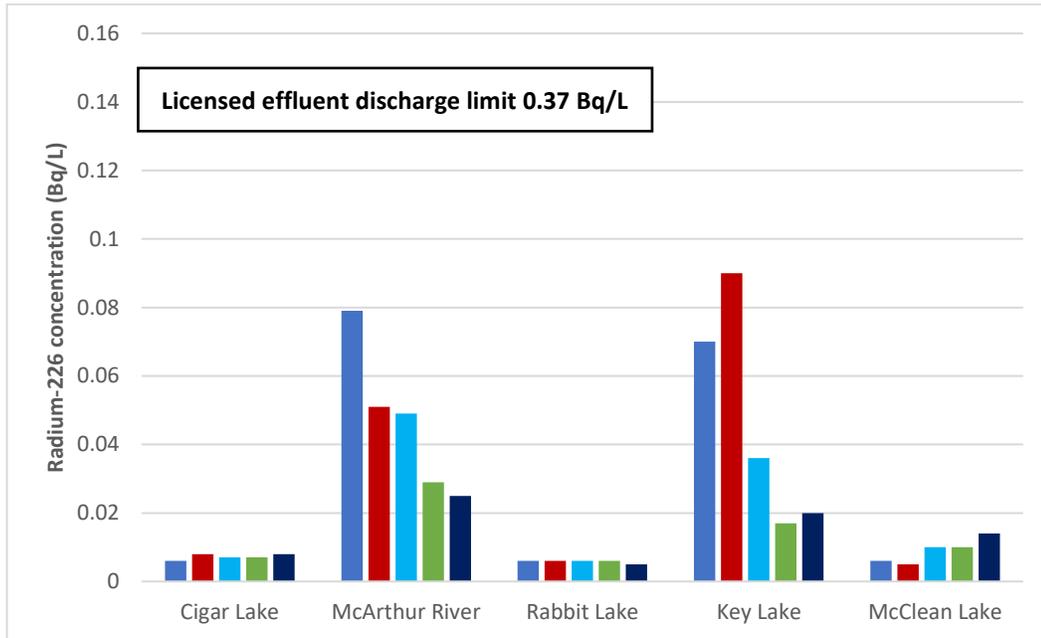


Appendix L includes information on the total annual release of relevant radionuclides to the environment from these facilities from 2018 to 2022.

To increase public access to data on releases of radionuclides to the environment from nuclear facilities, the CNSC provides this information in the appendices of this regulatory oversight report along with maintaining and annually updating downloadable databases on the [CNSC Open Government Portal](#).

In addition to the above COPCs with the potential for adverse environmental effects, a graph showing concentrations of radium-226 is provided in Figure 2.8. From 2018 to 2022, the annual average effluent concentrations of radium-226 for the 5 facilities were well below the CNSC's licence-authorized monthly mean effluent discharge limit of 0.37 Bq/L.

Figure 2.8: Annual average concentration of radium-226 in effluent released to the environment, 2018–22



| | Cigar Lake (Bq/L) | McArthur River (Bq/L) | Rabbit Lake (Bq/L) | Key Lake (Bq/L) | McClean Lake (Bq/L) |
|-------------|------------------------------|--------------------------------------|-----------------------------------|----------------------------|--------------------------------|
| 2018 | 0.006 | 0.079 | 0.006 | 0.07 | 0.006 |
| 2019 | 0.008 | 0.051 | 0.006 | 0.09 | 0.006 |
| 2020 | 0.007 | 0.049 | 0.006 | 0.036 | 0.010 |
| 2021 | 0.007 | 0.029 | 0.006 | 0.017 | 0.010 |
| 2022 | 0.008 | 0.025 | 0.006 | 0.020 | 0.014 |

Uranium mine and mill facilities also analyze treated effluent for concentrations of other regulated contaminants and COPCs such as arsenic, copper, lead, nickel, zinc, total suspended solids (TSS) and pH. Table 2.3 shows the annual average parameter concentration values in effluent for these substances released in 2022, as well as the discharge limits described in the *Metal and Diamond Mining Effluent Regulations* ([MDMER](#)) made under the *Fisheries Act*. All metal mines and mills in Canada are subject to the MDMER. The CNSC cites the effluent limit requirements of the MDMER in uranium mine and mill LCHs. In 2022, all treated effluent released to the environment from licensed mining and milling activities for the above substances met the effluent discharge limits.

Table 2.3: Annual average parameter concentration values in effluent released to the environment, 2022

| Parameters | Discharge Limit | Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|----------------------------|-----------------|------------|----------------|-------------|----------|----------------|
| Arsenic (mg/L) | 0.3* | 0.1080 | 0.0001 | 0.0009 | 0.0019 | 0.0521 |
| Copper (mg/L) | 0.3* | 0.0003 | 0.0006 | 0.0002 | 0.002 | 0.002 |
| Lead (mg/L) | 0.2* | 0.0001 | 0.0001 | 0.0001 | 0.0007 | 0.0006 |
| Nickel (mg/L) | 0.5* | 0.0007 | 0.0021 | 0.0011 | 0.083 | 0.018 |
| Zinc (mg/L) | 0.5* | 0.0212 | 0.0019 | 0.0006 | 0.0039 | 0.002 |
| Molybdenum (mg/L) | 1** | 0.0506 | 0.0142 | 0.163 | 0.013 | 0.006 |
| Selenium (mg/L) | 0.6*** | 0.0037 | 0.0004 | 0.0024 | 0.009 | 0.0139 |
| TSS (mg/L) | 15* | 1 | 1 | 1 | 2.4 | 2 |
| Un-ionized ammonium (mg/L) | 0.5* | 0.01 | <0.01 | 0.01 | 0.01 | 0.04 |
| pH annual mean value | 6.0–9.5* | 7.14 | 7.32 | 7.17 | 7.10 | 7.13 |

*MDMER discharge limit

**Key Lake action level

***Saskatchewan provincial limit

CNSC staff will continue to review effluent quality results to verify that effluent treatment performance remains effective.

Treated mining/milling effluent: A comparison of the uranium mining sector to other metal mining sectors across Canada

As noted earlier, metal mines and mills in Canada are subject to the [MDMER](#) made under the federal [Fisheries Act](#). Compliance with MDMER limits provide a good comparison of the effluent treatment in the uranium mining sector to other metal mining sectors across Canada. The quality of the effluent treatment at the uranium mine and mill facilities compares favorably to that in other mining sectors of base metal, precious metal and iron mines.

The data used for this comparison are acquired from ECCC. Figure 2.9 and Table 2.4 and Table 2.5 provide the sector-specific MDMER information available for 2018 for effluent contaminants of molybdenum, selenium and uranium. ECCC effluent quality data for 2018 for arsenic, copper, nickel, lead, zinc, pH, TSS and acute lethality testing was not available at the time of writing this report.

A comparison of these parameters for the most recent available [MDMER](#) data (2016) is presented in the [Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017](#). This 2017 regulatory oversight report concluded that the uranium sector was similar or better than the other 3 metal mining sectors with regard to the following performance indicators: effluent concentrations, compliance with regulatory limits, and toxicity test results.

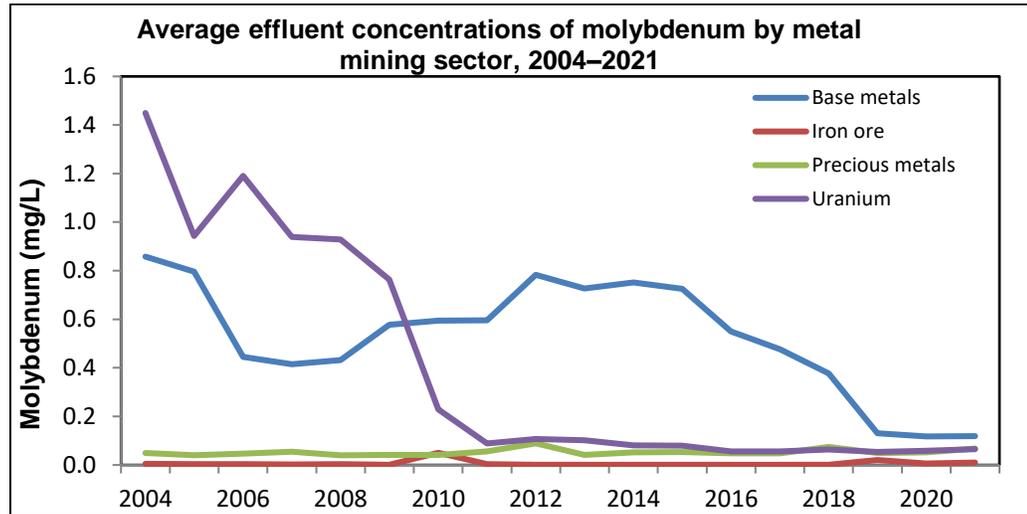
The mines that published treated effluent reporting under MDMER are grouped into 4 metal mining sectors based on the primary metal produced. The metal mining sectors are:

- uranium – 5 facilities
- base metals (such as copper, nickel, molybdenum or zinc) – 47 facilities
- precious metals (such as gold or silver) – 56 facilities
- iron – 8 facilities

The MDMER requires routine monitoring of molybdenum concentrations in treated effluent. Ecological risk assessments completed in the mid-2000s indicated that releases of molybdenum posed a risk to biota that warranted adaptive management. Following a request from the Commission, licensees added administrative controls and treatment technology upgrades to their effluent management systems. The success of these actions is evident in Figure 2.9, which shows that molybdenum releases in the uranium mining sector have decreased substantially.

In 2022, molybdenum concentrations in uranium mining effluent were similar to those measured in precious metal and iron mine effluent, and lower than those measured in base metal mine effluent.

Figure 2.9: Average treated effluent concentration of molybdenum by metal mining sector, 2005-2021



In mid-2012, the requirement to monitor selenium was added to the [MDMER](#). Table 2.4 summarizes the average selenium concentration in treated effluent from each mining sector using data collected since 2012. The selenium concentration in uranium sector effluent was similar to that of other metal mining sectors in Canada.

Table 2.4: Average selenium concentration in treated effluent by metal mining sector, last half of 2012 and all of 2013–2021

| Year | Metal mining sector | | | |
|-----------|---------------------|--------------------|------------------------|-------------|
| | Uranium (mg/L) | Base metals (mg/L) | Precious metals (mg/L) | Iron (mg/L) |
| 2012/2013 | 0.003 | 0.005 | 0.005 | 0.001 |
| 2014 | 0.004 | 0.006 | 0.005 | 0.001 |
| 2015 | 0.004 | 0.005 | 0.004 | 0.004 |
| 2016 | 0.008 | 0.006 | 0.003 | 0.003 |
| 2017 | 0.004 | 0.008 | 0.004 | 0.001 |
| 2018 | 0.006 | 0.006 | 0.004 | 0.003 |
| 2019 | 0.007 | 0.009 | 0.006 | 0.002 |
| 2020 | 0.007 | 0.033 | 0.003 | 0.001 |
| 2021 | 0.005 | 0.008 | 0.016 | 0.001 |

Uranium concentrations were added as a parameter to be monitored and reported under the [MDMER](#) in 2018. Table 2.5 presents the average uranium concentrations in treated effluent by metal mining sector. As shown in table 2.5, the uranium sector had an average uranium concentration of 0.0083 mg/L in 2021. Uranium mines have elevated natural uranium concentrations compared to other conventional mining operations. For context, action levels in the environmental code of practice range from 0.08 mg/L to 0.35 mg/L, and the Saskatchewan regulatory limit for uranium is 2.5 mg/L. CNSC staff continue to verify that releases of uranium are controlled and reduced to the extent practicable by reviewing effluent quality data, scrutinizing proposed facility changes that could affect effluent quality and validating the effectiveness of the licensees' programs to minimize the release of contaminants.

Table 2.5: Average uranium concentration in treated effluent by metal mining sector, 2018–2021

| Year | Metal mining sector | | | |
|------|---------------------|--------------------|------------------------|-------------|
| | Uranium (mg/L) | Base metals (mg/L) | Precious metals (mg/L) | Iron (mg/L) |
| 2018 | 0.0119* | 0.0027 | 0.0010 | 0.0036 |
| 2019 | 0.0108 | 0.0026 | 0.0033 | 0.0019 |
| 2020 | 0.0092 | 0.0015 | 0.0027 | 0.0019 |
| 2021 | 0.0083 | 0.0029 | 0.0074 | 0.0017 |

* Data not available from ECCC; value calculated from licensee annual reports.

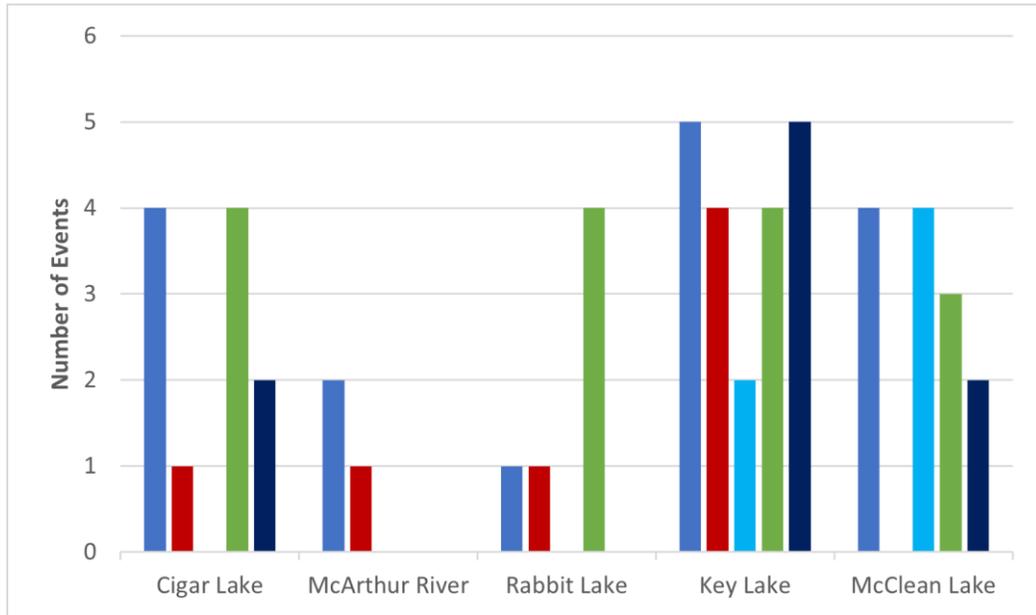
Uncontrolled releases

Licensees are required to report to regulatory authorities, including the CNSC, any unauthorized releases (spills) of hazardous or radioactive substances to the environment.

Figure 2.10 shows the number of reportable spills for uranium mine and mill facilities during the 2018 to 2022 reporting period. In each case, CNSC staff reviewed and evaluated the licensee's actions to verify effective remediation and prevention and were satisfied with actions taken by the licensee. CNSC staff rated all 2022 spills as "low significance" resulting in no residual impact on the environment.

The facility-specific sections and Appendix I describe each reportable spill and the licensee's corrective actions response. The CNSC's spill rating definitions are also found in Table I-2.

Figure 2.10: Uranium mines and mills reportable environmental spills, 2018-22



| | Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClean Lake |
|------|------------|----------------|-------------|----------|--------------|
| 2018 | 4 | 2 | 1 | 5 | 4 |
| 2019 | 1 | 1 | 1 | 4 | 0 |
| 2020 | 0 | 0 | 0 | 2 | 4 |
| 2021 | 4 | 0 | 4 | 4 | 5 |
| 2022 | 2 | 0 | 0 | 5 | 2 |

Air emissions released to the environment

Uranium mines and mills environmental programs include monitoring the effects of operations on the surrounding air and soil. Licensees measure airborne particulate levels and concentrations of regulated contaminants and COPC, as well as the concentration of radon gas in ambient air. Soil and vegetation may be affected by atmospheric deposition of particulate containing adsorbed metals and radionuclides associated with onsite activities. Licensees monitor contaminant concentrations in soil and terrestrial vegetation to verify that operational impacts are below regulatory limits.

Facilities with milling operations monitor atmospheric emissions from acid plants, yellowcake dryers, calciner operations, packaging, grinding and ammonium sulphate operations. Other measured parameters (e.g., ambient radon and stack testing for sulphur dioxide, uranium and heavy metals) verify facility design and evaluate the operation's performance against predictions made in ERAs.

CNSC staff verified that the mines and mills demonstrated satisfactory performance in monitoring and mitigating the effects of their operations on the surrounding air and soil. Soil monitoring results around the facilities indicated that all measured parameters are within background levels. As would be expected,

air monitoring for radon gas near tailings management facilities and waste rock piles shows results higher than the regional background level of 25 Bq/m³. However, the concentrations fall to background levels within a short distance within the facility fence line – less than 2 km from the facility. The monitoring results indicate negligible impacts to the environment from atmospheric releases and confirm that all uranium mines and mills are in compliance with their environmental programs and provincial standards.

2.3.3 Assessment and monitoring

In accordance with the [*Uranium Mines and Mills Regulations*](#) each uranium mine and mill licensee has an environmental monitoring program that monitors concentrations of nuclear and hazardous substances in the environment, and characterizes and monitors effects to the environment associated with the licensed facility. Nuclear and hazardous substances associated with monitoring programs are selected based on COPCs identified through the licensee's ERA. COPCs identified through the ERA that have the potential for adverse environmental effects are managed through increased monitoring, inclusion in the environmental code of practice and further study or implementation of additional controls by licensees. CNSC staff review and evaluate environmental monitoring programs as criteria for assessing environmental performance.

The results of the licensee's environmental monitoring programs relative to the ERA predictions are provided in a licensee's environmental performance report. These are typically completed every 5 years and provides environmental data collected over the previous 5-year period. CNSC staff and the Saskatchewan Ministry of Environment staff review these performance reports once they reports are released.

2.3.4 Environmental risk assessment

The CNSC uses facility-specific ERAs developed by licensees as a regulatory tool throughout the lifecycle of uranium mine and mill facilities. Applicants use ERAs during initial environmental and/or impact assessments for new facilities and for changes to existing facilities or activities at licensed operations, where applicable. The ERA identifies the need for mitigation technologies or practices and predicts:

- physical disturbances
- releases to the atmosphere
- releases to surface water
- air quality
- soil and sediment quality
- surface water quality
- groundwater quality
- changes to the physical environment
- biological and human health effects

ERAs are reviewed at a minimum every 5 years, and if necessary, are updated as part of the review process. ERAs are updated based on changes to operational activities, revised predictions, environmental monitoring data collected over the previous 5 years and the latest science. Table 2.6 shows the year of the most recent ERA submitted for each uranium mine and mill and the year the next ERA updates will be submitted to the CNSC for review. CNSC staff regularly review ERAs to determine the potential risks to human health and the environment and to verify that mitigation measures are adequate.

Table 2.6: ERAs – current and upcoming submissions

| | Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|---------------------|-------------------|-----------------------|--------------------|-----------------|-----------------------|
| Current ERA | 2021 | 2020 | 2020 | 2020 | 2016 |
| Upcoming ERA | 2026 | 2025 | 2025 | 2025 | 2025* |

*Deferred to align environmental monitoring and reporting frequencies, subject annual adequacy reviews, as approved by the CNSC on August 12, 2020.

2.3.5 Protection of people

Each licensee must demonstrate that persons are protected from exposures to radiological and hazardous substances released from an operation. Protection of people is assessed in the human health risk assessment (HHRA). The HHRA assesses hazardous and radiological releases from facilities, and it models the resultant concentrations of contaminants in air, water, soil and traditional foods (such as fish, waterfowl and moose). The concentrations of contaminants consumed by a typical land user are assessed against human health benchmarks in the HHRA. For all facilities, the HHRA confirm that the concentrations of contaminants for a typical local resident are well below concentrations that could cause health effects. Therefore, it has been determined that the health of persons in areas surrounding the facilities is protected.

Doses to persons are calculated based on an individual expected to have the highest possible exposure using conservative assumptions. Calculated dose values are determined for both camp workers (e.g., cook) and persons that are expected to be in close vicinity to the licensed site (such as traditional land users). To be conservative, the dose calculations assume that local Indigenous residents (including adult, child, and toddler) obtain their dietary components throughout the year from the local area.

CNSC staff reviewed the HHRA submitted by the uranium mines and mills and concluded that the estimated doses are a small fraction of the regulatory public dose limit of 1 mSv/year.

Eastern Athabasca Regional Monitoring Program

The Eastern Athabasca Regional Monitoring Program ([EARMP](#)) is a well-recognized environmental monitoring program designed to gather data on long-range environmental information and potential cumulative impacts downstream from uranium mining and milling operations. The program was initiated in 2011 with funding from the Saskatchewan government and the uranium mining industry (Cameco and Orano) as a sub-element of the Province of Saskatchewan's Boreal Watershed Initiative, which ended in 2017. The CNSC became a funding partner in 2017 to support the publication of an EARMP final report (2011 to 2017) with a 5-year long-term funding agreement (2018–2019 to 2022–2023) signed in 2018 between the Saskatchewan Government, the CNSC and industry. The community program monitors the safety of traditionally harvested country foods by analyzing water, fish, berries and wild meat (e.g., grouse, rabbit, caribou and moose) from representative northern Saskatchewan communities. The program contractor is an Indigenous-owned business in northern Saskatchewan. Samples are collected from areas identified by community members, with members either assisting in sample collection or providing samples from their own harvesting activities.

Harvesting and consuming traditional country foods are an important part of the culture in northern Saskatchewan. The intent of EARMP is to provide confidence and transparent communication with community members that traditional country foods remain safe to eat today and for future generations. The program has demonstrated that concentrations of COPC have been relatively consistent over time and are within the regional reference range, which indicates no evidence of long-range transport of contaminants associated with uranium mining.

Evaluation of country food data from previous years confirms uranium mines and mills are not affecting the safety of country foods at nearby communities. The results indicated that radiological and non-radiological exposures to residents consuming country foods were similar to exposures of the general Canadian population. The EARMP has proven to be a productive means of involving the community in monitoring the health of their local environment and provides them with confidence in the safety of their traditional foods. The conclusion of the EARMP is that water and country foods are considered safe for consumption.

The annual reports and data are available at the [EARMP website](#). The CNSC continues to support the EARMP and CNSC staff are working to further collaborate on this valuable program.

Estimated dose to the public

Uranium mine and mill operations are located in remote areas, away from local populations. The [Radiation Protection Regulations](#) set out a public radiation dose limit of 1 mSv per year above natural background radiation to ensure the protection of health and the public.

Radiological exposures measured at the boundaries of these remote licensed facilities are close to measured background radiation levels.

In 2022, CNSC staff were satisfied that uranium mine and mill licensees' controlled radiation doses to persons, were at levels well below the regulatory limits and are ALARA. This conclusion was based on the outcome of inspections, as well as reviews of licensees' environmental protection programs.

2.4 Conventional Health and Safety

Uranium mine and mill licensees in Canada are required to implement a conventional health and safety program. Each program must cover the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.

For 2022, CNSC staff rated the conventional health and safety SCA at uranium mine and mill facilities as satisfactory, following acceptable performance in health and safety practices, awareness and performance.

Conventional health and safety ratings

| Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|------------|----------------|-------------|----------|----------------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Practices

The CNSC requires licensees to identify potential safety hazards, assess associated risks, and introduce the necessary materials, equipment, programs, and procedures to effectively manage, control and minimize these risks. CNSC staff work in collaboration with the Saskatchewan Ministry of Labour Relations and Workplace Safety to provide regulatory oversight of conventional health and safety in uranium mines and mills. CNSC staff's compliance verification activities include inspections and reviews of compliance reports and health and safety events. Most CNSC inspections include some level of verification of conventional health and safety performance.

CNSC staff confirmed that licensees at uranium mines and mills implemented effective conventional health and safety practices in their activities. In addition to CNSC staff's regulatory oversight, the Saskatchewan Government conducts regular inspections of occupational health and safety, mine safety and fire protection through an agreement with the Government of Canada.

Awareness

CNSC staff observed how the implementation of conventional health and safety programs continued to provide workers with education, training, tools, and support (for example, see Figure 2.11). Each facility licensee promotes the idea that safety is the responsibility of all individuals; this message is reinforced by the licensees' management, supervisors and workers. The licensees' management stress the importance of conventional health and safety through regular communication, management oversight and the continual improvement of safety

systems. Through inspections, CNSC staff have identified an acceptable level of communication and awareness in the area of conventional health and safety. CNSC staff concluded that in 2022, licensees of uranium mines and mills were committed to accident prevention and safety awareness and focused on safety culture.

Figure 2.11: Warning signage in underground work area



Source: CNSC

Performance

Key performance measurement criteria for conventional health and safety are the number of LTIs and the total recordable incident rate (TRIR) that occur at each facility. An LTI is a workplace injury that results in the worker being unable to return to work for a period of time. In reviewing each LTI, CNSC staff consider injury severity and frequency rates. The TRIR is the incident frequency rate, measuring the number of fatalities, LTIs and other injuries requiring medical treatment. Table 2.7 shows the number of LTIs at the uranium mines and mills, along with severity, frequency and TRIRs.

Table 2.7: Uranium mines and mills, lost-time injury statistics, 2022 (including contractors)

| | Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|---|-------------------|-----------------------|--------------------|-----------------|-----------------------|
| Lost-time injuries¹ | 0 | 0 | 1 | 1 | 3 |
| Severity rate² | 4.18 | 0 | 0 | 0 | 49.8 |
| Frequency rate³ | 0 | 0 | 0 | 0.2 | 0.9 |
| Total Recordable Incident Rate⁴ | 2.54 | 2.76 | 3.47 | 1.76 | 5.6 |

1 An injury that takes place at work and results in the worker being unable to return to work for a period of time.

2 A measure of the total number of days lost to injury for every 200,000 person-hours worked at the facility. Accident severity rate = [(# of days lost in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

3 A measure of the number of LTIs for every 200,000 person-hours worked at the facility. Accident frequency rate = [(# of injuries in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

4 A measure of the number of fatalities, lost-time injuries, and other injuries requiring medical treatment for every 200,000 person-hours worked at the facility.

Recordable incident rate = [(#incidents in last 12 months) / # hours worked in last 12 months] x 200,000.

Appendix provides additional details on LTIs that occurred at the uranium mine and mill operations in 2022. Information about these events can also be found in sections 6.4 and 7.4, respectively. CNSC staff and the Saskatchewan Ministry of Labour Relations and Workplace Safety monitor and review each reportable injury to verify that the cause is identified and the corrective actions taken are satisfactory. When applicable, injury information is shared by licensees amongst the facilities for lessons learned to improve safety and prevent reoccurrences.

CNSC staff concluded through their compliance verification activities that the health and safety programs at all uranium mines and mills met regulatory requirements in 2022.

Lost-time injuries: Comparison of the uranium mining sector to other mining sectors in Saskatchewan

Table 2.8 displays the various safety statistics concerning mining sectors within Saskatchewan. Data for the uranium sector is presented both with and without contractor data, because contractors are included in CNSC oversight as workers under the NSCA. The data indicates that the uranium mining and milling sector exhibits performance similar to other mining sectors for LTIs and frequency rate.

Table 2.8: Safety statistics for mining sectors in Saskatchewan, 2021

| Mining sector | Number of LTIs¹ | Accident frequency rate (200,000 person-hours)¹ | Accident severity rate (200,000 person-hours)¹ | Total Recordable Incident Rate (200,000 person-hours)³ |
|--|-----------------------------------|---|--|--|
| Potash (underground) | 4 | 0.1 | 6.8 | 1.3 |
| Potash (solution) | 3 | 0.4 | 5.8 | 0.77 |
| Minerals (sodium sulphate, sodium chloride) | 2 | 0.7 | 2.5 | -- |
| Hard rock (gold, diamond) | 10 | 0.8 | 31.1 | 3.62 |
| Coal (strip mining) | 6 | 1.1 | 38.4 | 2.10 |
| Uranium (without contractors) | 2 | 0.08 | 8.5 | 1.74 |
| Uranium (including contractors)² | 2 | 0.06 | 14.0 | 2.74 ⁴ |

1 Saskatchewan Ministry of Labour Relations and Workplace Safety.

2 Statistics for all the other mining sectors do not include contractors.

3 Saskatchewan Mining Association, data provided voluntarily by member companies.

4 See tables 3.3, 4.3, 5.4, 6.3 and 7.3 for the data for each individual licensed uranium operation.

CNSC staff benchmarked the injury frequency rate at Saskatchewan uranium mines and mills with national and international mining statistics. The variation in definitions of a workplace injury is a limitation to consider when comparing safety-related statistics. However, where possible, efforts are made to compare and assess licensee performance against relevant national and international benchmarks. Table 2.9 shows various international benchmarks related to workplace incident frequency rates. The performance of the uranium mining and milling sector in Canada is similar.

Table 2.9: National and international benchmarking related to workplace safety

| Publication/Standard | Lost Time Frequency rate | Total Recordable Incident Rate | Notes |
|--|---------------------------------|---------------------------------------|---|
| Government of Western Australia Department of Mines, Industry Regulation and Safety¹ | 2.3, 3.1 | N/A | Lost time frequency rate of 2.3 across all mining sectors, and 3.1 in non-metal mining environments; rates are per million hours worked for 2016/2017 |
| International Council on Mining and Metals² | 4.3 | N/A | Average rate are per million hours worked for 2016 based on statistics from 27 of the largest international mining companies |
| 2017 Workplace Fatality and Injury Rate Report – Canada³ | 1.9 | N/A | Average rate across all Canadian provinces and territories per million hours worked |
| The National Institute for Occupational Safety and Health⁴ (US) | 1.7 | N/A | Average rate per 200,000 hours worked in 2015 |
| International Council on Mining and Metals (ICMM)⁵ | N/A | 3.94 | Total Recordable Injury Frequency Rate for ICMM Members. Rate per 200,000 hours worked in 2017 |
| International Council on Mining and Metals (ICMM)⁵ | N/A | 4.26 | Total Recordable Injury Frequency Rate for ICMM Members. Rate per 200,000 hours worked in 2016 |
| International Council on Mining and Metals (ICMM)⁵ | N/A | 4.70 | Total Recordable Injury Frequency Rate for ICMM Members. Rate per 200,000 hours worked in 2015 |
| Uranium (without contractors) | 0.08 | 1.74 | N/A |
| Uranium (including contractors)⁶ | 0.06 | 2.74 | N/A |

¹ [Safety performance in the Western Australian mineral industry 2016-17, Government of Western Australia, Department of Mines, Industry Regulations and Safety, 2018.](#)

² [Benchmarking 2016 Safety Data: Progress of ICMM Members, International Council on Mining and Metals.](#)

³ [2017 Workplace Fatality and Injury Rate, Tucker, S, University of Regina, 2017.](#)

⁴ [Number and rate of mining nonfatal lost-time injuries by year, 2006-15, The National Institute for Occupational Safety and Health.](#)

⁵ [Benchmarking 2017 safety data: progress of ICMM members, International Council on Mining and Metals.](#)

⁶ Other mining sectors do not include contractors

N/A = not available.

3 CIGAR LAKE OPERATION

Cameco is the operator of the Cigar Lake Operation, which is located approximately 660 kilometers north of Saskatoon, Saskatchewan.

The Cigar Lake Operation consists of an underground uranium mine with surface facilities for loading ore slurry into trucks, waste management facilities, a water treatment plant (WTP), surface freeze plants, administration offices and warehouses. Figure 3.1 shows an aerial view of the Cigar Lake Operation.

In June 2021, following a public hearing held virtually, the Commission issued a 10-year licence to Cameco for the Cigar Lake Operation. Cameco's licence expires on June 30, 2031.

Figure 3.1: Cigar Lake Operation – aerial view looking north



Source: Shaw Global

Table 3.1 presents the mining production data, 2018-22

| Mining | 2018 | 2019 | 2020 | 2021 | 2022 |
|--|-------|-------|------|------|------|
| Ore tonnage (Mkg/year) | 43.06 | 46.09 | 24.6 | 34.3 | 53.7 |
| Average ore grade mined (%U) | 16.1 | 17.9 | 17.3 | 16.6 | 15.8 |
| Uranium mined (Mkg U/year) | 6.94 | 6.98 | 3.61 | 4.83 | 7.17 |
| Authorized annual production (Mkg U/year)* | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 |

*Mining up to 7.0 Mkg of uranium per year, with a production flexibility up to 9.25 Mkg of uranium.

