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A Licence Renewal

Cameco Corporation

Cigar Lake Operation

Commission Public Hearing

Scheduled for:

April 28 and 29, 2021

Submitted by:

CNSC Staff

Un renouvellement de permis

Cameco Corporation

Établissement de Cigar Lake

Audience publique de la Commission

Prévue le :

28 et 29 avril 2021

Soumise par :

Le personnel de la CCSN

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Summary

This CMD presents information about the following matters of regulatory interest with respect to Cameco Corporation's Cigar Lake Operation:

- CNSC staff's review and assessment of Cameco's application for, and recommendation regarding, the renewal of uranium mine licence UML-MINE-CIGAR.01/2021

CNSC staff recommend the Commission take the following actions:

- Renew the uranium mine licence to authorize Cameco to operate the Cigar Lake Operation until June 30, 2031
- Issue the proposed licence, UML-MINE-CIGAR.00/2031
- Authorize the delegation of authority as set out in this CMD

The following items are attached:

- Current licence UML-MINE-CIGAR.01/2021
- Proposed licence changes
- Proposed licence UML-MINE-CIGAR.00/2031
- Proposed licence conditions handbook
- Environmental Protection Review Report

Résumé

Le présent CMD présente de l'information sur un ensemble de questions d'ordre réglementaire concernant l'établissement de Cigar Lake de Cameco Corporation :

- L'examen, l'évaluation et les recommandations du personnel de la CCSN concernant la demande de renouvellement du permis de mine d'uranium UML-MINE-CIGAR.01/2021de Cameco

La Commission pourrait considérer prendre les mesures suivantes :

- Renouveler le permis de mine d'uranium afin d'autoriser Cameco à exploiter l'établissement de Cigar Lake jusqu'au 30 juin 2031
- Délivrer le permis proposé, UML-MINE-CIGAR.00/2031
- Autoriser la délégation d'autorité telle que définie dans le présent CMD

Les pièces suivantes sont jointes :

- Le permis actuel, UML-MINE-CIGAR.01/2021
- Les modifications proposées au permis
- Le permis proposé, UML-MINE-CIGAR.00/2031
- L'ébauche du manuel des conditions de permis
- Le Rapport d'examen de la protection de l'environnement

Signed/signé le

02 February 2021

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EXECUTIVE SUMMARY

Cameco Corporation (Cameco) is the operator of the Cigar Lake Operation (CLO). The Cigar Lake site was first issued a licence under the *Atomic Energy Control Act* in August 1991 and since that time has been issued licences under the *Nuclear Safety and Control Act*. The initial Canadian Nuclear Safety Commission (CNSC) licence authorizing operation at the CLO was issued to Cameco on August 1, 2004 for underground development and construction activities together with surface construction. The current licence, issued July 1, 2013 (amended on November 13, 2020), covered the period in which the project began full commercial operation.

This Commission Member Document presents CNSC staff's assessment, conclusions and recommendations in respect of Cameco's licence application. CNSC staff have evaluated the licensee's compliance with the requirements of the *Nuclear Safety and Control Act*, the *Uranium Mines and Mills Regulations* and other applicable regulations.

Licensed activities at the CLO were the subject of several federal and provincial environmental assessments conducted since the discovery of the ore body in the 1980's. These assessments concluded that, after taking mitigation measures into consideration, activities conducted at the CLO will not cause significant adverse environmental effects.

CNSC staff assessment of the licensee's regulatory performance concludes that the environmental and radiological risks remain low. Effluent quality and radiation doses are effectively controlled and kept well below regulatory limits. The conventional health and safety performance verifies risks are managed and activities are conducted safely.

Therefore, CNSC staff conclude that the proposed operation of the mine and associated facilities remains within the bounds and intent of the current licensing basis. CNSC staff further conclude that the licensee is qualified to carry out those activities, make adequate provisions for the protection of the environment, the health and safety of persons, and the maintenance of national security and measures required to implement international obligations to which Canada has agreed. CNSC staff recommend that the Commission:

- Renew the Uranium Mine Licence to authorize Cameco to operate the Cigar Lake Operation until June 30, 2031.
- Issue the proposed licence, UML-MINE-CIGAR.00/2031.
- Authorize the delegation of authority as set out in this CMD.

PART ONE

This Commission Member Document (CMD) is presented in two parts.

Part One includes:

1. an overview of the matter being presented
2. overall conclusions and overall recommendations
3. general discussion pertaining to the safety and control areas (SCAs) that are relevant to this submission
4. discussion about other matters of regulatory interest
5. addenda material that complements items 1 through 4.

Part Two provides all available information pertaining directly to the current and proposed licence, including:

1. proposed changes to the conditions, licensing period, or formatting of the current licence and licence conditions handbook
2. proposed licence, UML-MINE-CIGAR.00/2031
3. proposed licence conditions handbook
4. current licence, UML-MINE-CIGAR.01/2021.

1. OVERVIEW

1.1 Background

Operated by Cameco Corporation (Cameco), the Cigar Lake Operation (CLO) is a joint venture owned by Cameco (50%), Orano Canada Inc. (Orano) (37%), Idemitsu Canada Resources (8%) and Tokyo Electric Power Company (TEPCO) Resources Inc. (5%). The CLO is located approximately 660 kilometres north of Saskatoon, Saskatchewan (figure 1.1). The First Nations communities of Wollaston Lake and Hatchet Lake, the closest permanent communities, are located approximately 80 kilometres east of the facility.

Figure 1.1: Location map

Facilities and infrastructure at the CLO include an underground mine, freezing plants and associated freeze pads, ore processing and load out, water treatment, mine rock storage pads, temporary waste storage, warehouses, worker camp, office and administrative buildings. Figure 1.2 presents an aerial view of the CLO.

Figure 1.2: Aerial view of the Cigar Lake Operation

Source: Cameco Corporation

High-grade ore slurry from the CLO is transported approximately 70 kilometres by truck to Orano's McClean Lake Operation for processing into uranium concentrate (U_3O_8). All tailings derived from the processing of Cigar Lake ore is placed into the John Everett Bates (JEB) in-pit tailings management facility at McClean Lake. Potentially acid generating waste rock and mineralized waste rock, the result of mining operations, is temporarily stored on impermeable lined pads at the CLO. This waste rock will be disposed of into the purpose-designed Sue pit disposal facility at McClean Lake.

CLO has been an active site for about four decades. The subsurface mineralization was discovered in 1981; an exploration camp and airstrip was constructed to support the delineation of the deposit by surface drilling.

From 1987 to 1992, an underground test-mine was constructed to assess mining methods and to further establish the character of the ore body. Following test-mine work, the site was placed into care and maintenance for four years to determine the commercial viability of the deposit, and to conduct and submit environmental studies. A summary of past environmental assessments conducted for the CLO is provided in appendix E.

From 1996 to 2000, the proponent conducted further engineering studies and testing of mine-development equipment. Following this period, the facility again was placed into care and maintenance for two years as the owner assessed the feasibility to mine the deposit.

All operating uranium mines and mills in Canada are regulated at both the provincial and federal levels. At the provincial level, the Saskatchewan Ministry of Environment issues an Approval to Operate a Pollutant Control Facility Licence, and the Saskatchewan Ministry of Labour Relations and Workplace Safety conducts facility inspections. At the federal level, the Canadian Nuclear Safety Commission, Environment and Climate Change Canada, and Employment and Social Development Canada regulate uranium mines and mills. In addition, under the *Nuclear Safety and Control Act* (NSCA), uranium mines and mills are issued a CNSC licence (table 1.1).

Table 1.1: Cigar Lake licensing history

Hearing No.	Document Title	Date of Decision
2020-H108	**Record of Decision,** Cameco Corporation, Application for Acceptance of a Revised Financial Guarantee and Licence Modernization Amendment for Cameco Corporation's Cigar Lake Operation	November 13, 2020
2013-H-01	**Record of Proceedings,** Cameco Corporation – Application for the Renewal of the Licence for Cigar Lake Project	April 3, 2013
2009-H-05	**Record of Proceedings,** Cameco Corporation – Application to Renew the Cigar Lake Project Uranium Mine Construction Licence	November 6, 2009
2009-H-102	**Record of Proceedings,** Cameco Corporation – Application to Amend the Cigar Lake Project's Financial Guarantee	February 27, 2009
2008-H-114	**Record of Proceedings,** Cameco Corporation – Application to Amend Cigar Lake Project Uranium Mine Construction Licence	June 17, 2008
2008-H-102	**Record of Proceedings,** Cameco Corporation – Application to Amend the value of the financial guarantee for the Cigar Lake Project	March 28, 2008
2007-H-14	**Record of Proceedings,** Cameco Corporation – Application to Amend the Cigar Lake Project Uranium Mine Construction Licence	November 1, 2007
2004-H-09	**Record of Proceedings,** Cameco Corporation – Application for a licence to construct the mining and support facilities at the Cigar Lake Project	November 17, 2004
2004-H-16	**Record of Proceedings,** Cameco Corporation – Application for a licence to construct the mining and support facilities at the Cigar Lake Project	July 8, 2004

On July 8, 2004, the Commission issued a CNSC licence to Cameco to allow construction of uranium mining and support facilities at Cigar Lake. In preparation for actual mine construction, improvements to surface infrastructure and initiation of freezing around the ore body started. In 2004, work to commence development of the mine began for a target production date of 2007. During sinking of a second shaft to augment the existing shaft, groundwater inflow flooded the incomplete second shaft in April 2006. This inflow did not affect the underground mine workings as this shaft had not yet linked with the mine workings.

In October 2006, during mine development, another uncontrollable groundwater inflow flooded the mine. After sealing the October 2006 inflow source, a second inflow event occurred in 2008 during dewatering of the mine. The licensee allowed the mine to re-flood in order to identify and address the new inflow.

Once the 2008 inflow source was sealed, dewatering started again. Remediation efforts continued and re-entry was accomplished in 2010. From 2010 to 2014, mining infrastructure and underground processing circuits were subsequently constructed and commissioned to facilitate ore production. Full ore production started in 2015 and continued through 2020 with the exception of the period noted below. The CLO is authorized to produce 7.0 million kilograms (MKg) of uranium per year, and authorized to produce up to 9.25 MKg uranium per year (flex production). Production flexibility allows the licensee to recoup production shortfalls experienced throughout the mine operation. An increase above the authorized annual production rate of 7.0 MKg of uranium per year, or above the production flexibility of 9.25 MKg of uranium per year would require review by CNSC staff. Annual production for the CLO is shown in table 1.2.

Table 1.2: Mining production data, 2014–20

	2014	2015	2016	2017	2018	2019	2020*
Ore tonnage (Mkg/year)	3.32	26.1	37.27	36.49	43.06	46.09	11.02
Average ore grade mined (%U)	6.02	22.92	18.27	18.85	16.1	15.18	13.48
Uranium mined (Mkg U/year)	0.2	4.95	6.81	6.88	6.94	6.98	1.49
Authorized annual production/Flex Production Limit (Mkg U/year)	7.0/9.25	7.0/9.25	7.0/9.25	7.0/9.25	7.0/9.25	7.0/9.25	7.0/9.25

* The 2020 reporting period is January 1, 2020 to June 30, 2020.

As a response to the COVID-19 pandemic, Cameco temporarily suspended mining at the CLO and entered a state of controlled care and maintenance with the last shipment of ore slurry to McClean Lake on March 24, 2020. Cameco resumed operations at the CLO on September 1, 2020; the first shipment of ore was transported to the McClean Lake facility on September 16, 2020. Currently, the CLO continues normal operations while implementing protocols related to protecting workers against COVID-19 exposure.

Cameco's CLO is currently licensed by the CNSC to operate a uranium mine. The licence authorizes Cameco to:

a) *prepare a site for and construct, operate, modify and decommission a nuclear facility (hereinafter "the facility") for the milling of uranium ore at a site known as the Cigar Lake Operation in the province of Saskatchewan as shown on the drawing referenced in appendix A to this licence;*

b) *mine a nuclear substance (uranium ore);*

c) *possess, transfer, import, use, store, and dispose of nuclear substances; and*

d) possess, transfer, import, use prescribed equipment that is required for or associated with laboratory studies, field studies, fixed gauge usage and borehole logging devices in relation to (a) and (b).

Cameco has applied to the CNSC for a licence renewal to continue its current activities.

This Commission Member Document (CMD) provides CNSC staff's assessment of the programs and measures planned or in place to provide adequate provision for the protection of the environment, the health and safety of persons, the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

1.2 Highlights

Cameco's application for licence renewal of its Cigar Lake Operation

On November 18, 2019, Cameco submitted an application [1] for renewal of the CNSC licence for the CLO. The proposed mining operations are within CLO's current operating limits for mining of uranium. CNSC staff assessed all aspects of Cameco's application for the renewal of its CNSC licence, UML-MINE-CIGAR.00/2021, for a 10-year period.

CNSC staff assessment of Cameco's application

CNSC staff assessed Cameco's licence renewal application for mining operations at the CLO under subsection 24(4) of the NSCA. This assessment determined whether the CLO remains qualified to perform the activities to be authorized by the Commission.

In preparation for Cameco's application for the renewal of the CNSC-issued licence, CNSC staff held an information session for the Wollaston Post/Hatchet Lake First Nation communities in 2016, and information sessions at the Black Lake and Fond du Lac First Nations communities in 2017. These sessions included information on the CLO well in advance of the expected application for the licence renewal. As discussed in section 4.1, CNSC staff also participated in outreach sessions in September 2019 in Prince Albert, Saskatchewan and again in September 2020, and November 2020 via Zoom meetings. These outreach events provided opportunities for community members and Indigenous leadership to express any concerns related to Cameco's future CLO licence renewal request, including the proposed licence term.

Based on compliance verifications conducted at the CLO by CNSC staff during the January 1, 2013 to June 30, 2020 review period, CNSC staff have confirmed that Cameco continued to improve the management and safety performance of the facility. CNSC staff rated Cameco's performance at the CLO for all 14 safety and control areas (SCAs) as "satisfactory". Cameco's overall performance ratings of the CLO are presented in section 3.

Requested licence period

In Cameco's application to renew the CNSC-issued licence, a 10-year licence term was requested. CNSC has a standardized licence and licence conditions handbook (LCH) framework which provides for effective regulatory oversight of operating facilities. Cameco is required by its licence to report on the CLO compliance performance through annual compliance reports, including significant changes to its operations. CNSC staff verify compliance through desktop reviews, inspections and event reviews. In addition, CNSC staff report compliance performance of the CLO annually to the Commission in public meetings through the regulatory oversight reports for uranium mines and mills in Canada that ensures adequate oversight of the licensee. Therefore, CNSC staff recommend that the Commission accept Cameco's request for a 10-year licence for uranium mining at the CLO.