In 2022, production mining continued through the year. Cigar Lake is authorized to mine up to 7.0 MKg U per year, with additional production flexibility to mine up to 9.25 MKg U per year. CNSC staff confirmed the Cigar Lake Operation production remained within the authorized CNSC licence limit for the 2022 calendar year and is carrying forward a cumulative production shortfall of 18.1 million kg of uranium, reduced from 18.3 million Kg in 2021. This shortfall can be recouped in future years by increasing production in accordance with the production flexibility limits in the Cigar Lake LCH.

3.1 Performance

For 2022, CNSC staff rated 12 SCAs for the Cigar Lake Operation as “satisfactory”, while the Management Systems and Radiation Protection SCAs were rated as “below expectation”. The SCA ratings for the 5-year period from 2018 to 2022 are provided in Appendix E.

In 2022, CNSC staff conducted 5 inspections that covered the following SCAs: conventional health and safety, emergency management and fire protection, environmental protection, fitness for service, human performance management, operating performance, packaging and transport, radiation protection, safety analysis, safeguards and non-proliferation, and waste management.

There were 33 non-compliances identified through CNSC inspections at the Cigar Lake Operation for the 2022 calendar year, and one Order issued. The majority of non-compliances were of low risk and related to the following SCAs: management system, human performance management, operating performance, radiation protection, environmental protection, and emergency management and fire protection. One non-compliance related to the Emergency Management Program was rated as medium risk based on the risk to emergency responders and one non-compliance related to the Radiation Protection Program was rated as medium risk, as described below. Each non-compliance may be related to more than one SCA. For all non-compliances in 2022, corrective actions were implemented by the licensee, then reviewed and accepted by CNSC staff. Ongoing verification of some corrective actions continues into 2023 and will continue into 2024 for corrective actions associated with the Order described below, and for elements related to the Radiation Protection and Management System SCAs. A complete list of these inspections, including the dates the reports were sent to licensees and SCAs assessed, can be found in Appendix B.

CNSC Order issued to Cigar Lake:

In October of 2022, CNSC staff conducted an inspection at the Cigar Lake Operation and identified that the amount of potentially acid generating material on Stockpile “C” exceeded the limit as identified in the Cigar Lake Waste Management Program. In response to the situation, CNSC staff issued an Inspector’s Order to Cameco Corporation as the CNSC licensee for the Cigar Lake Operation, to prevent any further addition of material to the stockpile until certain conditions were met, including assessments of the current and future safety of the stockpile, and CNSC staff acceptance of a plan to restore the facility to compliance. Cigar Lake provided sufficient documentation to meet the requirements of the

Order and in March of 2023 Cameco provided a plan to drawdown the stockpile through onsite processing of material. CNSC staff accepted this plan on May 1, 2023, and closed the Order. CNSC staff provided an update to the Commission on June 28, 2023, as described in [CMD 23-M26](#). CNSC staff will conduct additional regulatory oversight of the Stockpile “C” drawdown activities, including verification of construction activities associated with the drawdown. Cigar Lake is not expected to be fully compliant with the volume limit for Stockpile ‘C’ until August of 2024. It is CNSC staff’s opinion that the drawdown plan will be protective of workers, the public and the environment.

3.2 Radiation Protection

For 2022, CNSC staff rated the radiation protection SCA at Cigar Lake as “below expectation” based on regulatory oversight activities.

Cigar Lake Operation - radiation protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | BE |

SA = satisfactory

BE = below expectation

Radiological hazard control

The main source of radiological exposure at the Cigar Lake Operation is from mining high-grade uranium ore. The effective dose contributors to NEWs at Cigar Lake remained similar to previous years, with gamma radiation (54%), radon progeny (RnP, 29%) and LLRD (16%), and less than 1% attributed to radon gas (RnG). Gamma radiation hazards are controlled through the effective use of time, distance and shielding. Exposures to radon progeny, LLRD, and radon gas are controlled through source control, ventilation, contamination control and personal protective equipment.

Radiation protection program performance

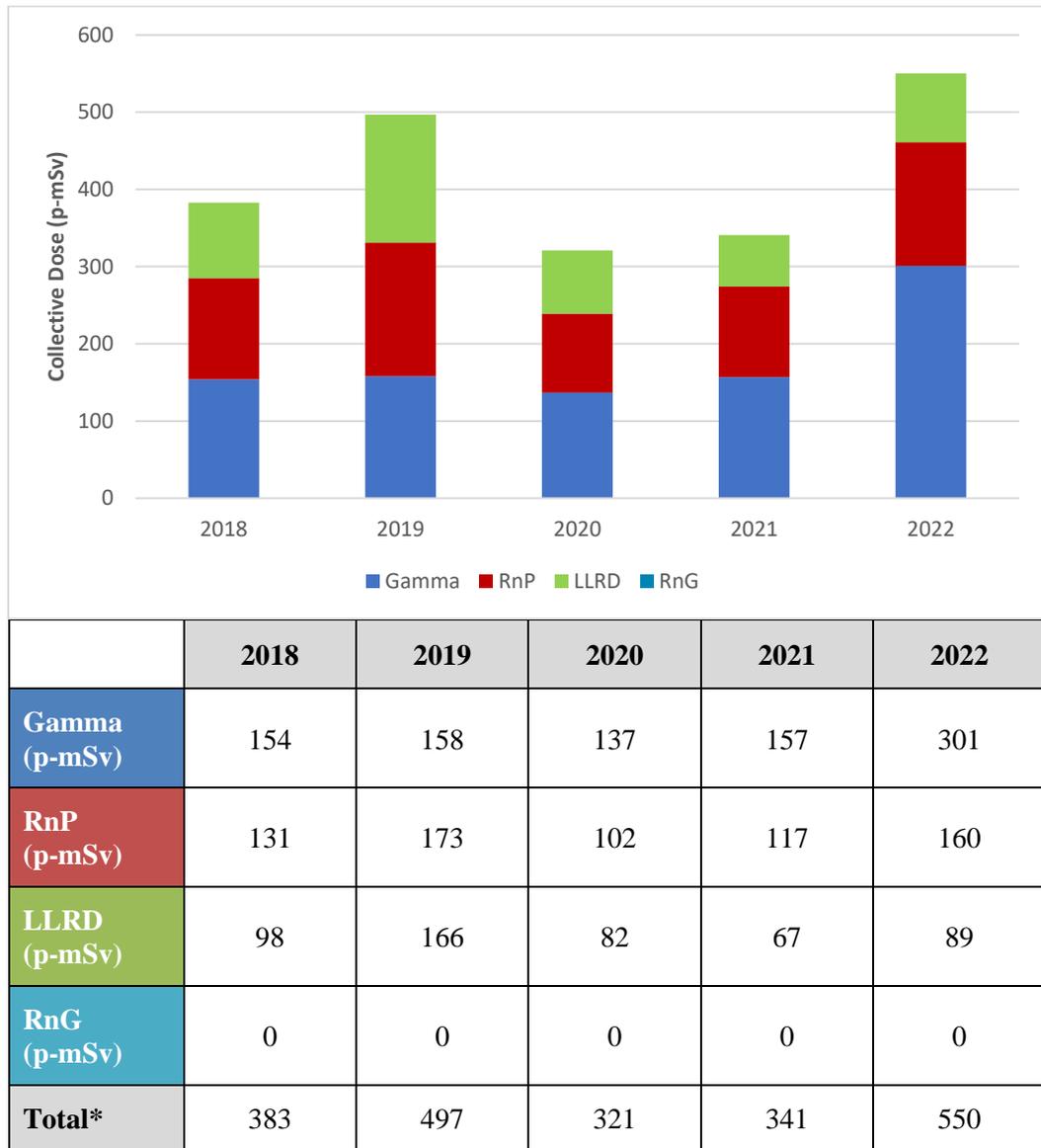
CNSC staff confirmed that the radiation protection program and practices at the Cigar Lake Operation remained effective in controlling radiological exposure to workers.

Upon receipt of the March 2022 PAD results, Cameco identified that a worker received 1.27 mSv, which exceeds the weekly action level of 1 mSv. Cameco’s response to the action level exceedance complied with subsection 6(2) of the [Radiation Protection Regulations](#) and 3 corrective actions were taken to ensure ongoing effectiveness of the radiation protection program. Further information on this reported event is included in Appendix H.

CNSC staff conducted a radiation protection-focused inspection of Cameco's Cigar Lake Operation in July 2022, in order to verify compliance with the NSCA, its associated regulations, the conditions of the licence and the LCH. The inspection team found areas of non-compliance and therefore 16 notices of non-compliance and 2 recommendations were raised for Cameco to address. The findings are considered low risk, with the exception of one medium risk non-compliance, and do not pose an immediate concern regarding the protection of the environment or the health and safety of the workers or the public. During this inspection CNSC staff determined that the radiation protection program as written fulfills requirements, but there are concerns with the implementation of the program. Therefore, CNSC staff are taking additional regulatory actions with respect to the Radiation Protection SCA, including a reactive inspection to be conducted in the 2023/2024 fiscal year, to be focused on the radiation protection program and Cameco's implementation of corrective actions in response to the July 2022 inspection.

Application of ALARA

Figure 3.2 illustrates the annual collective radiation exposures at the Cigar Lake Operation from 2018 to 2022. In 2022, the collective radiation exposure to NEWs at the Cigar Lake Operation was 540.4 person-millisieverts (p-mSv). The increase in collective dose compared to 2021 was due in large part to an increase in the workforce and collective effective dose as a result, which was partially offset by return to regular production numbers.

Figure 3.2: Cigar Lake Operation – annual collective dose, 2018-22

RnP = radon progeny; LLRD = long-lived radioactive dust; RnG = radon gas

* The total collective dose may not match the individual components due to rounding errors.

In 2022, Cameco continued the practice of identifying workers with the top 25 highest effective doses from the previous year and then working with both the supervisors and workers to reduce their effective dose. Based on a pro-rated exposure value due to the partial year of production, 7 of the 25 workers were successful in reducing their total effective dose, while the remaining 18 were slightly above the prorated individual target. The increased production in 2022 over the previous year was considered a main factor in not achieving the RP objective. It is important to note that the individual targets were on the order of 5 mSv, well under the regulatory limit for a Nuclear Energy Worker.

Worker dose control

During 2022, the average individual effective dose to NEWs was 0.46 millisieverts (mSv), compared to the average effective dose of 0.32 mSv in 2021.

As indicated in section 2 (Figure 2.3 and Figure 2.4) no worker exceeded the regulatory individual effective dose limit of 50 mSv per 1-year dosimetry period. CNSC staff verified that Cigar Lake Operation provided assurance that radiological hazards are anticipated and verified through suitable radiological monitoring by Cameco.

Based on compliance verification activities that included inspections, reviews of licensees' reports, work practices, monitoring results and individual effective dose results for 2022, CNSC staff were satisfied that the Cigar Lake Operation continued to be effective at controlling radiation doses to workers.

3.3 Environmental Protection

For 2022, CNSC staff continued to rate the environmental protection SCA as "satisfactory". CNSC staff concluded that the licensee's environmental protection program was effectively implemented and met all regulatory requirements.

Environmental Protection Ratings

Cigar Lake Operation - environmental protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|-------------|-------------|-------------|-------------|-------------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Environmental management system

The environmental management system at the Cigar Lake Operation includes activities such as establishing annual environmental objectives, goals and targets. Cameco conducts internal audits of its environmental management program at the Cigar Lake Operation, as identified in the CNSC-accepted management system program. CNSC staff reviewed and assessed the objectives, goals and targets through regular compliance verification activities. CNSC staff confirmed that Cameco continued to conduct routine inspections, internal audits, environmental training and periodic reviews of environmental monitoring data. These activities were conducted to assess continual improvement and to confirm that the controls put in place to protect the environment are effective.

Effluent and emissions control

Treated effluent released to the environment

CNSC staff confirmed that constituent concentrations in treated effluent were low and remained below treated-effluent discharge limits at the Cigar Lake Operation. CNSC staff verified that treated effluent released to the environment was well below regulatory requirements. At the Cigar Lake Operation throughout 2022, concentrations for molybdenum, selenium and uranium (shown in Figure 2.5 to

Figure 2.7) remained below their respective action levels and well below provincial licence effluent discharge limits.

The Cigar Lake Operation is required to monitor concentrations of other regulatory COPCs, such as radium-226, arsenic, copper, lead, nickel, zinc, TSS, un-ionized ammonia and pH. CNSC staff reviewed the Cigar Lake Operation effluent treatment concentrations and confirmed that it continued to meet [MDMER](#) discharge limits (shown in section 2.3). There were no exceedances of the action levels in the environmental code of practice.

In 2016, the Cigar Lake Operation Environmental Performance Report identified an increasing arsenic trend in effluent. While below regulatory limits, arsenic concentrations in the treated effluent were above EA predictions and above concentrations previously measured in the effluent prior to achieving full ore production. In response, Cameco created a working group to identify the causes of the elevated concentration and develop mitigation strategies. Cameco continues to implement several mitigation techniques to reduce arsenic loadings to the environment, such as improving the recycling of process water captured onsite for use in underground processes. As a result, arsenic loadings and mean concentrations decreased. CNSC staff reviewed the 2022 annual compliance report and noted that arsenic in effluent remained elevated compared to previous years and exceeded the expected and upper-bound benchmarks in the ERA. Arsenic concentrations are variable and depend on underground activities and the composition of the ore. Arsenic loadings and concentrations increased in 2022 compared to the previous years. For example, the arsenic loadings and mean concentrations were 42.2 kg and 0.108 mg/L in 2022 compared to 23.4 kg and 0.065 mg/L in 2021 and 22.2 kg and 0.063 mg/L in 2020. In 2022, Cameco continued to implement operational changes to lower arsenic loadings to the environment. CNSC staff are satisfied that Cameco continues to monitor and take appropriate actions to lower arsenic concentrations in the effluent, and that the environment remains protected.

CNSC staff will continue to review effluent quality results to verify that effluent treatment performance remains effective.

Air emissions released to the environment

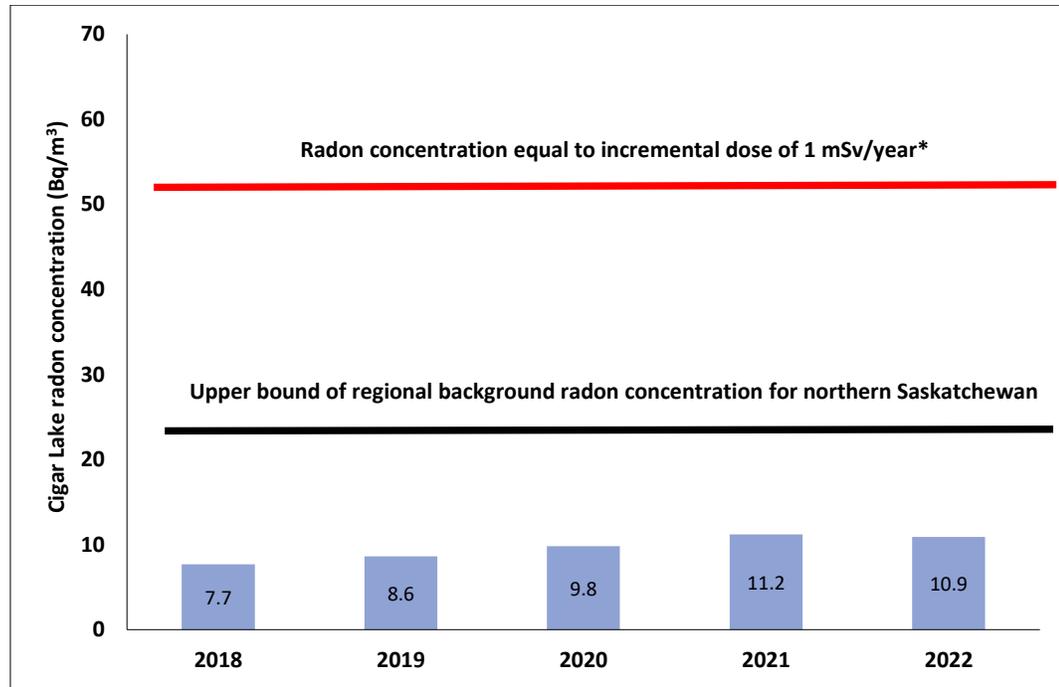
As required by the CNSC, the Cigar Lake Operation maintains an air and terrestrial monitoring program. Air monitoring at the Cigar Lake facility includes ambient radon, total suspended particulate (TSP), soil sampling and lichen sampling to assess the impact of air emissions. Lichen samples are analyzed to determine the level of airborne particulate contaminants deposited on the surface of the lichen as a means of estimating the level of contamination, if any, entering lichen consumers, such as caribou.

Radon in ambient air is measured using passive track etch cups at 8 monitoring stations around the operation. The background concentration of radon in northern Saskatchewan ranges from less than 7.4 Bq/m³ to 25 Bq/m³.

Figure 3.3 illustrates the average concentrations of radon in the air at the Cigar Lake Operation from 2018 to 2022 and shows that measured values are similar to

values measured as northern Saskatchewan regional background. The average radon concentrations are less than the reference level of 60 Bq/m³, which represents an incremental dose of 1 mSv per year over background. CNSC staff noted that concentrations remained well below the reference level. Note: 11 of the 16 sample points that were used for the 2022 average were below the detection limits.

Figure 3.3: Cigar Lake Operation - average concentrations of radon in ambient air, 2018-22



* Upper-bound of the incremental dose of 1 mSv per year above background (i.e., an incremental radon concentration of 30 Bq/m³ above natural background) based on ICRP, 2010. [Lung Cancer Risk from Radon and Progeny and Statement on Radon. ICRP Publication 115](#). Values are calculated as geometric means.

A high-volume air sampler was used to collect and measure TSP in air. Results showed that the TSP levels were lower than provincial standards (see Table 3.2). In addition, the mean concentrations of metal and radionuclides adsorbed to TSP were low and below the reference annual air quality levels identified in Table 3.2

Table 3.2: Cigar Lake Operation - concentrations of metal and radionuclides in air, 2018-22*

| Parameter | Reference levels | 2018 | 2019 | 2020 | 2021 | 2022 |
|-------------------------------------|------------------------------|----------|----------|----------|----------|----------|
| TSP ($\mu\text{g}/\text{m}^3$) | 60 ⁽³⁾ | 8.9 | 10.4 | 5.5 | 9.2 | 12.9 |
| As ($\mu\text{g}/\text{m}^3$) | 0.06 ⁽¹⁾ | 0.00023 | 0.00026 | 0.00019 | 0.00029 | 0.00035 |
| Mo ($\mu\text{g}/\text{m}^3$) | 23 ⁽¹⁾ | 0.0003 | 0.0002 | 0.0001 | 0.0003 | 0.0003 |
| Ni ($\mu\text{g}/\text{m}^3$) | 0.04 ⁽¹⁾ | 0.00083 | 0.00060 | 0.00030 | 0.00062 | 0.00070 |
| Pb ($\mu\text{g}/\text{m}^3$) | 0.10 ⁽¹⁾ | 0.0008 | 0.0007 | 0.0004 | 0.0005 | 0.0007 |
| Se ($\mu\text{g}/\text{m}^3$) | 1.9 ⁽¹⁾ | 0.00003 | 0.00003 | 0.00002 | 0.00003 | 0.00003 |
| Pb-210 (Bq/ m^3) | 0.021 ⁽²⁾ | 0.00037 | 0.00025 | 0.00031 | 0.00029 | 0.00038 |
| Po-210 (Bq/ m^3) | 0.028 ⁽²⁾ | 0.00013 | 0.000089 | 0.000095 | 0.000096 | 0.000126 |
| Ra-226 (Bq/ m^3) | 0.013 ⁽²⁾ | 0.000026 | 0.000013 | 0.000015 | 0.000017 | 0.000016 |
| Th-230 (Bq/ m^3) | 0.0085 ⁽²⁾ | 0.000018 | 0.000009 | 0.000012 | 0.000014 | 0.000014 |
| U ($\mu\text{g}/\text{m}^3$) | 0.06 ⁽¹⁾ | 0.00103 | 0.00096 | 0.00078 | 0.00082 | 0.00090 |

¹ Reference levels derived from [Ontario's Ambient Air Quality Criteria \(AAQC\), Ministry of the Environment, Conservation and Parks](#).

² Reference levels derived from International Commission on Radiological Protection (ICRP), 2005. [Protecting People Against Radiation Exposure in the Event of a Radiological Attack. ICRP Publication 96](#).

³ [Saskatchewan Environmental Quality Guidelines, Table 20](#): Saskatchewan Ambient Air Quality Standards. Values are calculated as geometric means.

* Reference levels based on Province of Ontario [AAQC](#) and ICRP are shown for reference only. No federal or Saskatchewan provincial limits were established at the time of this report.

Soil and terrestrial vegetation may be affected by the atmospheric deposition of particulate, adsorbed metals and radionuclides associated with onsite activities. Lichen and soil samples were collected in 2022 as required under Cigar Lake's triennial sampling program. The results will be submitted to the CNSC in 2023.

COPC concentrations measured in the soil samples collected from the study area in 2019 were comparable to historical results. Concentrations of metals remained below existing [Canadian Environmental Quality Guidelines](#) set by the Canadian Council of Ministers of the Environment (CCME), and radionuclide concentrations were low and near or at background levels and analytical detection limits. CNSC staff concluded that the level of airborne particulate contaminants produced by the Cigar Lake Operation is acceptable and does not pose a risk to the environment.

The lichen chemistry results from exposure stations in 2019 were similar to those of the reference stations and historic data. CNSC staff concluded that the level of airborne particulate contaminants was acceptable and did not pose a risk to lichen consumers.

Uncontrolled releases

In 2022, 2 events were reported where hazardous substances were released to the environment at the Cigar Lake Operation. None of these events resulted in residual impact to the environment. CNSC staff were satisfied with the licensee's reporting of releases and the corrective actions taken. CNSC staff rate spills in accordance with the definitions provided in Appendix I, Table I-2.

Figure **2.10** in section 2 displays the number of environmental reportable spills at the Cigar Lake Operation from 2018 to 2022.

Appendix I contains a brief description of reported spills, the corrective actions taken by the licensee, CNSC staff's assessment of those actions and the significance ratings for 2022.

Assessment and monitoring

CNSC staff confirmed that the licensee, in accordance with the Cigar Lake Environmental Protection Program, successfully carried out the required environmental monitoring.

Through the compliance verification activities conducted and the review of annual reports and environmental performance reports, CNSC staff concluded that the environmental monitoring conducted at the Cigar Lake Operation met regulatory requirements. Consequently, CNSC staff concluded that the environment remained protected.

Environmental risk assessment

The CNSC uses ERAs to determine whether people and the environment are protected. With the exception of arsenic, the Cigar Lake ERA 2017 submission indicated that contaminant levels in the receiving water and sediment were within the predictions made in the 2011 EA. Although arsenic levels in Seru Bay of Waterbury Lake were above ERA predictions, they remained below the [Saskatchewan Surface Water Quality Objectives](#) of 5 µg/L. Cameco implemented measures to address arsenic in the effluent as noted above, and CNSC staff verified that arsenic loading to the environment remains below 2017 levels.

The Cigar Lake environmental performance report and updated ERA for the period from 2016 to 2020 were submitted to the CNSC in late 2021. CNSC staff reviewed the environmental monitoring results for air, soil, vegetation, surface water, groundwater, sediment, and aquatic health indicators and confirmed that the results were within those predicted in the ERA.

After reviewing the environmental performance report and ERA, CNSC staff concluded that adequate measures have been taken at the Cigar Lake Operation to protect the environment.

Protection of people

Cameco is required to demonstrate that the health and safety of persons are protected from exposures to hazardous substances released from the Cigar Lake Operation. The effluent and environmental monitoring programs currently conducted by the licensee are used to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

The CNSC receives reports of discharges to the environment through the reporting requirements outlined in the licence and LCH. The review of Cigar Lake Operation's hazardous (non-radiological) discharges to the environment indicates that the public and the environment are protected. CNSC staff confirmed that environmental concentrations in the vicinity of the Cigar Lake Operation remained within those predicted in the 2021 ERA, and that human health remained protected.

Based on compliance verification activities that included inspections, reviews of licensees' reports, work practices and monitoring results for 2022, CNSC staff concluded that the Cigar Lake Operation's environmental protection program continued to be effective at protecting the public and the environment.

3.4 Conventional Health and Safety

CNSC staff continued to rate the conventional health and safety SCA as "satisfactory" based on regulatory oversight activities conducted during 2022.

Cigar Lake Operations – conventional health and safety ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|-------------|-------------|-------------|-------------|-------------|
| SA | SA | SA | SA | SA |

SA= satisfactory

Practices

CNSC staff monitored the implementation of the Cigar Lake Operation’s safety and health management program to verify the protection of workers. The program includes planned internal inspections, a safety permit system, occupational health and safety committees, training and incident investigations. Cameco’s incident reporting system includes reporting, trending and investigation of near misses, which helps reduce future incidents that could cause injury.

Cigar Lake implemented a “Safety Through Empowering Employee Leadership Committee”. This safety steering committee is unique to the Cigar Lake Operation along with the “Good Catch” reporting environment where facility staff are recognized for distinguishing near misses related to safety. These were found to be safety culture strengths at the Cigar Lake Operation.

CNSC staff verified that the conventional health and safety work practices and conditions at the Cigar Lake Operation continued to be effective in 2022.

Performance

Table 3.3 summarizes LTIs at the Cigar Lake Operation from 2018 to 2022. There were no LTIs at the Cigar Lake Operation in 2022. Events that took place as a result of the licensed operation were reported as required under section 29(1)h of the *General Nuclear Safety and Control Regulations* ([GNSCR](#)). The licensee identified causes and took appropriate corrective actions.

The TRIR for Cigar Lake is included for the last 5 years. The TRIR is the incident frequency rate that measures the number of fatalities, LTIs and other injuries requiring medical treatment, per 200,000 person-hours worked.

Table 3.3: Cigar Lake Operation - lost-time injury statistics, 2018 to 2022

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|------|------|------|-------|------|
| Lost-time injuries¹ | 0 | 0 | 0 | 2 | 0 |
| Severity rate² | 0 | 0 | 0 | 6.31 | 4.18 |
| Frequency rate³ | 0 | 0 | 0 | 0.37 | 0 |
| Total recordable incident rate⁴ | 1.00 | 1.67 | 2.08 | 2.60* | 2.54 |

¹ An injury that takes place at work and results in the worker being unable to return to work for a period of time.

² A measure of the total number of days lost to injury for every 200,000 person-hours worked at the facility. Accident severity rate = [(# of days lost in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

³ A measure of the number of LTIs for every 200,000 person-hours worked at the facility. Accident frequency rate = [(# of injuries in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

⁴ A measure of the number of fatalities, lost-time injuries and other injuries requiring medical treatment for every 200,000 person-hours worked at the facility. Recordable incident rate = [(# of incidents in last 12 months) / # of hours worked in last 12 months] x 200,000.

* 2021 TRIR changed from 2021 ROR due to a change in WCB incident reassessment

Awareness

CNSC staff verified, through remote compliance activities, that Cameco implemented effective controls to ensure that ongoing activities continued to be conducted safely as a result of any changes. CNSC staff confirmed that conventional health and safety events at the operation were investigated and that effective corrective actions were implemented. Managers, supervisors, and workers share and promote the idea that safety is the responsibility of all individuals. The facility's management stresses the importance of conventional health and safety through regular communication, management oversight and the continual improvement of safety systems.

CNSC staff compliance verification activities concluded that the Cigar Lake Operation's health and safety program met regulatory requirements in 2022.

3.5 Additional SCAs

In addition to the 3 primary SCAs of radiation protection, environmental protection, and conventional health and safety, CNSC staff have provided a brief discussion of the additional SCAs; these are presented in the following sections.

3.5.1 Management system

The licensee includes program documentation for the management system SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There was one inspection in 2022 at the Cigar Lake Operation that included direct evaluation of the management system SCA among other topics. No notices of non-compliance were issued for the management system SCA during that inspection. Note that most CNSC compliance activities involve the evaluation of Management System elements at some level.

Failure of components of the Cigar Lake's management system were identified as contributing factors to the events that resulted in Cigar Lake exceeding the limit for Stockpile "C". This resulted in an order being issued to Cameco's Cigar Lake facility as described in section 3.1. Weaknesses in implementation of the management system were also identified as contributing factors to several notices of non-compliance identified during inspections, including those identified in the radiation protection, and emergency management and fire protection SCAs and event reviews. Weaknesses identified in in key components of the management system include:

- Information control,
- Document control,
- Control of records,
- Operational control and Maintenance,
- Resource control and,
- Safety Culture

Further information can be found in Appendix , Appendix , and Appendix .

CNSC staff concluded that the licensee's program in respect of this SCA was below expectations (BE).

3.5.2 Human performance management

The licensee includes program documentation for the human performance management SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Cigar Lake Operation focused on evaluating the Human Performance Management SCA. There were no notices of non-compliance related to the Human Performance Management SCA and no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

3.5.3 Operating performance

The licensee includes program documentation for the operating performance SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Cigar Lake Operation focused on evaluating the operating performance SCA. There was one notice of non-compliance related to the operating performance SCA and no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

3.5.4 Safety analysis

The licensee includes program documentation for the safety analysis SCA as part of the overall management system documents and these are part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Cigar Lake Operation focused on evaluating the safety analysis SCA. There were no notices of non-compliance related to the safety analysis SCA and no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

3.5.5 Physical design

The licensee includes program documentation for the physical performance SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Cigar Lake Operation focused on evaluating the physical design SCA and no notices of non-compliance related to

this SCA. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

3.5.6 Fitness for service

The licensee includes program documentation for the fitness for service SCA as part of the overall management system documents and these are part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Cigar Lake Operation focused on evaluating the fitness for service SCA. No notices of non-compliance related to this SCA were issued. There was one event report for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

3.5.7 Emergency management and fire protection

The licensee includes program documentation for the emergency management and fire protection SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

CSA Standard N393, Fire Protection for facilities that process, handle, or store nuclear substances, (CSA N393), is currently indicated as a Guidance document within the Cigar Lake LCH.

Cameco Cigar Lake operation submitted an N393 Gap Analysis and Corrective Action Plan (CAP) in 2022 and is committed to close identified N393 gaps by December 31st, 2023.

CNSC staff reviewed and accepted Cameco's Gap Analysis and CAP and will follow-up on CSA N393 implementation once the implementation date has passed.

One Emergency Management and Fire Protection-focused inspection was conducted at Cigar Lake in October 2022. During the October 2022 inspection, 10 notices of non-compliance were issued by CNSC inspectors.

All notices of non-compliance have been rated as low risk with the exception of one that was related to Cigar Lake's emergency response training documents and work procedures.

In response to CNSC staff's notices of non-compliance, Cigar Lake staff undertook appropriate corrective actions, and CNSC staff are confident with Cigar Lake's progress on remaining corrective actions.

In addition, CNSC staff conducted several Desktop reviews, and there were no additional event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

3.5.8 Waste management

The licensee includes program documentation for the waste management SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Cigar Lake Operation focused on evaluating the waste management SCA. There were no notices of non-compliance related to the waste management SCA and no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

3.5.9 Security

The licensee includes program documentation for the security SCA as part of the overall management system documents and these constitute part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Cigar Lake Operation focused on evaluating the security SCA. There were no notices of non-compliance related to the security SCA and no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

3.5.10 Safeguards and non-proliferation

The licensee includes program documentation for the safeguards and non-proliferation SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Cigar Lake Operation focused on evaluating the safeguards and non-proliferation SCA. There were no notices of non-compliance related to the safeguards and non-proliferation SCA and no event reports for which this SCA was the main contributory factor.

In addition to CNSC compliance activities with respect to the specific areas under the safeguards and non-proliferation SCA, the International Atomic Energy Agency (IAEA) conducts its own inspections and activities with coordination and support through the CNSC regulatory framework. No IAEA inspections or activities were conducted at the Cigar Lake Operation during 2022.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

3.5.11 Packaging and transport

The licensee includes program documentation for the packaging and transport SCA as part of the overall management system documents and these form part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Cigar Lake Operation focused on evaluating the packaging and transport SCA. There were no notices of non-compliance related to this SCA and no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

4 MCARTHUR RIVER OPERATION

Cameco is the operator of the McArthur River mine, which is located approximately 620 kilometers north of Saskatoon, Saskatchewan.

The McArthur River Operation consists of an underground uranium mine, primary ore processing, ore slurry loading, waste management facilities, a water treatment plant, effluent storage ponds, surface freeze plants, administration offices and warehouses. Figure 4.1 shows an aerial view of the McArthur River Operation.

In October 2013, following a public hearing in La Ronge, Saskatchewan, the Commission issued a 10-year licence to Cameco for the McArthur River Operation. Cameco's licence expires on October 31, 2023. On April 20, 2021, Cameco submitted a licence renewal application for the facility. In June 2023, CNSC conducted a public hearing in Saskatoon, Saskatchewan, where the Commission were presented with Cameco's application to renew the uranium mine licence for the McArthur River Operation for a period of 20 years. A Commission Decision on the application for license renewal remains in progress.

Figure 4.1: McArthur River Operation – aerial view



Source: Cameco

In 2018, the McArthur River Operation halted active mining and the mining facility was placed in safe care and maintenance. In late 2022, Cameco resumed commercial mining at the McArthur River Operation. Mining production data from 2018 to 2022 for McArthur River Operation is provided in Table 4.1. CNSC regulatory oversight in 2022 was focused on ensuring the safe transition from the care and maintenance to normal operation in 2022.

Table 4.1: McArthur River Operation – mining production data, 2018-22

| Mining | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|-------------|-------------|-------------|-------------|-------------|
| Ore tonnage (Mkg/year) | 2.79 | 0 | 0 | 0 | 3.53 |
| Average ore grade mined (%U) | 6.42 | N/A | N/A | N/A | 8.3 |
| Uranium mined (Mkg U/year) | 0.18 | N/A | N/A | N/A | 0.25 |
| Authorized annual production (Mkg U/year)* | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 |

N/A = not applicable

4.1 Performance

The SCA ratings at McArthur River Operation for the 5-year period from 2018 to 2022 are shown in Appendix . For 2022, CNSC staff rated all SCAs as “satisfactory”.

In 2022, CNSC staff carried out 3 focused inspections which evaluated the following SCAs: conventional health and safety, human performance management, management systems, operating performance, and radiation protection. Two of the inspections focused on human performance management (training) and one inspection focused on management systems.

There were no event reports for which these SCAs were the contributory factor.

4.2 Radiation Protection

For 2022, CNSC staff continued to rate the radiation protection SCA at McArthur River as “satisfactory” based on regulatory oversight activities.

McArthur River Operation - radiation protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|-------------|-------------|-------------|-------------|-------------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Cameco includes the program documentation for the radiation protection SCA as part of the overall management system documents and these form part of the licensing basis in the LCH.

There were no exceedances of the regulatory dose limit and no exceedances of the weekly and quarterly action levels. There was 1 inspection conducted at the McArthur River Operation that evaluated compliance with the radiation protection SCA. There were no event reports for which this SCA was the contributory factor.

Radiological hazard control

In 2022, the radiation dose to NEWs at the McArthur River Operation was contributed by radon progeny (50%), gamma radiation (36%) and LLRD (14%). This distribution is similar to that in the previous year during which the mine was also in care and maintenance. Exposures to radon progeny, radon gas and LLRD are managed through source control, ventilation, contamination control and personal protective equipment. Gamma radiation hazards are controlled through practices that involve the effective use of time, distance and shielding.

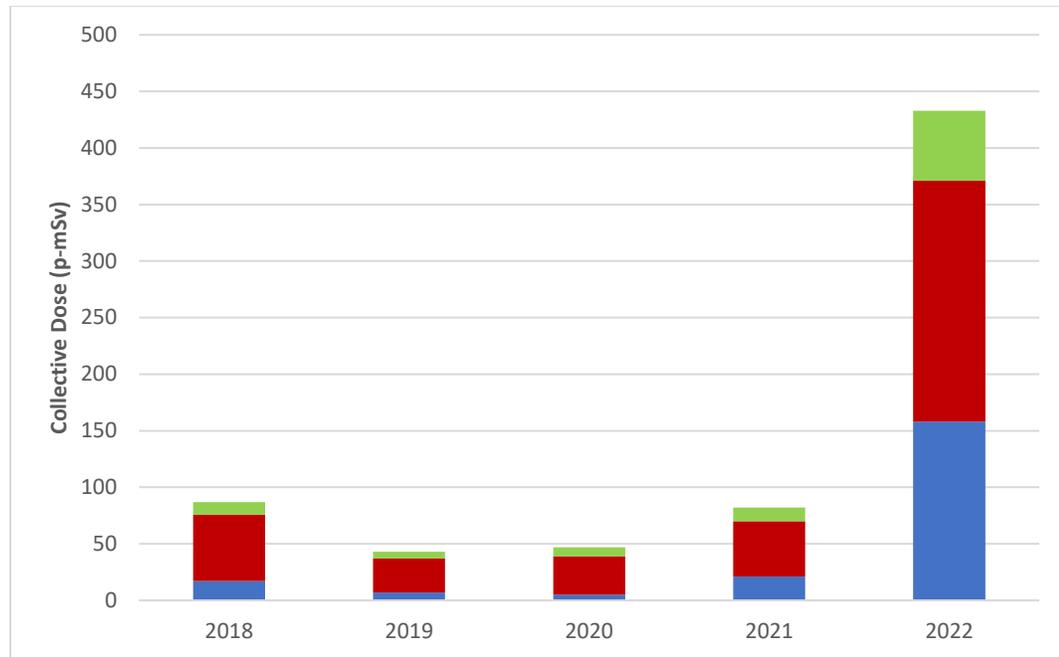
Radiation protection program performance

In 2022, CNSC staff were satisfied that the radiation protection program and practices at the McArthur River Operation remained effective at controlling radiological exposure to workers. The doses to workers remained below regulatory limits and ALARA. There were no exceedances of regulatory limits or action levels at the McArthur River Operation in 2022.

Application of ALARA

Figure 4.2 displays the annual collective radiation exposures at the McArthur Operation from 2018-2022. In 2022, the collective dose to NEWs at the McArthur River Operation was 433 p-mSv, an increase over recent years. The increase in the collective dose reflects the increase in personnel during the transition from a state of care and maintenance to production at the facility in 2022.

The ALARA focus at the McArthur River Operation was on improving radiation comprehension and awareness communications as well as keeping radon progeny doses low through ventilation upgrades and increases.

Figure 4.2: McArthur River Operation – annual collective dose, 2018-2022

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|----------------------|------|------|------|------|------|
| Gamma (p-mSv) | 17 | 7 | 5 | 21 | 158 |
| RnP (p-mSv) | 59 | 30 | 34 | 49 | 213 |
| LLRD (p-mSv) | 11 | 6 | 8 | 12 | 62 |
| RnG (p-mSv) | 0 | 0 | 0 | 0 | 0 |
| Total* | 87 | 43 | 47 | 82 | 433 |

RnP = radon progeny; LLRD = long-lived radioactive dust; RnG = radon gas

*The total collective dose may not match the individual components due to rounding errors.

Worker dose control

The average individual effective dose to NEWs was 0.59 mSv. The maximum individual effective dose of 7.14 mSv was assigned to an underground support worker. The 2022 values are higher than those from the previous year due to the return to operations from care and maintenance. All individual effective doses were well below the annual regulatory limit of 50 mSv, as indicated in section 2 Figure 2.3 and Figure 2.4.

Based on compliance verification activities, such as inspections, reviews of licensees' reports, work practices, monitoring results and individual effective dose

results, CNSC staff were satisfied that the radiation dose to workers continued to be effectively controlled at the McArthur River Operation during 2022.

4.3 Environmental Protection

For 2022, CNSC staff continued to rate the environmental protection SCA at McArthur River as “satisfactory”. CNSC staff verified that the licensee’s environmental protection program was effectively implemented and met all regulatory requirements.

McArthur River Operation - environmental protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Cameco includes program documentation for the environmental protection SCA as part of the overall management system documents and these constitute part of the licensing basis in the LCH.

Environmental management system

The environmental management system at the McArthur River Operation includes activities such as establishing annual environmental objectives, goals and targets. Cameco conducts internal audits of its environmental management program at the McArthur River Operation, as identified in their CNSC-accepted management system. CNSC staff reviewed and assessed the objectives, goals and targets through regular compliance verification activities. CNSC staff noted that Cameco had continued with routine inspections, internal audits, environmental training and periodic reviews of environmental monitoring data. These activities were conducted to verify continual improvement and to confirm that the controls put in place to protect the environment are effective.

Effluent and emissions control

Treated effluent released to the environment

CNSC staff verified that treated effluent released to the environment was below regulatory requirements and has remained stable or improved over the past 5-years. As discussed in section 2.3, COPC with potential to adversely affect the environment in treated effluent at multiple uranium mine and mill operations are molybdenum, selenium, and uranium (Figure 2.5, Figure 2.6 and Figure 2.7, respectively). Of the 3 COPCs, molybdenum posed an elevated risk at the McArthur River Operation. In response, Cameco implemented process changes prior to 2018 during active mining which reduced molybdenum concentrations in treated effluent. Since 2018, concentrations of molybdenum were further reduced by approximately 90% as a result of placing the facility into a state of care and maintenance.

Cameco analyzed treated effluent from the McArthur River Operation for other contaminants such as radium-226, arsenic, copper, lead, nickel, zinc, TSS and pH,

for which limits are defined in the McArthur River CNSC-issued licence and mirror those limits defined in the [MDMER](#) (section 2.3). CNSC staff reviewed the effluent treatment concentrations and confirmed that the McArthur River Operation continued to meet the discharge limits.

The CNSC will continue to review effluent quality results to verify that effluent treatment performance remains effective.

Figure 4.3: McArthur River Operation – monitoring pond



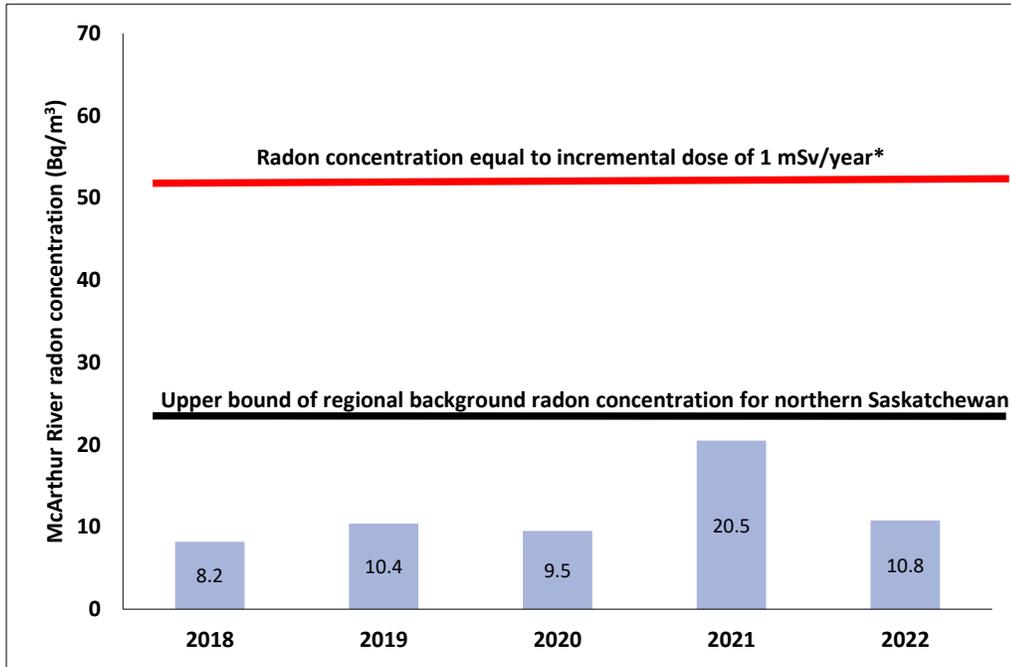
Source: Cameco

Air emissions released to the environment

The CNSC requires that Cameco maintain an air and terrestrial monitoring program at its McArthur River Operation. Air and terrestrial monitoring at the McArthur River facility includes ambient radon, TSP, soil sampling and lichen sampling to assess the impact of air emissions. An analysis of blueberry chemistry was also included to align with country food studies. Blueberry twigs are monitored to determine whether soil-borne contaminants (when present) are being absorbed through the roots into the growing plant parts. The monitoring of soil and blueberry stems/twigs was completed in the summer of 2021. The results are within the historical range for the stations sampled.

Radon in ambient air is monitored using passive track etch cups at 10 monitoring stations surrounding the operation. Figure 4.4 shows that the average concentrations of radon in ambient air from 2018 to 2022 were similar to past performance, with radon concentrations typical of the northern Saskatchewan regional background of less than 7.4 Bq/m³ to 25 Bq/m³. The average radon concentrations are less than the reference level of 60 Bq/m³, which represents an incremental dose of 1 mSv/year above background.

Figure 4.4: McArthur River Operation - concentrations of radon in ambient air, 2018-22



*Upper-bound of the incremental dose of 1 mSv per year above background (i.e., an incremental radon concentration of 30 Bq/m³ above natural background) based on ICRP, 2010. [Lung Cancer Risk from Radon and Progeny and Statement on Radon. ICRP Publication 115](#). Values are calculated as geometric means.

** Part of change in value in 2021 attributed to differing detection limit and laboratory performing analysis.

Two high-volume air samplers were used to collect and measure TSP in air. Taking the average of the 2 stations, the TSP levels were lower than provincial standards (see Table 4.2). In addition, the mean concentrations of metal and radionuclides adsorbed to TSP were low and below the reference annual air quality levels identified in Table 4.2.

Table 4.2: McArthur River Operation - concentrations of metal and radionuclides in air, 2018-22*

| Parameter | Reference levels | 2018 | 2019 | 2020 | 2021 | 2022 |
|-----------------------------------|-----------------------|---------|----------|-----------|----------|----------|
| TSP ($\mu\text{g}/\text{m}^3$) | 60 ⁽³⁾ | 1.66 | 2.50 | 1.31 | 2.18 | 2.7 |
| As ($\mu\text{g}/\text{m}^3$) | 0.06 ⁽¹⁾ | 0.00006 | 0.00004 | 0.00005 | 0.00005 | 0.00005 |
| Cu ($\mu\text{g}/\text{m}^3$) | 9.6 ⁽¹⁾ | 0.0072 | 0.0063 | 0.0042 | 0.007 | 0.0061 |
| Ni ($\mu\text{g}/\text{m}^3$) | 0.04 ⁽¹⁾ | 0.0006 | 0.00054 | 0.00049 | 0.00064 | 0.00064 |
| Pb ($\mu\text{g}/\text{m}^3$) | 0.10 ⁽¹⁾ | 0.0008 | 0.00063 | 0.00046 | 0.00419 | 0.00083 |
| Se ($\mu\text{g}/\text{m}^3$) | 1.9 ⁽¹⁾ | 0.00003 | 0.000025 | 0.00003 | 0.00003 | 0.00002 |
| Zn ($\mu\text{g}/\text{m}^3$) | 23 ⁽¹⁾ | 0.0295 | 0.023 | 0.010 | 0.00608 | 0.00639 |
| Pb-210 (Bq/m^3) | 0.021 ⁽²⁾ | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 |
| Po-210 (Bq/m^3) | 0.028 ⁽²⁾ | 0.0001 | 0.0001 | 0.0001 | 0.00009 | 0.00010 |
| Ra-226 (Bq/m^3) | 0.013 ⁽²⁾ | 0.00001 | 0.000006 | 0.0000044 | 0.000004 | 0.000006 |
| Th-230 (Bq/m^3) | 0.0085 ⁽²⁾ | 0.00001 | 0.000008 | 0.000008 | 0.000008 | 0.000008 |
| U ($\mu\text{g}/\text{m}^3$) | 0.06 ⁽¹⁾ | 0.0001 | 0.0001 | 0.00009 | 0.000085 | 0.00017 |

¹ Reference annual air quality levels are derived from [Ontario's Ambient Air Quality Criteria \(AAQC\)](#), [Ministry of the Environment, Conservation and Parks](#).

² Reference level is derived from ICRP, 2005. [Protecting People Against Radiation Exposure in the Event of a Radiological Attack](#). ICRP Publication 96

³ [Saskatchewan Environmental Quality Guidelines, Table 20](#): Saskatchewan Ambient Air Quality Standards. Values are calculated as geometric means.

* Reference levels based on Province of Ontario [AAQC](#) and are shown for reference only. No federal or Saskatchewan provincial limits were established at the time of this report.

Soil and terrestrial vegetation may be affected by the atmospheric deposition of particulate and adsorbed metals and radionuclides associated with onsite activities. A terrestrial monitoring program is in place and includes triennial measurements of metals and radionuclides in soil and blueberry samples.

Soil, blueberry twig and lichen samples were last collected in 2021 as required by the triennial sampling program. The results indicated that the parameters measured were within historical ranges.

CNSC staff concluded that the level of airborne particulate contaminants produced by the McArthur River Operation is acceptable and does not pose a risk to the environment.

Uncontrolled releases

In 2022, zero events reported to the CNSC were classified as a release (spill) of a hazardous substance to the environment. CNSC spill rating definitions can be found in Appendix I, Table I-2.

Figure 2.10 in section 2 shows the number of spills at the McArthur River Operation from 2018 to 2022.

Assessment and monitoring

CNSC staff confirmed that the licensee, in accordance with the McArthur River environmental protection program, successfully carried out the required environmental monitoring.

Through the compliance verification activities conducted and the review of annual reports and environmental performance reports, CNSC staff concluded that the environmental monitoring conducted at the McArthur River Operation met regulatory requirements. Consequently, CNSC staff concluded that the environment remains protected.

Environmental risk assessment

In 2020, the McArthur River environmental performance report and updated ERA for 2015 to 2019 were submitted to the CNSC and the Saskatchewan Ministry of Environment. CNSC staff have reviewed the environmental monitoring results for air, soil, vegetation, surface water, groundwater and sediment, as well as the health indicators for fish and their prey inhabiting sediment and confirmed the results to date were within those predicted in the ERA. After reviewing the environmental performance report and ERA data that has been collected, CNSC staff concluded that adequate measures have been taken at the McArthur River Operation to protect the environment.

Protection of people

Cameco is required to demonstrate that the health and safety of persons are protected from exposures to hazardous substances released from the McArthur River Operation. The effluent and environmental monitoring programs currently conducted by the licensee are used to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

The CNSC receives reports of discharges to the environment through the reporting requirements outlined in the licence and LCH. The review of McArthur River Operation's hazardous (non-radiological) discharges to the environment indicates that the public and the environment are protected. CNSC staff confirmed that environmental concentrations in the vicinity of the McArthur River Operation remained within those predicted in the ERA, and that human health remained protected.

Based on compliance verification activities that included inspections, reviews of licensees' reports, work practices and monitoring results for 2022, CNSC staff concluded that the McArthur River Operation's environmental protection program continued to be effective at protecting the public and the environment.

4.4 Conventional Health and Safety

CNSC staff rated the conventional health and safety SCA as "satisfactory" based on regulatory oversight activities conducted during 2022.

McArthur River Operation - conventional health and safety ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA= satisfactory

Cameco includes program documentation for the conventional health and safety SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There was 1 inspection conducted at the McArthur River Operation that examined elements of the conventional health and safety SCA. As a result of this inspection, no non-compliances were identified. There were no event reports for which this SCA was the main contributory factor.

Practices

To promote continued effective safety performance, the McArthur River Operation has implemented a health and safety management program to identify and mitigate risks at the facility. The program includes a safety permit system, continued training, planned internal inspections, occupational health committees and incident investigations. The incident reporting system includes investigating and reporting on near misses and reduces the chances of future incidents that could cause injury. CNSC staff verified that Cameco's conventional health and safety work practices and conditions at the McArthur River Operation met regulatory requirements in 2022.

Performance

Table 4.3 summarizes LTIs at the McArthur River Operation from 2018 to 2022. There were no LTIs at the McArthur River Operation in 2022.

The TRIR for McArthur River is included for the last 5 years. The TRIR is the incident frequency rate that measures the number of fatalities, LTIs and other injuries requiring medical treatment, per 200,000 person-hours worked.

Table 4.3: McArthur River Operation – lost-time injury statistics, 2018-22

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|-------|------|------|------|------|
| Lost-time injuries¹ | 0 | 0 | 0 | 0 | 0 |
| Severity rate² | 22.6* | 0 | 0 | 0 | 0 |
| Frequency rate³ | 0 | 0 | 0 | 0 | 0 |
| Total recordable incident rate⁴ | 5.02 | 2.12 | 1.98 | 0.70 | 2.76 |

¹ An injury that takes place at work and results in the worker being unable to return to work for a period of time.

² A measure of the total number of days lost to injury for every 200,000 person-hours worked at the facility. Accident severity rate = [(# of days lost in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

³ A measure of the number of LTIs for every 200,000 person-hours worked at the facility. Accident frequency rate = [(# of injuries in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

⁴ A measure of the number of fatalities, lost-time injuries and other injuries requiring medical treatment for every 200,000 person-hours worked at the facility. Recordable incident rate = [(# of incidents in last 12 months) / # of hours worked in last 12 months)] x 200,000.

* Severity rating of 23.2 is related to time lost in 2018 due to injuries that occurred in 2016 and 2017.

Awareness

CNSC staff observed that the conventional health and safety programs at the McArthur River Operation continued to provide education, training, tools and support to workers. Managers, supervisors, and workers share and promote the idea that safety is the responsibility of all individuals. The facility's management stresses the importance of conventional health and safety through regular communication, management oversight and the continual improvement of safety systems.

CNSC staff verified that the health and safety program at the McArthur River Operation met regulatory requirements.

4.5 Additional SCAs

In addition to the 3 primary SCAs of radiation protection, environmental protection, and conventional health and safety, CNSC staff have provided a brief discussion of the additional SCAs; these are presented in the following sections.

4.5.1 Management system

Cameco maintains a quality management program which is part of the licensing basis for McArthur River Operation in the LCH.

There was 1 inspection at the McArthur River Operation that focused on evaluating the management system SCA in 2022 and no event reports for which this SCA was the main contributory factor. There were 3 notices of non-compliance and 1 recommendation, which were of low safety significance.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

4.5.2 Human performance management

Cameco includes program documentation for the human performance management SCA as part of the overall management system documents; these form part of the licensing basis in the LCH.

There were 2 inspections at the McArthur River Operation that focused on evaluating the human performance management SCA in 2022. The first inspection focused on the training and onboarding of workers related to the planned restart of activities at the site. There was 1 recommendation and 3 notices of non-compliances issued related to the update and maintenance of training governance, training analysis documents, and the training record system. The second inspection was conducted to verify Cameco's implementation of *REGDOC-2.2.2, Personal Training, Version 2*, ([REGDOC-2.2.2](#)). There were 2 recommendations 4 notices of non-compliance issued related to the update and alignment of training governance and training material, worker completion of training, and accurate storage of training records. All of the notices of non-compliance issued have been addressed to the satisfaction of CNSC staff. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

4.5.3 Operating performance

Cameco includes program documentation for the operating performance SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There was 1 inspection at the McArthur River Operation that evaluated the operating performance SCA in 2022. There was 1 notice of non-compliance issued which has been addressed to the satisfaction of CNSC staff. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

4.5.4 Safety analysis

Cameco includes program documentation for the safety analysis SCA as part of the overall management system documents; these constitute part of the licensing basis for McArthur River Operation in the LCH.

There were no inspections conducted in 2022 with a focus on evaluating the safety analysis SCA. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

4.5.5 Physical design

Cameco includes program documentation for the physical design SCA as part of the overall management system documents; these form part of the licensing basis for McArthur River Operation in the LCH.

There were no inspections conducted in 2022 at the McArthur River Operation evaluating the physical design SCA. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program with respect of this SCA remains satisfactory.

4.5.6 Fitness for service

Cameco includes program documentation for the fitness for service SCA as part of the overall management system documents; these constitute part of the licensing basis for the McArthur River Operation in the LCH.

There were no inspections conducted in 2022 at the McArthur River Operation that focused on evaluating the fitness for service SCA. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

4.5.7 Emergency management and fire protection

Cameco includes program documentation for the emergency management and fire protection SCA as part of the overall management system documents; these form part of the licensing basis for McArthur River Operation in the LCH.

There were no inspections conducted at the McArthur River Operation in 2022 that focused on evaluating the emergency management and fire protection SCA. One such inspection had been scheduled but was deferred when Cameco decided to reschedule a drill into the 2023 calendar year. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

4.5.8 Waste management

Cameco includes program documentation for the waste management SCA as part of the overall management system documents; these form part of the licensing basis for McArthur River Operation in the LCH.

No inspections were conducted at the McArthur River Operation in 2022 that focused on evaluating the waste management SCA. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

4.5.9 Security

Cameco includes program documentation for the security SCA as part of the overall management system documents; these constitute part of the licensing basis for McArthur River Operations in the LCH.

There were no inspections conducted at the McArthur River Operation that focused on evaluating the security SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program with respect of this SCA remains satisfactory.

4.5.10 Safeguards and non-proliferation

Cameco includes program documentation for the safeguards and non-proliferation SCA as part of the overall management system documents; these form part of the licensing basis for McArthur River Operation in the LCH.

There were no inspections in 2022 at the McArthur River Operation focused on evaluating the safeguards and non-proliferation SCA. There were no event reports for which this SCA was the main contributory factor.

In addition to CNSC compliance activities with respect to the specific areas under the safeguards and non-proliferation SCA, the IAEA conducts independent inspections and activities with coordination and support through the CNSC regulatory framework. No IAEA inspections or activities were conducted at the McArthur River Operation during 2022.

CNSC staff concluded that the licensee's program in respect to this SCA remains satisfactory.

4.5.11 Packaging and transport

Cameco includes program documentation for the packaging and transport SCA as part of the overall management system documents; these form part of the licensing basis for McArthur River Operation in the LCH.

There were no inspections at the McArthur River Operation that focused on evaluating the packaging and transport SCA. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

5 RABBIT LAKE OPERATION

The Rabbit Lake Operation is located 750 kilometers north of Saskatoon, Saskatchewan. Operated by Cameco, the facility stretches across approximately 20 kilometers. It consists of an underground mine; 3 mined-out pits, of which 2 are reclaimed; a further mined-out pit which has been converted into an in-pit tailings management facility (TMF), a mill and supporting infrastructure. Figure 5.1 provides an aerial view of the mill area of the Rabbit Lake Operation.

In October 2013, following a public hearing in La Ronge, Saskatchewan, the Commission issued a 10-year licence to Cameco for the Rabbit Lake Operation. Cameco's licence expires on October 31, 2023. On April 20, 2021, Cameco submitted a licence renewal application for the facility. In June 2023, CNSC conducted a public hearing in Saskatoon, Saskatchewan, where the Commission were presented with Cameco's application to renew the uranium mine and mill licence for the Rabbit Lake Operation for a period of 20 years. A Commission Decision on the application for license renewal remains in progress.

Figure 5.1: Rabbit Lake Operation - aerial view of mill



Source: Cameco

Mining production data for the Rabbit Lake Operation are provided in Table 5.1.

Table 5.1: Rabbit Lake Operation - mining production data, 2018-22

| Mining | 2018 | 2019 | 2020 | 2021 | 2022 |
|-------------------------------------|-------------|-------------|-------------|-------------|-------------|
| Ore tonnage (Mkg/year) | 0 | 0 | 0 | 0 | 0 |
| Average ore grade mined (%U) | 0 | 0 | 0 | 0 | 0 |
| Uranium mined (Mkg U/year) | 0 | 0 | 0 | 0 | 0 |

In 2016, Cameco halted mining and milling operations at the Rabbit Lake Operation and the facility was placed in a safe state of care and maintenance. Rabbit Lake has remained in a safe state of care and maintenance to the present day.

No uranium concentrate was produced nor was any ore production conducted at the Rabbit Lake Operation during the 2022 reporting period. Table 5.2 provides milling production data from 2018 to 2022.

Table 5.2: Rabbit Lake Operation - milling production data, 2018-22

| Milling | 2018 | 2019 | 2020 | 2021 | 2022 |
|--|-------------|-------------|-------------|-------------|-------------|
| Mill ore feed (Mkg/year) | 0 | 0 | 0 | 0 | 0 |
| Average annual mill feed grade (%U) | 0 | 0 | 0 | 0 | 0 |
| Percent uranium recovery (%) | 0 | 0 | 0 | 0 | 0 |
| Uranium concentrate produced (Mkg U/year) | 0 | 0 | 0 | 0 | 0 |
| Authorized annual production (Mkg U/year) | 4.25 | 4.25 | 4.25 | 4.25 | 4.25 |

5.1 Performance

For 2022, CNSC staff rated all 14 SCAs as “satisfactory” based on regulatory oversight activities. Ratings at the Rabbit Lake Operation for these 14 SCAs during the 5-year period from 2018 to 2022 are shown in Appendix E.

In 2022, CNSC staff conducted 5 inspections on the following SCAs: conventional health and safety, environmental protection, emergency management and fire protection, human performance management, operating performance, packaging and transport, radiation protection, and waste management. There were 4 non-compliances identified as a result of the CNSC inspections of the Rabbit Lake Operation. A list of inspections is provided in Appendix .

5.2 Radiation Protection

For 2022, CNSC staff continued to rate the radiation protection SCA at Rabbit Lake as “satisfactory” based on regulatory oversight activities.

Rabbit Lake Operation - radiation protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Radiological hazard control

The sources of radiological exposure at the Rabbit Lake Operation during production were from mining at the Eagle Point underground mine and from milling uranium ore into yellowcake at the Rabbit Lake mill. The effective dose contributors to NEWs at Rabbit Lake were radon progeny (62%), gamma radiation (29%), LLRD (5%) and radon gas (4%). Effective doses to NEWs from exposures to radon progeny, radon gas and LLRD are controlled through the effective use of source control, ventilation, contamination control and personal protective equipment. Gamma radiation exposure is controlled through practices related to the effective use of time, distance and shielding.

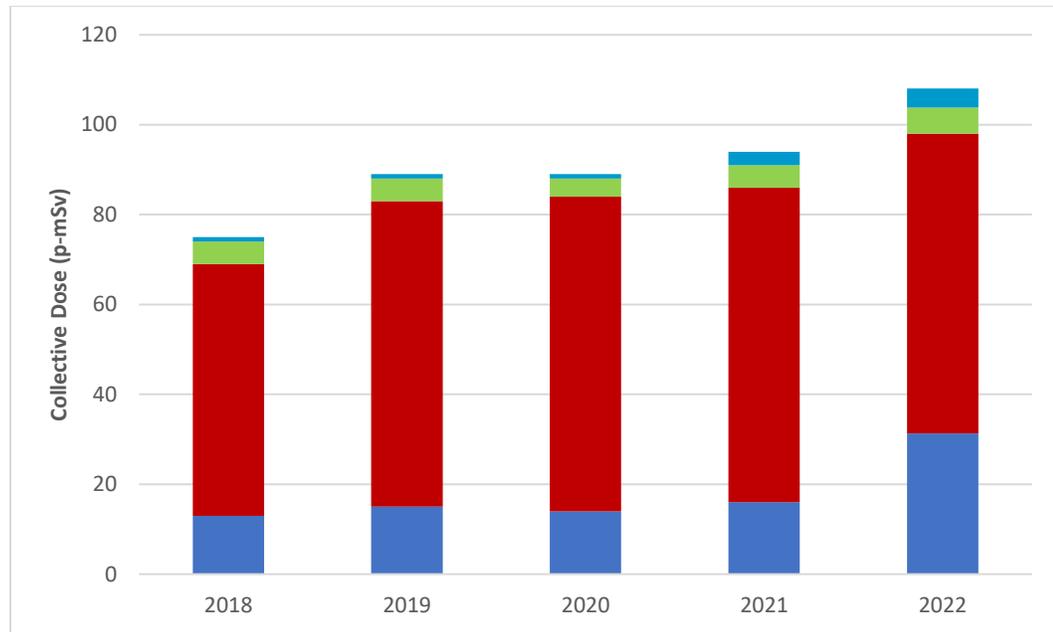
Radiation protection program performance

In 2022, CNSC staff were satisfied that the radiation protection program and practices at the Rabbit Lake Operation remained effective at controlling radiological exposure to workers. The doses to workers remained below regulatory limits and ALARA. No exceedances of action levels were reported at the Rabbit Lake Operation in 2022.

Application of ALARA

In 2022, the collective dose to NEWs at the Rabbit Lake Operation was 108 person-millisieverts (p-mSv), a minor increase over the 2021 value of 93 p mSv (see Figure 5.2).