Financial Guarantee

On November 13, 2020, the Commission approved the application for an updated financial guarantee for the CLO in the amount of C$61.79 million [2].

1.3 Overall Conclusions

CNSC staff have concluded the following with respect to paragraphs 24(4)(*a*) and (*b*) of the NSCA, in that Cameco Corporation:

1. Is qualified to carry on the activity to be authorized by the licence.
2. Will, in carrying out that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

1.4 Overall Recommendations

CNSC staff recommend the following:

1. The Commission accept the conclusions of CNSC staff that Cameco is qualified to carry out the activities authorized by the uranium mine licence.
2. The Commission renew the uranium mine licence for the Cigar Lake Operation and issue the proposed licence, UML-MINE-CIGAR.00/2031.
3. Delegate authority as set out in section 4.10 of this CMD.

2. MATTERS FOR CONSIDERATION

2.1 Environmental Assessment

CNSC staff reviewed Cameco's licence renewal application in the context of the *Impact Assessment Act*. CNSC staff determined that the *Impact Assessment Act* does not apply because the activities proposed in the application are not captured in its associated *Physical Activities Regulations*.

CNSC staff conduct Environmental Protection Reviews (EPRs) for all licence applications with potential environmental interactions, in accordance with its mandate under the *NSCA* and associated regulations. For this licence renewal application, CNSC staff conducted an EPR to ensure the protection of the environment and the health of persons. CNSC staff's assessment included a review of Cameco's licence renewal application, supporting documents (i.e., Environmental Risk Assessment [ERA] and annual compliance monitoring reports), and past environmental performance. The EPR report, which contains the results of this assessment and a summary of past environmental assessments for the CLO, can be found in appendix E of this CMD.

Based on the EPR, CNSC staff have concluded that the environment (terrestrial, aquatic and air) around the CLO is adequately protected; Cameco has and will continue to implement and maintain an effective environmental protection program to adequately protect the environment and the health and safety of persons. Through ongoing licensing, compliance activities and reviews, CNSC staff will continue to verify and ensure that the environment and the health and safety of persons are protected, and will continue to be protected over the proposed licence period.

2.2 Relevant Safety and Control Areas (SCAs)

The functional areas of any licensed facility or activity consist of a standard set of safety and control areas (SCAs). Each SCA is comprised of "specific areas" of regulatory interest; however, the specific areas associated with each SCA vary between facility types. For further information regarding SCAs, see appendix D of this CMD.

In table 2.1, the risk ranking column indicates the overall level of risk associated with each SCA and the rating level indicates the overall compliance with regulatory requirements for implementation at the CLO. Appendix A provides additional information related to "Risk Ranking" and appendix B further defines the "Rating Levels".

Table 2.1: Safety and control areas relevant to the CLO

Functional Area	Safety and Control Area	Risk Ranking*	Rating Level**
Management	Management System	M	SA
	Human Performance Management	H	SA
	Operating Performance	H	SA
Facility and Equipment	Safety Analysis	M	SA
	Physical Design	H	SA
	Fitness for Service	H	SA
Core Control Processes	Radiation Protection	H	SA
	Conventional Health and Safety	H	SA
	Environmental Protection	H	SA
	Emergency Management and Fire Protection	H	SA
	Waste Management	H	SA
	Security	L	SA
	Safeguards and Non-Proliferation	L	SA
	Packaging and Transport	M	SA

* H = High; M = Moderate; L = Low; SA = Satisfactory

** Overall rating level for the current licence period (July 1, 2013 to June 30, 2020).

The risk rankings provided in table 2.1 are all relevant to this CMD.

2.3 Other Matters of Regulatory Interest

The following table identifies other matters that are relevant to this CMD.

Table 2.2: Other matters of regulatory interest

Area	Relevant to this CMD?
Indigenous Consultation	Yes
Other Consultation	Yes
Cost Recovery	Yes
Financial Guarantees	Yes
Improvement Plans and Significant Future Activities	Yes
Licensee's Public Information Program	Yes
Nuclear Liability Insurance	No

The relevant "other matters" of regulatory interest are discussed in section 4 of this CMD.

2.4 Regulatory and Technical Basis

The regulatory and technical basis for the matters discussed in this CMD arise directly from the *Uranium Mines and Mills Regulations* (UMMR) and the *General Nuclear Safety and Control Regulations* (GNSCR) as well as other regulatory requirements associated with the NSCA. Further information regarding the regulatory and technical basis for the matters discussed in this CMD are provided in appendix C of this document.

3. GENERAL ASSESSMENT OF SCAS

CNSC staff's assessments provided in the following sections are based on a comprehensive review of Cameco's past performance at the CLO and a thorough evaluation of the safety and control measures to be implemented for the next licence period. These areas are outlined in Cameco's licence application [1] and supporting documentation submitted for this application.

The CNSC implements a risk-informed approach in the regulation of nuclear facilities and activities. The depth of regulatory reviews of each SCA and the baseline frequency of regulatory compliance activities is informed by the risk ranking of that SCA (section 2.2, table 2.1).

CNSC staff provided continuous regulatory oversight at the CLO which consisted of licensing and compliance activities. The specific areas that comprise the SCAs for this facility or activity type are identified in section D.2 (appendix D). The assessment period referenced within this report is from January 1, 2013, to June 30, 2020.

3.1 Management System

Safe and reliable operation requires a commitment and adherence to a set of management system principles and, consistent with those principles, the establishment and implementation of processes that achieve the expected results. CSA standard N286-12, *Management System Requirements for Nuclear Facilities* contains the requirements for a management system for nuclear facilities and extends to all safety and control areas. The management system must satisfy the requirements set out in the NSCA, regulations made pursuant to the NSCA, the licence and the measures necessary to ensure that safety is of paramount consideration in implementation of the management system. An adequately established and implemented management system provides the evidence that the licensing basis remains valid.

The following specific areas that comprise this SCA are discussed as relevant to the licence renewal application including:

- management system and organization
- performance assessment, improvements and management review
- change management and records management
- contractor management program.

3.1.1 Trends

The following table indicates the overall rating trends for the management system SCA over the current licensing period:

TRENDS FOR MANAGEMENT SYSTEM							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation has a mature management system which continues to improve to meet evolving regulatory requirements. CNSC staff monitor implementation of the management system at the Cigar Lake Operation through compliance verification activities which includes desktop reviews and inspections. During the current licensing period, areas of improvement have been identified and implemented by Cameco. Cameco continues to have an effective management system and has taken proactive steps to review and incorporate the requirements of CSA standard N286-12, *Management System Requirements for Nuclear Facilities* into the Cigar Lake Operation management system.							

3.1.2 Discussion

Cameco has established a management system to oversee its CLO activities to assure the protection of the health and safety of workers, the public, and the environment. Cameco is also required to implement and maintain written operating procedures and carry out the licensed activities in accordance with the policies and programs for the purposes described in the licence renewal application. Cameco uses an integrated quality management system for the CLO that is comprised of management system policies, procedures, work instructions, forms, and other controlled documents (including reports and training manuals). CNSC staff monitored and evaluated the management system processes used for the licensed activities during the current licensing period.

Management system and organization

CNSC staff determined that the CLO has a management system that meets requirements as outlined in the LCH. CNSC staff regularly assess the compliance of CLO documents and programs through desktop reviews and planned compliance verification inspection activities.

Verification activities conducted throughout the licensing period included areas of maintenance, calibration, problem identification/resolution, change and design control, document and records control, procurement (specifically in the areas of inspection on receipt, vendor qualification, and storage and handling), the internal audit program, management self-assessments, and annual reviews. All inspection findings were of low risk significance.

CNSC staff evaluated the CLO's organizational structure. Personnel roles and responsibilities were also reviewed and are well defined and documented. CNSC staff's compliance verification conducted during the current licence period verified no issues concerning the licensee's organizational structure and individual responsibilities of positions with oversight on licensed activities.

Performance assessment, improvements and management review

The CLO management team conducts periodic management reviews to analyze the previous years' performance when compared with its plans, assess compliance with standards, assess the effectiveness of the CLO's management system and considers any trends. CNSC staff assessed these management reviews as part of compliance verification activities and found them acceptable.

CLO also conducts internal assessments to confirm conformance and effectiveness of its licensed programs and associated documentation. CLO completes internal assessments on a three-year frequency and tracks resulting actions. Over the current licence period, CNSC staff performed inspections on the CLO's internal assessment program and confirmed that the program met requirements.

Change management and records management

CLO's design and change control procedure ensures that changes are tested, reviewed and approved before implementation and that changes are controlled and carried out according to its change control documentation. Change control is a formal process used to ensure that changes to a product or system are introduced in a controlled and coordinated manner. The purpose of change control is to identify, evaluate, and control the risks associated with change.

CLO's records management process encompasses the control of documents, which includes the development, validation, approval of documents and the tracking of associated changes. CNSC staff confirmed that documents and procedures are available for use in the location of the activity, and outdated or expired documents are removed in a timely manner. Over the current licence period, CLO's change management program and records management program met CNSC requirements.

Contractor management program

Cameco's contractor management program ensures that all contract workers at the CLO comply with the same requirements as the licensee's permanent staff. In 2016, CNSC staff reviewed Cameco's contractor management program and carried out a focused management system inspection using LCH compliance verification criteria as inspection guidance. Only minor issues were identified for updating documentation to current practices. Additionally, CNSC staff verified aspects of Cameco's contractor management program during inspections in 2013, 2014 and 2020; no issues were identified. CNSC staff conclude that Cameco's performance in this area is satisfactory.

3.1.3 Summary

A summary of Cameco's past performance, challenges and proposed improvements at the CLO are presented in the following subsections.

3.1.3.1 Past Performance

Through review of Cameco's documentation and CNSC staff's regular compliance inspections, CNSC staff found that Cameco's performance in this area meets CNSC regulatory requirements. CNSC staff rated Cameco's performance for the management system SCA at the CLO as satisfactory during the 2013 to 2020 licence period.

3.1.3.2 Regulatory Focus

CNSC staff verified through inspections and desktop reviews that Cameco has implemented its management system in accordance with CNSC's regulatory requirements.

Management system criteria were included in 11 CNSC inspections during the licensing period.

Onsite verification activities conducted from 2013 to 2020 included areas of maintenance, calibration, problem identification/resolution, change and design control, document and records control, the internal audit program, management self-assessments, contractor management, work planning, work control, annual reviews, supply chain specific to receipt inspection, segregation of non-conforming parts, storage and handling. All inspection findings were of low risk significance.

In November 2016, a focused management system inspection was conducted at the CLO to verify implementation and effectiveness of Cameco's management system program. CNSC staff developed inspection criteria to assess selected components of the management system and mitigation measures identified by Cameco to manage risks to the operation. The inspection verified some low risk deficiencies that resulted in five non-compliances in the areas of design control/change control, independent and self-assessments, contractor management, and documentation related to non-conformances. As required by CNSC staff, Cameco provided an action plan to address the non-compliances. CNSC staff reviewed and confirmed that Cameco addressed the non-compliances in a timely and satisfactory manner.

Cameco is required to implement and maintain a management system in compliance with CSA standard N286-12, *Management System Requirements for Nuclear Facilities*. In 2019, CNSC staff performed a detailed desktop review of Cameco's Cigar Lake quality management program to determine the readiness for a transition to CSA N286-12. CNSC staff's current desktop review assessment is that Cameco's Cigar Lake Quality Management Program meets the requirements of CSA N286-12. Inspections throughout the proposed licence term are required to confirm the implementation of the CSA N286-12 requirements.

CNSC staff will continue to monitor Cameco's performance in this area through regulatory oversight activities including inspections and desktop reviews.

3.1.3.3 Proposed Improvements

In order to assess safety culture at the CLO, section 2 of CNSC's REGDOC-2.1.2 *Safety Culture* has been added to the Cigar Lake LCH, and will be implemented by the licensee in 2022. CNSC staff will conduct verification after it has been implemented. CNSC staff, as part of ongoing compliance activities, will review any proposed modifications to Cameco's management system documentation as it is adapted to conform to CSA N286-12.

3.1.4 Conclusion

CNSC staff conclude that Cameco met its regulatory requirements and has maintained and implemented a satisfactory management system program.

3.1.5 Recommendation

CNSC staff recommend that no changes to licence condition 1.1 are required and the condition should be retained.

3.2 Human Performance Management

The human performance management SCA 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.

This CMD covers the following specific area of human performance management:

- personnel training.

3.2.1 Trends

The following table indicates the overall rating trends for the human performance management SCA over the current licensing period:

TRENDS FOR HUMAN PERFORMANCE MANAGEMENT							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
CNSC staff consistently rated the human performance management SCA as satisfactory during the current licence period. Cameco has an acceptable training program and has improved performance through the implementation of a systematic approach to training (SAT) at the Cigar Lake Operation during the licensing period. Cameco continues to maintain and improve its training system and confirm implementation.							

3.2.2 Discussion

Systematic approach to training (SAT) is the framework endorsed by the CNSC for establishing and maintaining training for persons working in uranium mines and mills. The CNSC requires the licensee ensures that employees and contractors are trained and assessed to confirm that they have acquired and maintain the knowledge, skills, and competencies to safely perform their work assignments. Cameco has implemented a SAT framework to train its workers at the CLO.

Cameco reports to the CNSC annually on improvements to its training programs and training delivered to the CLO workers. CNSC staff review Cameco's adherence to its training plan and maintenance of training records through periodic routine compliance inspections.

CNSC's REGDOC-2.2.2, *Human Performance Management, Personnel Training*, updated in December 2016, defines the requirements for the development and implementation of a training system in a nuclear facility. It requires licensees to have a training system to systematically analyze, design, develop, implement, evaluate, document and manage training for persons working in a nuclear facility. REGDOC-2.2.2 is included as compliance verification criteria in the draft LCH, provided in Part Two of this CMD.

Cameco's revised management system included sections related to the training program and a suite of training procedures. In March 2015, CNSC staff conducted an inspection at the CLO to evaluate and verify compliance regarding Cameco's training program and its effective implementation. CNSC staff evaluated Cameco's training documentation to determine if regulatory requirements of the human performance management (training) SCA are met. CNSC staff concluded that Cameco is qualified to carry out its authorized licensed activities and CNSC staff are satisfied with the training system at the CLO.

3.2.3 Summary

A summary of Cameco's past performance, challenges and proposed improvements are presented in the following subsections.