Figure 5.2b displays the annual collective radiation exposures at the Rabbit Lake Operation from 2018 to 2022.

Figure 5.2: Rabbit Lake Operation – annual collective dose, 2018-22

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|---------------|------|------|------|------|------|
| Gamma (p-mSv) | 13 | 15 | 14 | 16 | 31 |
| RnP (p-mSv) | 56 | 68 | 70 | 70 | 67 |
| LLRD (p-mSv) | 5 | 5 | 4 | 5 | 6 |
| RnG (p-mSv) | 1 | 1 | 1 | 3 | 4 |
| Total* | 76 | 89 | 89 | 93 | 108 |

RnP = radon progeny; LLRD = long-lived radioactive dust; RnG = radon gas

*The total collective dose may not match the individual components due to rounding errors.

In 2022, the Rabbit Lake Operation identified 4 targets for the ALARA program. They are all related to compliance with sampling, reporting and job task observation activities.

CNSC staff have verified through regulatory oversight activities that Cameco continued to keep worker exposures ALARA.

Worker dose control

During 2022, the average individual effective dose for NEWs was 0.70 mSv and the maximum individual effective dose was 2.86 mSv. This is higher than the average effective dose of 0.57 mSv and the maximum individual dose of 2.47 mSv in 2021. As indicated in section 2 Figure 2.3 and Figure 2.4, all individual effective doses for NEWs were below the annual regulatory limit of 50 mSv.

Based on CNSC staff's compliance verification activities, such as inspections, reviews of licensees' reports and work practices, and monitoring of results and individual effective dose results for 2021, CNSC staff were satisfied that the Rabbit Lake Operation continued to be effective at controlling radiation doses to workers.

5.3 Environmental Protection

For 2022, CNSC staff continued to rate the environmental protection SCA at Rabbit Lake as "satisfactory" based on regulatory oversight activities. CNSC staff concluded that the licensee's environmental protection program was effectively implemented and met all regulatory requirements.

Rabbit Lake Operation - environmental protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|-------------|-------------|-------------|-------------|-------------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Environmental management system

The environmental management system at the Rabbit Lake Operation includes activities such as establishing annual environmental objectives, goals and targets. Cameco conducts internal audits of its environmental protection program at the Rabbit Lake Operation as identified in its CNSC-accepted management system program. CNSC staff review and assess the objectives, goals and targets through regular compliance verification activities. CNSC staff noted that Cameco continued to conduct routine inspections, internal audits, environmental training and periodic reviews of environmental monitoring data. These activities were conducted to verify continual improvement and to confirm that the controls put in place to protect the environment are effective.

Effluent and emissions control

Treated effluent released to the environment

For previously identified COPC with the potential to adversely affect the environment (i.e., uranium, molybdenum and selenium), the effluent treatment system at the Rabbit Lake Operation continued to meet performance expectations in terms of reducing the concentrations of these parameters (see Figure 2.5 to Figure 2.7 of section 2). The mean annual concentration (0.184 mg/L) remained relatively consistent with the 3-year historical mean (0.174 mg/l) and was stable

most of the year. Molybdenum concentrations did not exceed action levels at any time in 2022.

As shown in section 2.3, CNSC staff verified that the Rabbit Lake Operation continued to meet the discharge limits set out in the [MDMER](#).

Cameco's environmental management system and effluent monitoring programs at the Rabbit Lake Operation met regulatory requirements, and all treated effluent discharged to the environment complied with licence requirements. In 2022, the concentrations of regulated parameters in treated effluent released to the environment were well below the regulatory limits and there were no exceedances of environmental action levels at the Rabbit Lake Operation. Figure 5.3 shows the B-Zone settling pond at the Rabbit Lake Operation. CNSC staff will continue to review effluent quality results to verify that effluent treatment performance remains effective

Figure 5.3: Rabbit Lake Operation - B-Zone settling pond



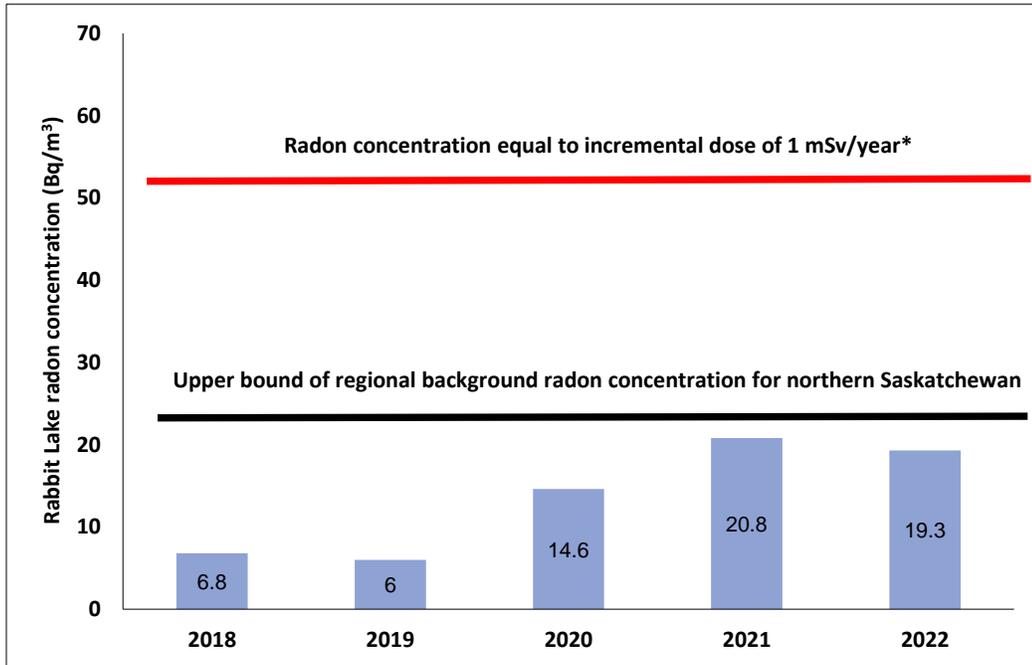
Source: Cameco

Air emissions released to the environment

Cameco also maintains an air and terrestrial monitoring program at the Rabbit Lake Operation. Air and terrestrial monitoring at the Rabbit Lake facility includes ambient radon, TSP, sulphur dioxide, soil sampling and lichen sampling to assess the impact of air emissions.

Radon in ambient air around the Rabbit Lake Operation is monitored at 19 stations using passive track etch cups. Figure 5.4 shows that the average concentrations of radon in ambient air from 2018 to 2022 is similar to background concentrations for northern Saskatchewan's regional baseline of less than 7.4 Bq/m³ to 25 Bq/m³. The average radon concentrations are less than the reference level of 60 Bq/m³, which represents an incremental dose of 1 mSv/year above background.

Figure 5.4: Rabbit Lake Operation - concentrations of radon in ambient air, 2018-22



*Upper-bound of the incremental dose of 1 mSv per year above background (i.e., an incremental radon concentration of 30 Bq/m³ above natural background) based on ICRP, 2010. [Lung Cancer Risk from Radon and Progeny and Statement on Radon. ICRP Publication 115](#). Values are calculated as geometric means.

**part of change in value in 2021 and 2022 attributed to differing detection limit and laboratory performing analysis.

Three high-volume air samplers were used to collect and measure TSP in air. The TSP levels from the average of the 3 stations were lower than provincial standards (see Table 5.3). TSP samples were also analyzed for concentrations of metals and radionuclides. The mean concentrations of metals and radionuclides adsorbed to TSP are low and remained below the reference annual air quality levels identified in Table 5.3.

Table 5.3: Rabbit Lake Operation – concentrations of metal and radionuclides in air, 2018-22

| Parameter | Reference annual air quality levels | 2018 | 2019 | 2020 | 2021 | 2022 |
|-----------------------------------|-------------------------------------|-----------|----------|-----------|----------|----------|
| TSP ($\mu\text{g}/\text{m}^3$) | 60 ⁽³⁾ | 3.91 | 4.31 | 3.00 | 3.67 | 3.0 |
| As ($\mu\text{g}/\text{m}^3$) | 0.06 ⁽¹⁾ | 0.000340 | 0.000128 | 0.000247 | 0.000168 | 0.000511 |
| Ni ($\mu\text{g}/\text{m}^3$) | 0.04 ⁽¹⁾ | 0.000183 | 0.000140 | 0.000580 | 0.000157 | 0.000307 |
| Pb-210 (Bq/m^3) | 0.021 ⁽²⁾ | 0.000015 | 0.000006 | 0.000007 | 0.000010 | 0.00001 |
| Ra-226 (Bq/m^3) | 0.013 ⁽²⁾ | 0.0000002 | 0.000000 | 0.0000002 | 0.000000 | 0.000000 |
| Th-230 (Bq/m^3) | 0.0085 ⁽²⁾ | 0.0000003 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| U ($\mu\text{g}/\text{m}^3$) | 0.06 ⁽¹⁾ | 0.000277 | 0.000117 | 0.00012 | 0.000148 | 0.000098 |

¹ Reference annual air quality levels are derived from [Ontario's Ambient Air Quality Criteria \(AAQC\)](#), [Ministry of the Environment, Conservation and Parks](#).

² Reference level is derived from ICRP, 2005. [Protecting People Against Radiation Exposure in the Event of a Radiological Attack](#). ICRP Publication 96.

³ [Saskatchewan Environmental Quality Guidelines, Table 20](#): Saskatchewan Ambient Air Quality Standards. Values are calculated as geometric means.

* Reference levels based on Province of Ontario [AAQC](#) and are shown for reference only. No federal or Saskatchewan provincial limits were established at the time of this report.

Daily in-stack monitoring of sulphur dioxide emissions from the mill acid plant was discontinued in 2017 for the duration of the care and maintenance period, as the acid plant and mill processing circuits have not operated in that time.

Soil and terrestrial vegetation may be affected by the atmospheric deposition of particulate and adsorbed metals and radionuclides associated with onsite activities. A terrestrial monitoring program is in place and includes measurements of metals and radionuclides in lichen.

Lichen sampling has been conducted for 3 decades at the Rabbit Lake Operation, most recently in 2019. CNSC staff concluded that the level of airborne particulate contaminants produced by the Rabbit Lake Operation does not pose a risk to lichen consumers, such as caribou.

Uncontrolled releases

In 2022, zero events were reported where hazardous substances were released to the environment (spills) at the Rabbit Lake Operation.

Figure **2.10** in section 2 displays the number of environmental reportable spills at the Rabbit Lake Operation from 2018 to 2022.

Appendix contains a brief description of reported spills, the corrective actions taken by the licensee, CNSC staff's assessment of those actions and the significance ratings for 2022.

Assessment and monitoring

CNSC staff confirmed that the licensee successfully carried out required environmental monitoring, in accordance with the Rabbit Lake environmental protection program.

Through the compliance activities conducted and the review of annual reports and environmental performance reports, CNSC staff concluded that the environmental monitoring conducted at the Rabbit Lake Operation met regulatory requirements. Consequently, CNSC staff concluded that the environment remains protected.

Environmental risk assessment

The Rabbit Lake Operation updated ERA for 2015 to 2019 was submitted to the CNSC and the Saskatchewan Ministry of Environment in December 2020. CNSC staff finalized their review of the environmental monitoring results for air, soil, vegetation, surface water, groundwater and sediment, as well as health indicators for fish and their prey inhabiting sediment, to confirm that the results were within those predicted in the ERA. The 2020 ERA was also in compliance with the CSA N288.6-12 *Environmental Risk Assessment at Class I nuclear facilities and uranium mines and mills*, ([CSA N288.6-12](#)),.

Protection of people

Cameco is required to demonstrate that the health and safety of the public are protected from exposures to hazardous substances released from the Rabbit Lake Operation. The effluent and environmental monitoring programs currently conducted by the licensee are used to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

The CNSC receives reports of discharges to the environment through the reporting requirements outlined in the licence and the LCH. The review of Rabbit Lake Operation's hazardous (non-radiological) discharges to the environment indicates that the public and environment are protected. CNSC staff confirmed that environmental concentrations in the vicinity of the Rabbit Lake Operation remained within those predicted in the current 2020 ERA and that human health remained protected in 2022.

Based on compliance verification activities that included inspections, reviews of licensees' reports and work practices and monitoring results for 2022, CNSC staff concluded that the Rabbit Lake Operation's environmental protection program continued to be effective at protecting the public and the environment.

5.4 Conventional Health and Safety

For 2022, CNSC staff continued to rate the conventional health and safety SCA as “satisfactory” based on regulatory oversight activities.

Rabbit Lake Operation – conventional health and safety ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA= satisfactory

Practices

Cameco’s Rabbit Lake Operation has implemented a health and safety program to identify and mitigate risks. The program includes internal inspections, a safety permit system, occupational health committees, training and incident investigations. CNSC staff monitor this program through compliance activities to verify the protection of workers.

The incident reporting system at the Rabbit Lake Operation includes reporting on and investigating near misses with the aim of reducing future incidents that could cause injury. CNSC compliance verification activities confirmed that the Rabbit Lake Operation continued to focus on preventing accidents and injuries through the implementation of its health and safety management program.

Performance

One (1) LTI was reported for the Rabbit Lake Operation in October 2022. The LTI performance at the Rabbit Lake Operation from 2018 to 2022 is shown in Table 5.4.

The TRIR at Rabbit Lake is included for the last 5 years. The TRIR is the incident frequency rate that measures the number of fatalities, LTIs and other injuries requiring medical treatment, per 200,000 person-hours worked.

Table 5.4: Rabbit Lake Operation – lost-time injury statistics, 2018-22

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|------|--------|--------|------|------|
| Lost-time injuries¹ | 0 | 1 | 0 | 0 | 1 |
| Severity rate² | 0 | 104.79 | 40.860 | 0 | 0 |
| Frequency rate³ | 0 | 1.05 | 0 | 0 | 0 |
| Total recordable incident rate⁴ | 5.03 | 2.10 | 1.13 | 1.04 | 3.47 |

¹ An injury that takes place at work and results in the worker being unable to return to work for a period of time.

² A measure of the total number of days lost to injury for every 200,000 person-hours worked at the facility. Accident severity rate = [(# of days lost in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

³ A measure of the number of LTIs for every 200,000 person-hours worked at the facility. Accident frequency rate = [(# of injuries in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

⁴ A measure of the number of fatalities, lost-time injuries, and other injuries requiring medical treatment for every 200,000 person-hours worked at the facility.

Recordable incident rate = [(#incidents in last 12 months) / # hours worked in last 12 months] x 200,000.

Awareness

CNSC staff observed that Cameco’s conventional health and safety program at the Rabbit Lake Operation continued to provide education, training, tools and support to workers. Managers, supervisors and workers share and promote the idea that safety is the responsibility of all individuals. Facility management emphasizes the importance of conventional health and safety through regular communication, management oversight and the continual improvement of safety systems.

CNSC staff verified that the conventional health and safety program at the Rabbit Lake Operation remained effective at managing health and safety risks.

5.5 Additional SCAs

In addition to the 3 primary SCAs of radiation protection, environmental protection, and conventional health and safety, CNSC staff have provided a brief discussion of the additional SCAs; these are presented in the following sections.

5.5.1 Management system

The licensee maintains a quality management program; this program forms part of the licensing basis for this facility in the LCH.

There were no inspections at the Rabbit Lake Operating that focused on evaluating the management system SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee’s program in respect of this SCA remains satisfactory.

5.5.2 Human performance management

The licensee includes program documentation for the human performance management SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the Rabbit Lake Operating that focused on evaluating the human performance management SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

5.5.3 Operating performance

The licensee includes program documentation for the operating performance SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the Rabbit Lake Operating that focused on evaluating the operating performance SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

5.5.4 Safety analysis

Cameco includes program documentation for the safety analysis SCA as part of the overall management system documents; these constitute part of the licensing basis for McArthur River Operation in the LCH.

There were no inspections at the Rabbit Lake Operating that focused on evaluating the safety analysis SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

5.5.5 Physical design

The licensee includes program documentation for the safety analysis SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the Rabbit Lake Operating that focused on evaluating the physical design SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

5.5.6 Fitness for service

The licensee includes program documentation for the fitness for service SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the Rabbit Lake Operating that focused on evaluating the fitness for service SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

5.5.7 Emergency management and fire protection

The licensee includes program documentation for the emergency management and fire protection SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

[CSA N393, "Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances"](#), is currently indicated as a Guidance document within Rabbit Lake (RL) LCH.

Cameco Cigar Lake Operation submitted a N393 Gap Analysis and CAP in 2022 and is committed to close identified N393 gaps by December 31, 2023.

CNSC staff reviewed and accepted Cameco Gap Analysis and CAP, and will follow-up on CSA N393, "[Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances"](#) full implementation as CVC once the implementation period has passed.

There were no inspections conducted at the Rabbit Lake Operation focused on evaluating the emergency management and fire protection SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff is confident with Cameco Cigar Lake Emergency management and fire protection capabilities, as per Cameco Regulatory requirement, and concluded that the licensee's program in respect of this SCA remains satisfactory.

5.5.8 Waste management

The licensee includes program documentation for the waste management SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There was one inspection at the Rabbit Lake Operation that focused on evaluating the waste management SCA in 2022. There were no areas of non-compliance found during this inspection. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

5.5.9 Security

The licensee includes program documentation for the security SCA as part of the overall management system documents; these documents constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the Rabbit Lake Operating that focused on evaluating the security SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

5.5.10 Safeguards and non-proliferation

The licensee includes program documentation for the safeguards and non-proliferation SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Rabbit Lake Operation related to the safeguards and non-proliferation SCA. There were no notices of non-compliance related to the safeguards and non-proliferation SCA and no event reports for which this SCA was the main contributing factor.

In addition to CNSC compliance activities with respect to the specific areas under the safeguards and non-proliferation SCA, the IAEA conducts independent inspections with coordination and support through the CNSC regulatory framework. No IAEA inspections were conducted at the Rabbit Lake Operation during 2022.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

5.5.11 Packaging and transport

The licensee includes program documentation for the packaging and transport SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the Rabbit Lake Operating that focused on evaluating the packaging and transport SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6 KEY LAKE OPERATION

Cameco is the operator of the Key Lake Operation which is located approximately 570 kilometers north of Saskatoon. The operation began with 2 open-pit mines and a mill complex. The Gaertner open pit was mined from 1983 to 1987, followed by the Deilmann open pit until 1997. Uranium mining is no longer carried out at Key Lake. Figure 6.1 provides an aerial view of the Key Lake facility.

In October 2013, following a public hearing in La Ronge, Saskatchewan, the Commission issued a 10-year licence to Cameco for the Key Lake Operation. Cameco's licence expires on October 31, 2023. On April 20, 2021, Cameco submitted a licence renewal application for the facility. In June 2023, CNSC conducted a public hearing in Saskatoon, Saskatchewan, where the Commission were presented with Cameco's application to renew the uranium mill licence for the Key Lake Operation for a period of 20 years. A Commission Decision on the application for license renewal remains in progress.

Figure 6.1: Key Lake Operation – aerial view



Source: Cameco

Milling of the stockpiled Deilmann ore continued until 1999. In 2000 the mill started processing ore from the McArthur River Operation. The Key Lake Operation continues today as a mill operation that is licensed to process McArthur River ore and residual special waste from previous mining at Key Lake.

After open pit mining in the eastern pit of the Deilmann ore body was completed in 1995, the pit was converted to the engineered Deilmann tailings management

facility (DTMF), while mining continued in other parts of the pit area (see Figure 6.2). Mill tailings continue to be deposited in this facility today.

Figure 6.2: Key Lake Operation – Deilmann tailings management facility



Source: CNSC (May 2023)

In 2018, the Key Lake Operation halted milling activities and the mill facility was placed in safe care and maintenance. In February 2022, Cameco indicated their intent to begin the process of transitioning the Key Lake Operation from care and maintenance to production. In November 2022 Cameco announced that the first uranium ore from the McArthur mine was milled and packaged at Key Lake. CNSC regulatory oversight in 2022 has been focused on ensuring the safe transition from the care and maintenance to normal operation in 2022.

Milling data for the Key Lake Operation during the 5-year reporting period are presented in Table 6.1.

Table 6.1: Key Lake Operation – milling production data, 2018-22

| Milling | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|-------|---------|------|------|-------|
| Mill ore feed (Mkg/year) | 0 | 0 | 0 | 0 | 10.0 |
| Average annual mill feed grade (% U) | N/A | N/A | N/A | N/A | 6.35 |
| Percentage of uranium recovery (%) | N/A | N/A | N/A | N/A | 98.86 |
| Uranium concentrate produced (Mkg U/year) | 0.06* | 0.006** | 0 | 0 | 0.442 |
| Authorized annual production (Mkg U/year) | 9.60 | 9.60 | 9.60 | 9.60 | 9.60 |

* Processing of remaining ore slurry from 2017.

**From calciner clean-out and disposal of laboratory samples.

6.1 Performance

The SCA ratings at the Key Lake Operation for the 5-year period from 2018 to 2022 are shown in Appendix . CNSC staff continued to rate all SCAs for 2022 as “satisfactory” based on regulatory oversight activities.

In 2022, CNSC staff carried out 7 inspections that covered multiple SCAs, as detailed in Appendix . 15 non-compliances all with low safety significance that were noted as a result of CNSC inspections at the Key Lake Operation for the 2022 calendar year were addressed to the satisfaction of CNSC staff. A list of inspections can be found in Appendix of this report.

This report covers all SCAs but focuses on the 3 SCAs that cover many of the key performance indicators for these mines and mills: radiation protection, environmental protection, and conventional health and safety.

6.2 Radiation Protection

Based on regulatory oversight activities during the reporting period, CNSC staff rated the radiation protection SCA at the Key Lake Operation as “satisfactory”.

Key Lake Operation - radiation protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Radiological hazard control

The effective dose contributors to NEWs at the Key Lake mill were gamma radiation (53%), radon progeny (28%) and long lived radioactive dust (LLRD) (19%). Gamma radiation hazards are controlled through practices related to the

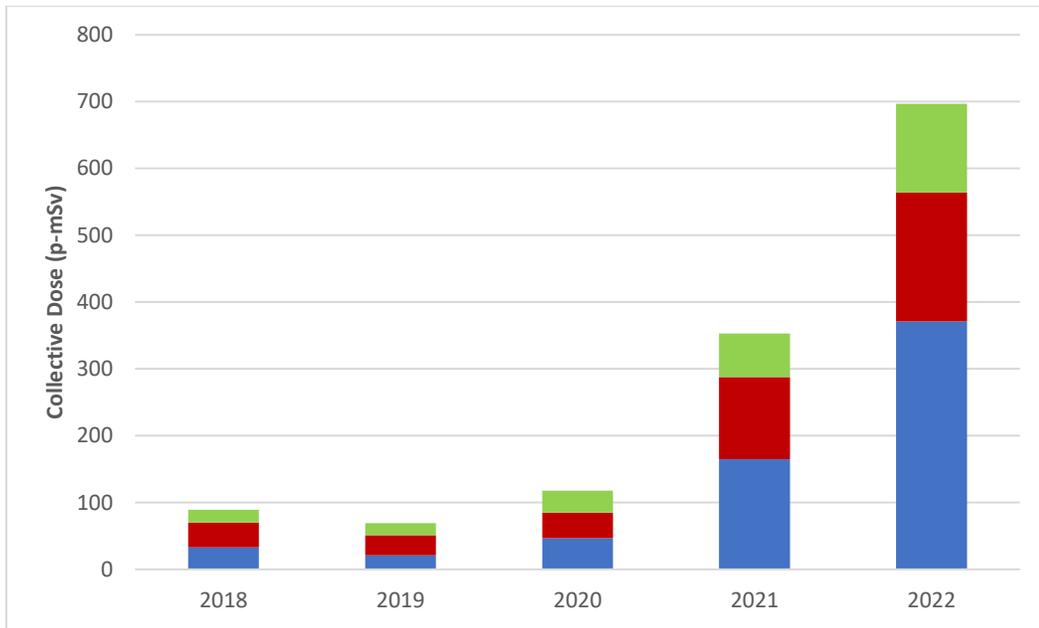
effective use of time, distance and shielding. Radon progeny and LLRD are controlled through source control, ventilation contamination control and personal protective equipment.

Radiation protection program performance

In 2022, CNSC staff were satisfied that the radiation protection program and practices at the Key Lake Operation remained effective at controlling radiological exposure to workers. The doses to workers remained below regulatory limits and ALARA. There was one action level exceedance reported by Cameco at the Key Lake Operation in 2022. The exceedance involved a worker performing cleaning duties in the counter current decantation (CCD) circuit. Post-work urine samples collected indicated that one worker had an intake of LLRD. The intake event for this worker was reported at 4.19 mSv, which is above the weekly action level of 1 mSv. The quarterly dose for this worker was reported at 4.62 mSv, which is below the quarterly action level of 5 mSv. Cameco conducted a root cause investigation and provided CNSC staff with a summary of the results, along with the proposed correction actions, which were accepted by CNSC staff.

Application of ALARA

Figure 6. 3 displays the annual collective radiation exposures at the Key Lake Operation from 2018-2022. In 2022, the collective dose to NEWs at the Key Lake Operation was 697 person-millisieverts (p-mSv), an increase over 2021 numbers due to the increased number of workers as a result of efforts to resume production. The collective dose for 2022 is comparable to values prior to pausing of production activities in 2018.

Figure 6. 3: Key Lake Operation - annual collective dose, 2018-22

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|----------------------|------|------|------|------|------|
| Gamma (p-mSv) | 33 | 21 | 47 | 165 | 371 |
| RnP (p-mSv) | 37 | 30 | 38 | 123 | 193 |
| LLRD (p-mSv) | 19 | 18 | 33 | 65 | 133 |
| RnG (p-mSv) | 0 | 0 | 0 | 0 | 0 |
| Total* | 88 | 69 | 118 | 353 | 697 |

RnP = radon progeny; LLRD = long-lived radioactive dust; RnG = radon gas

*The total collective dose may not match the individual components due to rounding errors.

Cameco continued to meet its objectives in 2022 for keeping doses consistent with the ALARA principle at the Key Lake Operation. To support this objective, the radiation area monitoring program was revised for the transition from care and maintenance.

Worker dose control

In 2022, the average individual effective dose to NEWs was 0.75 mSv, while the maximum individual effective dose received was 6.46 mSv. The effective doses received by workers from 2018 to 2021 are lower than historic values and the 2022 value because the facility was in a state of care and maintenance during that period.

Based on compliance verification activities, such as onsite inspections, reviews of licensee reports and work practices, monitoring of results and individual effective dose results, CNSC staff were satisfied that the Key Lake Operation continued to be effective at controlling radiation doses to workers in 2022.

6.3 Environmental Protection

For 2022, CNSC staff continued to rate the environmental protection SCA at Key Lake as “satisfactory” based on regulatory oversight activities. CNSC staff concluded that the licensees’ environmental protection program was effectively implemented and met all regulatory requirements.

Key Lake Operation - environmental protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Environmental management system

The environmental management system at the Key Lake Operation includes activities such as establishing annual environmental objectives, goals and targets. Cameco conducts internal audits of its environmental protection program at the Key Lake Operation, as identified in its CNSC-accepted management system program. CNSC staff review and assess the objectives, goals and targets through regular compliance verification activities. CNSC staff noted that Cameco had continued to conduct routine inspections, internal audits, environmental training and periodic reviews of environmental monitoring data. These activities were conducted to verify continual improvement and to confirm that the controls put in place to protect the environment are effective.

Effluent and emissions control

Treated effluent released to the environment

At the Key Lake Operation, 2 effluent streams are processed in separate treatment facilities before being released to the environment:

- The mill effluent is processed with a treatment system of chemical precipitation and liquid/solid separation, then released to Wolf Lake in the David Creek system.
- Effluent from dewatering wells of the Gaertner pit and Deilmann pit hydraulic containment systems is treated with a reverse osmosis system before being released to Horsefly Lake in the McDonald Lake system.
- Monitoring confirmed that the effluent from dewatering wells is within design specifications and the predictions outlined in the ERA. Effluent from the reverse osmosis system was in compliance with regulatory limits.

The treated effluent quality presented in Table 6.2 refers only to the mill effluent as released to the David Creek system. CNSC staff verified that the concentration

of all regulated contaminants in the treated mill effluent released in 2022 met regulatory limits. However, there were 2 environmental action level exceedances in 2022. The first action level exceedance occurred on October 28, 2022. After treatment, mill effluent is stored in 1 of 4 monitoring ponds and effluent quality of each pond is verified prior to discharge to the environment. In this instance, the pond fill sample has a uranium concentration of 60 µg/L, which is acceptable for discharge, however the pond discharge composite sample was 81 µg/L, which is above the action level of 80µg/L. Cameco investigated the incident and determined that fluctuations in uranium concentrations in feedwater from reservoir #1 and the final effluent were occurring at the time of the incident. Accumulated solids/sediment within the reservoir were being removed in the summer by agitating the solids using a water jet and then pumping out the solids/water mixture. This resulted in increased solids, including uranium, in the water column even after water jet agitation was suspended for the winter months. Immediately after the incident, water feed for water treatment was switched to reservoir #2 to allow reservoir #1 water quality to improve/stabilize. Although the discharge was above the action level, the effluent quality remained within the CNSC's interim objective for uranium in effluent of 0.1 mg/L and no impact on the environment occurred.

The second action level exceedance occurred on November 25, 2022, in which approximately a third of a treated effluent pond was discharged at TSS concentration of 37 mg/L, before the turbidity interlock engaged and the discharge ceased. This is above the action level of 18 mg/L. The pond fill sample had a TSS result of 3.3 mg/L. CNSC staff reviewed the immediate corrective actions and accepted these. A root cause investigation was completed by Cameco and they provided CNSC staff a summary of the results, including any additional proposed corrective actions.

As discussed in section 2.3, COPC in treated effluent at uranium mine and mill operations with potential to adversely affect the environment are molybdenum, selenium and uranium (see Figure 2.5 to Figure 2.7). Of these, molybdenum and selenium concentrations were the primary concerns at the Key Lake Operation. The licensee previously completed process changes to reduce concentrations in treated effluent.

Reductions of molybdenum and selenium occurred from 2007 to 2009 when additional treatment components were installed and optimized. As indicated in section 2, Figure 2.5 and Figure 2.6 display stable or declining concentrations of molybdenum and selenium in treated effluent from 2017 to 2021, indicating these parameters are being effectively controlled. Cameco submitted a molybdenum and selenium follow-up program closure report in 2018. Based on the results of the follow-up program, Cameco proposed that current regulatory monitoring requirements were sufficient to monitor future changes in sediment and other environmental receptors and proposed that the formal follow-up program cease. CNSC staff confirmed in 2019 that the molybdenum and selenium follow-up program could conclude, and, as a result, the monitoring requirements were added to the environmental monitoring program for the facility.

Section 2 Figure 2.7 indicates that uranium concentrations in treated effluent released from the Key Lake mill remain low and are effectively controlled. In addition to analyzing treated effluent for uranium, molybdenum and selenium, Cameco analyzed treated effluent at Key Lake for concentrations of other COPCs, such as radium-226, arsenic, copper, lead, nickel, zinc and TSS, as well as pH levels. As discussed in section 2.4, the Key Lake Operation continued to meet [MDMER](#) discharge limits.

CNSC staff will continue to review effluent quality results to verify that the treatment of effluent remains effective.