3.2.3.1 Past Performance

Based on a comprehensive review of Cameco's updated training documentation, annual reports and routine compliance inspections, CNSC staff conclude that Cameco's performance for this area meets regulatory requirements. CNSC staff rated Cameco's overall performance for the human performance management SCA at the CLO as satisfactory for the current licence period. CNSC staff are also satisfied that Cameco has taken, and will continue to take, all appropriate corrective actions necessary to resolve any non-compliances that stem from inspections and document reviews conducted during the current licence period.

3.2.3.2 Regulatory Focus

During the licence period, human performance management criteria were included in six inspections conducted by CNSC staff.

Onsite compliance activities conducted from 2013 to 2020 included verification of the implementation of the systematic approach to training. All inspection findings were of low risk significance.

In March 2015, a focused human performance management inspection was conducted to verify implementation and effectiveness of the CLO's training program. The inspection identified three low risk administrative non-compliances associated with linkage between some of the SAT phases (i.e., analysis, design, development, implementation and evaluation) and the development of training documentation for worker re-qualification. All non-compliances have been addressed and are closed.

CNSC staff will continue to monitor performance in this area through routine regulatory oversight activities including inspections and desktop reviews.

3.2.3.3 Proposed Improvements

The compliance verification criteria for this SCA in the licence conditions handbook will be updated to include CNSC's REGDOC-2.2.2. There are no other proposed improvements for this SCA in the licence conditions handbook. For the current licence period, the performance rating for this SCA has been focused on the training program and its implementation.

As part of on-going compliance activities, CNSC staff will continue to review any proposed modifications to Cameco's training program.

3.2.4 Conclusion

CNSC staff conclude that Cameco met its regulatory requirements and has maintained and implemented a satisfactory human performance management program.

3.2.5 Recommendation

CNSC staff recommend the current licence condition for the human performance system SCA is sufficient and should be retained.

3.3 Operating Performance

The operating performance SCA includes an overall review of the conduct of the licensed activities and other activities that enable effective performance. The specific areas that comprise this SCA are not addressed individually in this document.

3.3.1 Trends

The following table indicates the overall rating trends for the operating performance SCA over the current licensing period:

TRENDS FOR OPERATING PERFORMANCE							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco has implemented and maintained operating performance systems at the Cigar Lake Operation that include construction, commissioning and operation of the facility in accordance with CNSC regulatory requirements. CNSC staff monitor implementation of this operating program through compliance verification activities, which includes desktop reviews and routine inspections. The operating performance SCA is a key compliance area and is included in the majority of CNSC staff inspections. CNSC staff's compliance activities verify that Cameco continues to improve its operating performance. Cameco's operating performance program at the Cigar Lake Operation continues to be effective and meet regulatory requirements.							

3.3.2 Discussion

The operating performance SCA requires that the licensee implement and maintain an operating performance program for the conduct of licensed activities. This SCA focuses on the conduct of operations and the controls that are in place to manage risks from licensed activities.

The CNSC expects Cameco to take all reasonable precautions to protect workers and to control the release of nuclear and hazardous substances into the environment during the conduct of activities. The necessary precautions include engineering and administrative controls to minimize risks. The CNSC expects the licensee to maintain the integrity of its facilities and to apply managed processes for operations and control.

During the licensed period, Cameco completed the rehabilitation of the flooded underground mine, resumed underground development, and commenced mining and transport of ore slurry to Orano's McClean Lake mill. As a result of the COVID-19 pandemic, the CLO was in a state of safe care and maintenance during the summer of 2020, resuming production in September 2020. CNSC staff confirmed throughout the licence period that Cameco operated the CLO in accordance with regulatory requirements. CNSC staff are satisfied with Cameco's programs, which provide adequate assurance that any modifications to the facility or its operation will remain within the licensing basis.

3.3.3 Summary

A summary of Cameco's past performance, challenges and proposed improvements are presented in the following subsections.

3.3.3.1 Past Performance

Cameco has operated the CLO in compliance with CNSC regulatory requirements during the licensing term and findings from inspections or desktop reviews were addressed in a timely manner. CNSC staff rate Cameco's overall performance for the operating performance SCA at the CLO as satisfactory for the current licence period.

3.3.3.2 Regulatory Focus

Cameco is required to report unplanned events at the CLO and take necessary corrective actions to improve safety and to prevent the recurrence of such events.

As identified in the attached draft LCH, and as reflected in CNSC's REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills*, Cameco is required to submit detailed reports on unplanned situations or events.

During the current licence period, events related to mine operations, lost time injuries, environmental spills, and radiation protection (RP) action levels exceedances were promptly reported to the CNSC and other relevant regulators including Saskatchewan Ministry of Environment (SMOE), Saskatchewan Ministry of Labour Relations and Workplace Safety (LRWS), and Environment and Climate Change Canada. All incidents were of medium or low safety significance. In addition, an event initial report was presented at the September 21, 2016 Commission meeting CMD 16-M58, *Worker injured due to animal attack at Cigar Lake uranium mine* [3] following a wolf attack on an employee at the CLO on August 29, 2016. Cameco's implemented measures to reduce potential reoccurrence of the event were assessed as satisfactory by the CNSC. CNSC staff verified that, in accordance with CNSC's REDGOC-3.2.1, *Public Information and Disclosure*, Cameco has continued to proactively disclose reportable events.

Table 3.1 lists the number of events reported to the CNSC by the licensee over the current licence period.

Table 3.1: Number of reported events, 2013-20

Year	2013	2014	2015	2016*	2017	2018	2019	2020**
Total number of events	6	4	14	7	5	12	3	0

* The 2016 data includes the animal attack initially reported in 2016, but only classified as an LTI in 2018.
** The 2020 reporting period is January 1, 2020 to June 30, 2020.

CNSC staff review all reported events to identify if there are any regulatory concerns and report significant events at public meetings of the Commission. Reported events include injuries, spills, and releases of hazardous substances to the environment. Details on each reported event is included in the regulatory oversight report on uranium mines and mills for the year in which the event occurred.

CNSC staff verified that Cameco conducted investigations into these reported events to determine probable causes and necessary corrective actions were taken by Cameco to prevent reoccurrences. CNSC staff confirmed that workers, the public and the environment continue to be safe. CNSC staff are satisfied with the CLO event reporting, investigation processes, and timely implementation of corrective actions and lessons learned to minimize and/or eliminate future recurrences.

CNSC staff will continue to monitor performance in this area through regulatory oversight activities including inspections and desktop reviews of CLO's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.3.3.3 Proposed Improvements

Improvements to operation, equipment and programs are identified on an ongoing basis and implemented as part of a process of continuous improvement. There are no other proposed improvements for this SCA.

3.3.4 Conclusion

During the current licence period, CNSC staff observed that Cameco has operated the CLO facility in compliance with the CNSC's regulatory requirements.

CNSC staff concluded that Cameco has maintained and satisfactorily implemented their operational performance program, and has made adequate provision for safe operation of the CLO.

3.3.5 Recommendation

CNSC staff recommend that the three licence conditions associated with this SCA be retained without change.

3.4 Safety Analysis

The safety analysis SCA covers the 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.

The specific area that comprises this SCA at the CLO addressed individually in this document is hazard analysis.

3.4.1 Trends

The following table indicates the overall rating trends for the safety analysis SCA over the current licensing period:

TRENDS FOR SAFETY ANALYSIS							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation has implemented and maintained a process to identify hazards and assessment of risks related to the protection of the environment and to the health and safety of workers and the public, as well as radiation protection. CNSC staff verify Cameco's implementation of the safety analysis SCA through inspections and desktop reviews. Cameco's safety analysis program continues to be effective in providing CNSC staff with an assessment of the proposed changes or modifications, identification and evaluation of risks and impacts, and proposed mitigation measures.							

3.4.2 Discussion

As a licensing requirement, Cameco must implement and maintain a process to identify and assess hazards and risks on an ongoing basis at the CLO. This includes identifying and evaluating new or unforeseen risks that were not considered at the planning and design stages and updating previous risk assessments by replacing important assumptions with performance data.

Hazard analysis

Hazard analysis provides an opportunity to identify and mitigate potential hazards to worker health and safety, and to the environment, to an acceptable level. These analyses are completed by workers and subject matter experts before the job begins. Cameco uses the following methods for identifying risks and hazards at the CLO as the jobs are being planned:

- risk assessment
- safe work plans.

Risk assessment

As per CNSC regulatory requirements, Cameco's CLO continues to maintain a register of hazards, risks and mitigation measures for the facility, which are reviewed and updated for the new projects, significant changes or modifications and non-routine tasks. Risk assessments are carried out to identify, manage, and reduce the potential of adverse risk. An assessment of controls is conducted as required and may be triggered by:

- predetermined need to re-evaluate a control
- changes to processes or facilities
- an incident
- an identified non-conformance
- following legislation/regulation changes
- following required actions as identified in investigations, inspections or by regulators.

Risks are mitigated with consideration to the following hierarchy:

- elimination
- substitution
- engineering controls
- signage/warnings and/or administrative controls
- personal protective equipment.

Safe work plans

Safe work plans are prepared for any work considered non-routine and high risk. The purpose of a safe work plan is to assess hazards specific to tasks, to ensure controls are developed and that all personnel understand the risks associated with the completion of the job. The safe work plan outlines the tasks and hazards involved, corrective actions, level of risk, training and personal protective equipment required. Safe work plans are to be reviewed and signed by all personnel working on the job.

Prior to implementing any significant change or modification to the facility, its operation or safety and control measures described in the documents provided to support the application, Cameco must provide the CNSC with an assessment of the proposed changes or modifications, identification and assessment of potential risks, impacts, proposed mitigation measures, and demonstrate that the changes meet the objective of the licensing basis.

Cameco has a change control process for the CLO that CNSC staff have reviewed and accepted. Changes to facility processes are completed through the CLO's change control process, which also includes a risk assessment requirement. CNSC staff conducted inspections and desktop reviews to confirm that safety analysis is also completed on an ongoing basis by Cameco's CLO on specific job requirements to assess all jobs of non-routine or complex nature. Through inspections, CNSC staff also verified that Cameco has the necessary safety analyses to plan, implement and monitor construction operations ensuring mitigation of risks to workers, the public and the environment have been conducted. A CNSC inspection conducted in March 2017 that included compliance verification criteria from the safety analysis SCA verified Cameco was in compliance.

3.4.3 Summary

A summary of Cameco's past performance, challenges and proposed improvements are presented in the following subsections.

3.4.3.1 Past Performance

Through CNSC staff's review of Cameco's CLO documentation, CNSC staff concluded that the safety analysis program meets requirements.

For the current licence period, CNSC staff rated Cameco's overall performance for the safety analysis SCA as satisfactory.

3.4.3.2 Regulatory Focus

CNSC staff conducted four inspections during the review period where compliance verification criteria related to the safety analysis SCA were assessed, including a focused inspection of the safety analysis SCA conducted in March 2017. The focused inspection concluded the licensee was in compliance with the criteria assessed and no enforcement actions were issued. CNSC staff will continue to monitor performance in this area through regulatory oversight activities, including inspections and desktop reviews of CLO's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.4.3.3 Proposed Improvements

There are no other proposed improvements for this SCA.

3.4.4 Conclusion

Based on the above assessment, CNSC staff concluded that Cameco is meeting the regulatory requirements and CNSC staff's expectations to protect both workers and the environment at the CLO as it relates to the development and maintenance of the safety analysis for the facility.

3.4.5 Recommendation

One condition in the proposed licence is associated with the safety analysis SCA. CNSC staff recommend the licence condition remain.

3.5 Physical Design

The physical design SCA 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.

The specific areas that comprise this SCA at the CLO are not addressed individually in this document.

3.5.1 Trends

The following table indicates the overall rating trends for the physical design SCA over the current licensing period:

TRENDS FOR PHYSICAL DESIGN							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation has implemented and maintained a design control process that verifies and validates the design to ensure safety, performance and dependability of the facility. Cameco has a mature physical design control system in place, which continues to remain effective and meet regulatory requirements.							

3.5.2 Discussion

The CNSC expects licensees to implement and maintain a design control process to ensure that design outputs are verified against design inputs and performance expectations. The design control process includes:

- design planning
- input
- output
- review
- verification
- validation
- transfer
- records
- change management.

Cameco's CLO continues to maintain and verify its mining ventilation design in accordance with CNSC requirements. The mine design process includes consideration of geology, hydrogeology, rock mechanics, hydrology, water management, ventilation and waste management.

Cameco's CLO physical design is described and documented in its mining facility description manual (MFDM) [4]. The MFDM provides details including physical description, technical specifications and capacities. The MFDM provides the next level of detail in support of the mining facility licensing manual (MFLM) [5]. Cameco uses facility change control and design control processes to ensure that any physical changes to the facility are reviewed and approved by site management before implementation. The facility change control and design

control processes have been reviewed and accepted by CNSC staff. Focused inspections conducted by CNSC staff in September 2013 and February 2019 verified that continuous improvements to the change control process have been implemented at the CLO, thereby making the process more effective.

3.5.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.5.3.1 Past Performance

During the current licence period, Cameco demonstrated to CNSC staff that the CLO follows its design control process when undertaking modifications or additions to facilities, processes, or equipment. Cameco's CLO exercised control and maintained its design basis in the dynamic environment of mining so as to ensure the protection of workers from physical and radiological risks. Upgrades or replacements to the physical design were reviewed and found acceptable by CNSC staff.

CNSC staff conducted eight inspections that included compliance verification criteria related to the physical design SCA, including two focused inspections. All non-compliances identified were of low safety significance and have been adequately addressed. Cameco's CLO continues to implement and follow the design control process as per CNSC's regulatory requirements.

3.5.3.2 Regulatory Focus

CNSC staff will continue to monitor performance in this area through regulatory oversight activities including inspections and desktop reviews of CLO's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.5.3.3 Proposed Improvements

There are no other proposed improvements for this SCA. Improvements to operation, facility equipment and processes are identified on an ongoing basis and implemented as part of continuous improvement.

3.5.4 Conclusion

CNSC staff confirmed that Cameco followed their approved design and change management program in managing changes and improvements to the facility during the licence period. Cameco's projects were completed as planned and within their respective safety cases, with no major deficiencies or events. Cameco continues to effectively maintain, verify and control its ventilation design to ensure a safe underground environment. CNSC staff assessed Cameco's documentation and analyses under this SCA and found it to be acceptable. CNSC staff conclude that Cameco's overall performance at the CLO for this SCA is satisfactory and that Cameco is qualified to carry out the authorized activities in this SCA.

3.5.5 Recommendation

There is one condition in the proposed licence associated with the physical design SCA. CNSC staff recommend that the condition be maintained.

3.6 Fitness for Service

The fitness for service SCA 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 verify equipment is available to perform its intended design function when called upon to do so.