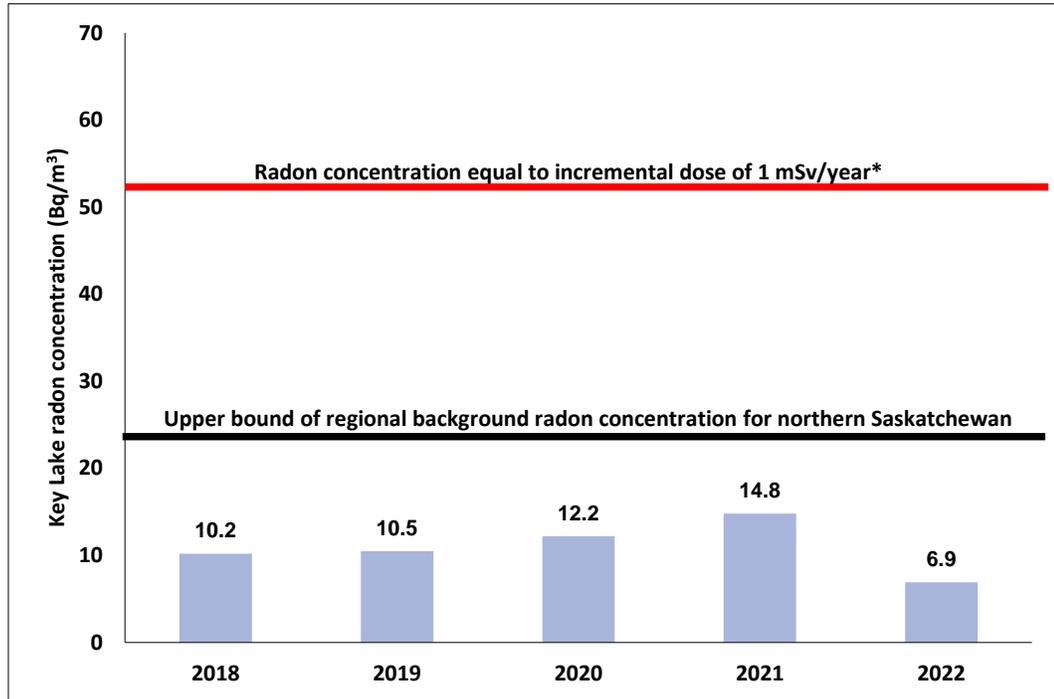
Air emissions released to the environment

The air and terrestrial monitoring program at the Key Lake Operation includes ambient monitoring for sulphur dioxide, radon and TSP, as well as soil and lichen sampling to assess air quality. Air emissions monitoring from the mill stacks is also included in the air-quality monitoring program.

The Key Lake calciner stack was not sampled in 2022 due to the mill and calciner not being operated for most of 2022 and not being fully operational in 2022. Sulphur dioxide concentrations from the acid plant stack are monitored daily when in operation, however, the plant did not produce any acid in 2022. Stack and ambient monitoring resumed in 2023.

Radon in air around the Key Lake Operation is monitored at 5 stations using passive track etch cups. Figure 6.4 shows the average concentrations of radon in ambient air from 2018 to 2022. Ambient radon concentrations were typical of the northern Saskatchewan regional background of less than 7.4 Bq/m³ to 25 Bq/m³. The measured radon concentrations are also below a reference radon concentration of 60 Bq/m³, which is equal to an incremental dose of 1 mSv per year above background.

Figure 6.4: Key Lake Operation - concentrations of radon in ambient air, 2018-22



*Upper-bound of the incremental dose of 1 mSv per year above background (i.e., an incremental radon concentration of 30 Bq/m³ above natural background) based on ICRP, 2010. [Lung Cancer Risk from Radon and Progeny and Statement on Radon. ICRP Publication 115](#). Values are calculated as geometric means.

Five high-volume air samplers were used to collect and measure TSP. The TSP levels are below the province of Saskatchewan's authorized concentration of contaminants monitored for ambient air quality, as listed in the facility's approval to operate pollutant control facilities. TSP samples are also analyzed for concentrations of metals and radionuclides. The mean concentrations of metal and radionuclides adsorbed to TSP are low and below the reference annual air quality levels, as identified in Table 6.2.

Table 6.2: Key Lake Operation - concentrations of metal and radionuclides in air, 2018–22

| Parameter | Reference annual air quality levels | 2018 | 2019 | 2020 | 2021 | 2022 |
|-----------------------------------|-------------------------------------|--------|---------|--------|---------|---------|
| TSP ($\mu\text{g}/\text{m}^3$) | 60 ⁽³⁾ | 8.80 | 6.91 | 6.04 | 6.75 | 6.37 |
| As ($\mu\text{g}/\text{m}^3$) | 0.06 ⁽¹⁾ | 0.0021 | 0.0021 | 0.0008 | 0.00056 | 0.00052 |
| Ni ($\mu\text{g}/\text{m}^3$) | 0.04 ⁽¹⁾ | 0.0011 | 0.0017 | 0.0006 | 0.00066 | 0.00038 |
| Pb-210 (Bq/m^3) | 0.021 ⁽²⁾ | 0.0002 | 0.00026 | 0.0002 | 0.0002 | 0.00026 |
| Ra-226 (Bq/m^3) | 0.013 ⁽²⁾ | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| Th-230 (Bq/m^3) | 0.0085 ⁽²⁾ | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| U ($\mu\text{g}/\text{m}^3$) | 0.06 ⁽¹⁾ | 0.0012 | 0.0008 | 0.0002 | 0.0003 | 0.00096 |

¹ Reference annual air quality levels are derived from [Ontario's Ambient Air Quality Criteria \(AAQC\)](#), [Ministry of the Environment, Conservation and Parks](#).

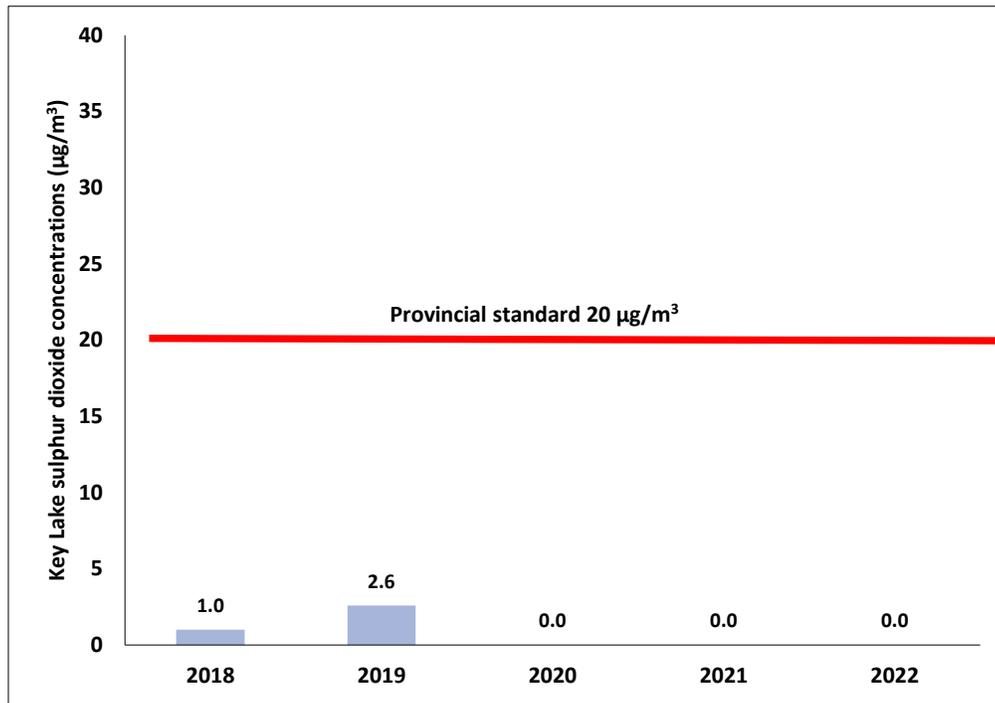
² Reference level is derived from ICRP, 2005. [Protecting People Against Radiation Exposure in the Event of a Radiological Attack. ICRP Publication 96](#).

³ [Saskatchewan Environmental Quality Guidelines, Table 20](#): Saskatchewan Ambient Air Quality Standards. Values are calculated as geometric means.

* Reference levels based on Province of Ontario [AAQC](#) and are shown for reference only. No federal or Saskatchewan provincial limits were established at the time of this report.

A sulphur dioxide monitor is located approximately 300 metres in a predominantly downwind direction of the mill facility and is used to continuously measure the ambient sulphur dioxide associated with mill emissions. As the site has been in a state of care and maintenance, CNSC staff and the Saskatchewan Ministry of Environment granted approval to cease ambient sulphur dioxide monitoring. Monitoring will be required when the acid plant resumes operation in 2023.

Figure 6.5: Key Lake Operation - concentrations of ambient sulphur dioxide, 2018-22



* Monitoring temporarily suspended in 2020 due to shut down of acid plant during care and maintenance period.

In addition to ambient air monitoring for sulphur dioxide, sulphate levels have been monitored in 4 lakes to measure the effects of sulphur dioxide emissions from the operation. The results of the 2021 lake sampling program continued to show that sulphate concentrations remain relatively unchanged from historical concentrations. CNSC staff concluded that the operations at Key Lake and the resulting sulphur dioxide emissions do not have an adverse effect on the sulphate levels in nearby lakes.

Soil and terrestrial vegetation may be affected by atmospheric deposition of particulate, adsorbed metals and radionuclides associated with onsite activities. The terrestrial monitoring program in place includes measurements of metals and radionuclides in soil and in lichen. Lichen and soil samples were collected in 2021.

There were no significant differences in total lichen richness observed from 2011 to 2021. The similarity in results from the past decade indicate that species abundance has not been affected by the SO₂ emissions 4 kilometers downwind of the Key Lake Operation. Overall epiphytic lichens were observed to be increasing in abundance and richness, a sign of a healthy epiphytic lichen community.

The 2021 lichen chemistry data indicate parameter concentrations tended to be higher at locations in closer proximity to the operation as compared to locations farther from site. Levels of arsenic, nickel, and uranium are generally declining with time and 2021 saw some of the lowest levels reported to date. Levels of radionuclides have been relatively low over time and again in 2021 some

parameters were the lowest recorded to date. Results from the 2016 soil sampling program illustrate that parameter concentrations at all stations were comparable to, or lower than, historical results, with the exception of lead-210 and polonium-210 which increased in 2016 but returned to lower levels during the 2021 sampling period.

Uncontrolled releases

In 2022, there were 5 events reported to CNSC staff that were considered to be releases of hazardous substances to the environment:

- On February 16, 2022, approximately 240 litres of propane was release from the mill propane storage area. On February 15, 2022, maintenance work on the propane skid was completed and a propane pump was returned to operation without opening the safety bypass regulator discharge valve, causing the braided hose on the regulator discharge to leak near the flange. An employee reported the smell of propane at on February 16, 2022, and the maintenance department responded. The propane pump was shut-off and the leaking line was isolated. The release occurred outdoors on a cement pad.
- On March 29, 2022, up to 12.8 cubic meters of water was released from a dewatering well water. During daily inspections standing water was identified in and around Gaertner dewatering Well V. The dewatering Well V is located southwest of the grinding and crushing plant and is directly between Gaertner Pit and the DTMF. Water from Well V is fed into the reverse osmosis WTP. Cameco indicated that Well V is inspected twice per day and the duration of the leak and volume released was conservatively estimated to begin immediately after the last inspection occurred.
- On September 20, 2022, approximately 2,000 litres of water overflowed a pump test pit within the Mineshop Pump Bay to the exterior of the building. A worker discovered the pump testing pit overflowing. It was determined that the fill valve was bumped into the fill position when hose was placed on the hose rack.
- On October 22, 2022, an estimated 6.0 cubic meters of water was released from a ruptured line which directs overflow from the Neutral Thickener tank at the mill. The overflow line was blocked off inside the facility during care and maintenance and it is suspected that this allowed for rain/melt water to collect within the overflow line causing the pipe to freeze during winter month resulting in a split beneath the insulation cover.
- On November 25, 2022, approximately 8.1 cubic meters of helium was released from a helium cylinder when changing out and installing a new cylinder within the chemical lab. When removing the plastic safety cover from the cylinder outlet valve the helium began immediately venting. The area was evacuated, and the door closed, and the cylinder was allowed to discharge.

Appendix I provides a brief description of each release and the actions taken by the licensee. All corrective actions related to these spills have been completed and accepted by CNSC staff.

2018 Uranium in groundwater event

In 2018, Cameco required the completion of investigation and development of corrective action plans after the discovery of uranium contamination in groundwater under the mill terrace. A site assessment and Corrective Action Plan (CAP) was developed and accepted by CNSC staff. The remediation involves the installation of recovery wells to pump out and treat the contaminated groundwater. The installation and commissioning of the recovery wells scheduled to be completed in the fourth quarter of 2022, was delayed with the final commissioning of the system taking place in March 2023.

As part of the site assessment uranium in groundwater event, Cameco installed and sampled several new wells. Water quality results from 2 of these newly installed wells showed elevated contaminant levels including ammonia and sulphate. These wells are also located on the mill terrace. This is not associated with the 2018 uranium in groundwater event but is thought to be from a separate discharge which occurred sometime before the facility went into care and maintenance in 2018. Cameco notified CNSC staff of these findings in June 2021 and continue to provide updates. Information provided to date from Cameco indicates that this new contamination is still limited to the mill terrace, and the environment remains protected. On May 17, 2022, Cameco submitted another site assessment report in response to this discovery; this assessment report has also been accepted by CNSC staff. Cameco developed a CAP which was submitted to CNSC staff in July 2023 and is undergoing review. Six existing ammonia recovery wells, and the newly installed uranium recovery wells will continue to operate while the CAP is developed.

The environment remains protected while the remediation of the elevated uranium proceeds and the CAP for the elevated ammonia and sulphate is developed and implemented.

Figure 2.10 in section 2 displays the number of environmental reportable spills, as well as the number of releases of hazardous material to the environment from the licensed activities at the Key Lake Operation from 2018 to 2022.

Assessment and monitoring

CNSC staff confirmed that the licensee, in accordance with the Key Lake environmental protection program, successfully carried out the required environmental monitoring.

Through the compliance activities carried out and the review of annual reports and environmental performance reports, CNSC staff concluded that the environmental monitoring conducted at the Key Lake Operation met regulatory requirements. Consequently, CNSC staff concluded that the environment remains protected.

Environmental risk assessment

The Key Lake Operation environmental performance report and updated ERA for 2015 to 2019 were submitted to the CNSC and the Saskatchewan Ministry of Environment in December 2020. CNSC staff reviewed the environmental monitoring results for air, soil, vegetation, surface water, groundwater and sediment, as well as health indicators for fish and their prey inhabiting sediment and confirmed that the results were within those predicted in the ERA.

After reviewing the environmental performance report and ERA, CNSC staff concluded that adequate measures have been taken at the Key Lake Operation to protect human health and the environment.

Protection of people

Cameco is required to demonstrate that the health and safety of persons are protected from exposures to hazardous substances released from the Key Lake Operation. The effluent and environmental monitoring programs currently conducted by the licensee verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

The CNSC receives reports of discharges to the environment through the reporting requirements outlined in the Key Lake licence and LCH. A review of the hazardous (non-radiological) discharges to the environment indicates that persons and the environment are protected. CNSC staff confirmed that environmental concentrations in the vicinity of the Key Lake Operation remained within those predicted in the 2020 ERA and that human health and the environment remained protected in 2022.

Based on compliance verification activities that included inspections, reviews of licensees' reports and work practices, and monitoring results for 2022, CNSC staff concluded that the Key Lake Operation's environmental protection program continued to be effective at protecting persons and the environment.

6.4 Conventional Health and Safety

For 2022, CNSC staff continued to rate the conventional health and safety SCA as “satisfactory”, based on regulatory oversight activities.

Key Lake Operation - conventional health and safety ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Practices

The Key Lake Operation’s incident reporting system records health and safety related events and uses several layers of review in investigations. Corrective measures are tracked and assessed for effectiveness before the incident record is closed. The Key Lake Operation continued its planned health and safety inspection program in 2022. Any items of concern found during these inspections are included in the licensee’s incident reporting system.

Performance

Table 6.3 summarizes LTIs at the Key Lake Operation from 2018 to 2022. There was 1 LTI at the Key Lake Operation between 2018 and 2022.

The TRIR for Key Lake is included for the last 5 years. The TRIR is the incident frequency rate that measures the number of fatalities, LTIs and other injuries requiring medical treatment.

Table 6.3: Key Lake Operation – lost-time injury statistics, 2018-22

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|------|------|------|-------|--------|
| Lost-time injuries¹ | 0 | 0 | 0 | 0 | 1 |
| Severity rate² | 0 | 0 | 0 | 0 | 0 |
| Frequency rate³ | 0 | 0 | 0 | 0 | 0.20 |
| Total recordable incident rate⁴ | 2.59 | 2.22 | 2.04 | 1.99* | 1.76** |

¹ An injury that takes place at work and results in the worker being unable to return to work for a period of time.

² A measure of the total number of days lost to injury for every 200,000 person-hours worked at the facility. Accident severity rate = [(# of days lost in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

³ A measure of the number of LTIs for every 200,000 person-hours worked at the facility. Accident frequency rate = [(# of injuries in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

⁴ A measure of the number of fatalities, lost-time injuries and other injuries requiring medical treatment for every 200,000 person-hours worked at the facility. Recordable incident rate = [(# of incidents in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

* The total recordable incident rate for 2021 was revised by Cameco after the reclassification of two injuries.

** TRIR remains unchanged for 2022, as LTI was reclassified from a previously reported MWI that was already included in recordable injuries.

Awareness

CNSC staff evaluated Cameco's conventional health and safety program at Key Lake and determined that it continued to provide education, training, tools and support to workers. The idea that safety is the responsibility of all individuals is promoted by the licensee's managers, supervisors and workers. The licensee's management stresses the importance of conventional health and safety through regular communication, management oversight and continual improvement of safety systems.

CNSC staff's compliance verification activities concluded that Cameco's health and safety program at the Key Lake Operation met regulatory requirements in 2022.

6.5 Additional SCAs

In addition to the 3 primary SCAs of radiation protection, environmental protection, and conventional health and safety, CNSC staff have provided a brief discussion of the additional SCAs; these are presented in the following sections.

6.5.1 Management system

The licensee maintains a quality management program; this program forms part of the licensing basis for this facility in the LCH.

There was 1 inspection at the Key Lake Operation that focused on evaluating the management system SCA in 2022. There were 3 notices of non-compliance and 1 recommendation issued. The notices of non-compliance and recommendation were addressed to the satisfaction of CNSC staff. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.2 Human performance management

The licensee includes program documentation for the human performance management SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were 2 inspections at the Key Lake Operation focused on evaluating the human performance SCA in 2022. The first inspection was focused on training and onboarding associated with the planned restart of milling activities at the site. There were 2 recommendations and 3 notices of non-compliances issued related to the update and maintenance of training governance documents, training analysis documents, and the training record system. The second inspection was conducted to verify Cameco's implementation of [REGDOC-2.2.2](#). There were 2 recommendations and 4 notices of non-compliances issued related to the update and alignment of training governance and training material, worker completion of training, and accurate storage of training records. All of the notices of non-compliance issued have been addressed to the satisfaction of CNSC staff. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.3 Operating performance

The licensee includes program documentation for the operating performance SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the Key Lake Operation focused on evaluating the operating performance SCA in 2022 and there were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.4 Safety analysis

The licensee includes program documentation for the safety analysis SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the Key Lake Operation focused on evaluating the safety analysis SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.5 Physical design

The licensee includes program documentation for the physical design SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the Key Lake Operation focused on evaluating the physical design SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.6 Fitness for service

The licensee includes program documentation for the fitness for service SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the Key Lake Operation focused on evaluating the fitness for service SCA. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.7 Emergency management and fire protection

The licensee includes program documentation for the emergency management and fire protection SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

[CSA N393](#) is currently indicated as a Guidance document within Key Lake Operation LCH.

At the request of CNSC staff in May 2022, Cameco conducted and submitted a gap analysis and implementation plan for this standard in August 2022 and has committed to fully implement the standard as CVC by December 31, 2023. CNSC staff reviewed and accepted the gap analysis and implementation date. Staff will verify the implementation of the standard post implementation as part of regularly scheduled inspections at the facility.

There was one inspection at the Key Lake Operation focused on evaluating the emergency management and fire protection SCA in 2022. An emergency response exercise was conducted by Cameco and observed by CNSC staff including pre-brief, exercise and post-brief meetings, document review of programs, procedures and work instructions, interview with key Cameco staff, verification of inventory and condition of the fire hall and safety equipment, and field inspection of the mill. There were no notices of non-compliance issued. One recommendation was issued, which was addressed to the satisfaction of CNSC staff. In addition, CNSC staff conducted several desktop reviews. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.8 Waste management

The licensee includes program documentation for the waste management SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There was one inspection at the Key Lake Operation focused on evaluating the waste management SCA in 2022. There was 1 notice of non-compliance and 4 recommendations issued. The notice of non-compliance and recommendations were addressed to the satisfaction of CNSC staff. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.9 Security

The licensee includes program documentation for the security SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the Key Lake Operation focused on evaluating the security SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.10 Safeguards and non-proliferation

The licensee includes program documentation for the safeguards and non-proliferation SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the Key Lake Operation focused on evaluating the safeguards and non-proliferation SCA. There were no notices of non-compliance related to the safeguards and non-proliferation SCA and no event reports for which this SCA was the main contributing factor.

In addition to CNSC compliance activities with respect to the specific areas under the safeguards and non-proliferation SCA, the IAEA conducts independent inspections and activities with coordination and support through the CNSC regulatory framework. No IAEA inspections or activities were conducted at the Key Lake Operation during 2022.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

6.5.11 Packaging and transport

The licensee includes program documentation for the packaging and transport SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the Key Lake Operation focused on evaluating the packaging and transport SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7 MCCLEAN LAKE OPERATION

Orano is the operator of the McClean Lake Operation. The McClean Lake Operation is a uranium mine and mill facility located approximately 750 kilometers north of Saskatoon in the Athabasca Basin of northern Saskatchewan. The McClean Lake Operation includes the John Everett Bates (JEB) milling area, Sue mining area, JEB tailings management facility (TMF) and the undeveloped McClean, Midwest and Caribou ore deposits. An aerial view of the facility is presented in Figure 7.1.

Figure 7.1: McClean Lake Operation - aerial view



Source: Orano

Cigar Lake Mine ore slurry was the only ore processed at the McClean Lake Mill. Some exploration drilling activities occurred at the Surface Access Borehole Resource Extraction (SABRE) site in 2022, but there was no mining associated with these activities.

Table 7.1 presents mining data for the McClean Lake Operation from SABRE for the 5-year reporting period.

Table 7.1: McClean Lake Operation - mining production data, 2018-22

| Mining | 2018 | 2019 | 2020 | 2021 | 2022 |
|-------------------------------------|-------------|-------------|-------------|-------------|-------------|
| Ore tonnage (Mkg/year) | N/A | N/A | N/A | 1.21 | N/A |
| Average ore grade mined (%U) | N/A | N/A | N/A | 5.66 | N/A |
| Uranium mined (Mkg U/year) | N/A | N/A | N/A | 0.058 | N/A |

Table 7.2 presents milling production data for the McClean Lake Operation for the 5-year reporting period.

Table 7.2: McClean Lake Operation - milling production data, 2018-22

| Milling | 2018 | 2019 | 2020 | 2021 | 2022 |
|--|-------------|-------------|-------------|-------------|-------------|
| Mill ore feed (Mkg/year) | 42.9 | 46.2 | 26.3 | 35.2 | 52.3 |
| Average annual mill feed grade (%U) | 16.26 | 15.15 | 14.56 | 13.82 | 13.46 |
| Percentage of uranium recovery (%) | 98.94 | 98.91 | 98.81 | 98.7 | 98.86 |
| Uranium concentrate produced (Mkg U) | 6.94 | 6.94 | 3.88 | 4.75 | 6.94 |
| Authorized annual production (Mkg U/year) | 9.23 | 9.23 | 9.23 | 9.23 | 10.9 |

* Processing of remaining ore slurry from 2017.

**From calciner clean-out and disposal of laboratory samples.

Licence Amendments

Following a public hearing held on June 7 and 8, 2017 in La Ronge, Saskatchewan, the current operating licence was renewed on July 1, 2017, and expires on June 30, 2027. The Commission amended the McClean Lake operating licence on July 1, 2018, to reflect the licensee's corporate name change from AREVA Resources Canada Inc. to Orano Canada Inc. After a public hearing held on October 4, 2021, the Commission amended the CNSC licence again for McClean Lake on January 17, 2022, to allow JEB TMF expansion.

The Commission also approved Orano's revised financial guarantee of C\$102,098,000 for the McClean Lake Operation.

7.1 Performance

The SCA ratings at the McClean Lake Operation for the 5-year period from 2018 to 2022 are shown in Appendix . For 2022, CNSC staff rated all SCAs as “satisfactory” based on regulatory oversight activities.

In 2022, CNSC staff carried out 5 inspections that covered multiple SCAs, including 1 waste management focused inspection and 1 conventional health and safety focused inspection as detailed in Appendix .

For the 2022 calendar year, 15 instances of non-compliance were noted during CNSC inspections at the McClean Lake Operation. These instances of non-compliance were of low safety significance and related to the fitness for service, radiation protection, waste management and conventional health and safety SCAs. The licensee has implemented corrective actions, which have been reviewed and accepted by CNSC staff. A list of inspections can be found in Appendix .

This report covers all SCAs but focuses on the 3 SCAs that cover many of the key performance indicators for these mines and mills: radiation protection, environmental protection, and conventional health and safety.

7.2 Radiation Protection

Based on regulatory oversight activities during the reporting period, CNSC staff rated the radiation protection SCA at McClean Lake as “satisfactory” as shown in the table below.

McClean Lake Operation - radiation protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Radiological hazard control

The source of radiological exposure at the McClean Lake Operation is the milling of high-grade uranium ore received from Cameco’s Cigar Lake mine. The 3 primary dose contributors are gamma radiation (40%), RnP (37%) and LLRD (23%). Gamma radiation hazards are controlled through practices related to the effective use of time, distance and shielding. Effective doses to NEWs from exposures to RnP and LLRD are controlled through the effective use of source control, ventilation, contamination control and personal protective equipment.

Orano has incorporated specific radiation protection features into its mill design to allow for processing of undiluted, high-grade uranium ore at McClean Lake. These design features were established to limit radiological hazards to achieve specific design objectives. Orano continues to implement a comprehensive monitoring program for all hazards to confirm that the engineered control of hazards remains effective, verify that design hazard objectives continue to be met and identify opportunities for improvement at the McClean Lake Operation.

CNSC staff concluded that Orano continues to implement a comprehensive monitoring program and remains highly effective at controlling all radiological hazards at the McClean Lake Operation during 2022.

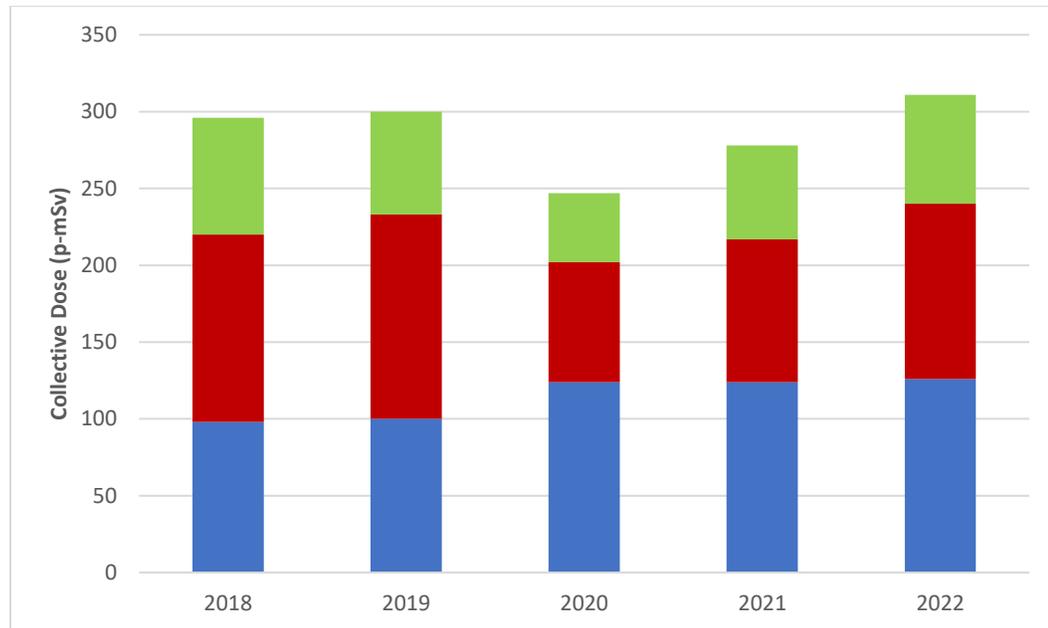
Radiation protection program performance

In 2022, CNSC staff were satisfied that the radiation protection program and practices at the McClean Lake Operation remained effective at controlling radiological exposure to workers. The doses to workers remained below regulatory limits and ALARA. No exceedances of action levels were reported at the McClean Lake Operation in 2022.

There were two administrative level exceedances based on radiological monitoring results of LLRD concentration and gamma radiation dose rates, occurring during a planned maintenance shutdown in July 2022. However, the CNSC was not notified of the exceedances in writing within 48 hours of the occurrences as required by the McClean Lake Operation's Radiation Code of Practice. Orano discussed with CNSC staff as soon as they became aware and subsequently reported the exceedances to the CNSC in the Radiation Monitoring Report Q3. As a result of this missed regulatory notification requirement, Orano issued internal non-conformances and took corrective action, which included reviewing the Radiation Code of Practice notification requirements with radiation group supervisors and emphasizing the importance of the daily review of radiological monitoring results. CNSC staff reviewed Orano's corrective action and found it to be acceptable.

Application of ALARA

In 2022, collective radiation exposure to NEWs at the McClean Lake Operation was 311 person-millisieverts (p-mSv), a 11% increase from the 2021 value of 278 p mSv (Figure 7.2). The year-over-year increase in collective dose is attributed to increased mill production in 2022.

Figure 7.2: McClean Lake Operation - annual collective dose, 2018-22

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|---------------|------|------|------|------|------|
| Gamma (p-mSv) | 98 | 100 | 124 | 124 | 126 |
| RnP (p-mSv) | 122 | 133 | 78 | 93 | 114 |
| LLRD (p-mSv) | 76 | 67 | 45 | 61 | 71 |
| RnG (p-mSv) | 0 | 0 | 0 | 0 | 0 |
| Total* | 296 | 300 | 247 | 278 | 311 |

RnP = radon progeny; LLRD = long-lived radioactive dust; RnG = radon gas

*The total collective dose may not match the individual components due to rounding errors.

Through reviews of radiation monitoring, exposure reports and inspections, CNSC staff confirmed that the radiation protection program was effective and verified that worker exposures remained consistent with the ALARA principle in 2022.

Worker dose control

In 2022, the average individual effective dose to NEWs was 0.81 mSv, while the maximum individual effective dose received by a NEW was 6.86 mSv. These values compare to an average individual effective dose of 0.79 mSv and a maximum individual dose of 4.89 mSv in 2021. All individual effective doses

received by NEWs were well below the CNSC’s regulatory dose limit of 50 mSv in a 1-year dosimetry period.

Based on Orano’s compliance verification activities, such as inspections, reviews of licensee reports and work practices, and the monitoring of results and individual effective dose results in 2022, CNSC staff were satisfied that the McClean Lake Operation continued to be effective at controlling radiation doses to workers in 2022.

7.3 Environmental Protection

For 2022, CNSC staff continued to rate the environmental protection SCA at McClean Lake as “satisfactory” based on regulatory oversight activities. CNSC staff concluded that the licensee’s environmental protection program was effectively implemented and met all regulatory requirements.

McClean Lake Operation - environmental protection ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Environmental management system

The environmental management system at the McClean Lake Operation includes activities such as establishing annual environmental objectives, goals and targets. Orano conducts internal audits of its environmental management program at the McClean Lake Operation, as identified in their CNSC-accepted management system program. CNSC staff review and assess the objectives, goals and targets through regular compliance verification activities. CNSC staff noted that Orano continued with routine inspections, internal audits, environmental training and periodic reviews of environmental monitoring data. These activities were conducted to verify continual improvement and to confirm that the controls put into place to protect the environment are effective.

Effluent and emissions control

Effluent and emissions monitoring programs serve to demonstrate that the facility’s emissions, wastes, tailings and effluent discharges of nuclear and hazardous substances are properly controlled at the McClean Lake Operation.

Treated effluent released to the environment

At the McClean Lake Operation, 2 effluent streams are processed in separate treatment facilities before being released to the environment:

- The mill effluent is processed at the JEB WTP with a treatment system of chemical precipitation and liquid/solid separation.
- The Sue WTP treats effluent which is pumped to control the water level from the mined-out open pits using a chemical precipitation and settling pond clarification process.

The blended treated effluent is then released in a controlled manner.

The 2016 ERA identified future potential risks to aquatic organisms in McClean Lake east due to exposure to selenium from the milling of Cigar Lake ore. In the [*Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017*](#), CNSC staff reported on the selenium adaptive management plan developed and implemented by Orano. CNSC staff continue to review reported selenium concentrations in effluent through quarterly reports to verify that the receiving environment remains protected.