The specific areas that comprise this SCA at the CLO are not addressed individually in this document.

3.6.1 Trends

The following table indicates the overall rating trends for the fitness for service SCA over the current licensing period:

TRENDS FOR FITNESS FOR SERVICE							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation has implemented and maintained programs to ensure structures and equipment remain effective and perform as designed over time. CNSC staff are satisfied with the implementation of the fitness for service program at the Cigar Lake Operation.							

3.6.2 Discussion

The fitness for service SCA at the CLO covers activities that are carried out to ensure that the physical condition of systems, components and structures remain effective over time. This includes programs that ensure all equipment is available to perform its intended design function reliably when called upon to do so. The CNSC requires the licensee to implement and maintain a maintenance program to comply with regulatory requirements and accepted industry practice to minimize potential impacts to workers, the public and the environment. In addition, maintenance activities must provide assurance to achieve desired results, provide effective management of inventory of maintenance materials, manage maintenance records and procedures and provide systematic management of maintenance change control.

Cameco's maintenance group organizes and stores equipment information, maintenance records and facilities information on a computerized maintenance management system to coordinate the routine, predictive and preventative maintenance activities at the CLO. This computerized maintenance management system keeps track of the preventive maintenance program for all equipment and

logs the equipment operating history. A facility change control procedure, reviewed and accepted by CNSC staff, is in place to control and record changes to the facilities.

CNSC staff verified through inspections and desktop reviews that Cameco maintains the CLO according to regulatory requirements and uses operational experience to ensure that the procedures, processes, structures, containment systems and components remain effective over time. Cameco has identified the safety-significant structures, systems and components at the CLO and implemented a documented and approved maintenance program to ensure that these remain effective.

CNSC staff's review of the maintenance management system at the CLO during regular inspections confirms that preventative maintenance activities are scheduled, completed and recorded. CNSC staff routinely inspect maintenance records associated with the CLO preventative maintenance program and found them acceptable. Random sampling of equipment, maintenance and monitoring records were also verified during inspections. These compliance verification activities confirmed that the maintenance program is well documented and implemented. CNSC staff conducted nine inspections where compliance verification criteria related to the fitness for service SCA were assessed. All compliance verification criteria assessed complied with regulatory requirements identified in the LCH.

3.6.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.6.3.1 Past Performance

Based on the results of compliance inspections and desktop reviews, CNSC staff rated Cameco's performance for the fitness for service SCA at the CLO as satisfactory for the current licence period.

3.6.3.2 Regulatory Focus

CNSC staff will continue to monitor performance in this area through regulatory oversight activities including inspections and desktop reviews of Cameco's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.6.3.3 Proposed Improvements

There are no other proposed improvements for this SCA.

3.6.4 Conclusion

CNSC staff have assessed Cameco's CLO documentation under the fitness for service SCA and found it to be acceptable. Cameco continues to maintain the facility to ensure that structures, systems and components remain effective over time.

3.6.5 Recommendation

One condition in the proposed licence is associated with the fitness for service SCA. CNSC staff recommend that this condition remain.

3.7 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection (RP) program in accordance with the *Radiation Protection Regulations*. The program must ensure that radiation doses received by individuals and contamination levels are monitored, controlled and maintained as low as reasonably achievable (ALARA), social and economic factors taken into account.

The specific areas that comprise this SCA at the CLO addressed individually in this document are:

- effective doses to workers
- estimated dose to the public
- application of ALARA
- worker dose control
- radiation protection program performance
- radiological hazard control.

3.7.1 Trends

The following table indicates the overall rating trends for the radiation protection SCA over the current licensing period:

TRENDS FOR RADIATION PROTECTION							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation has implemented a radiation protection program that meets regulatory requirements and protects the health and safety of workers. During the current licence period, no worker or member of the public received a radiation dose in excess of CNSC regulatory limits. CNSC staff are satisfied with the implementation of the radiation protection program at the Cigar Lake Operation.							

Effective doses to workers

The main source of radiological exposure at the CLO is from mining high-grade uranium ore. The effective dose contributors to nuclear energy workers (NEWs) at the CLO are gamma radiation, radon progeny (RnP), long-lived radioactive dust (LLRD) and radon gas (RnG). Gamma radiation hazards are controlled

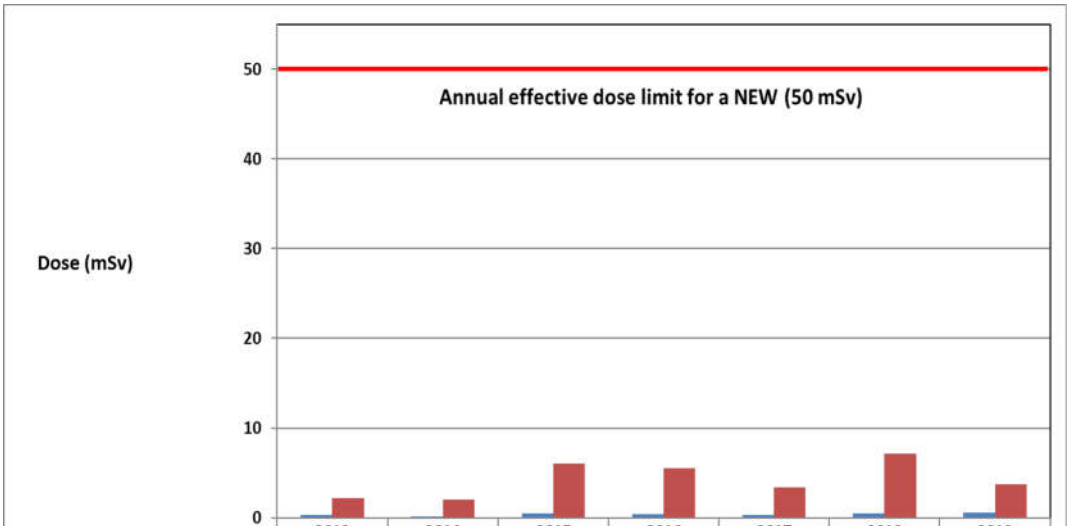
through the effective use of time, distance and shielding. Exposures to RnP and LLRD are controlled through source control, ventilation, contamination control and personal protective equipment.

Cameco's RP program provides assurance that exposures to all NEWs is compliant with the *Radiation Protection Regulations*. Licensed dosimetry services are utilized at the CLO for both external and internal dose assignment. The total effective dose assignment for workers is the sum of whole body dose as measured by optically stimulated luminescent dosimeters for exposure to gamma radiation, and personal alpha dosimeters (PAD) to measure exposures due to LLRD and RnP. For higher risk maintenance activities that involve the use of respiratory protection, worker exposures to airborne hazards are monitored through air sampling techniques and are administratively controlled through radiation work permits.

Cameco's RP program includes processes and criteria to provide assurance that workers are identified as NEWs, as defined in section 2 of the *Nuclear Safety and Control Act*. The regulatory effective dose limit for a NEW is 50 mSv/year and 100 mSv over a five-year dosimetry period. Cameco's CLO has radiation protection design features enabling it to mine high-grade ore. As seen in the following graph, annual doses to workers at the CLO remained well below the 50 mSv/year regulatory limit.

Figure 3.1 displays the maximum and average individual effective doses to NEWs from 2013 through to 2019.

Figure 3.1: Maximum and average individual effective doses to NEWs, 2013-19



	2013	2014	2015	2016	2017	2018	2019
Average effective dose (mSv)	0.27	0.16	0.45	0.39	0.34	0.47	0.57
Maximum effective dose (mSv)	2.21	2.04	5.99	5.53	3.36	7.16	3.70
Number of NEWs monitored	3039	1458	1222	1243	1107	824	875

As defined in the *Radiation Protection Regulations*, the five-year dosimetry period is a fixed five-year period. The five-year dosimetry periods that are applicable over this licensing period are 2011 to 2015 and 2016 to 2020. In the 2011 to 2015 dosimetry period, the maximum dose was 33.6 mSv. In the current dosimetry period of 2016 to 2020, the maximum period dose to date is 18.3 mSv. The regulatory dose limit for a five-year dosimetry period is 100 mSv.

During the current licensing period, the annual collective dose[1] totals for the CLO ranged from 821 person-mSv (p-mSv) in 2013, to a low of 233 p-mSv in 2014.

In 2013, the increase in collective doses is attributed to both a higher number of workers performing radiological work and higher RnP in levels in the work area. Specifically, the number of workers, with assigned dose, were more than double that of any year in the current licensing period. This was due to construction activities leading up to production. These activities included increasing the number of freeze holes required in the north end of the mine, which contributed to higher than typical RnP exposures. However, RnP exposures remained well controlled during this period. In 2013, the maximum effective dose due to RnP was 1.93 mSv and the maximum individual dose from all sources was 2.21 mSv.

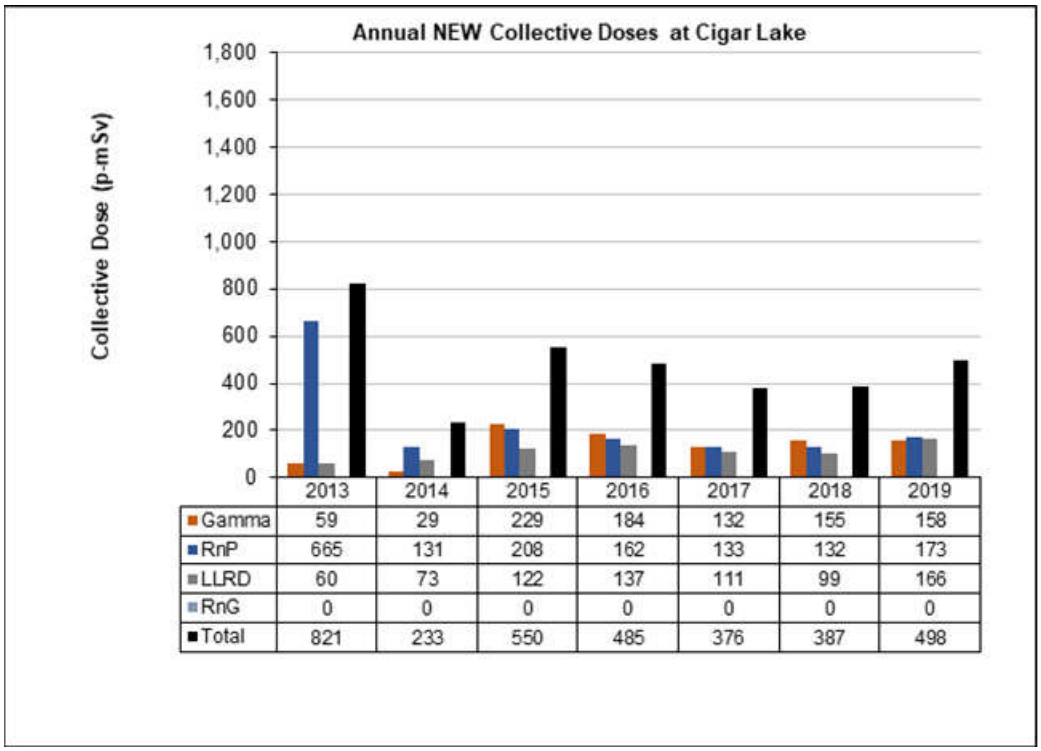
During 2014, residual construction and commissioning activities were completed and the transition to routine production began. The increases in collective dose in 2015 were consistent with increased mine production (both in total mass and ore grade). Production levels consistently increased from 21.6 Mkg of ore in 2015 to 46.09 Mkg of ore in 2019. Nevertheless, worker collective dose values remained stable.

Throughout the licensing period, there were no instances in which the collective dose due to radon gas exceeded 1 p-mSv. At the CLO, individual exposures to radon gas are assigned when workers spend time in areas where the radon gas concentrations are greater than 3,000 Bq/m^3 [2]. However, radon gas levels (as confirmed through routine monitoring programs) rarely exceed these levels. The maximum radon gas dose to an individual in the current licence period was 0.12 mSv. Figure 3.2 displays the annual collective doses for NEWs at the CLO for the current licensing period.

[1] The annual collective dose is the sum of effective dose assigned to workers at Cigar Lake Operation in a given calendar year.

[2] Continuous occupancy in radon gas (excluding progeny which is accounted for separately) at than 3,000 Bq/m^3 for 2,000 hrs (considered a working year) would result in a committed effective dose of 1 mSv.

Figure 3.2: Annual collective doses for NEWs, 2013-19



	2013	2014	2015	2016	2017	2018	2019
Gamma	59	29	229	184	132	155	158
RnP	665	131	208	162	133	132	173
LLRD	60	73	122	137	111	99	166
RnG	0	0	0	0	0	0	0
Total	821	233	550	485	376	387	498

Estimated dose to the public

Radiological releases to the environment are controlled and monitored by the effluent and emissions control, and the environmental monitoring programs. The *Radiation Protection Regulations* require licensees to implement an RP program for the protection of the public. The focus for radiation protection within the environmental protection framework is on radiological protection of the environment and the public.

The *Radiation Protection Regulations* define prescribed dose limits for workers and members of the public, and require doses to be monitored by direct measurement or by estimation of the quantities and concentrations of any nuclear substance released as a result of a proposed activity.

Licensees must meet the requirements of the NSCA and the regulations for radiological protection of members of the public. Accordingly, a human health risk assessment (HHRA) is completed for both radioactive and hazardous substances. Cameco's 2017 HHRA concluded that the highest estimated annual dose to a public receptor is 0.1 mSv. CNSC staff reviewed Cameco's assessment and concluded that public doses are well below the annual public dose limit of 1 mSv.

3.7.2 Discussion

The *Radiation Protection Regulations* require licensees to implement an RP program to keep exposures ALARA, social and economic factors taken into account, through the implementation of a number of controls. These include: management control over work practices, personnel qualification and training, control of occupational and public exposures to radiation, and planning for unusual situations. The *Radiation Protection Regulations* also prescribe dose limits for workers and members of the public.

As required by the UMMR, Cameco has an RP program and radiation code of practice (RCOP) in place at the CLO. The RP program includes continuous and routine radiological monitoring, dosimetry, and contamination control.

Application of ALARA

The RP program describes how the CLO manages radiation protection hazards and meets applicable regulatory requirements.

Cameco's application of ALARA within its RP program at the CLO includes management commitment and oversight, personnel qualification and training.

In addition to key performance indicators for parameters such as radiation protection training, objectives, personnel dosimetry results, and workplace monitoring data, Cameco's CLO establishes annual ALARA targets focused on worker dose reduction initiatives.

CNSC staff are satisfied with Cameco's measures in applying the ALARA principle to radiation exposures at the CLO.

Worker dose control

The source of radiological exposure at the CLO is the mining of high-grade uranium ore. The primary dose contributors are radon progeny, gamma radiation, and long-lived radioactive dust. In addition, radiation dose due to radon gas may be included in the total effective dose assigned to a worker if there is a radon gas exposure that exceeds the RCOP level where a radon gas dose must be calculated.

Utilizing jet boring as a mining method (figure 3.3) ensures that the high-grade ore mined at the CLO is captured in a contained process: from the point of ore extraction, through the loading of slurry into transport containers, and delivered to the McClean Lake mill slurry receiving building. Additional protocols ensure that long-lived radioactive dust is controlled through ventilation, dust control methods and good housekeeping. Gamma radiation is controlled through time, distance and shielding; and radon gas and radon progeny are controlled through effective use of capture ventilation. Cameco uses a combination of engineered controls (e.g. design features), administrative controls (e.g. staff training and qualification, and dose management tools such as work planning, administrative levels, management oversight) and protective equipment (e.g. respiratory protection during higher risk maintenance activities) to ensure radiation doses to workers are controlled and kept ALARA.

Figure 3.3: Underground jet bore used for ore removal

Source: CNSC

As required by the *Radiation Protection Regulations*, all NEWs are notified in writing of their status, of the risks associated with radiation that they may be exposed to in the course of their work, and of the applicable effective and equivalent dose limits. Female NEWs are also notified in writing of their rights and obligations related to pregnancy.

No CLO worker received an effective or equivalent dose that exceeded the corresponding regulatory dose limits pursuant to the *Radiation Protection Regulations*.

Radiation protection program performance

CNSC compliance activities

CNSC staff assessed RP program performance at the CLO over the current licence period through various compliance verification activities including desktop reviews of monthly, quarterly and annual compliance reports. CNSC staff have observed and verified RP practices during 18 compliance inspections, including three focused RP inspections conducted in March 2014, June 2017, and August 2019.

Overall, inspection findings have confirmed ongoing compliance with the *Radiation Protection Regulations* during the current licensing period. Non-compliant findings have been identified; however, these regulatory findings have been of low safety significance and were not indicative of widespread deficiencies in RP program implementation. The licensee has taken timely actions to address all regulatory findings. CNSC staff have verified that Cameco has taken appropriate corrective actions and these non-compliances are now closed.

The CLO RP program has been effective in providing adequate protection to workers from radiological hazards throughout the current licensing period. As a result of inspections and desktop review verification activities, CNSC staff confirmed the CLO RP program complies with CNSC regulatory requirements.

Radiological action levels

The *Uranium Mines and Mills Regulations* and the *Radiation Protection Regulations* require that a licensee report any radiation protection action level exceedances. The action levels for effective dose identified in the CLO RP program are 1 mSv per week and 5 mSv per quarter. The only action level exceedances during the current licence period at the CLO occurred in 2018.

In June and July of 2018, a total of four workers exceeded the 1 mSv/week action level due to exposures to long-lived radioactive dust. One of these four workers also exceeded the 5 mSv/quarter action level due to this event.

In November of 2018, a maintenance activity on the jet bore system resulted in a worker exceeding the weekly and quarterly action level due to exposure to elevated radon progeny levels.

Details on these events were provided by CNSC staff in CMD 19-M36, *Regulatory Oversight Report on Uranium Mines and Mills in Canada: 2018* [6]. CNSC staff conducted an inspection to confirm Cameco's follow-up to these events and verified Cameco's corrective action plan is being implemented. CNSC staff will continue to monitor the implementation and effectiveness of the corrective action plan.

The following table provides the 2013 to 2020 reported action level exceedances at Cameco's CLO.

Table 3.2: Reported action level exceedances, 2013-20

Period	2013	2014	2015	2016	2017	2018	2019	2020*	Action Level
Weekly Action Level	0	0	0	0	0	5	0	0	1.0 mSv/wk
Quarterly Action Level	0	0	0	0	0	2	0	0	5.0 mSv/qtr

* The 2020 reporting period is January 1, 2020 to June 30, 2020.

CNSC staff are satisfied with the performance of Cameco's RP program and its implementation at the CLO.

Radiological hazard control

Radiation and contamination control procedures have been established at the CLO to control and minimize radiological hazards and the spread of radioactive contamination. Radiological monitoring results confirm the effectiveness of contamination control procedures and include a combination of direct and indirect contamination monitoring of eating areas, footwear, work clothing and personal protective equipment. Routine airborne monitoring programs have been established for long-lived radioactive dust, radon progeny and radon gas. When sample results exceed administrative levels, protective actions are taken as specified in the RCOP. The CLO uses continuous radon progeny detectors with warning lights to monitor and warn workers of elevated radon progeny levels.

Cameco possesses sealed sources, unsealed sources and radiation devices at the CLO that are regulated under the *Nuclear Substances and Radiation Devices Regulations*. These radiation sources range in type from fixed nuclear gauges to radiation instrumentation calibration sources. The controls associated with these radiation sources are supported by the RP program including training, leak testing, radiation warning signs and access control to areas where such sources are used or stored.

CNSC staff are satisfied that radiological hazards have been adequately controlled at the CLO.

3.7.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.7.3.1 Past Performance

Based on the review of CLO's monthly, quarterly and annual compliance reports and CNSC staff's routine compliance verification activities, CNSC staff rate the CLO performance for the radiation protection SCA as satisfactory for the current licence period.

3.7.3.2 Regulatory Focus

CNSC staff will continue to monitor performance in this area through regulatory oversight activities including inspections and desktop reviews of Cameco's compliance reporting and revisions to relevant program documentation at the CLO pertaining to this SCA.

3.7.3.3 Proposed Improvements

There are no other proposed improvements for this SCA.

3.7.4 Conclusion

CNSC staff assessed Cameco's documentation and analyses at the CLO under the radiation protection SCA and found them to be acceptable. CNSC staff are satisfied with Cameco's efforts in applying the ALARA principle to keep the

doses to persons ALARA over the current licence period. Therefore, CNSC staff concluded that the overall performance for this SCA is satisfactory and that Cameco is qualified to carry out the authorized activities at the CLO in this SCA.

3.7.5 Recommendation

One condition in the proposed licence is associated with the radiation protection SCA. CNSC staff recommend that there be no change to the current licence condition.

3.8 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.

The specific areas that comprise this SCA at CLO addressed individually in this document are:

- performance
- practices
- awareness.

3.8.1 Trends

The following table indicates the overall rating trends for the conventional health and safety SCA over the current licensing period:

TRENDS FOR CONVENTIONAL HEALTH AND SAFETY							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
FS	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation has an acceptable conventional health and safety program to identify and control risks. CNSC staff monitor implementation of this program to ensure protection of workers. Cameco has been proactive in identifying and managing risks to improve health and safety performance. Cameco's conventional health and safety program and its implementation continues to improve, be effective and meet applicable regulatory requirements.							

3.8.2 Discussion

The CNSC requires licensees of uranium mines and mills to develop, implement and maintain effective safety programs, to promote a safe and healthy workplace for employees, and to minimize the incidence of occupational injuries and illnesses. The CNSC requires Cameco to identify potential safety hazards, assess the associated risks, and implement the necessary materials, equipment, programs and procedures to effectively manage, control and minimize these risks at the CLO.

The occupational health and safety program at the CLO is comprised of several components designed for employees, visitors and contractors. This health and safety program has been developed to meet legislated requirements and internal standards. The program includes audits, inspections, a systematic approach to training (SAT), incident reporting and tracking, objectives and targets, hazard identification (figure 3.4), risk assessments, job hazard analysis, key performance indicators, and regular safety meetings.

Figure 3.4: Underground work area, showing signage for hazard identification

Source: CNSC

Performance

A key performance measure for this SCA is the number of lost time injuries (LTIs) that occur per year. An LTI is an injury that takes place at work, resulting in the worker being unable to return to work and carry out their duties for a period of time.

Table 3.3 shows the total number of LTIs, their frequency and severity that occurred during this licensing period at the CLO. CNSC staff reviewed the investigation reports and verified that corrective actions have been implemented and remain effective. Since 2010, all LTIs are discussed and reported to the Commission as part of CNSC staff's uranium mines and mills annual regulatory oversight report.

Table 3.3: Total number of FTE workers, LTIs, severity rate and frequency rate, 2013-20

Year	2013	2014	2015	2016[6]	2017	2018	2019	2020*
Total number of FTE workers[1]	1,570	833	714	701	630	607	539	198
Number of LTIs[2]	4	1	4	2	0	0	0	0
Severity rate[3]	5.3	0.0	18.0	8.8	0	0	0	0
Frequency rate[4]	0.3	0.12	0.56	0.29	0	0	0	0
Total Recordable Incident Rate[5]	5.23	2.52	2.38	2.14	1.58	1.00	1.67	2.03

* The 2020 reporting period is January 1, 2020 to June 30, 2020.

1 Total number of workers (employees and contractors) expressed as full-time equivalents (FTE). FTE = total person-hours / 2,000 hours worked per employee per year.

2 Lost-time injury - an injury that takes place at work and results in the worker being unable to return to work for a period of time.

3 Severity rate - the accident severity rate measures the total number of days lost to injury for every 200,000 person-hours worked at the site. Severity = [(# of days lost in last 12 months)/# of hours worked in last 12 months)] x 200,000.

4 Frequency rate - the accident frequency rate measuring the number of LTIs for every 200,000 person-hours worked at the site. Frequency = [(# of injuries in last 12 months)/ # of hours worked in last 12 months)] x 200,000.

5 Total reportable incident rate - 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.

6 2016 LTI data was modified from previous reports following a reclassification of the animal attack in 2016.

Inspections regarding conventional health and safety were also carried out by Saskatchewan Ministry of Labour Relations and Workplace Safety (LRWS) inspectors during the current licensing period. Inspection reports are shared with CNSC staff and regular oversight is provided by CNSC staff as needed. Safety-related findings and incidents were properly investigated and corrected by Cameco in a timely manner and the resulting reports were acceptable to both the CNSC and LRWS.

Practices

In addition to the NSCA and its associated regulations, the CLO activities and operations must comply with applicable federal and provincial health and safety related acts and regulations. Cameco has a joint occupational health and safety committee in accordance with the Saskatchewan *Occupational Health and Safety Act*.

To assure continued strong safety performance and continual improvement, Cameco's conventional health and safety program at the CLO includes the following provisions:

- scheduled safety orientation and training
- five-point daily safety cards

- work permits for specialized work
- planned inspection program
- occupational health committees
- health centre operation
- incident investigations and corrective action performance tracking
- contractor safety management
- management of change
- regular safety meetings.

CNSC staff have observed and verified safety practices during compliance inspections. The conventional health and safety SCA is included as a component in all CNSC inspections. Cameco reported safety events in a timely manner for the CLO and in compliance with the regulations.

Risk assessments are used to compile a list of safety and health hazards and their controls. The list of safety and health hazards and their controls is routinely reviewed and updated to reflect continual improvement and changes at the CLO.

Cameco uses leading key performance indicators to monitor preventative efforts. Health and safety objectives are developed based upon the review of the hazards, reviews of investigation and inspection reports and reviews of five-point safety cards.

Contractor safety risk continues to be effectively managed. Contractors are expected to follow Cameco's safety program or have an equivalent program. Contractors are required to comply with program requirements and regulations, manage the hazards and controls associated with its work, and provide a health and safety program for its workers.

Both general safety and high hazard specific procedures have been developed to assist employees with planning work and to mitigate risk. Some specific high hazard work procedures include confined space entry, ground disturbance, hot work, lockout, working in hot environments and respiratory protection.

All new employees, contractors or service representatives arriving at the CLO mine site receive site orientation. This orientation covers general site rules and provides the worker with the required information to work safely at Cameco's CLO.

Cameco is meeting expectations and CNSC staff are satisfied with its performance at the CLO in this area.

Awareness

Cameco has established conventional health and safety policies and programs for the CLO to ensure the protection of workers from physical, chemical and radiation hazards that may arise in the course of their work at the facility. Cameco has developed and continues to deliver safety-related training to employees and

contractors. This encompasses the safety areas of general health and safety knowledge, radiation protection, fire protection, regulatory requirements and job/task-specific safety training related to hot work permit, lock-out/tag-out, and the use of a Workplace Hazardous Materials Information System which provides information on the safe use of hazardous materials.

The Cameco integrated safety, health, environment and quality management system requires that both Cameco corporate and Cigar Lake senior management review the Cigar Lake safety and health management program at scheduled intervals to ensure the program's continuing suitability, adequacy, effectiveness, and sustainability.

3.8.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.8.3.1 Past Performance

Through the review of the occupational health and safety documentation, site conditions and practices during the licence period, CNSC staff conclude that Cameco's occupational health and safety program at the CLO meets CNSC regulatory requirements.

For the current licence period, CNSC staff rated Cameco's overall performance for the conventional health and safety SCA as fully satisfactory in 2013 and satisfactory for the subsequent years.

3.8.3.2 Regulatory Focus

CNSC staff conducted 20 inspections that included compliance verification criteria related to the conventional health and safety SCA, including one focused inspection conducted in April 2018. During the focused inspection, no corrective actions were identified. Cameco addressed all non-conformances and recommendations identified during the current licence period. CNSC staff will continue to monitor performance in this area through regulatory oversight activities including inspections and desktop reviews of Cameco's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.8.3.3 Proposed Improvements

There are no proposed improvements for this SCA.

3.8.4 Conclusion

CNSC staff conclude that Cameco has effectively managed workplace safety hazards at the CLO. Compliance verification activities will continue to be conducted at the facility to confirm that Cameco's CLO continues to view conventional health and safety as an important consideration.

Cameco's conventional health and safety program and implementation continue to be effective, meet applicable regulatory requirements, and are rated as satisfactory.

3.8.5 Recommendation

One condition in the proposed licence is associated with the conventional health and safety SCA. CNSC staff recommend that the licence condition remain.

3.9 Environmental Protection

The environmental protection SCA covers programs that identify, control and monitor all releases of nuclear and hazardous substances and effects on the environment from facilities or as the result of licensed activities.

The specific areas that comprise this SCA at the CLO addressed in this CMD are:

- effluent and emissions control (releases)
- environmental management system (EMS)
- assessment and monitoring
- protection of the public and Indigenous groups
- environmental risk assessment.

3.9.1 Trends

The following table provides the annual compliance ratings for the environmental protection SCA for the current licence period, 2013 to 2020:

ENVIRONMENTAL PROTECTION SCA							
Overall compliance ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA

Comments

Cameco has implemented, maintained and continuously improved its environmental protection program at the Cigar Lake Operation that protects the environment and the public in accordance with evolving CNSC regulatory requirements.