In April 2020, the CNSC requested that Orano propose a long-term solution for sustained reduction of selenium loading to the environment. In response, Orano submitted an update to the selenium adaptive management plan in September 2020, which provides an assessment of treatment technologies as well as the preferred option of the use of ferrous sulphate treatment technology. In October 2021, Orano submitted an implementation plan for the ferrous sulphate treatment at the JEB WTP for enhanced selenium removal.

In February 2022, Orano provided an updated forecast indicating that the predicted 12-month rolling average selenium loadings will remain below the Environmentally Based Reference Level (EBRL) with implementation of treatment planned for September 2022. The latest update provided by Orano in the 2022 annual compliance report indicated that 12-month rolling average selenium loadings were expected to remain below the EBRL until the end of Q3 2023 without ferrous sulphate treatment.

Although, the construction of the ferrous sulphate treatment technology was largely completed in June 2022, due to low selenium concentration in the JEB WTP feed, the final stage of commissioning and operation of the technology has been delayed. Orano anticipates commissioning to be complete by Q2 of 2023. In the meantime, Orano continues to implement optimization techniques to reduce releases of selenium to the environment. Orano continues to provide selenium updates in the quarterly McClean Lake Operation Environment Reports. Orano will provide notification when the last stage of the ferrous sulphate commissioning process is complete, and when selenium treatment commences.

CNSC staff will continue to monitor to ensure that the 12-month rolling average selenium loadings remain below EBRL of 112 g/day. CNSC staff confirmed that selenium loadings in 2022 were below the EBRL.

The 2022 effluent discharges complied with [MDMER](#) requirements and discharge limits with one exception. The 24-hour composite discharge sample for the February 10 JEB WTP discharge indicated a TSS concentration of 23 mg/L, which was above the regulatory discharge limit of 22.5 mg/L. The routing pond samples from other 3 monitoring ponds that comprised the 24-hour discharge had TSS concentrations of 3, 4, and 1 mg/L. A grab sample was also collected from the pond discharging at the time the exceedance was discovered and the TSS was <1 mg/L. CNSC staff agree with Orano's determination that the sample was not representative of the actual effluent discharged. A sample was also collected from

Sink Reservoir and tested for acute lethality as required under [MDMER](#) and passed.

In 2022, Orano reported 2 action level exceedances, one for un-ionized ammonia and one TSS from the JEB WTP.

On June 29, 2022, an effluent action level exceedance was identified for un-ionized ammonia (U-NH₃) that occurred at the JEB WTP. An Orano employee started discharging a pond from the JEB WTP after inadvertently looking at the wrong Pond Fill Sample results. After finalizing the Pond Fill Sample results, Orano became aware of the elevated U-NH₃ results. When it was discovered that the pond was already discharging, the discharge was immediately stopped, and the remainder of the pond was recycled to the TMF. Approximately 208 m³ of effluent was discharged to Sink Reservoir with elevated U-NH₃. The effluent action level for unionized ammonia is 0.45 mg/L and the pond routing sample result was 0.60 mg/L. On July 3, 2022, Orano took the corrective action of reviewing proper discharge procedures with all Orano groups involved.

On July 5, 2022, a 24hr pond composite release was above the TSS action level for the JEB WTP. TSS was measured to be 14 mg/L while the action level is 12 mg/L. A grab sample was taken to the lab and the result was 3 mg/L. The probable cause for the apparent action level exceedance was a dirty container used to take a sample from the composite release. The sampling container was cleaned and a standard for container cleanliness was implemented.

Orano analyzed treated effluent for concentrations of various substances such as radium 226, arsenic, copper, lead, nickel, zinc and TSS, and verified pH levels at McClean Lake. As discussed in section 2.3, the McClean Lake Operation continued to meet the discharge limits set out in the MDMER.

CNSC staff will continue to review results on the quality of effluent in order to verify that the treatment of effluent remains effective.

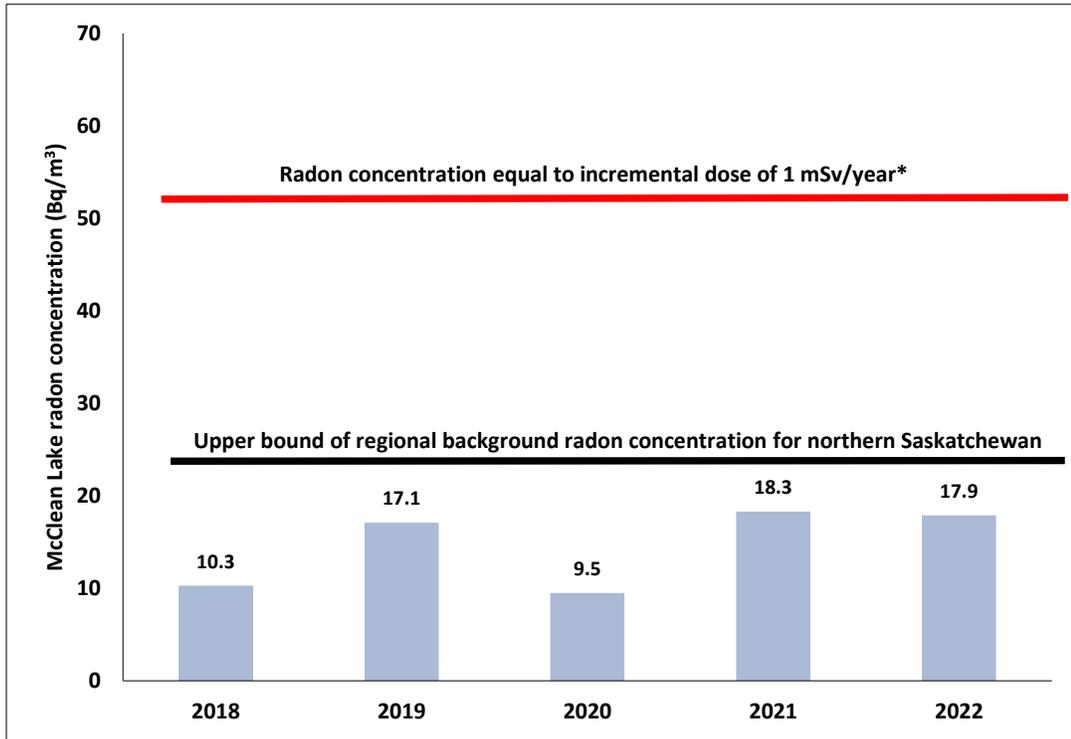
Air emissions released to the environment

Air quality at the McClean Lake Operation is monitored directly by measuring emissions from the mill and the ambient air quality near the operation, and indirectly by measuring metal accumulations in the terrestrial environment.

Air quality monitoring at the McClean Lake Operation includes ambient radon, TSP, sulphur dioxide and exhaust stack monitoring. Terrestrial monitoring components include soil and vegetation sampling.

Environmental monitoring for radon concentrations is conducted using the passive method of track etch cups. There are 23 monitoring stations in various locations around the site-lease boundary. Figure 7.3 shows the average concentrations of radon in ambient air from 2018 to 2022. Ambient radon concentrations were typical of the northern Saskatchewan regional background concentration of less than 7.4 Bq/m³ to 25 Bq/m³. The measured radon concentrations were also below the reference radon concentration of 60 Bq/m³, which is equal to an incremental dose of 1 mSv per year above background.

Figure 7.3: McClean Lake Operation - concentrations of radon in ambient air, 2018-22



*Upper-bound of the incremental dose of 1 mSv per year above background (i.e., an incremental radon concentration of 30 Bq/m³ above natural background) based on ICRP, 2010. [Lung Cancer Risk from Radon and Progeny and Statement on Radon. ICRP Publication 115](#). Values are calculated as geometric means.

Five high-volume air samplers monitor TSP and are located at the McClean Lake Operation. As shown in Table 7.3, TSP values remained low in 2022 and well below the provincial standard of 60 µg/m³.

TSP samples were also analyzed for concentrations of metals and radionuclides. The mean concentrations of metal and radionuclides adsorbed to TSP were low and below the reference annual air quality levels identified in Table 7.3.

Table 7.3: McClean Lake Operation - concentrations of metal and radionuclides in air, 2018-22

| Parameter | Reference annual air quality levels* | 2018 | 2019 | 2020 | 2021 | 2022 |
|--------------------------|--------------------------------------|----------|----------|----------|----------|----------|
| TSP (µg/m ³) | 60 ⁽³⁾ | 8.00 | 5.00 | 3.24 | 10.26 | 9.63 |
| As (µg/m ³) | 0.06 ⁽¹⁾ | 0.000354 | 0.000239 | 0.000122 | 0.000165 | 0.000217 |

| | | | | | | |
|---|-----------------------------|----------|----------|------------|-----------|----------|
| Cu ($\mu\text{g}/\text{m}^3$) | 9.6⁽¹⁾ | 0.018107 | 0.021454 | 0.0367798 | 0.040201 | 0.029963 |
| Mo ($\mu\text{g}/\text{m}^3$) | 23⁽¹⁾ | 0.001154 | 0.001005 | 0.00132060 | 0.000167 | 0.001594 |
| Ni ($\mu\text{g}/\text{m}^3$) | 0.04⁽¹⁾ | 0.000262 | 0.000144 | 0.0001016 | 0.000179 | 0.000152 |
| Pb ($\mu\text{g}/\text{m}^3$) | 0.10⁽¹⁾ | 0.000417 | 0.00025 | 0.0001648 | 0.000281 | 0.000276 |
| Zn ($\mu\text{g}/\text{m}^3$) | 23⁽¹⁾ | 0.004684 | 0.00839 | 0.0025862 | 0.0004419 | 0.004335 |
| Pb-210 (Bq/m^3) | 0.021⁽²⁾ | 0.000253 | 0.000261 | 0.0002894 | 0.000252 | 0.000303 |
| Po-210 (Bq/m^3) | 0.028⁽²⁾ | 0.000087 | 0.000083 | 0.000087 | 0.000192 | 0.000106 |
| Ra-226 (Bq/m^3) | 0.013⁽²⁾ | 0.000022 | 0.000022 | 0.000001 | 0.00006 | 0.000005 |
| Th-230 (Bq/m^3) | 0.0085⁽²⁾ | 0.000004 | 0.000005 | 0.0000052 | 0.000002 | 0.000002 |
| U ($\mu\text{g}/\text{m}^3$) | 0.06⁽¹⁾ | 0.001654 | 0.002497 | 0.000889 | 0.001173 | 0.002026 |

¹ Reference annual air quality levels are derived from [Ontario's Ambient Air Quality Criteria \(AAQC\)](#), Ministry of the Environment, Conservation and Parks.

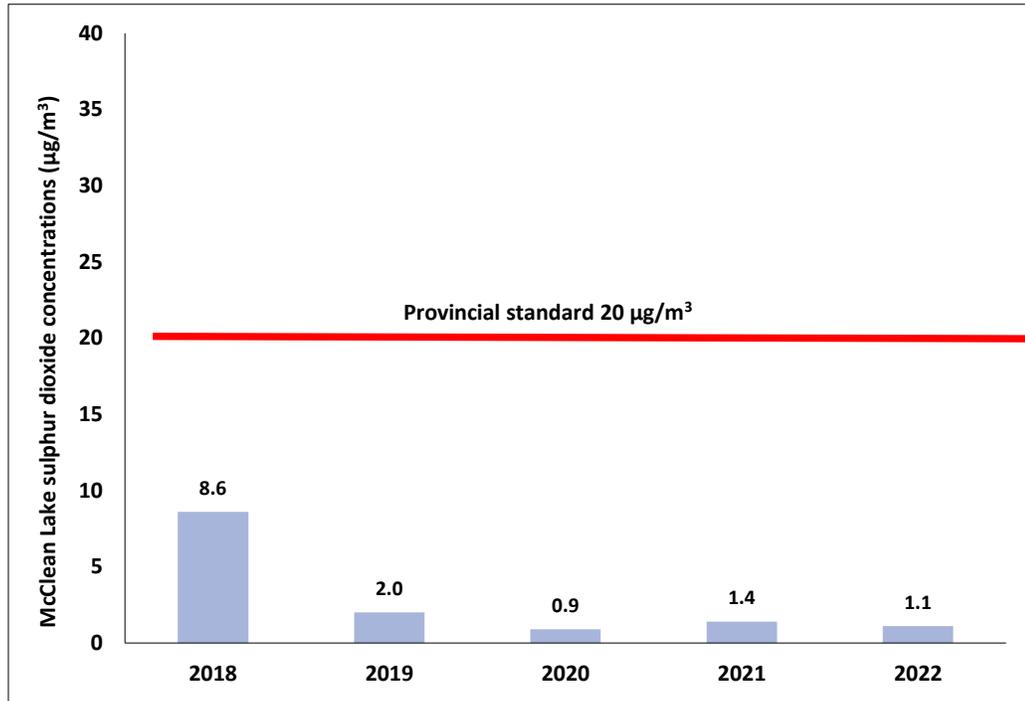
² Reference level is derived from ICRP, 2005. [Protecting People Against Radiation Exposure in the Event of a Radiological Attack. ICRP Publication 96](#). ICRP Publication 96. Ann. ICRP 35 (1)

³ [Saskatchewan Environmental Quality Guidelines, Table 20](#): Saskatchewan Ambient Air Quality Standards. Values are calculated as geometric means.

* Reference levels based on Province of Ontario [AAQC](#) and are shown for reference only. No federal or Saskatchewan provincial limits were established at the time of this report.

A sulphur dioxide monitor is used during operations to continuously measure ambient sulphur dioxide concentrations associated with mill emissions. The monitor is located approximately 200 meters in a predominantly downwind direction of the sulphuric acid plant stack. The measured sulphur dioxide monitoring data (see Figure 7.4) showed no exceedances of the annual standard of $20 \mu\text{g}/\text{m}^3$ in 2022.

Figure 7.4: McClean Lake Operation - concentrations of ambient sulphur dioxide, 2018-22



*Province of Saskatchewan's ambient air quality standard is shown.

Orano's terrestrial monitoring program at McClean Lake determines whether any impact on the environment arises from aerial deposition. Soil and terrestrial vegetation may be affected by the atmospheric deposition of particulate and adsorbed metals and radionuclides associated with onsite activities. This program includes measurements of metals and radionuclides in soil and vegetation.

Soil monitoring results from soil samples collected in 2015 are presented in the 2016 Technical Information Document – Environmental Performance (TID-EP). The results show that the soil metal parameter concentrations were below the [Canadian Environmental Quality Guidelines](#) set by the CCME. Radionuclide concentrations in soils were near or at background levels and analytical detection limits. CNSC staff concluded that the level of airborne particulate contaminants produced by the McClean Lake Operation is acceptable and does not pose a risk to the environment.

Vegetation sampling was also presented in the 2016 TID-EP and shows that most parameters are within the range of concentrations previously measured in lichen, Labrador tea and blueberry twig samples. The concentrations of metals and radionuclides in lichen, Labrador tea and blueberry twigs were higher than background concentrations for some samples located in the immediate vicinity of mining and milling activities, although the concentrations decreased within a short distance. Overall, the results indicated that the McClean Lake Operation has had a localized effect on the vegetation in areas of activity.

These higher concentrations were below levels that are toxic to plants, and they decreased to within background concentrations at a short distance from the facility. Therefore, no changes are predicted to terrestrial habitat, both within and outside the facility boundary. The elevated concentrations of contaminants within the facility boundary were modelled in an ERA, and no adverse effects were predicted for terrestrial non-humans.

In 2021, McClean Lake conducted its terrestrial and aquatic environmental monitoring program. This included sampling of sediment, benthic invertebrates, soil, lichen, vegetation and fish. The results are included in the 2022 TID-EP and indicate that the environmental effects downstream of the McClean Lake Operation are negligible and consistent with the predictions for the 2022 TID and confirmed the conclusions made in the 2016 TID.

CNSC staff concluded that the level of airborne particulate contaminants produced by the McClean Lake Operation was acceptable and did not pose a risk to browse (twigs and Labrador tea) and lichen consumers, such as caribou.

Uncontrolled releases

In 2022, 2 events reported to CNSC staff were identified as releases of hazardous substances to the environment:

On February 10, 2022, approximately 5 m³ of tailings were released from a hole in the exterior wall of the Tails Thickener Tank to the mill terrace.

On May 27, 2022, approximately 120 m³ of partially treated Sue C pit water was released to the environment because of a hole in the pond liner.

All releases were of low safety significance and reporting met the requirements of CNSC [REGDOC-3.2.1](#). Appendix I describes the spills and corrective actions taken. As a result of the actions taken by Orano, no residual impacts to the environment and human health were caused by the releases. CNSC staff were satisfied with the reporting of releases of hazardous materials to the environment and the corrective actions taken. CNSC staff rated all the 2022 spills as being of low significance.

Figure 2.10 shows the number of reportable environmental spills that occurred at the McClean Lake Operation from 2018 to 2022.

Assessment and monitoring

CNSC staff confirmed that the licensee successfully carried out required environmental monitoring, in accordance with the McClean Lake environmental protection program.

Based on compliance activities and the review of annual reports and the environmental 2016 TID-EP, CNSC staff concluded that the environmental monitoring conducted at the McClean Lake Operation met regulatory requirements. Consequently, CNSC staff concluded that the environment and the public remain protected.

Environmental risk assessment

The McClean Lake Operation's TID-EP, submitted to the CNSC in 2016, contained environmental monitoring data from 2011 to 2015 as well as an updated ERA. CNSC staff reviewed the environmental monitoring results for air, soil, vegetation, surface water, groundwater, and sediment, as well as the health indicators for fish and their prey inhabiting sediment and confirmed that the results were within those predicted in the ERA.

After reviewing the 2016 TID-EP, the 2022 annual adequacy review of the ERA, and Orano's ongoing activities to ensure the protection of the environment, CNSC staff concluded that adequate measures have been taken at the McClean Lake Operation to protect the environment.

Protection of people

Orano is required to demonstrate that the health and safety of persons are protected from exposures to hazardous substances released from the McClean Lake Operation. The effluent and environmental monitoring programs currently conducted by the licensee are used to verify that releases of hazardous substances do not result in environmental concentrations that may affect public health.

The CNSC receives reports of discharges to the environment through the reporting requirements outlined in the McClean Lake Operation CNSC-issued licence and LCH. The review of Orano's hazardous (non-radiological) discharges to the environment at the McClean Lake Operation in 2022 indicated that the public and environment were protected. CNSC staff confirmed the environmental concentrations in the vicinity of the McClean Lake Operation remained within those predicted in the 2016 ERA and also confirmed through 2022 annual adequacy review of the ERA, and that human health remained protected.

Based on compliance verification activities that included inspections, reviews of licensee reports and work practices, and monitoring results for 2022, CNSC staff concluded that the McClean Lake Operation's environmental protection program continued to be effective at protecting persons and the environment.

7.4 Conventional Health and Safety

For 2022, CNSC staff continued to rate the conventional health and safety SCA as “satisfactory”, based on regulatory oversight activities.

McClellan Lake Operation - conventional health and safety ratings

| 2018 | 2019 | 2020 | 2021 | 2022 |
|------|------|------|------|------|
| SA | SA | SA | SA | SA |

SA = satisfactory

Practices

As required under the [NSCA](#), Orano continued to take actions to improve performance and maintain health and safety programs at the McClellan Lake Operation to minimize occupational health and safety risks. CNSC staff confirmed that Orano had an effective occupational health and safety committee and that it was completing regular reviews of its safety program at the McClellan Lake facility.

Orano’s McClellan Lake Operation investigates safety concerns and incidents, including near-miss events. In 2022, several investigations were completed to determine the cause of incidents, near misses, injuries or property damage. Their incident investigation process employs a collaborative effort to identify a problem, analyze its causes and determine the best solutions. CNSC staff reviewed the investigation results and corrective actions and confirmed Orano’s commitment to accident prevention and safety awareness with a focus on safety culture.

Performance

Table 7.4 shows that from 2018 to 2022, Orano’s McClellan Lake Operation reported 12 LTIs. There were 3 LTIs reported in 2022. Details on the 2022 LTIs and corrective actions can be found in Appendix .

The TRIR for McClellan Lake is included for the last 5 years. The TRIR is the incident frequency rate that measures the number of fatalities, LTIs and other injuries requiring medical treatment.

Table 7.4: McClean Lake Operation - lost-time injury statistics, 2018-22

| | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|------|------|------|------|------|
| Lost-time injuries¹ | 1 | 3 | 2 | 3 | 3 |
| Severity rate² | 4.8 | 48 | 42.8 | 49.8 | 28.6 |
| Frequency rate³ | 0.3 | 0.9 | 0.7 | 0.9 | 0.8 |
| Total recordable incident rate⁴ | 0.75 | 3.15 | 2.7 | 5.6 | 2.9 |

¹ An injury that takes place at work and results in the worker being unable to return to work for a period of time.

² A measure of the total number of days lost to injury for every 200,000 person-hours worked at the facility. Accident severity rate = [(# of days lost in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

³ A measure of the number of LTIs for every 200,000 person-hours worked at the facility. Accident frequency rate = [(# of injuries in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

⁴ A measure of the number of fatalities, lost-time injuries and other injuries requiring medical treatment for every 200,000 person-hours worked at the facility. Recordable incident rate = [(# of incidents in last 12 months) / (# of hours worked in last 12 months)] x 200,000.

Corrective actions, where necessary, were implemented and the effectiveness was verified and documented by management. CNSC staff verified that Orano strives to involve all levels of its organization in the health and safety program at the McClean Lake Operation. Employees are encouraged and trained to continuously identify and assess risks and propose solutions.

Awareness

CNSC staff observed that conventional health and safety programs provided education, training, tools, and support to verify worker protection at the McClean Lake Operation. An active onsite occupational health and safety committee completes regular reviews of the McClean Lake safety program. Through inspections, reviews of incidents and discussions with McClean Lake staff, CNSC staff verified that the McClean Lake Operation is committed to accident prevention and safety awareness. CNSC staff's compliance verification activities concluded that the McClean Lake Operation's health and safety program met regulatory requirements in 2022.

7.5 Additional SCAs

In addition to the 3 primary SCAs of radiation protection, environmental protection, and conventional health and safety, CNSC staff have provided a brief discussion of the additional SCAs; these are presented in the following sections.

7.5.1 Management system

The licensee maintains an Integrated Management System; this forms part of the licensing basis for this facility in the LCH.

There were no inspections at the McClean Lake Operation that focused on evaluating the management system SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.2 Human performance management

The licensee includes program documentation for the human performance management SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the McClean Lake Operation that focused on evaluating the human performance management SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.3 Operating performance

The licensee includes program documentation for the operating performance SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the McClean Lake Operation with a focus on evaluating the operating performance SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.4 Safety analysis

The licensee includes program documentation for the safety analysis SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the McClean Lake Operation focused on evaluating the safety analysis SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.5 Physical design

The licensee includes program documentation for the physical design SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the McClean Lake Operation with a focus on evaluating the physical design SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.6 Fitness for service

The licensee includes program documentation for the fitness for service SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the McClean Lake Operation focused on evaluating the fitness for service SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.7 Emergency management and fire protection

The licensee includes program documentation for the emergency management and fire protection SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the McClean Lake Operation focused on evaluating the emergency management and fire protection SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

The licensee conducted 2 full-scale Emergency Preparedness (EP) exercises with scenarios focused on 'Search and Rescue', conducted in September 2022, and on 'Mass Casualty, Mutual Aid and Hazardous Substances', conducted in October 2022.

CNSC staff conducted a desk-top review of Orano's After Action Report (AAR) / CAP and third-party fire drill and incident assessment report.

CNSC staff is confident that McClean Lake's emergency management and fire protection capabilities, meet regulatory requirements, and concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.8 Waste management

The licensee includes program documentation for the waste management SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

In July 2022, a waste management focus inspection was conducted to verify the implementation and effectiveness of Orano's waste management program at the McClean Lake Operation and also the construction work related to the JEB tailings management facility (TMF) expansion to 457.5 meters above sea level (mASL). The inspection report outlined some deficiencies that resulted in 4 non-compliances related to the JEB TMF expansion (e.g., regrade crest, seal the liner patch edge opening, check integrity of the liner at section between concrete block #11 & 15, and manage the surface and seepage water). The safety significance associated with these non-compliances is low. CNSC staff reviewed and confirmed that Orano addressed the non-compliances in a satisfactory manner and have taken appropriate corrective actions; therefore, all 4 non-compliances were closed.

There were no event reports for which this SCA was the main contributory factor. CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.9 Security

The licensee includes program documentation for the security SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections at the McClean Lake Operation focused on evaluating the security SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.10 Safeguards and non-proliferation

The licensee includes program documentation for the safeguards and non-proliferation SCA as part of the overall management system documents; these constitute part of the licensing basis for this facility in the LCH.

There were no inspections in 2022 at the McClean Lake Operation focused on evaluating the safeguards and non-proliferation SCA. There were no event reports for which this SCA was the main contributing factor.

In addition to CNSC compliance activities with respect to the specific areas under the safeguards and non-proliferation SCA, the IAEA conducts independent inspections and activities with coordination and support through the CNSC regulatory framework. One IAEA Complementary Access (CA) was conducted at McClean Lake Operation from June 27-29, 2022. The IAEA concluded that the agency was able to carry out all planned activities during the CA.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

7.5.11 Packaging and transport

The licensee includes program documentation for the packaging and transport SCA as part of the overall management system documents; these form part of the licensing basis for this facility in the LCH.

There were no inspections at the McClean Lake Operation focused on evaluating the packaging and transport SCA in 2022. There were no event reports for which this SCA was the main contributory factor.

CNSC staff concluded that the licensee's program in respect of this SCA remains satisfactory.

GLOSSARY

For definitions of terms used in this document, see [REGDOC-3.6, Glossary of CNSC Terminology](#), which includes terms and definitions used in the [Nuclear Safety and Control Act](#) and the *Regulations* made under it, and in CNSC regulatory documents and other publications.

A. FACILITY LICENSING INFORMATION

The following table presents CNSC licensing information for the facilities discussed in this report.

A-1: Operating Uranium Mines and Mills – Licensing Information

| Licensee/Site/Licence # | Licence effective | Last licence amendment | Licence expiration |
|--|--------------------------|-------------------------------|---------------------------|
| Orano Canada Inc. McClellan Lake Operation Uranium Mine Licence UML-MINEMILL- McCLELLAN.02/2027 | July 1, 2017 | January 13, 2022 | June 30, 2027 |
| Cameco Corporation Cigar Lake Operation Uranium Mine Licence UML-MINE-CIGAR.00/2031 | July 1, 2021 | June 28, 2022 | June 30, 2031 |
| Cameco Corporation Key Lake Operation Uranium Mill Licence UML-MILL-KEY.01/2023 | November 1, 2013 | July 29, 2020 | October 31, 2023 |
| Cameco Corporation Rabbit Lake Operation Uranium Mine and Mill Licence UML-MINEMILL- RABBIT.01/2023 | November 1, 2013 | March 9, 2021 | October 31, 2023 |
| Cameco Corporation McArthur River Operation Uranium Mine Licence UML-MINE- McARTHUR.01/2023 | November 1, 2013 | June 26, 2019 | October 31, 2023 |

B. LIST OF INSPECTIONS

The following table present CNSC's inspections by facility and safety control area (SCA) for the facilities discussed in this report.

Table B-1: Operating Uranium Mines and Mills - Inspections by facility and SCA

| Facility | Method | Safety and control area | Notices of non-compliance | Inspection report issued |
|-----------------------------|---------|---|---------------------------|--------------------------|
| Cigar Lake Operation | Remote | Safety Analysis Environmental Protection Conventional Health and Safety Human Performance Management Emergency Management & Fire Protection Packaging and Transport Other – Public Information and Disclosure | None | Jan 31, 2022 |
| | Remote | Safety Analysis Radiation Protection Conventional Health and Safety Emergency Management and Fire Protection Safeguards and Non-Proliferation Packaging and Transport | None | June 21, 2022 |
| | On-Site | Radiation Protection | 16 | December 2, 2022 |
| | On-Site | Operating Performance Environmental Protection Conventional Health and Safety Waste Management Radiation Protection | 7 1 Order | January 18, 2023 |
| | On-Site | Emergency Management and Fire Protection | 10 | March 20, 2023 |

| Facility | Method | Safety and control area | Notices of non-compliance | Inspection report issued |
|---------------------------------|---------|---|---------------------------|--------------------------|
| McArthur River Operation | Remote | Management Systems | 3 | Dec 20, 2022 |
| | Remote | Human Performance Management (Personnel Training) Radiation Protection | 4 | July 19, 2022 |
| | On Site | Human Performance Management (Training) Conventional Health and Safety Operating Performance | 5 | Jan 11, 2023 |
| Rabbit Lake Operation | Remote | Operating Performance Radiation Protection Conventional Health & Safety Environmental Protection | 0 | April 21, 2022 |
| | On Site | Radiation Protection, Human Performance Management | 1 | August 29, 2022 |
| | On Site | Waste Management | 2 | October 11, 2022 |
| | On Site | Environmental Protection | None | October 11, 2022 |
| | On Site | Management System Human Performance Management Conventional Health and Safety Waste Management | 1 | March 17, 2023 |
| Key Lake Operation | Remote | Human Performance Management Operating Performance Radiation Protection | None | April 1, 2022 |

| Facility | Method | Safety and control area | Notices of non-compliance | Inspection report issued |
|-------------------------------|---------|--|---------------------------|--------------------------|
| | | Emergency Management and Fire Protection Waste Management Security | | |
| | Remote | Management System | 3 | August 5, 2022 |
| | Remote | Human Performance Management (Training) Radiation Protection | 4 | July 19, 2022 |
| | On Site | Emergency Response and Fire Protection | None | May 12, 2023 |
| | On Site | Management System Fitness for Service Environmental Protection Radiation Protection | 1 | November 30, 2022 |
| | On Site | Waste Management Conventional Health and Safety Environmental Protection | 1 | October 19, 2022 |
| | On Site | Human Performance Management | 6 | January 3, 2023 |
| McClean Lake Operation | Remote | Management System, Operating Performance, and Safety Analysis | None | April 26, 2022 |
| | Onsite | Waste Management Focused | 4 | August 24, 2022 |
| | Onsite | Fitness for Service, Packaging and Transport | 1 | October 24, 2022 |

| Facility | Method | Safety and control area | Notices of non-compliance | Inspection report issued |
|-----------------|---------------|--|----------------------------------|---------------------------------|
| | Onsite | Conventional Health & Safety | None | May 17, 2023 |
| | Onsite | Fitness for Service, Radiation Protection, Conventional Health and Safety and Waste Management | 10 | May 16, 2023 |

C. SAFETY AND CONTROL AREA DEFINITIONS

The CNSC evaluates how well licensees meet regulatory requirements and CNSC performance expectations for programs in 14 safety and control areas (SCAs). The SCAs are grouped into 3 functional areas: management, facility and equipment, and core control processes.

| Safety and Control Area Framework | | | |
|-----------------------------------|------------------------------|---|--|
| Functional area | Safety and control area | Definition | Specific areas |
| Management | Management system | Covers the framework that establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture. | <ul style="list-style-type: none"> ▪ Management system ▪ Organization ▪ Performance assessment, improvement and management review ▪ Operating experience (OPEX) ▪ Change management ▪ Safety culture ▪ Configuration management ▪ Records management ▪ Management of contractors ▪ Business continuity |
| | Human performance management | Covers activities that enable effective human performance through the development and implementation of processes that ensure a sufficient number of licensee personnel are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties. | <ul style="list-style-type: none"> ▪ Human performance program ▪ Personnel training ▪ Personnel certification ▪ Initial certification examinations and requalification tests ▪ Work organization and job design ▪ Fitness for duty |
| | Operating performance | Includes an overall review of the conduct of the licensed activities and the activities that enable effective performance. | <ul style="list-style-type: none"> ▪ Conduct of licensed activity ▪ Procedures ▪ Reporting and trending ▪ Outage management performance ▪ Safe operating envelope ▪ Severe accident management and recovery ▪ Accident management and recovery |

| Safety and Control Area Framework | | | |
|-----------------------------------|-------------------------|---|---|
| Functional area | Safety and control area | Definition | Specific areas |
| Facility and equipment | Safety analysis | Covers maintenance of the safety analysis that supports the overall safety case for the facility. Safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventative measures and strategies in reducing the effects of such hazards. | <ul style="list-style-type: none"> ▪ Deterministic safety analysis ▪ Hazard analysis ▪ Probabilistic safety analysis ▪ Criticality safety ▪ Severe accident analysis ▪ Management of safety issues (including R&D programs) |
| | Physical design | Relates to activities that impact the ability of structures, systems and components to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account. | <ul style="list-style-type: none"> ▪ Design governance ▪ Site characterization ▪ Facility design ▪ Structure design ▪ System design ▪ Component design |
| | Fitness for service | Covers activities that impact the physical condition of structures, systems and components to ensure that they remain effective over time. This area includes programs that ensure all equipment is available to perform its intended design function when called upon to do so. | <ul style="list-style-type: none"> ▪ Equipment fitness for service / equipment performance ▪ Maintenance ▪ Structural integrity ▪ Aging management ▪ Chemistry control ▪ Periodic inspection and testing |
| Core control processes | Radiation protection | Covers the implementation of a radiation protection program in accordance with the <i>Radiation Protection Regulations</i> . The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA. | <ul style="list-style-type: none"> ▪ Application of ALARA ▪ Worker dose control ▪ Radiation protection program performance ▪ Radiological hazard control ▪ Estimated dose to public |

| Safety and Control Area Framework | | | |
|--|--|--|--|
| Functional area | Safety and control area | Definition | Specific areas |
| | Conventional health and safety | The implementation of a program to manage workplace safety hazards and to protect workers. | <ul style="list-style-type: none"> ▪ Performance ▪ Practices ▪ Awareness |
| | Environmental protection | Covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities. | <ul style="list-style-type: none"> ▪ Effluent and emissions control (releases) ▪ Environmental management system ▪ Assessment and monitoring ▪ Protection of people ▪ Environmental risk assessment |
| | Emergency management and fire protection | Covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This area also includes any results of participation in exercises. | <ul style="list-style-type: none"> ▪ Conventional emergency preparedness and response ▪ Nuclear emergency preparedness and response ▪ Fire emergency preparedness and response |
| | Waste management | Covers internal waste-related programs that form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning. | <ul style="list-style-type: none"> ▪ Waste characterization ▪ Waste minimization ▪ Waste management practices ▪ Decommissioning plans |
| | Security | Covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity. | <ul style="list-style-type: none"> ▪ Facilities and equipment ▪ Response arrangements ▪ Security practices ▪ Drills and exercises |

| Safety and Control Area Framework | | | |
|---|----------------------------------|---|--|
| Functional area | Safety and control area | Definition | Specific areas |
| | Safeguards and non-proliferation | Covers the programs and activities required for the successful implementation of the obligations arising from the Canada/ International Atomic Energy Agency (IAEA) safeguards agreements, as well as all other measures arising from the <i>Treaty on the Non-Proliferation of Nuclear Weapons</i> . | <ul style="list-style-type: none"> ▪ Nuclear material accountancy and control ▪ Access and assistance to the IAEA ▪ Operational and design information ▪ Safeguards equipment, containment and surveillance ▪ Import and export |
| | Packaging and transport | Programs that cover the safe packaging and transport of nuclear substances to and from the licensed facility. | <ul style="list-style-type: none"> ▪ Package design and maintenance ▪ Packaging and transport ▪ Registration for use |
| Other Matters of Regulatory Interest | | | |
| <ul style="list-style-type: none"> ▪ Environmental assessment ▪ CNSC consultation – Indigenous ▪ CNSC consultation – other ▪ Cost recovery ▪ Financial guarantees ▪ Improvement plans and significant future activities ▪ Licensee public information program ▪ Nuclear liability insurance | | | |

D. SAFETY AND CONTROL AREA RATING METHODOLOGY

Performance ratings used in this report are defined as follows:

Satisfactory (SA)

The licensee meets all of the following criteria:

- Performance meets CNSC staff expectations.
- Licensee non-compliances or performance issues, if any, are not risk-significant.
- Any non-compliances or performance issues have been, or are being, adequately corrected.