During the current licence period, releases to the environment were well below the release limits specified in the CNSC licence. CNSC staff monitor Cameco's implementation of the environmental protection program through compliance verification activities.

Cameco updated its Environmental Risk Assessment (ERA) in 2017 (with an addendum in 2019). The predicted environmental impacts from the Cigar Lake Operation are consistent with those outlined in previous environmental assessments.

3.9.2 Discussion

Under the UMMR, Cameco's CLO is required to develop and implement environmental protection policies, programs and associated procedures that comply with all applicable federal and provincial regulatory requirements, in order to control the release of radioactive and hazardous substances into the environment, and to protect the environment and human health. Listed below are the environmental protection regulatory documents and standards that Cameco must implement under its licence for the proposed licence period.

Cameco has implemented the requirements of:

- CSA N288.4, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*
- CSA N288.5, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*
- CSA N288.6*, Environmental Risk Assessment at Class 1 Nuclear Facilities, and Uranium Mines and Mills*
- *CSA* N288.7, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills*
- *CSA* N288.8, *Establishing and implementing action levels for releases to the environment from nuclear facilities.*
- CNSC's REGDOC-2.9.1 (2017), *Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.1.*

During the current licence period, CNSC staff verified Cameco's performance with respect to environmental protection through inspections and desktop reviews. CNSC staff conducted a focused environmental protection inspection in September 2013 and June 2018; all findings were minor in nature and have been adequately addressed. CNSC staff also performed general inspections with an environmental protection component. The results of these inspections allowed CNSC staff to conclude that Cameco's implementation of the environmental protection program at the CLO meets CNSC's regulatory requirements and expectations.

Effluent and emissions control (releases)

Treated effluent released to the environment after the final point of control from the CLO (Station 2.2B, figure 1.2.), mine water treatment plant final discharge must meet the effluent discharge limits stipulated in appendix B of the current licence. The release limits are adopted from the *Metal and Diamond Mining Effluent Regulations* (MDMER). The CNSC also requires that Cameco meet the licence limits for selenium and uranium from the province of Saskatchewan. The CNSC not only requires Cameco to respect these provincial limits, but also demonstrate the principles of ALARA and Best Available Technology Economically Available (BATEA) at the CLO. This results in effluent releases substantially lower than those authorized by the province of Saskatchewan.

The CNSC has an interim objective for uranium in effluent of 0.1 mg /L for liquid effluent. The CNSC uses the interim objective to assess the performance of a licensee's effluent monitoring program with respect to uranium. This value is based on a 2006 review of uranium treatment within the uranium mining and milling sector, which was contracted by the CNSC [7]. The interim objective will be in place until the publication and implementation of CNSC's REGDOC-2.9.2 *Controlling Releases to the Environment from Nuclear Facilities*. At that time, a site-specific licence limit for uranium will be determined.

The effluent discharge is also subject to regular toxicity testing as required by the MDMER and to the action levels specified within the CLO's environmental code of practice. Action levels provide early indication of a potential loss of control of part of the environmental protection program. Thus, action levels are used to ensure that the licence release limits will not be exceeded. In 2019, Cameco updated the action levels using actual performance data and by following the requirements as outlined in CSA standard N288.8-17, *Establishing and Implementing Action Levels to Control Releases to the Environment from Nuclear Facilities*.

At the CLO, potentially contaminated water is treated at the mine water treatment plant before being released to the environment (figure 3.5). The mine water treatment plant removes and precipitates solids and other contaminants in the effluent through a two-stage water treatment process. The treated effluent is pumped to a monitoring pond and a sample is collected as the pond is filled up. The treated effluent is released in a controlled batch manner if the lab results show that the concentrations of contaminants are lower than the licence limits. Throughout the previous licensing period, monitoring has verified that this effluent poses no environmental concern.

Figure 3.5: Outflow point at Seru Bay

Source: CNSC

During the previous licensing period, concentrations of contaminants in the effluents remained below federal and provincial limits. The effluent contaminant concentrations were maintained below the effluent discharge limits; the effluent discharge passed all toxicity tests and there were no exceedances of the effluent action levels contained in the environmental code of practice. Furthermore, all of the average annual concentrations of parameters are within the predictions in the 2017 Human Health and Ecological Risk Assessment [8] and additional 2019 Addendum [9].

With the start of high-grade ore mining in 2015, concentrations of arsenic in effluent increased, but remained at about 10 percent of the licence limit. In response to a potentially increasing trend of arsenic concentration, the CLO proactively conducted investigations and implemented several administrative, operational, and/or engineering solutions in the mine water treatment plant. This resulted in a reduction in arsenic in effluent. The CLO is working on implementing additional techniques to control and to reduce arsenic in effluent. CNSC staff requested that Cameco provide an update on arsenic in quarterly and annual compliance reports. Based on CNSC staff reviews of these reports, CNSC staff conclude that releases of arsenic to the environment remain well below the limits in the MDMER, are below the predictions made in the ERA and have stabilized. Thus, CNSC staff are satisfied that arsenic is being effectively controlled at the CLO.

Molybdenum, uranium and selenium in effluent

The CLO started to mine high-grade ore in 2015. As a result, the concentrations of many contaminants in effluent increased compared to effluent concentrations during construction (table 3.4). For uranium, concentrations were elevated in the first four months of 2015 at levels above the CNSC interim uranium objective of 0.1 mg/L. Once an increase in uranium concentrations was noticed, the CLO proactively performed an investigation and determined that these increased concentrations were a result of processing significantly higher ore grades further compounded by fluctuations in pH in process waters. The CLO implemented some process changes and process optimization techniques in the mine water treatment plant. This resulted in uranium concentrations below the interim objective and lower loadings for the rest of 2015 and in subsequent years.

Concentrations of selenium and molybdenum also increased in 2015 but remained below the predictions made in the ERA and, in the case of selenium, well below the provincial limit (there is no provincial limit for molybdenum). Thus, this increase did not result in a risk to the environment. In response to this increase, Cameco implemented some process optimization techniques at the CLO mine water treatment plant. As a result, concentrations of selenium and molybdenum in effluent have stabilized over time, despite increased ore tonnage being mined. Therefore, CNSC staff conclude that molybdenum and selenium are being effectively controlled at the CLO. Furthermore, releases of molybdenum from the CLO are below the site-specific molybdenum administrative and action levels as identified in their approved environmental code of practice.

CNSC staff are satisfied that Cameco is taking the appropriate measures to effectively control and reduce arsenic, molybdenum, uranium and selenium in effluent.

Annual monthly mean concentrations of treated effluent

The annual monthly mean concentrations and associated licence limits for the treated effluent are provided in table 3.4. Releases have been substantially lower than the licence limits throughout the review period.

Table 3.4: Annual monthly mean concentrations of treated effluent released to the environment from the mine water treatment plant, 2013-20

Year	Limits	Interim Objective	2013	2014	2015	2016	2017	2018	2019	2020*
As mg/L	0.5[4]	N/A	0.0007	0.0033	0.0565	0.0919	0.0750	0.0603	0.0952	0.0793
Cu mg/L	0.3[4]	N/A	0.0036	0.0008	0.0004	0.0004	0.0006	0.0008	0.0014	0.0012
Pb mg/L	0.2[4]	N/A	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002
Ni mg/L	0.5[4]	N/A	0.0018	0.0020	0.0041	0.0027	0.0008	0.0009	0.0013	0.0010
Zn mg/L	0.5[4]	N/A	0.0089	0.0275	0.0083	0.0241	0.0259	0.0271	0.0232	0.0490
TSS mg/L	15[4]	N/A	1	1	1	1	1	1	2	1
Ra^{226} Bq/L	0.37[4]	N/A	0.010	0.007	0.010	0.007	0.007	0.006	0.008	0.008
pH[1] units	6.0-9.5[4]	N/A	7.3	7.1	6.8	6.8	7.3	7.3	7.3	7.3
Se mg/L	0.6[3]	N/A	0.0005	0.0009	0.0041	0.0062	0.0042	0.0044	0.0041	0.0025
U mg/L	2.5[3]	0.1	0.0023	0.0166	0.0590	0.0063	0.0018	0.0005	0.0004	0.0002
Mo[2] mg/L	N/A	N/A	0.0099	0.0360	0.0763	0.0369	0.0640	0.1030	0.1069	0.1022

* The 2020 reporting period is January 1, 2020 to June 30, 2020.

1 pH taken from daily discharge samples – not measured in monthly composite samples.

2 No provincial or federal limit is available. Level of molybdenum in treated effluent meets the federal water quality guidelines and are below the action level.

3 Provincial limits.

4 Limits as identified in the MDMER.

Environmental management system

Cameco has implemented and maintained an environmental management system (EMS) to describe the activities associated with the protection of the environment at the CLO. The EMS is described in the Cigar Lake environmental management program and includes programs for effluent and environmental monitoring. The CLO's EMS is in conformance with Cameco's Safety, Health, Environment and Quality Policy and also meets the requirements of the ISO 14001:2015 standard *Environmental Management System – Requirements with Guidance for Use*.

Cameco conducts internal audits to determine whether the EMS has been properly implemented and is effective. Any deficiencies and findings that are identified from the internal audit are documented and a plan is devised to address any non-conformance items. Cameco verifies compliance of its EMS through an annual management review where minutes and follow-up actions to outstanding issues from the internal audits are documented. Cameco sets objectives, goals, and targets related to the environmental management program every year. The status of these objectives, goals, and targets is evaluated and the results are documented in the annual compliance report.

CNSC staff verify the effectiveness of CLO's EMS through desktop reviews of annual compliance reports and inspections. CNSC staff confirm that Cameco's EMS is meeting expectations.

Assessment and monitoring

The core activity of the environmental management program (EMP) is to acquire the data for assessing impacts on the environment from the operation and ensuring that possible impacts are detected as early as possible and mitigated. The environmental monitoring requirements of the EMP provide details about monitoring locations, frequencies and environmental parameters to be measured. The CLO EMP demonstrates that the site emissions and effluent discharge of nuclear and hazardous substances are properly controlled. Key components of the EMP are air quality, surface water hydrology, water quality, terrestrial monitoring, aquatic monitoring, and groundwater monitoring.

The data collected under the EMP are compared with predictions in Cameco's ERA to confirm that there is minimal risk to the environment and human health from CLO site emissions and effluent discharge. Additional details and results are provided within the Environmental Protection Review Report included in appendix E.

Air monitoring

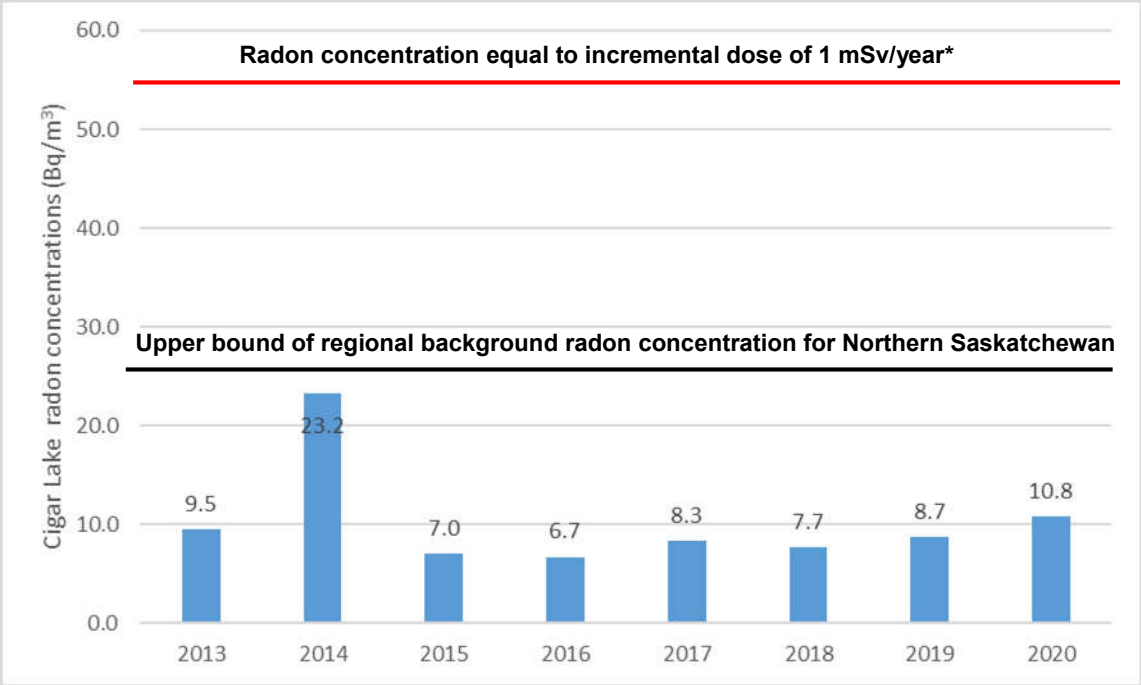
Air quality at the CLO is monitored through ambient air quality near the operation and indirectly through measurements of metal accumulations in the terrestrial environment. Figure 3.6 displays use of a high volume air sampler at the CLO.

Figure 3.6: High volume air sampler at Cigar Lake

Source: Cameco Corporation

Air quality monitoring at the CLO includes programs for ambient radon and total suspended particulates (TSP). Environmental monitoring for radon concentrations is conducted using the passive method of track-etch cups. There are eight monitoring stations in various locations around the site-lease boundary. Figure 3.7 shows that the average concentrations of radon in ambient air for 2013 to 2020 were below the reference level for radon. The radon concentrations were also typical of the northern Saskatchewan regional baseline which range from 7.4 Bq/m^3 to 25 Bq/m^3.

Figure 3.7: Concentrations of radon in ambient air, 2013-20**

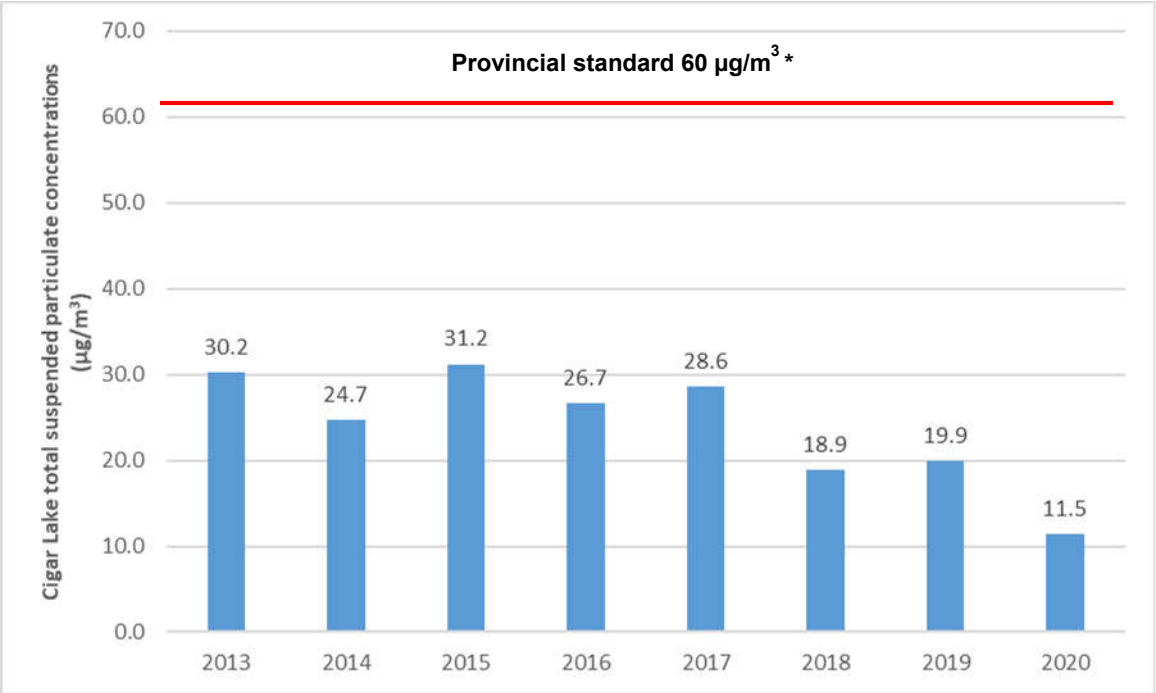


* Upper-bound of the incremental dose of 1 mSv per year above background (i.e., an incremental radon concentration of 30 Bq/m^3 above natural background) based on ICRP Publication 115. Values are calculated as geometric means.

** The 2020 reporting period values are based on January 1, 2020 to June 30, 2020 data.

Environmental monitoring for dust, particulates and associated contaminants is conducted using a high volume sampling unit located approximately 150 metres from the facility in the prevailing downwind direction. TSP values remained low and well below the provincial standard of 60 µg/m^3 as shown in figure 3.8.

Figure 3.8: Concentrations of total suspended particulate, 2013–20**



* Values are calculated as geometric mean.

** The 2020 reporting period values are based on January 1, 2020 to June 30, 2020 data.

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 reference annual air quality levels identified in table 3.5.

Table 3.5: Concentrations of metals and radionuclides in air, 2013-20

Parameter	Reference annual air quality levels*	2013	2014	2015	2016	2017	2018	2019	2020**
As ($\mu g/m^3$)	**0.06** (1)	0.00025	0.00025	0.00031	0.00030	0.00039	0.00023	0.00026	0.00016
Cu ($\mu g/m^3$)	**9.6** (1)	---	---	---	---	---	0.0046	0.0034	0.0013
Mo ($\mu g/m^3$)	**23** (1)	0.00021	0.00010	0.00010	0.00020	0.00020	0.00030	0.00020	0.00010
Ni ($\mu g/m^3$)	**0.04** (1)	0.00104	0.00067	0.00062	0.00105	0.00103	0.00083	0.00060	0.00026
Pb ($\mu g/m^3$)	**0.10** (1)	0.0007	0.0013	0.0009	0.0009	0.0008	0.0008	0.0007	0.0004
Se ($\mu g/m^3$)	**1.9** (1)	0.00003	0.00003	0.00003	0.00003	0.00004	0.00003	0.00003	0.00002
Zn ($\mu g/m^3$)	**23** (1)	---	---	---	---	---	0.0149	0.0123	0.0031
Pb^{210} (Bq/m^3)	**0.021** (2)	0.000268	0.000248	0.000315	0.000305	0.000360	0.000365	0.000250	0.000315
Po^{210} (Bq/m^3)	**0.028** (2)	0.000074	0.000086	0.000095	0.000099	0.000123	0.000133	0.000089	0.000102
Ra^{226} (Bq/m^3)	**0.013** (2)	0.000004	0.000008	0.000014	0.000020	0.000031	0.000026	0.000013	0.000024
Th^{230} (Bq/m^3)	**0.0085** (2)	0.000011	0.000010	0.000014	0.000012	0.000023	0.000018	0.000009	0.000010
U ($\mu g/m^3$)	**0.06** (1)	0.00007	0.00008	0.00055	0.00113	0.00151	0.00103	0.00096	0.00054

* Province of Ontario and ICRP reference annual air quality levels are shown for reference only, as no federal or Province of Saskatchewan limits are currently established.

** The 2020 reporting period values are based on January 1, 2020 to June 30, 2020 data.

1 Reference annual air quality levels have been derived from *Ontario 24-hour Ambient Air Quality Criteria* (Ontario Ministry of Environment 2012).

2 Reference level has been derived from ICRP 96.

Terrestrial monitoring

Cameco's terrestrial monitoring program at the CLO determines if there is influence on the environment from aerial deposition as soil and lichen and associated ecological receptors may be affected by atmospheric deposition of particulate and adsorbed metals and radionuclides associated with onsite activities. Cameco executes terrestrial monitoring programs every three years in accordance with the EMP. During the current licensing period, terrestrial monitoring data were collected in 2013, 2016 and 2019.

Cameco submitted the *Cigar Lake Operation Environmental Performance Report 2011 to 2015* in November 2016 [10]. This report included terrestrial monitoring data collected in 2013. Terrestrial monitoring data collected in 2016 and 2019 were reported in the *Cigar Lake Operation: 2016 Annual Report* [11] and the *Cigar Lake Operation: 2019 Annual Report* [12], respectively.

1. Soil monitoring

Soil monitoring results from soil samples collected in 2013, 2016 and 2019 showed that the soil metal parameter concentrations were below the *Canadian Environmental Quality Guidelines* for residential/parkland land use. Radionuclide concentrations in soils were also low, near, or at background levels and analytical detection limits. CNSC staff concluded that the level of airborne particulate contaminants produced by the CLO is acceptable and does not pose a risk to the environment.

2. Lichen monitoring

Lichen samples are analyzed to determine the level of airborne particulate contaminants deposited on the surface of the lichen as a means of ensuring that a significant level of contamination is not entering lichen consumers, such as caribou. Quantitative predictions of concentrations of contaminants in lichen were not included in Cameco's ERAs as lichen were not expected to accumulate constituents and therefore were predicted to be largely unaffected by the mine construction and operation.

Results from lichen samples collected in 2013, 2016 and 2019 indicated overall similarities in metal and radionuclide concentrations between exposure and reference stations[3]. Mean concentrations were comparable over time and fall within the range of baseline concentrations for all contaminants except nickel. Nickel concentration measured at the reference station was higher than the historical mean in 2019, and higher than the exposure stations.

CNSC staff concluded that the level of airborne particulate contaminants produced by the CLO is acceptable and does not pose a risk to lichen consumers such as caribou.

Surface water monitoring

As per Cameco's surface water quality monitoring program, the CLO takes surface water samples at 11 locations around the site at different intervals. Samples are taken at exposure stations (locations that could potentially be impacted by the operations of the facility) and at reference stations (locations that are not impacted by the operations of the facility). These samples are submitted to an accredited laboratory and are analyzed for pH, temperature, conductivity, total suspended solids, heavy metals, radionuclides, nutrients and general chemistry. The results are compared against the *Saskatchewan Environmental Quality Guidelines* (SEQG[4]) and are reported to the CNSC on a quarterly basis. CNSC staff reviewed the surface water quality results and found that the majority of the results were below the SEQG. At some of the reference and exposure stations, the

[3] An exposure station is a sampling location that may be impacted by the operation. A reference station is a sampling location that is not impacted by the operation and thus, it is considered background.

[4] The province of Saskatchewan publishes the *Surface Water Quality Guidelines* for a variety of water uses. *Surface Water Quality Guidelines* are developed to provide basic scientific information about the effects of water quality variables on potential water use by aquatic life. Surface water quality concentrations below the SEQG mean that the surface water is safe for aquatic life.

concentrations of iron and aluminum are naturally higher than the SEQG. At the exposure stations where the SEQGs were exceeded, concentrations of iron and aluminum are comparable to historical and seasonal values. Based on this rationale, CNSC staff conclude that there is minimal risk to the environment from the CLO.

Aquatic environment monitoring

Environmental effects monitoring at Saskatchewan uranium mines and mills is necessary to meet the requirements of the MDMER as well as any additional requirements from CNSC and the Saskatchewan Ministry of Environment. Cameco's aquatic environment monitoring programs are executed every three years in accordance with the EMP. CNSC staff review the environmental effects monitoring information along with any other routine or special investigations to ensure any impacts to the aquatic receiving environment and biota are identified. During the current licensing period, aquatic monitoring data were collected in 2013, 2016 and 2019.

Cameco's 2016 EPR included aquatic monitoring data collected in 2013. In June 2017, Cameco submitted the *Cigar Lake Operation – 2016 Comprehensive Aquatic Monitoring Report* [13] and in June 2020, Cameco submitted the *Cigar Lake Operation – 2019 Comprehensive Aquatic Monitoring Report* [14]. These reports provided a comprehensive understanding of the aquatic environment surrounding the CLO and the operation's current environmental performance.

CNSC staff reviewed the reports to confirm whether the risks to ecological receptors accepted by the CNSC in previous environmental impact statements (EIS) and environmental risk assessments (ERA) are still valid and the public, Indigenous groups and the environment remain protected. Based on CNSC staff's review, CNSC staff confirmed that the environment in the vicinity of the CLO remains protected.

CNSC Independent Environmental Monitoring Program

The CNSC implemented its Independent Environmental Monitoring Program (IEMP) to verify that the public, Indigenous groups, and the environment around nuclear facilities are safe. It is separate from, but complementary to, the CNSC's ongoing compliance verification program. The IEMP involves taking samples from public areas around the facility and measuring and analyzing the amount of radiological (nuclear) and hazardous substances in those samples. In 2020, samples of surface water, fish (trout, lake whitefish, and northern pike), medicinal/edible plants and blueberries were collected in publicly accessible exposure and reference locations in the vicinity of the CLO.

CNSC staff developed a sampling plan in consultation with interested Indigenous groups. For example, CNSC staff consulted with the Ya'thi Néné Land and Resource Office and with the Métis Nation of Saskatchewan. The Ya'thi Néné reviewed the draft sampling plan and provided suggestions, including sampling locations and species of interest. CNSC staff incorporated some of their

suggestions in the final sampling plan. CNSC staff held meetings with the Métis Nation of Saskatchewan to discuss the sampling plan and to answer their questions about the sampling methodology.

Similar to previous IEMP campaigns in northern Saskatchewan, CNSC staff contracted CanNorth Environmental Services to help in the collection of the samples. However, for the CLO IEMP, CNSC staff did not accompany CanNorth on the sampling trip to avoid interprovincial travelling during the COVID-19 pandemic.

The samples were analyzed for radionuclides, including radium-226, thorium-230, polonium-210, and lead-210, and hazardous substances including arsenic, copper, lead, molybdenum, nickel, selenium, uranium, and zinc. These parameters were chosen because they were contaminants that had the most regulatory and public significance. The samples were analyzed by an accredited laboratory.

The results will be posted on the CNSC's IEMP web page prior to the hearing.

Protection of the public and Indigenous groups

Cameco is required to demonstrate that the health and safety of the public and Indigenous groups are protected from exposures to hazardous and radioactive nuclear substances released from the CLO. The effluent and environmental monitoring programs currently conducted by Cameco at the CLO are used to confirm that releases of hazardous substances do not result in environmental concentrations that may affect public health.

CNSC receives reports of discharges to the environment through the reporting requirements outlined in the CLO licence and LCH. CNSC staff's review of discharges to the environment from the CLO confirm that these releases are below regulatory limits and are within those predicted in the 2004 Environmental Assessment [15], the 2011 Environmental Impact Study [16], the 2017 ERA [8] and the 2019 Addendum [9], which concluded negligible risks to the environment, the public and Indigenous groups.

Based on review of the results of the programs at the CLO, CNSC staff have concluded that the public and Indigenous groups continue to be protected from facility effluent releases and emissions.

Environmental risk assessment

Cameco submitted an Environmental Risk Assessment (ERA) in 2017 [8] as per CSA standard N288.6-12, *Environmental Risk Assessment at Class I Nuclear Facilities and Uranium Mines and Mills*. CNSC staff reviewed the 2017 ERA and determined it to be in compliance with this standard.

The 2017 predicted ecological and human health risks due to releases to air and water from the CLO were within the predictions in the 2004 Environmental Assessment (EA) [15] and 2011 Environmental Impact Study (EIS) [16] accepted by CNSC with the exception of arsenic. Predicted increases in arsenic concentration in the effluent showed potential risk to benthic invertebrate community structures in Seru Bay toward the end of the operating life of the

mine. The EA and the EIS previously accepted by CNSC predicted negligible impacts to the aquatic biota in Seru Bay. As a result, Cameco committed to assessing effluent treatment improvements for arsenic. Predicted risks to the environment and human health was negligible for all other contaminants.

Cameco undertook various investigations between 2017 and 2019 to increase their understanding of organic arsenic in the Cigar Lake ore body, assess efficiencies in water handling and water treatment plant circuits, and consider potential effluent treatment technologies. As a result, Cameco optimized the water handling and treatment circuits at the CLO to limit the release of arsenic in effluent to ALARA.

Cameco submitted the CLO Addendum to the 2017 ERA in 2019 [9] which included revised ERA predictions for all constituents of potential concern (COPCs) released to the aquatic environment to reflect the reduction in arsenic releases in the water treatment plant effluent. Predicted concentrations of arsenic in water and sediment decreased as well as the associated risks to the aquatic environment of Seru Bay, to levels similar to those predicted in the 2011 EIS. The predicted water and sediment concentrations for the other COPCs were largely unchanged compared with the 2017 ERA, with the exception of slightly increased predictions of molybdenum and selenium water and/or sediment concentrations and associated minor increased potential risks to muskrat and the rusty blackbird for conservative effluent release and modelled scenarios.

CNSC staff reviewed the 2019 Addendum [9] to the 2017 ERA [8] and confirmed that despite these minor increased potential risks, the overall risk to the environment and human health from the CLO are negligible. Further, CNSC staff reviewed the measured concentrations of COPCs in water and sediment provided in the 2019 Comprehensive Aquatic Monitoring Report [14] and confirmed the measured values are below predictions.

Additional details and information are provided in the CNSC staff Environmental Protection Review Report in appendix E.