Below expectations (BE)

One or more of the following criteria apply:

- Performance does not meet CNSC staff expectations.
- The licensee has risk-significant non-compliance(s) or performance issue(s).
- Non-compliances or performance issues are not being adequately corrected.

Unacceptable (UA)

One or both of the following criteria apply:

- The risk associated with a non-compliance or performance issue is unreasonable.
- At least one significant non-compliance or performance issue exists with no associated corrective action.

The following rating is no longer used by the CNSC. It is defined below for informational purposes only. This rating may appear in historic data.

Fully satisfactory (FS)

Safety and control measures implemented by the licensee are highly effective. In addition, compliance with regulatory requirements is fully satisfactory (FS), and compliance within the SCA or specific area exceeds requirements and CNSC expectations. Overall, compliance is stable or improving, and any problems or issues that arise are promptly addressed.

The following rating definitions are no longer used by the CNSC. They are defined below for informational purposes only. These definitions may appear in historic data.

Satisfactory (SA)

Safety and control measures implemented by the licensee are sufficiently effective. In addition, compliance with regulatory requirements is satisfactory. Compliance within the SCA or specific area meets requirements and the CNSC expectations. Any deviation is only minor, and any issues are considered to pose a low risk to the achievement of regulatory objectives and the CNSC's expectations. Appropriate improvements are planned.

Below expectations (BE)

Safety and control measures implemented by the licensee are marginally ineffective. In addition, compliance with regulatory requirements falls below expectations. Compliance within the SCA or specific area deviates from requirements or CNSC expectations to the extent that there is a moderate risk of ultimate failure to comply. Improvements are required to address identified weaknesses. The licensee or applicant is taking appropriate corrective action.

Unacceptable (UA)

Safety and control measures implemented by the licensee are significantly ineffective. In addition, compliance with regulatory requirements is unacceptable and is seriously compromised. Compliance within the overall SCA or specific area is significantly below requirements or CNSC expectations or there is evidence of overall non-compliance. Without corrective action, there is a high probability that the deficiencies will lead to an unreasonable risk. Issues are not being addressed effectively, no appropriate corrective measures have been taken, and no alternative plan of action has been provided. Immediate action is required.

E. SAFETY AND CONTROL AREA RATINGS

Table E-1: Safety and control area ratings for Cigar Lake Operation, 2018 - 2022

| Safety and control area | 2018 | 2019 | 2020 | 2021 | 2022 |
|--|------|------|------|------|------|
| Management system | SA | SA | SA | SA | BE |
| Human performance management | SA | SA | SA | SA | SA |
| Operating performance | SA | SA | SA | SA | SA |
| Safety analysis | SA | SA | SA | SA | SA |
| Physical design | SA | SA | SA | SA | SA |
| Fitness for service | SA | SA | SA | SA | SA |
| Radiation protection | SA | SA | SA | SA | BE |
| Conventional health and safety | SA | SA | SA | SA | SA |
| Environmental protection | SA | SA | SA | SA | SA |
| Emergency management and fire protection | SA | SA | SA | SA | SA |
| Waste management | SA | SA | SA | SA | SA |
| Security | SA | SA | SA | SA | SA |
| Safeguards and non-proliferation | SA | SA | SA | SA | SA |
| Packaging and transport | SA | SA | SA | SA | SA |

Table E-2: Safety and control area ratings for McArthur River Operation, 2018 - 2022

| Safety and control area | 2018 | 2019 | 2020 | 2021 | 2022 |
|--|------|------|------|------|------|
| Management system | SA | SA | SA | SA | SA |
| Human performance management | SA | SA | SA | SA | SA |
| Operating performance | SA | SA | SA | SA | SA |
| Safety analysis | SA | SA | SA | SA | SA |
| Physical design | SA | SA | SA | SA | SA |
| Fitness for service | SA | SA | SA | SA | SA |
| Radiation protection | SA | SA | SA | SA | SA |
| Conventional health and safety | SA | SA | SA | SA | SA |
| Environmental protection | SA | SA | SA | SA | SA |
| Emergency management and fire protection | SA | SA | SA | SA | SA |
| Waste management | SA | SA | SA | SA | SA |
| Security | SA | SA | SA | SA | SA |
| Safeguards and non-proliferation | SA | SA | SA | SA | SA |
| Packaging and transport | SA | SA | SA | SA | SA |

Table E-3: Safety and control area ratings for Rabbit Lake Operation, 2018 - 2022

| Safety and control area | 2018 | 2019 | 2020 | 2021 | 2022 |
|--|------|------|------|------|------|
| Management system | SA | SA | SA | SA | SA |
| Human performance management | SA | SA | SA | SA | SA |
| Operating performance | SA | SA | SA | SA | SA |
| Safety analysis | SA | SA | SA | SA | SA |
| Physical design | SA | SA | SA | SA | SA |
| Fitness for service | SA | SA | SA | SA | SA |
| Radiation protection | SA | SA | SA | SA | SA |
| Conventional health and safety | SA | SA | SA | SA | SA |
| Environmental protection | SA | SA | SA | SA | SA |
| Emergency management and fire protection | SA | SA | SA | SA | SA |
| Waste management | SA | SA | SA | SA | SA |
| Security | SA | SA | SA | SA | SA |
| Safeguards and non-proliferation | SA | SA | SA | SA | SA |
| Packaging and transport | SA | SA | SA | SA | SA |

Table E-4: Safety and control area ratings for Key Lake Operation, 2018- 2022

| Safety and control area | 2018 | 2019 | 2020 | 2021 | 2022 |
|--|------|------|------|------|------|
| Management system | SA | SA | SA | SA | SA |
| Human performance management | SA | SA | SA | SA | SA |
| Operating performance | SA | SA | SA | SA | SA |
| Safety analysis | SA | SA | SA | SA | SA |
| Physical design | SA | SA | SA | SA | SA |
| Fitness for service | SA | SA | SA | SA | SA |
| Radiation protection | FS | FS | SA | SA | SA |
| Conventional health and safety | SA | SA | SA | SA | SA |
| Environmental protection | SA | SA | SA | SA | SA |
| Emergency management and fire protection | SA | SA | SA | SA | SA |
| Waste management | SA | SA | SA | SA | SA |
| Security | SA | SA | SA | SA | SA |
| Safeguards and non-proliferation | SA | SA | SA | SA | SA |
| Packaging and transport | SA | SA | SA | SA | SA |

Table E-5: Safety and control area ratings for McClean Lake Operation, 2018–2022

| Safety and control area | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|-------------|-------------|-------------|-------------|-------------|
| Management system | SA | SA | SA | SA | SA |
| Human performance management | SA | SA | SA | SA | SA |
| Operating performance | SA | SA | SA | SA | SA |
| Safety analysis | SA | SA | SA | SA | SA |
| Physical design | SA | SA | SA | SA | SA |
| Fitness for service | SA | SA | SA | SA | SA |
| Radiation protection | SA | SA | SA | SA | SA |
| Conventional health and safety | SA | SA | SA | SA | SA |
| Environmental protection | SA | SA | SA | SA | SA |
| Emergency management and fire protection | SA | SA | SA | SA | SA |
| Waste management | SA | SA | SA | SA | SA |
| Security | SA | SA | SA | SA | SA |
| Safeguards and non-proliferation | SA | SA | SA | SA | SA |
| Packaging and transport | SA | SA | SA | SA | SA |

F. FINANCIAL GUARANTEES

The following tables outline the financial guarantees, as of December 31, 2022, for the uranium mine, mill, historic, and decommissioned sites discussed in this report.

Table F-1: Operating Uranium Mines and Mills – financial guarantees:

| Facility | Canadian dollar amount |
|---------------------------------|-------------------------------|
| Cigar Lake Operation | \$61,790,000 |
| McArthur River Operation | \$42,100,000 |
| Rabbit Lake Operation | \$202,700,000 |
| Key Lake Operation | \$213,400,000 |
| McClellan Lake Operation | \$102,098,000 |
| Total | \$636,331,000 |

G. WORKER DOSE DATA

Table G-1 shows the total number of nuclear energy workers (NEWs) monitored at each of the 5 uranium mines and mills for 2022. An individual who is required to work with a nuclear substance or in a nuclear industry is designated as a NEW if they have a reasonable probability of receiving an individual effective dose greater than the prescribed effective dose limit for a member of the public (i.e., 1 millisievert [mSv] in a calendar year).

Table G-1: Number of NEWs at uranium mines and mills, 2022

| | Cigar Lake | McArthur River | Rabbit Lake | Key Lake | McClellan Lake |
|-------------------|-------------------|-----------------------|--------------------|-----------------|-----------------------|
| Total NEWs | 1188 | 729 | 154 | 931 | 383 |

The following table compares the average and maximum individual effective dose for the 5 operating uranium mines and mills.

Table G-2: Radiation dose data for NEWs at uranium mines and mills, 2022

| Facility | Average individual effective dose (mSv/year) | Maximum individual effective dose (mSv/year) | Regulatory limit |
|---------------------------------|---|---|-------------------------|
| Cigar Lake Operation | 0.46 | 5.00 | 50 mSv/year |
| McArthur River Operation | 0.59 | 7.14 | |
| Rabbit Lake Operation | 0.70 | 2.86 | |
| Key Lake Operation | 0.74 | 6.46 | |
| McClellan Lake Operation | 0.81 | 6.86 | |

Tables G-3 to G-7 show a 5-year trend (from 2018 to 2022) of the average and maximum effective annual doses to NEWs at the 5 uranium mines and mills. No radiation dose at any facility exceeded the regulatory effective dose limit during 2022.

Table G-3: Radiation dose data for NEWs, Cigar Lake Operation, 2018 - 2022

| Dose data | 2018 | 2019 | 2020 | 2021 | 2022 | Regulatory limit |
|--|------|------|------|-------|-------|--------------------|
| Total NEWs | 824 | 875 | 861 | 1,047 | 1,188 | N/A |
| Average individual effective dose (mSv) | 0.47 | 0.57 | 0.38 | 0.32 | 0.46 | N/A |
| Maximum individual effective dose (mSv) | 7.28 | 3.70 | 2.82 | 6.03 | 5.00 | 50 mSv/year |

Table G-4: Radiation dose data for NEWs, McArthur River Operation, 2018 - 2022

| Dose data | 2018 | 2019 | 2020 | 2021 | 2022 | Regulatory limit |
|--|------|------|------|------|------|--------------------|
| Total NEWs | 595 | 136 | 172 | 333 | 729 | N/A |
| Average individual effective dose (mSv) | 0.15 | 0.33 | 0.27 | 0.25 | 0.59 | N/A |
| Maximum individual effective dose (mSv) | 2.67 | 2.82 | 2.94 | 3.06 | 7.14 | 50 mSv/year |

Table G-5: Radiation dose data for NEWs, Rabbit Lake Operation, 2018 - 2022

| Dose data | 2018 | 2019 | 2020 | 2021 | 2022 | Regulatory limit |
|--|------|------|------|------|------|--------------------|
| Total NEWs | 166 | 119 | 128 | 163 | 154 | N/A |
| Average individual effective dose (mSv) | 0.46 | 0.75 | 0.70 | 0.57 | 0.70 | N/A |
| Maximum individual effective dose (mSv) | 1.7 | 2.73 | 2.93 | 2.47 | 2.86 | 50 mSv/year |

Table G-6: Radiation dose data for NEWs, Key Lake Operation, 2018 - 2022

| Dose data | 2018 | 2019 | 2020 | 2021 | 2022 | Regulatory limit |
|--|-------------|-------------|-------------|-------------|-------------|-------------------------|
| Total NEWs | 481 | 260 | 302 | 676 | 931 | N/A |
| Average individual effective dose (mSv) | 0.19 | 0.27 | 0.35 | 0.52 | 0.74 | N/A |
| Maximum individual effective dose (mSv) | 2.02 | 1.64 | 2.11 | 3.13 | 6.46 | 50 mSv/year |

Table G-7: Radiation dose data for NEWs, McClean Lake Operation, 2018 - 2022

| Dose data | 2018 | 2019 | 2020 | 2021 | 2022 | Regulatory limit |
|--|-------------|-------------|-------------|-------------|-------------|-------------------------|
| Total NEWs | 330 | 323 | 369 | 353 | 383 | N/A |
| Average individual effective dose (mSv) | 0.90 | 0.93 | 0.67 | 0.79 | 0.81 | N/A |
| Maximum individual effective dose (mSv) | 5.50 | 4.70 | 4.28 | 4.89 | 6.86 | 50 mSv/year |

H. RADIOLOGICAL ACTION LEVEL EXCEEDANCES REPORTED TO THE CNSC

CNSC staff reviewed and were satisfied with the remedial actions taken by the licensees for the radiological action level exceedances reporting in Table H-1. Table H-1 notes the details of each event, the corrective actions taken by the licensee and the CNSC's associated significance ratings. Table H-2 lists the rating definitions and examples of safety significance across fuel cycle facilities.

Table H-1: Uranium mines and mills – exceedances of radiological action levels in 2022

| Facility | Action level exceedance | Corrective action | Significance rating |
|---------------------------------|---|---|---------------------|
| Cigar Lake Operation | Upon receipt of the March 2022 PAD results, Cameco discovered that a worker received 1.27 mSv. The worker was onsite for only two days of the month, indicating an exceedance of the 1 mSv per week action level. | The investigation found it highly likely that the worker removed their PAD and left it in an area exposed to high RnP levels in an area restricted from access during laser surveying of a completed mining cavity. There were three corrective actions associated with this event, including reviewing the event with workers performing similar work activities to reinforce the proper use of the PAD, random follow-up audits of the workers to ensure proper use of the dosimeter, and application to replace the PAD result with an estimate, as the investigation found it was highly unlikely that the result was representative of the worker's actual exposure for the month. Corrective actions will be verified through onsite verification activities during regular CNSC inspections. | Low |
| McArthur River Operation | None reported | N/A | N/A |

| Facility | Action level exceedance | Corrective action | Significance rating |
|---------------------------------|---|---|---------------------|
| Rabbit Lake Operation | None reported | N/A | N/A |
| Key Lake Operation | On June 26, 2022, a worker performing cleaning duties in the CCD circuit in preparation for commissioning had an intake of LLRD. The conservatively estimated dose was 4.19 mSv, which is above the weekly action level of 1 mSv. | A root cause investigation was undertaken, and the results provided to CNSC staff. Corrective actions implemented by Cameco included a review of training and documentation to clarify expectation on decontamination procedures and the completion of LLRD focused housekeeping inspections. | Medium |
| McClellan Lake Operation | None reported | N/A | N/A |

Table H-2: CNSC Radiation protection rating definitions and examples

| Radiation protection | | |
|-----------------------------|---|--|
| Safety significance | Definition | Fuel cycle facility specific examples |
| High | Exposures to multiple workers in excess of regulatory limits. Widespread contamination to several persons or to a place. | Incident that results in, or has reasonable potential for, a worker to exceed regulatory limits. Examples: <ul style="list-style-type: none"> ▪ nuclear energy worker (NEW) exceeding 50 millisievert (mSv)/year or 100 mSv/5 years ▪ non-NEW exceeding 1 mSv |
| Medium | Exposure to a worker in excess of regulatory limits. An incident that would result in a licensee exceeding action level. Limited contamination that could affect a few persons or a limited area. | Incident that results in or has reasonable potential to exceed an action level. Example: <ul style="list-style-type: none"> ▪ doses to workers of 1 mSv/week or 5 mSv/quarter |
| Low | Increased dose below reportable limits. Contamination that could affect a worker. | Incident that results in, or has reasonable potential to exceed, the highest administrative level. |

I. REPORTABLE RELEASES TO THE ENVIRONMENT (SPILLS)

Canadian Nuclear Safety Commission (CNSC) staff reviewed and were satisfied with the remedial actions taken by the licensees in response to the spills presented in Table I-1 and concluded that these spills resulted in no residual impacts to the environment. Table I-1 notes the details of each spill, the corrective actions taken by the licensee and the CNSC's spill significance ratings. Table I-2 lists the spill rating definitions and gives examples of safety significance across fuel cycle facilities.

Table I-1: Uranium mines and mills reportable releases to the environment, 2022

| Facility | Details | Corrective actions | Significance rating |
|----------------------|---|--|---------------------|
| Cigar Lake Operation | On October 1, 2022, at approximately 17:00, during rounds as the freeze plants were down due to other site maintenance, the operator noticed the smell of ammonia by the condenser. The condenser was pumped down and isolated. The cause was determined to be from a small pin hole leak along the manufactured seam on the piping within the condenser coil bundles. Ammonia level indicators in the area remained unchanged indicating that the release volume is likely negligible | The manufacturer was contacted to help isolate the cause. It was determined that it was a manufacturing failure. The unit was taken out of service until the line could be repaired. | Low |
| | On October 17, 2022, during a CNSC General Inspection, the CNSC identified an area along the ramp leading into Stockpile B with elevated radiological readings. The radiation department headed out to do a grid scan and confirmed there was a small area with higher radiological readings. Site services was requested to remove the top layer of material. When the radiation department went back to confirm the ground was clean, the radiological readings were higher. Site services scraped the area deeper and discovered a greyish material which was believed to be uranium ore. The radiologically | The area was cleaned up and gamma dose rate measurements were conducted to verify effectiveness of the clean-up. Procedures were updated to prevent recurrence. | Low |

| Facility | Details | Corrective actions | Significance rating |
|---------------------------------|--|--|---------------------|
| | contaminated material was removed and placed on Stockpile B. A subsequent grid scan confirmed the affected area had readings of 0.8 μ Sv/hr. | | |
| McArthur River Operation | None | N/A | N/A |
| Rabbit Lake Operation | None | N/A | N/A |
| Key Lake Operation | On February 16, 2022, approximately 240 litres of propane was releases from the mill propane storage area. On February 15, 2022, maintenance work on the propane skid was completed and a propane pump was returned to operation without opening the safety bypass regulator discharge valve, causing the braided hose on the regulator discharge to leak near the flange. An employee reported the smell of propane at on February 16 and the maintenance department responded. The propane pump was shut-off and the leaking line was isolated. The release occurred outdoors on a cement pad. | The damaged line was replaced and the shut off valve was re-opened allowing for normal operations of the mill propane facility to resume. Cameco reviewed the propane system to determine a proper combination of pipe/hose ratings and protection devices to ensure the piping us protected and the system performs safely and adequately. A review of the propane facility daily checks and preventative maintenance plans was also conducted to ensure inspections and maintenance activities were optimized. | Low |
| Key Lake Operation | On March 29, 2022, up to 12.8 cubic meters of water was released of dewatering well water was discovered. During daily inspections standing water was identified in and around Gaertner dewatering Well V. The dewatering Well V is located southwest of the grinding and crushing plant and is directly between Gaertner Pit and the DTMF. Well V is used as a feed source for the reverse osmosis WTP. Cameco indicated that Well V is inspected twice per day and the duration of the leak and volume released was | The well will remain locked out of service until the leak on the underground pipe can be adequately investigated and repaired. An investigation was entered into the Cameco Incident Reporting Systems (CIRS) to ensure the cause of the leak is investigated and repaired after the ground thaws allowing for excavation. After initial investigation Cameco indicated that more excavation than initially anticipated, including the removal of the well housing, will be required. Cameco staff indicated that the well is to remain isolated | Low |

| Facility | Details | Corrective actions | Significance rating |
|---------------------------|---|---|---------------------|
| | conservatively estimated to begin immediately after the last inspection occurred. | until repaired. Project may not be completed in 2022. | |
| Key Lake Operation | On September 20, 2022, approximately 2,000 litres of water overflowed a pump test pit within the Mineshop Pump Bay to the exterior of the building. A worker discovered the pump testing pit overflowing. It was determined that the fill valve was bumped into the fill position when hose was placed on the hose rack. | Cameco relocated hose hangers that were in close proximity to pump testing sump fill valve to prevent accidental opening of the valve in the future. The pump testing sump fill valve was labelled and signage added to identify that the valve is to remain closed unless the sump area is being actively filled for use. | Low |
| Key Lake Operation | On October 22, 2022, an estimated 6.0 cubic meters of water was released from a ruptured line which directs overflow from the Neutral Thickener tank at the mill. The overflow line was blocked off inside the facility during care and maintenance and it is suspected that this allowed for rain/melt water to collect within the overflow line causing the pipe to freeze during winter month resulting in a split beneath the insulation cover. | The damaged insulated pipe was removed and replaced. Operational readiness activities were completed, including a significant pipeline inspection (spot testing for thickness, to assess general condition of the pipe) campaign. The information collected will be used as data to further support the structural integrity program at the operation. The overflow pipe is a gravity feed line that directs water into the grinding facility. This line remains open and in use during active operations, which reduces the risk of freezing. This specific pipe location will be inspected prior to use after any further care and maintenance periods. | Low |
| Key Lake Operation | On November 25, 2022, approximately 8.1 cubic meters of helium was released from a helium cylinder when changing out and installing a new cylinder within the chemical lab. When removing the plastic safety cover from the cylinder outlet valve the helium began immediately venting. The area was evacuated, and the door closed and the cylinder was allowed to discharge. | The cylinder was tagged out of service and will be sent back to the manufacturer to investigate the possible defective valve. | Low |

| Facility | Details | Corrective actions | Significance rating |
|-------------------------------|--|---|---------------------|
| McClean Lake Operation | On February 10, 2022, approximately 5 m ³ of tailings were released from a hole in the exterior wall of the Tails Thickener Tank to the mill terrace. | A temporary plug was installed to immediately stop the release of tailings from the tank. The level of tailings in the thickener tank was lowered to allow for repair. The hole was on an undercut weld seam which was cleaned and re-welded from the outside. Ultrasonic thickness testing was performed on the area around the hole and results show that the tank wall is sound. | Low |
| McClean Lake Operation | On May 27, 2022, approximately 120 m ³ of partially treated Sue C pit water was released to the environment because of a hole in the pond liner. | The water was removed from under the liner with a vacuum truck and returned into the Sue C pit. The hole was repaired. | Low |

Table I-2: CNSC environmental protection spill rating definitions and examples

| Environmental protection | | |
|---------------------------------|--|---|
| Safety significance | Definition | Fuel cycle facility-specific examples |
| High | Nuclear or hazardous substances being released to the environment exceeding regulatory limits (including public exposure) or that results in significant impact to the environment. | <p>Incident that results in, or has reasonable potential to have, a significant or moderate impact or extensive future remediation.</p> <p>Examples:</p> <ul style="list-style-type: none"> ▪ impairment of ecosystem functions ▪ effluent licence limit exceedance ▪ spill into fish bearing water ▪ fish kill |
| Medium | Nuclear or hazardous substances being released to the environment exceeding action levels (including public exposure) or that result in impact to the environment outside the licensing basis. | <p>Incident that results in, or has reasonable potential to have, a minor impact or that requires some future remediation.</p> <p>Examples:</p> <ul style="list-style-type: none"> ▪ effluent action level exceedance ▪ spills to environment (including atmosphere) with short-term or seasonal impacts |
| Low | Release of hazardous or nuclear substances to the environment below regulatory limits. | <p>Incident that results in, or has reasonable potential to have, a negligible impact.</p> <p>Examples:</p> <ul style="list-style-type: none"> ▪ effluent administrative level-exceedance ▪ spills to environment (including atmosphere) with no future impacts |

J. ENVIRONMENTAL ACTION LEVEL AND REGULATORY LIMIT EXCEEDANCES REPORTED TO THE CNSC

Canadian Nuclear Safety Commission (CNSC) staff reviewed and were satisfied with the corrective actions taken by the licensees for the environmental action level and regulatory exceedances reporting in Table J-1. Table J-1 notes the details of each event, the corrective actions taken by licensees and the CNSC's associated significance ratings. Table J-2 lists the rating definitions and examples of safety significance across fuel cycle facilities.

Table J-1: Uranium mines and mills – environmental action level exceedances, 2022

| Facility | Action level or regulatory limit exceedance | Corrective action | Significance rating |
|---------------------------------|--|---|---------------------|
| Cigar Lake Operation | None | N/A | N/A |
| McArthur River Operation | None | N/A | N/A |
| Rabbit Lake Operation | None | N/A | N/A |
| Key Lake Operation | <p>On October 28, 2022, a monitoring pond was discharged after treatment within the mill WTP. Monitoring ponds are used to store treated effluent while effluent quality is verified prior to discharge to the environment. In this instance, the pond fill sample had a uranium concentration of 60 µg/L, which is acceptable for discharge, however the pond discharge composite sample was 81 µg/L, which is above the action level of 80µg/L.</p> <p>Cameco investigated the incident and determined that fluctuations in uranium concentrations in feedwater from reservoir #1 and the final effluent were occurring at the time of the incident. Accumulated solids/sediment within the reservoir were being</p> | Immediately after the incident, water feed for water treatment was switched to reservoir #2 to allow reservoir #1 water quality to improve/stabilize. | Low |

| Facility | Action level or regulatory limit exceedance | Corrective action | Significance rating |
|---------------------------|---|--|---------------------|
| | <p>removed in the summer by agitating the solids using a water jet and then pumping out the solids/water mixture. This resulted in increased solids, including uranium, in the water column even after the project was suspended for the winter months. Though the discharge was above the action level, the effluent quality remained within the CNSC's interim objective for uranium in effluent of 0.1 mg/L and no impact on the environment occurred.</p> | <p>Following the event, the feed water for bulk neutralization was changed from reservoir #1 to reservoir #2. Pond 5 was filled and recycled until the lab assays showed that the treated effluent was releasable. Ponds 2, 3, and 5 were then filled, flushed, and recycled to ensure no cross contamination from the residual water left in the pond following release. Pond 4 was a releasable pond and did not require flushing. The pH set-point in Pachuca 4 was raised from 10.5 to 11.5 to improve uranium removal in the thickener while Pachuca 3 was offline for repairs.</p> | |
| Key Lake Operation | <p>On November 25, 2022, approximately a third of a treated effluent pond was discharged at a TSS concentration of 37 mg/L, before the turbidity interlock engaged and the discharge ceased. This is above the action level of 18 mg/L. The pond fill sample had a result of 3.3 mg/L.</p> | <p>An initial investigation was completed which resulted in some immediate corrective actions being implemented. Pond 2 was temporarily taken out of service and the effluent</p> | Low |

| Facility | Action level or regulatory limit exceedance | Corrective action | Significance rating |
|---------------------------------|---|--|---------------------|
| | | sampling equipment was inspected and all rubberized hosing was replaced with new hosing. A root cause investigation is being completed by Cameco and they will be providing CNSC staff a summary of the results, including any additional proposed corrective actions. | |
| McClellan Lake Operation | On February 10, 2022, Orano reported a TSS concentration in discharged effluent of 23 mg/L, which was above the regulatory discharge limit of 22.5 mg/L. | The routing pond samples from 3 other monitoring ponds that comprised the 24-hour discharge had TSS concentrations of 3, 4, and 1 mg/L. A grab sample was also collected from the pond discharging at the time the exceedance was discovered and the TSS was <1 mg/L. CNSC staff agree with Orano's determination that the sample was not representative of the actual readings. A sample was also collected from Sink Reservoir and tested for acute lethality as required under MDMER and passed. | Low |
| McClellan Lake Operation | On June 29, 2022, an effluent action level exceedance was identified for un-ionized ammonia (U-NH ₃) that occurred at the JEB WTP. An Orano employee started discharging a pond from the JEB WTP after inadvertently looking | Orano took corrective action of reviewing proper discharge procedures with all Orano groups involved. | Low |

| Facility | Action level or regulatory limit exceedance | Corrective action | Significance rating |
|---------------------------------|--|--|---------------------|
| | <p>at the wrong Pond Fill Sample results. After finalizing the Pond Fill Sample results, Orano became aware of the elevated U-NH₃ results. When it was discovered that the pond was already discharging, the discharge was immediately stopped, and the remainder of the pond was recycled to the TMF. Approximately 208 m³ of effluent was discharged to Sink Reservoir with elevated U-NH₃.</p> <p>The effluent action level for unionized ammonia is 0.45 mg/L and the pond routing sample result was 0.60 mg/L.</p> | | |
| McClellan Lake Operation | <p>On July 5, 2022, a 24hr pond composite release was above the action level in the JEB WTP. TSS was 14 mg/L and the action level is 12 mg/L.</p> | <p>A grab sample was taken to the lab and the result was 3 mg/L. The probable cause for the apparent action level exceedance was a dirty container. The sampling dirty container was cleaned and a standard for cleanliness was implemented.</p> | Low |

Table J-2: CNSC Environmental protection rating definitions and examples

| Environmental protection | | |
|---------------------------------|--|---|
| Safety significance | Definition | Fuel cycle facility-specific examples |
| High | Nuclear or hazardous substances being released to the environment exceeding regulatory limits (including public exposure) or that results in significant impact to the environment. | <p>Incident that results in, or has reasonable potential to have, a significant or moderate impact or extensive future remediation.</p> <p>Examples:</p> <ul style="list-style-type: none"> ▪ impairment of ecosystem functions ▪ effluent licence limit exceedance ▪ spill into fish bearing water ▪ fish kill |
| Medium | Nuclear or hazardous substances being released to the environment exceeding action levels (including public exposure) or that result in impact to the environment outside the licensing basis. | <p>Incident that results in, or has reasonable potential to have, a minor impact or that requires some future remediation.</p> <p>Examples:</p> <ul style="list-style-type: none"> ▪ effluent action level exceedance ▪ spills to environment (including atmosphere) with short-term or seasonal impacts |
| Low | Release of hazardous or nuclear substances to the environment below regulatory limits. | <p>Incident that results in, or has reasonable potential to have, a negligible impact.</p> <p>Examples:</p> <ul style="list-style-type: none"> ▪ effluent administrative level-exceedance ▪ spills to environment (including atmosphere) with no future impacts |

K. LOST-TIME INJURIES

A lost-time injury (LTI) is a workplace injury that results in the worker being unable to return to work for a period of time. Table K-1 outlines the LTI's reported in the 2022 reporting period at the 5 operating uranium mines and mills. Table K-2 lists the rating definitions.

Table K-1: Uranium mines and mills – Lost-time injuries (LTIs), 2022

| Facility | Incident | Corrective action | Significance rating |
|---------------------------------|---|--|---------------------|
| Cigar Lake Operation | None | N/A | N/A |
| McArthur River Operation | None | N/A | N/A |
| Rabbit Lake Operation | October 17, 2022 – A worker struck their elbow against a retracted steel jack stand and developed an infection requiring medical treatment (antibiotics) that resulted in the employee being unable to work for 2 days. | Health professionals diagnosed the worker as having a ruptured or torn synovial sac at the elbow joint which resulted in fluid accumulation within their arm and infection. The worker was prescribed antibiotics and placed on bed rest to promote recovery. The worker returned to work on October 18, 2022. | Low |
| Key Lake Operation | An injury occurred on November 19, 2022 and was originally classed as a modified work injury. The classification of this event has been changed from a restricted work activity to a lost time event by Cameco, with days | Corrective actions/preventive measures in follow-up to this event included developing a new method to rotate the centrifuge manually (to eliminate the pinch point) and creating a work instruction for sheered pin replacement and how to manually | Medium |

| Facility | Incident | Corrective action | Significance rating |
|--|--|---|---------------------|
| | <p>lost beginning July 11, 2023.</p> <p>Workers had de-energized and isolated the yellowcake centrifuge to unplug the centrifuge.</p> <p>While manually turning the centrifuge by the drive belts, the worker's left ring-finger-tip was pinched between the belt and sheave.</p> <p>This caused a partial amputation of the tissue from the finger-tip to the base of the nail bed.</p> <p>The worker was wearing gloves at the time.</p> | <p>rotate the centrifuge.</p> | |
| <p>McClellan Lake Operation</p> | <p>February 27, 2022 – Worker inadvertently stepped into open sump (Approximately 4m deep)</p> | <p>Orano arranged a safety stand-down with workers to highlight the seriousness of the incident and to highlight important aspects of the Orano Safety Program. This included:</p> <ul style="list-style-type: none"> • Critical risk identification and control • Orano's Pathway to Safety – STOP, THINK, ACT • Safe work planning and permitting • Proactive safety measures such as inspections, safety improvement opportunities and | <p>Medium</p> |

| Facility | Incident | Corrective action | Significance rating |
|-------------------------------|---|--|---------------------|
| | | behavior-based observations. | |
| McClean Lake Operation | May 4, 2022 – While removing scaffolding, a worker stepped down off a 1-foot platform and rolled their ankle when stepping on a bolt. | Orano requires workers to continually assess hazards in the workplace. This incident was reviewed with workers to reinforce field level hazard assessment process with Orano’s Pathway to Safety – STOP, THINK, ACT. | Medium |
| McClean Lake Operation | September 27, 2022 – A worker was setting up lids and rings to prepare for packaging when they noticed three rings, weighing approximately 3 kg, were about to fall. The worker attempted to catch the lids before they fell which resulted in lower back pain. | The worker was assessed at the health centre at the site and subsequently left site for further medical assessment. Orano conducted an ergonomics assessment of the workstation for improvement. | Medium |

Table K-2: CNSC Conventional health and safety rating definitions

| Safety significance | Definition |
|---------------------|--------------------------------------|
| High | Fatality or serious injury |
| Medium | Serious injury or lost-time accident |
| Low | Minor injury |

L. ANNUAL RELEASES OF RADIONUCLIDES TO THE ENVIRONMENT

Introduction

Operating uranium mines and mills in northern Saskatchewan have process waters, which require capture, treatment and release through a final point of control. This appendix represents the total annual release of relevant radionuclides from these facilities from 2018 through 2022.

Releases for total uranium are reported as kilograms (kg) while releases of uranium-238 progeny are reported in megabecquerels (MBq).

CNSC staff have commenced publishing annual releases of radionuclides to the environment from nuclear facilities on the CNSC Open Government Portal.

Liquid releases to surface waters

The uranium mines and mills in northern Saskatchewan have process waters requiring interception, collection and treatment prior to release. Total uranium and a number of uranium-238 progeny are monitored at the operating uranium mines and mills in northern Saskatchewan. CNSC staff publish annual releases of radionuclides to the environment from nuclear facilities on the [CNSC Open Government Portal](#).

M. LIST OF INDIGENOUS NATIONS AND COMMUNITIES

List of Indigenous Nations and communities whose traditional and/or treaty territories are in proximity to the sites covered by this report:

Birch Narrows Dene Nation (BNDN)

English River First Nation (ERFN)

Lac La Ronge Indian Band (LLRIB)

Métis Nation-Saskatchewan (MN-S) (Northern Region I, Northern Region II and Northern Region III)

Pinehouse Kineepik Métis Local (KML)

Prince Albert Grand Council (PAGC)

Ya'thi Néné Lands and Resource Office (YNLR) who represents Black Lake Denesuliné First Nation, Fond-du-Lac Denesuliné First Nation, Hatchet Lake Denesuliné First Nation, Camsell Portage, Stony Rapids, Uranium City and Wollaston Lake

N. PARTICIPANT FUNDING RECIPIENTS FOR THE 2022 UMM REGULATORY OVERSIGHT REPORT

| Recipients |
|---------------------------------------|
| English River First Nation |
| Ya'thi Néné Lands and Resource Office |
| Nuclear Transparency Project |
| Kineepik Métis Local |

Further information on the CNSC's participant funding program can be found on the [CNSC Participant Funding Program website](#).

O. REGULATORY OVERSIGHT REPORT OUTREACH

The CNSC's Indigenous engagement practices are consistent with the principles of upholding the honour of the Crown and reconciliation. These practices include information sharing and funding support through the CNSC Participant Funding Program (CNSC PFP) to assist Indigenous peoples to meaningfully participate in Commission proceedings and ongoing regulatory activities.

CNSC staff held an outreach session to present an *Update on the Regulatory Oversight Report for Uranium Mines and Mills in Canada, 2021* to Indigenous Nations and communities on September 15, 2022 in Saskatoon, Saskatchewan as described in the agenda listed below. The outreach session was well attended and supported both in-person participation and virtual participation.

Canadian Nuclear Safety Commission
Update on *Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2021*
September 15, 2022 – 9:00 AM – 4:00 PM (CST)
Hilton Garden Inn, 90-22nd Street East, Saskatoon
Garden South/Center Room
 Coffee and snacks available 8:30-9:00

- | | |
|--|-------------------------|
| 1. Opening | 9:00 – 9:30 am |
| <ul style="list-style-type: none"> • Prayer (Elder, Norman Wolverine) • Welcome (Mr. Patrick Burton, CNSC) • Introductions (All) | |
| 2. 2021 Uranium Mines and Mills Regulatory Oversight Report | 9:30 – 10:30 am |
| <ul style="list-style-type: none"> • CNSC presentation, including site updates on McArthur River, Key Lake, Cigar Lake, McClean Lake and Rabbit Lake • Question and answer period | |
| <i>Coffee/Health Break</i> | 10:30 – 11:00 am |
| 3. Other Sites of Interest | 11:00 – 12:00 pm |
| <ul style="list-style-type: none"> • CNSC presentation, including site updates on Gunnar, Lorado, Cluff Lake, Beaverlodge, NexGen's Rook-I, and Denison's Wheeler River • Question and answer Period | |
| <i>Lunch (provided)</i> | 12:00 - 1:00 pm |
| 4. Energy and Resources - Institutional Control Program | 1:00 - 1:30 pm |
| 5. Canadian Uranium Workers Study, (Dr. Rachel Lane, CNSC) | 1:30 - 2:00 pm |

-
- | | |
|---|-----------------------|
| <i>Coffee/Health Break</i> | 2:00 - 2:30 pm |
| 6. CNSC's Independent Environmental Monitoring Program 2:50 pm | 2:30 - |
| 7. EARMP – 10 years (Mr. Ryan Froess, CNSC) | 2:50 - 3:15 pm |
| 8. Country foods Presentation (Dr. James Irvine) | 3:15 - 3:45 pm |
| 9. Closing | 3:45 - 4:00 pm |
- Question and answer
 - Closing remarks (Patrick Burton, any others who wish to provide remarks)
 - Closing Prayer (Elder – YNLR)

P. REGULATORY OVERSIGHT REPORT 2021 DASHBOARD

Regulatory Oversight Report (ROR)

Dashboard of Uranium Mines & Mills: 2021

This dashboard reports on the safety performance of active Uranium Mine & Mill (UMM) sites and the efforts of the Canadian Nuclear Safety Commission (CNSC) to ensure the safety and protection of people and the environment around these sites in 2021.
For the full ROR (CMD 22-M36) and associated documents, please scan this QR code.



CMD 22-M36

2021 Site Status

X = Operational Site
X = Site in Temporary Shutdown



7

CNSC Inspectors

dedicated to UMM sites

17

CNSC Subject Matter Experts

With direct regulatory effort at UMM sites

Regulatory Conclusion

CNSC staff conclude that all UMM sites operated safely in 2021

3 areas of focus in the ROR

1



Environmental protection

2



Radiation protection

3



Conventional health & safety

Events

- ## 0

 Radiological Action Level Exceedances
- ## 12

 Environmental Action Level Exceedances
- ## 15

 Reportable Releases to the Environment
- ## 5

 Lost-Time Injuries

6,465 hours

Compliance work



3,712 hours

Licensing work

For more information on CNSC regulatory efforts regarding uranium mines and mills in Canada scan this QR code to visit our website



Activities

- ## 12

 CNSC Compliance Inspections
- ## 15

 CNSC Notices of Non-Compliance (NNCs)

All NNCs and Events were considered low-risk and did not have an impact on safety at UMM sites

Maximum doses

- Regulatory limit
- Effective dose

The Public

Doses to the public from all active mines and mills are negligible. These doses are well below the regulatory limit of 1 mSv/y.

Nuclear energy workers (NEWs)

6.03mSv

50 mSv/yr

The maximum effective dose received by a NEW in 2021 across UMM sites was at Cigar Lake

Public Outreach & Indigenous Engagement

CNSC staff worked with Indigenous Nations and communities to identify opportunities for formalized and regular engagement throughout the lifecycle of UMM sites. Most of the engagement and consultation in 2021 occurred via remote means due to public health recommendations related to COVID-19.

Independent Environmental Monitoring Program (IEMP)

IEMP sampling campaigns were conducted at 2 UMM sites in 2021: Key Lake and McArthur River. Analysis of samples indicates that the environment is protected. Scan this QR code to see the data.



e-Doc 6993702 (WORD)
e-Doc 7117524 (PDF)

- 171 -

12 September 2023

Q. LINKS TO WEBSITES

[Ambient Air Quality Criteria, Ontario Ministry of the Environment, Conservation and Parks](#)

[Canadian Environmental Quality Guidelines](#)

[Cameco Corporation](#)

[Cameco Corporation – Cigar Lake Operation](#)

[Cameco Corporation – McArthur River/Key Lake Operations](#)

[Cameco Corporation – Rabbit Lake Operation](#)

[CNSC Financial Guarantees](#)

[CNSC Fact Sheet on natural background radiation](#)

[CNSC Environmental Protection Reviews](#)

[CNSC Environmental Protection Review Report: Cluff Lake Project](#)

[CNSC Environmental Protection Review Report: Key Lake Operation](#)

[CNSC Environmental Protection Review Report: McArthur River Operation](#)

[CNSC Environmental Protection Review Report: Rabbit Lake Operation](#)

[CNSC Independent Environmental Monitoring Program](#)

[CNSC Independent Environmental Monitoring Program: Rabbit Lake Operation](#)

[CNSC Indigenous Engagement](#)

[CNSC Open Government Portal](#)

[CNSC Participant Funding Program](#)

[Eastern Athabasca Regional Monitoring Program](#)

[National Pollutant Release Inventory](#)

[Northern Saskatchewan Environmental Quality Committee](#)

[Orano Canada Inc.](#)

[Orano Canada Inc. – McClean Lake Operation](#)

[Saskatchewan Environmental Quality Guidelines](#)

[Saskatchewan Mining Association](#)

R. ACRONYMS

| | |
|-------------------|---|
| AAR | After Action Report |
| ALARA | As Low As Reasonably Achievable |
| ALPC | Athabasca Lands and Protection Committee |
| AREVA | AREVA Resources Canada Inc. (now Orano Canada Inc.) |
| BE | Below Expectations |
| Bq/L | Becquerels per liter |
| Bq/m ³ | Becquerels per cubic meter |
| Cameco | Cameco Corporation |
| CA | Complementary Access |
| CAP | Corrective Action Plan |
| CCD | counter current decantation |
| CCME | Canadian Council of Ministers of the Environment |
| CMD | Commission Member Document |
| CNSC | Canadian Nuclear Safety Commission |
| COPC | Contaminants of Potential Concern |
| CSA | Canadian Standards Association |
| CVC | Compliance Verification Criteria |
| DTMF | Deilmann Tailings Management Facility |
| EARMP | Eastern Athabasca Regional Monitoring Program |
| EBRL | Environmentally Based Reference Level |
| ECCC | Environment and Climate Change Canada |
| EP | Emergency Preparedness |
| EPR | Environmental Protection Report |
| EQC | Environmental Quality Committee |
| ERA | Environmental Risk Assessment |
| ERFN | English River First Nation |
| FS | Fully Satisfactory |
| HHRA | Human Health Risk Assessment |
| IAEA | International Atomic Energy Agency |
| ICRP | International Commission on Radiological Protection |
| IEMP | Independent Environmental Monitoring Program |

| | |
|--------|--|
| JEB | John Everett Bates |
| Kg | Kilograms |
| KLM | Kineepik Métis Local |
| LCH | Licence Conditions Handbook |
| LLRD | Long-lived Radioactive Dust |
| LTI | Lost-Time Injury |
| MAP | Minerals and Products |
| mASL | Meters Above Sea Level |
| MBq | megabecquerels |
| MDMER | <i>Metal and Diamond Mining Effluent Regulations</i> |
| mg/L | milligram per litre |
| Mkg | Million kilograms |
| mSv | Millisievert |
| mSv/hr | Macrosievert per hour |
| NEW | Nuclear Energy Worker |
| NSCA | <i>Nuclear Safety and Control Act</i> |
| NPRI | <i>National Pollutant Release Inventory</i> |
| NTP | Nuclear Transparency Project |
| Orano | Orano Canada Inc. |
| OSLD | optically stimulated luminescence dosimeter |
| p-mSv | Person-millisieverts |
| PAD | Personal Alpha Dosimeter |
| PFP | Participant Funding Program |
| PIDP | public information and disclosure program |
| REGDOC | Regulatory Document |
| RIB | Regulatory Information Bank |
| RnG | Radon Gas |
| RnP | Radon Progeny |
| ROR | Regulatory Oversight Report |
| SA | Satisfactory |
| SABRE | Surface Access Borehole Resource Extraction |
| SCA | Safety and Control Area |
| SMA | Saskatchewan Mining Association |

| | |
|-----------------|--|
| SO ₂ | Sulphur Dioxide |
| SRC | Saskatchewan Research Council |
| TID-EP | Technical Information Document – Environmental Performance |
| TMF | Tailings Management Facility |
| TRIR | Total Recordable Incident Rate |
| TSP | Total Suspended Particulate |
| TSS | Total Suspended Solids |
| U | Uranium |
| UA | Unacceptable |
| UMM | Uranium Mines and Mills |
| UMMD | Uranium Mines and Mills Division |
| WTP | Water Treatment Plant |
| YNLR | Ya’Thi Nene Lands and Resource |

S. SUMMARY OF ENGAGEMENT IN RELATION TO CNSC'S TERMS OF REFERENCE FOR LONG-TERM ENGAGEMENT AND ASSOCIATED WORKPLANS IN 2022

As committed to with the Ya'Thi Nene Lands and Resource Office (YNLR) as part of the Terms of Reference (ToR) for long-term engagement agreed between YNLR and the CNSC, the update below was prepared in collaboration with representatives from YNLR's seven Athabasca communities including Black Lake Denesų́liné First Nation, Hatchet Lake Denesų́liné First Nation, Fond du Lac Denesų́liné First Nation, the Northern Hamlet of Stony Rapids, the Northern Settlement of Camsell Portage, the Northern Settlement of Uranium City and the Northern Settlement of Wollaston Lake.

In December of 2021, CNSC staff and YNLR representatives started discussions to establish a formal long-term relationship with the YNLR, and a ToR was signed in July of 2022. This ToR enables YNLR to receive funding to participate in consultation and engagement activities throughout the year and provides a formalized structure for ongoing dialogue on CNSC-regulated facilities and activities of interest in the YNLR traditional and treaty territories.

As committed to with YNLR as part of the ToR the update below was prepared in collaboration with the YNLR staff and the Athabasca Lands and Protection Committee (ALPC) representatives who are members of the YNLR Working Group. The ALPC is made up of 8 appointed community members from three Denesų́liné First Nations (Hatchet Lake, Fond du Lac and Black Lake) and four communities (Uranium City, Camsell Portage, Stony Rapids, and Wollaston Lake) who report back to the communities and their leadership. The Executive Director of YNLR also participates in the Working Group along with CNSC representatives, other YNLR staff and invited guests.

In addition, an annual engagement work plan was developed between the CNSC and YNLR that provides information on the scope of work, detailed activities, and general timelines associated with work items for collaboration and engagement.

YNLR and CNSC staff have agreed to meet quarterly to advance work plan items and shared priorities. In September 2022, YNLR and CNSC staff held the first quarterly ToR meeting in person in Saskatoon. Through these meetings and interactions, YNLR and the CNSC have developed a positive working relationship based on open communication, two-way dialogue and actions.

The 2022 engagement work plan included:

- ToR maintenance and updates
- Collaborative annual reporting to the Commission and to the elected leadership of the seven Athabasca communities.
- Enhanced two-way information sharing and communication between the CNSC and YNLR community members
- Engagement and Participation in the CNSC's Independent Environmental Monitoring Program (IEMP) in northern Saskatchewan

- Updates and discussions on specific projects on Uranium Mines and Mills (UMM) facilities of interest and upcoming licenses activities including operating, decommissioned, and any proposed CNSC regulated projects in northern Saskatchewan.
- Communications on other topics and opportunities (i.e., regulatory document updates, feedback on UMM ROR, Health studies, CNSC compliance activities, [CNSC PFP](#) opportunities)

The facilities of interest in the workplan directly related to the Uranium Mines and Mills Regulatory Oversight Report of 2022 include the following: Rabbit Lake, Cigar Lake, McClean Lake, Key Lake, and the McArthur River Operations.

Other topics of discussion included historic and decommissioned sites located in the Athabasca basin including the former Gunnar mine site and the former Lorado mill site both being licensed to the Saskatchewan Research Council, the Beaverlodge properties licensed to Cameco, as well as the Cluff Lake Operation, which was licensed to Orano, but for which the licence was revoked by the Commission in 2023. Other topics of discussion have also included consultation and engagement activities with regards to the ongoing CEAA 2012 EAs of interest to YNLR, including NexGen's Rook I Project and Denison's Wheeler River Project, which are outside the scope of the 2022 UMM ROR.

In 2022, CNSC staff and YNLR collaborated together on the IEMP sampling campaign at the Rabbit Lake Operation in Treaty 10 territory. In September of 2022, a YNLR Community Land Technician (CLT) participated in a weeklong IEMP sampling campaign around the Rabbit Lake Operation. Having a YNLR CLT participate directly in the sampling campaign with CNSC staff contributed to a better understanding of the IEMP, of sampling methods and improves input into sampling activities and plans by including YNLR species of interest, valued components, knowledge and sampling locations of interest and importance to local Elders and land users.

In addition, CNSC staff conducted a number of in-person engagement activities in YNLR communities including:

- In October of 2022, CNSC staff attended an in-person meeting with YNLR that took place in Hatchet Lake, Saskatchewan. This tour provided an opportunity for senior CNSC staff to engage directly with the community members of Hatchet Lake Denesūłiné First Nation and Chief and Council on Cameco's 2023 license renewal for Key Lake, McArthur River and Rabbit Lake Operations and have a discussion on longer license terms being proposed.
- In November of 2022, CNSC staff travelled to six of the seven YNLR communities (Uranium City, Black Lake, Fond du Lac, Stony Rapids and Wollaston/Hatchet Lake) and participated in meetings with the community and leadership to engage on Cameco's 2023 license renewals for Key Lake, McArthur River and Rabbit Lake facilities.

CNSC staff and YNLR do not agree on all topics of discussion. However, both parties are interested in strengthening the relationship through on-going respectful dialogue to share knowledge, information on culture, history and perspectives that help CNSC staff and YNLR learn from each other. The activities completed in 2022 have been beneficial for

building the relationship and advancing project-specific discussions. CNSC staff and YNLR look forward to continuing the collaborative work and continuing to strengthen the relationship in 2023.

T. SUMMARY TABLE OF THE STATUS OF ISSUES, CONCERNS AND REQUESTS FROM INDIGENOUS INTERVENORS IN THE 2021 UMM ROR

In response to the Commission's action outlined in the [Minutes of the CNSC Meeting on CMD 22-M29 to CMD 22-M34, CMD22-M37, and CMD 22-M40 to CMD 22-M42, held on November 1, 2, and 3, 2022](#) for CNSC ROB and ISRD staff to work towards the transparent resolution of intervenor recommendations, and where comments and recommendations are made by Indigenous Nations and communities, the Commission expects CNSC staff to provide an update to the Commission on whether and how such recommendations have been, or will be, addressed, including where there are disagreements CNSC staff has established an internal CNSC issues, concerns, and comments tracking table for each intervening Indigenous Nation or community in the 2021 UMM ROR to track and organize the requests concerns and comments submitted in their interventions. These tables also summarize and track CNSC's efforts to respond to and address intervenor requests concerns and comments, where feasible. In the 2021 UMM ROR hearing, the Commission noted the concerns raised by several intervenors that comments and recommendations made regarding past RORs had not been addressed directly by CNSC staff. As a result, the Commission expects to be updated on the status of CNSC staff's efforts to address and track intervenor recommendations across all RORs, including the UMM ROR, moving forward. The Commission has directed CNSC staff to provide an update on whether and how comments and recommendations made by Indigenous Nations and communities in particular have been, or will be, addressed, including where there are disagreements.

The purpose of this appendix is to provide a summary of information and data from CNSC's internal tracking process to the Commission. The tables below provide an overview of the issues raised in the interventions in relation to the previous year's ROR, and the proposed path forward to address them. Table A outlines the number of specific issues and concerns raised by each intervenor and their related themes, as well as CNSC responses and proposed path forward. Table B provides an overview of the key thematic categories raised by each intervenor and the total number of times each theme or topic was raised by intervenors in their interventions. Tracking this thematic information will provide a baseline to help direct CNSC staff's focus to areas that raise the most concerns. This is a new ROR initiative and will continue taking shape moving forward as CNSC staff begin tracking trends in intervention topics and track progress with Indigenous Nations and communities as well as repeat public intervenors.

The following table provides details regarding the number of specific issues and concerns raised in the interventions by Indigenous Nations and communities in relation to the 2021 UMM ROR, the number of thematic categories the issues and concerns are grouped by, and the status of the CNSC's approach to responding to and addressing each issue, concern or request raised in the interventions to date.

CNSC staff are committed to responding to and following up with intervenors with regards to their interventions and working collaboratively to identify options for a path forward to address the comments, where possible. For Indigenous Nations and communities that have a ToR for long-term engagement with the CNSC, requests, concerns and comments raised in relation to the ROR have been integrated into the engagement work plan and regular meetings with each Indigenous Nation or community, including sharing the specific issues and concerns tracking table with each Indigenous Nation and community in order to verify the data and discuss a path forward for meaningfully addressing their comments.

In addition, CNSC staff have also followed up with Indigenous Nations and communities who the CNSC does not currently have a ToR for long-term engagement with, in order to follow up on or set a path forward on their comments and issues.

Table A. Issues and Concerns Raised in Interventions from Indigenous Nations and Communities from the 2021 UMM ROR Tracking and Response Table

| 2021 UMM ROR Interventions from Indigenous Nations and Communities | The number of requests/ Concerns/ Comments Raised in the intervention for the 2021 ROR | Requests/ Concerns/ Comments Responded to by CNSC staff* | Notes |
|---|---|---|--|
| English River First Nation (ERFN) | 5 (falling within 4 main subjects/categories) | 5 | The issues, concerns and recommendations raised by ERFN in their intervention for the 2021 UMM ROR are being addressed and discussed with ERFN through an issues tracking table and regular monthly meetings. In addition, CNSC staff reached out to ERFN to start drafting a long-term ToR which would include a workplan to address concerns raised by ERFN. A draft of this is currently under review by ERFN. CNSC staff look forward to hearing back from ERFN with regards to working towards finalizing a ToR for long-term engagement, developing a workplan and prioritizing discussions on addressing their comments, concerns and recommendations. Examples of the themes, issues raised by ERFN |

| | | | |
|---|--|---|---|
| | | | <p>are spills and non-compliances, environmental protection, safety and lost time injuries, and CNSC oversight activities and inspections.</p> <p>ERFN also included issues and concerns raised for Cameco and Orano and those have been addressed by both licensees.</p> |
| Kineepik Métis Local (KML) | 4 (falling within 3 main subjects/categories) | 4 | <p>The issues, concerns and recommendations raised by KML in their intervention for the 2021 UMM ROR are being addressed and discussed with KML based on an issues tracking table and regular monthly meetings. CNSC is committed to working with KML to address each topic to the greatest extent possible.</p> <p>In addition, CNSC has offered KML a ToR for long-term engagement to continue to work through the concerns that KML has. KML has responded that they are pleased with the relationship they currently have with the CNSC and want to continue the monthly meetings. KML may be interested in signing a long-term ToR in the future. Examples of the themes, issues raised by KML are consultation and engagement, economic development and Indigenous knowledge, language and culture.</p> |
| Ya'thi Néné Lands and Resource Office (YNLR) | 6 (falling within 6 main subjects/categories) | 6 | <p>The issues, concerns and recommendations raised by YNLR in their intervention for the 2021 UMM ROR are being addressed and discussed with YNLR through an issues tracking table and quarterly meetings as part of the ToR between the CNSC and YNLR signed in 2022. This includes a workplan that was developed by both CNSC staff and YNLR where we discuss current projects, proposed projects and issues and concerns that YNLR may have. Example of the themes, issues raised by YNLR are spills and non-</p> |

| | | | |
|--|--|--|--|
| | | | compliances, longer licensing, cumulative impacts, improvement to the ROR process and ROR content, historic and decommissioned sites and environmental monitoring. |
|--|--|--|--|

**“Responded to” refers to the number of requests/concerns/comments that CNSC staff have provided dispositions to, responded to directly, or have made requests with intervenors to have a specific meeting and discussions to address their concerns, comments and recommendations. See notes column for more details.*

Engagement with Other Public Intervenors

CNSC staff are committed to engaging with the public and learning more about their values, issues and concerns. Repeat public intervenors, including individuals and civil society organizations, have been reached out to, to follow up on their issues, concerns, and recommendations. This is being facilitated through existing opportunities for engagement and individualized bilateral meetings – the first of which have either been offered or already taken place.

Table B. Key Themes Raised by Intervenors

The following table provides an overview of the key thematic categories raised in the interventions in relation to the 2021 UMM ROR and the number of times each theme or topic was raised in total across all interventions that had concerns. In total for 2021 UMM ROR, there were 4 intervenors that raised concerns in the categories outlined below. The categories included in Table B have been ordered from most frequently raised to least. The thematic categories are derived from the review of the 2021 interventions and CNSC staff’s analysis of the issues and topics raised.

CNSC staff are committed to continuing to follow up and work with each intervenor in Table A, as well as other repeat individuals and civil society organizations who intervened to continue discussions on how best to address these themes and areas of interest identified in their interventions.

Table B – Key Themes Raised by Intervenors

| Requests/Concerns/ Comments Category in the intervention for the 2021 UMM ROR | Total number of times the topic was raised across interventions in relation to the 2021 UMM ROR | Total Number of Intervenors who raised the topic in their intervention |
|---|--|---|
| Improvements to the ROR process and ROR content (e.g. requests related to: improving accessibility, providing additional information or clarification in specific sections of the report, providing information about the performance rating system, improving the format of the report and improving the ROR engagement session) | 5 | 2 |
| CNSC Oversight Activities and Inspections (e.g. concerns about potential gaps in the CNSC's oversight, questions regarding CNSC inspections and questions about the approach to and conclusions made in relation to oversight activities) | 4 | 2 |
| Spills and Non-compliances (e.g. concerns regarding information on spills, notifying the community in the case of an emergency and concerns about the environmental impact when spills occur) | 3 | 2 |
| Environmental Monitoring (e.g. requests to be included in the development of monitoring plans and for additional monitoring to occur) | 2 | 2 |
| Environmental Protection (e.g. concerns around protecting the environment for future generations and traditional activities) | 1 | 1 |
| Indigenous Knowledge, language, and culture (e.g. ensuring that Indigenous | 1 | 1 |

| | | |
|---|---|---|
| knowledge, language and culture is both incorporated as well as protected) | | |
| Economic Development (e.g. requests to ensure that the communities have equal economic opportunities) | 1 | 1 |
| Cumulative impacts (e.g. concerns regarding the uptake of mining in northern Saskatchewan and the cumulative impacts that may occur in the future) | 1 | 1 |
| Historic and decommissioned sites (e.g. concerns regarding legacy mining sites in northern Saskatchewan) | 1 | 1 |
| Longer licensing (e.g. concerns around requests for longer licenses for current mining operations in northern Saskatchewan) | 1 | 1 |
| Safety and Lost time injuries (e.g. concerns regarding safety of employees on site and how to minimize lost time injuries) | 1 | 1 |
| CNSC's Indigenous Consultation and Engagement (e.g. concerns regarding UNDRIP and how it is being considered in consultation and engagement activities) | 1 | 1 |

Conclusion

CNSC staff take the issues and concerns raised by intervenors seriously and are working with each intervenor identified in Table A who has raised issues and concerns on identifying approaches to addressing the different topic areas, requests and comments raised, as appropriate. Furthermore, the CNSC is committed to continuously improving the quality of data included in RORs, and the ROR reporting process. CNSC acknowledges that the two main themes of issues raised in the 2021 UMM ROR were “improvements to the ROR process and ROR content, and CNSC oversight activities and inspections”, and has made it a priority to further discuss and address these issues, where feasible. As part of this commitment, CNSC staff have

included annexes in all 2022 RORs with information on the issues and concerns raised by intervenors and the status of the CNSC's work to follow-up, respond to and address each intervention as appropriate, and are working towards the continued expansion and enhancement of reporting to the Commission on issues tracking and engagement efforts.

The CNSC is dedicated to continuous improvement, and actively works to identify meaningful ways and approaches for addressing the concerns, comments and recommendations made by intervenors identified in the 2021 UMM ROR, where appropriate. In instances where issues and concerns are raised that the CNSC and the intervenor may disagree, the CNSC is open to having dialogue and working towards finding solutions and building consensus around key issues within the CNSC's mandate and authority.