3.9.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.9.3.1 Past Performance

Cameco has developed, implemented and maintained an effective environmental protection program at the CLO that protects the environment and the public in accordance with CNSC regulatory requirements. During the current licensing period, all monitored releases to the environment were well below licence limits specified in the CNSC licence and in the provincial permit. CNSC staff monitor implementation of the environmental protection program through compliance verification activities. CNSC staff rate Cameco's overall performance at the CLO for this SCA as satisfactory for the current licence period.

3.9.3.2 Regulatory Focus

CNSC staff will continue to monitor performance in this area through regulatory oversight activities, inspections, and desktop reviews of Cameco's compliance reporting and revisions to relevant program documentation pertaining to this SCA. CNSC staff conducted 10 inspections, two of which were focused on the CLO environmental program. All findings were minor in nature and have been adequately addressed.

3.9.3.3 Proposed Improvements

Starting in June 2021, the MDMER will have additional provisions come into force. There will be more stringent licence limits for arsenic and lead, and new licence limits for un-ionized ammonia. In addition, the MDMER will change the Daphnia magna toxicity testing from a reporting requirement to a compliance requirement. The MDMER does not consider an initial Daphnia magna toxicity test failure as a non-compliance; however, failure on any subsequent Daphnia magna toxicity tests would be considered a non-compliance. In July 2013, there was one Daphnia magna toxicity test failure, but an investigation determined that the sample shipment temperature may have caused this result. A follow-up effluent sample was taken a few days later and passed the Daphnia magna toxicity test. The new MDMER limits are included in the draft LCH. CNSC staff note that the CLO is already in compliance with the new MDMER and the more stringent effluent limits.

CNSC staff, as part of on-going compliance activities, will review any proposed modifications to Cameco's environmental management program documentation to ensure effective implementation with updates to CSA Group standards and CNSC's regulatory framework.

3.9.4 Conclusion

Cameco's CLO has implemented and maintained an environmental protection program that adequately protects the environment and the public in accordance with regulatory requirements. No adverse effects are expected on human health during operation.

The environmental protection program at the CLO continues to be effective in protecting the environment and minimizing adverse impacts to human health. As documented in the Environmental Protection Review Report (appendix E), CNSC staff concluded that impacts to aquatic receptors from contaminant exposure are expected to be limited to the near-field environment during operation and are predicted to decline following decommissioning. Cameco's CLO has and will continue to make adequate provision for the protection of the environment and the health and safety of persons.

3.9.5 Recommendation

Two conditions in the proposed licence are associated with the environmental protection SCA. CNSC staff recommend that the licence conditions remain.

3.10 Emergency Management and Fire Protection

The emergency management and fire protection SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions.

This SCA also includes the requirement for Cameco's CLO to have a comprehensive fire protection program to minimize the risk to the health and safety of persons and to the environment from fire; through appropriate fire protection system design, fire safety analysis, fire safe operation and fire prevention.

The specific areas that comprise this SCA at CLO that are addressed individually in this document are:

- emergency preparedness and response
- fire protection.

3.10.1 Trends

The following table indicates the overall rating trends for the emergency management and fire protection SCA over the current licensing period:

TRENDS FOR EMERGENCY MANAGEMENT AND FIRE PROTECTION							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation has an acceptable emergency preparedness and response program that meets CNSC regulatory and performance requirements. Cameco's fire protection program is in place to minimize both the probability of occurrence and the consequences of fire and meets CNSC regulatory requirements.							

3.10.2 Discussion

Emergency preparedness and response

Uranium mines and mills are required to have emergency plans in place for the protection of the health and safety of workers, the public and the environment. Cameco's emergency response program and emergency response plan contain the necessary guidelines and responsibilities for a Cigar Lake staff response should an emergency occur. The plan identifies the onsite emergency response organization members and their duties and responsibilities for responding to emergencies. The plan also specifies the required equipment to be used in responding to such emergencies, maintenance of equipment and detailed response procedures. The emergency response plan addresses both general emergency response and firefighting response procedures.

As required by the CNSC and also by Saskatchewan's *The Mines Regulations, 2018*, Cameco must train emergency response team members. Cameco utilizes classroom and field training as well as drills and exercises to ensure the preparedness of licensee personnel and the emergency response team (ERT) and mine rescue team (MRT). The knowledge and performance for the ERT and MRT are tested during planned emergency exercises. Ongoing field training includes drills and exercises to ensure the preparedness of site personnel. To test specific skills, the ERT and MRT are mobilized for events such as medical emergencies and transportation of ill or injured personnel, rescue drills, fire drills with search and rescue, ventilation and fire suppression activities. As well, Cameco's ERT and MRT trains for, and regularly competes in, emergency mine rescue and industrial fire and response competitions.

CNSC staff verified Cameco's implementation of its emergency response program at the CLO in accordance with CNSC regulatory requirements through inspections and desktop reviews during the current licence period. In September 2016, a focused emergency preparedness inspection was conducted to verify implementation and effectiveness of Cameco's emergency response program at the CLO. The inspection report outlined some low risk deficiencies resulting in one non-compliance and four recommendations. Examples of the low risk deficiencies include emergency response work instruction and check sheets not being used in the emergency command center; personal names rather than position titles used during communication; no clear "end of exercise" announcement to all participants and site staff at termination of exercises. Cameco provided an action plan addressing the inspection findings in a timely and satisfactory manner and have taken all appropriate corrective actions. CNSC staff have verified and are satisfied with the corrective measures taken by Cameco.

Fire protection

Cameco has a fire protection program (FPP) in place at the CLO to minimize both the probability of occurrence and the consequences of fire at the facility. The program has been established to comply with the requirements of the *National Building Code of Canada* and the *National Fire Code of Canada, 2010*.

Cameco maintains a fire safety plan (FSP) at the CLO that describes the facilities, systems, activities and training designed to prevent the outbreak of fire, to protect the health and safety of all persons and to minimize the loss of property in the event of a fire. The FSP is a province of Saskatchewan requirement of the *Occupational Health and Safety Regulations* and the *National Fire Code of Canada, 2010*. The province administers fire protection requirements in accordance with *The Mines Regulations, 2018* that provides specific requirements applicable to mines including underground workings.

The FSP provides information on specific responsibilities, emergency instructions in the event of a fire, training provided to personnel during orientation, fire protection inspections, execution of fire drills, description of how fire hazards are controlled and descriptions of specific fire hazards at the site. The FSP is reviewed annually at a minimum.

The maintenance, tests and inspections performed on the fire protection system at the CLO are designed to meet the requirements of the *National Fire Code of Canada, 2010*, *National Building Code of Canada, 2010*, applicable *National Fire Protection Association* standards, provincial regulations and Occupational Health and Safety Assessment Series (OHSAS):18001 standards. Cameco utilizes a third-party consultant to review proposed projects with potential impact to fire protection. The third-party consultant evaluates the proposed change(s), assesses its potential fire hazards, appropriate fire protection system and features used to mitigate the fire hazards. These third-party reports were submitted to and reviewed by CNSC staff.

The objective of the fire hazard assessments (FHA) is to demonstrate that a comprehensive assessment has been made of the potential fires and that its impacts on people, equipment, buildings and the environment are within acceptable limits. This was accomplished by demonstrating that the fire protection objective for a facility, as defined by the CNSC, can be met under foreseeable fire events. As required by the CNSC, a FHA was completed in 2012 by a third-party consultant for all existing buildings at the CLO along with a corrective action plan to address recommendations arising from the FHA [17]. The FHA and corrective action plan were reviewed by CNSC staff and found to be acceptable and meeting expectations.

3.10.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.10.3.1 Past Performance

Emergency preparedness program

Based on CNSC staff's desktop reviews and inspections, CNSC staff concluded that Cameco's emergency preparedness program continues to be satisfactory at the CLO. Cameco continues to improve its emergency preparedness and response program based on changes to regulatory requirements as well as lessons learned from exercises and drills.

Fire protection program

Cameco's CLO has an acceptable FPP in place to minimize both the probability of occurrence and the consequences of fire. The contents of the FPP contain elements that would be expected for a mine/mill facility and comply with the requirements of the *National Fire Code of Canada, 2010*, and the *National Building Code of Canada, 2010*.

In conclusion, Cameco's FPP and its implementation at the CLO continue to meet regulatory requirements.

3.10.3.2 Regulatory Focus

CNSC staff conducted three inspections which included compliance verification criteria from the emergency management and fire protection programs during the licence term, including a focused inspection conducted in September 2016. All non-compliances identified during the inspections were of low safety significance and all action notices issued were addressed by CLO staff. CNSC staff will continue to monitor performance in this area through regulatory oversight activities including inspections and desktop reviews of Cameco's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

Saskatchewan Ministry of Labour Relations and Workplace Safety, under its agreement with Employment and Social Development Canada and the CNSC, also conduct regular compliance inspections including fire protection. Inspection reports are shared with the CNSC and regular oversight is provided by CNSC staff as needed.

3.10.3.3 Proposed Improvements

For the proposed licence term, CNSC staff added regulatory document CSA standard N393, *Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances* as guidance to the draft LCH. CNSC staff will continue to monitor implementation through regulatory oversight activities including inspections and desktop reviews of Cameco's compliance reporting on this matter.

3.10.4 Conclusion

As part of the licence renewal application, revised emergency preparedness and fire protection program documents and associated procedures were submitted by Cameco to meet applicable regulatory requirements. CNSC staff performed a desktop review of the documents and identified some gaps. Cameco addressed CNSC staff comments satisfactorily and in a timely manner.

Based on desktop reviews and inspections, CNSC staff concluded the overall performance for this SCA is satisfactory and that Cameco is qualified to carry out the authorized activities at the CLO in this SCA.

3.10.5 Recommendation

Two conditions in the proposed licence are associated with the emergency management and fire protection SCA.

CNSC staff recommend that the existing licence conditions remain.

3.11 Waste Management

The waste management SCA 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, or placed into long-term storage on site. This area also covers the planning for decommissioning.

The specific areas that comprise this SCA addressed individually in this document are:

- waste rock piles
- solid and liquid wastes
- decommissioning plans.

3.11.1 Trends

The following table indicates the overall rating trends for the waste management SCA over the current licensing period:

TRENDS FOR WASTE MANAGEMENT							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation programs are adequate for the management of domestic, industrial and chemically/radiologically contaminated waste. CNSC staff monitor Cameco's implementation of this program through compliance verification activities. Cameco's Cigar Lake Operation presently has a valid preliminary decommissioning plan in place, which accepted by CNSC staff following its submission in August 2017. CNSC staff are satisfied with Cameco's waste management program and its implementation.							

3.11.2 Discussion

The CNSC requires the licensees of uranium mines and mills to have in place a waste management program for generation, transport, handling, processing, storing, or disposing of the wastes that are produced as a result of licensed activities. The CNSC requires Cameco to take all reasonable precautions for the safe management of waste to protect workers and the environment and to control releases of nuclear and hazardous substances.

Cameco has implemented its waste management program to effectively control wastes generated and stored at the CLO. The objectives of this program are to minimize the generation of waste at the facility and dispose of wastes and by-products generated in accordance with CNSC regulatory requirements. The CLO waste management program referenced in the LCH describes how waste is

managed throughout its lifecycle to the point of disposal. This includes waste generation, storage, processing, recycling and removal/transfer activities. The regulated activities at Cameco's CLO have and will continue to produce or dispose of various wastes which include the following:

- clean waste rock and overburden piles
- potentially acid generating and mineralized waste rock piles
- site run-off containment ponds
- drill core storage areas
- contaminated industrial waste storage
- storage and recycling facilities for hazardous wastes
- landfill for uncontaminated industrial and domestic waste
- domestic sewage treatment.

During the review period, seven CNSC inspections included waste management compliance verification criteria. A focused inspection of the waste management program conducted in August 2018 did not identify any non-compliances related to the waste management program. Cameco adequately addressed all non-compliances and recommendations identified during the review period.

Waste rock piles

Cameco has a waste rock management plan for three types of waste rock piles, these include:

- Stockpile A and A-1 - unlined storage areas for benign waste rock (mostly sandstone)
- Stockpile B - lined and used to store mineralized waste that is potentially contaminated with radioactive material
- Stockpile C - lined and used for storage of potentially acid-generating waste rock.

CNSC staff continue to monitor the management of waste rock at Cameco's CLO to verify compliance with CNSC regulatory requirements.

Solid and liquid wastes

Industrial, radiologically contaminated, chemically contaminated, dangerous goods and domestic wastes are generated in both liquid and solid forms at the CLO. A waste management system has been implemented at the CLO to track and control the appropriate disposition of contaminated and non-contaminated wastes. In August 2018, CNSC staff verified through an inspection that wastes are being disposed of in an appropriate manner in approved facilities.

Decommissioning plans

In accordance with paragraph 3(a)(viii) of the UMMR and the CNSC Regulatory Guide G-219, *Decommissioning Planning for Licensed Activities,* the CNSC requires Cameco to maintain decommissioning plans throughout the lifecycle of the CLO. The CNSC and SMOE staff work closely to ensure regulatory requirements are met. A memorandum of understanding (MOU) with the province of Saskatchewan guides the nature of the cooperation between the parties [18].

Cameco's *Preliminary Decommissioning Plan (PDP) and Preliminary Decommissioning Cost Estimate* (PDCE) [19] sets out the strategy and the preliminary plan by which CLO will be decommissioned in the future. The PDP must remain current to reflect any changes in the facility or operations, and meet the requirements of CSA standard N294-09, *Decommissioning of Facilities Containing Nuclear Substances,* and CNSC Regulatory Guide G-219. The licensee's submitted plan is reviewed and assessed by CNSC staff in accordance with these documents.

In 2017, Cameco revised and submitted the PDP and PDCE for the CLO following a five-year cycle requirement. The PDCE has been updated to include decommissioning of the CLO, current labour and equipment rates, and future water treatment requirements. The revised plan was prepared based on a "decommission tomorrow" scenario with consideration of planned activities within a five-year period to the end of 2022 and covered all decommissioning costs resulting from past and expected future activities.

Based on current mineral reserves, Cameco has indicated that the life of the CLO mine is estimated at 15 years following initial production. Cameco has provided timeline estimates for the completion of each of the major decommissioning activities planned. The decommissioning of the facility is expected to occur over a period of approximately 14 years.

Based on the revised PDP and PDCE, Cameco proposed to revise their financial guarantee to the amount of $61.79 million. CNSC staff reviewed the proposed revisions and concluded that the revised PDP including cost estimates for decommissioning and financial assurance continue to meet CNSC regulatory requirements. The SMOE has also reviewed and approved the revised PDP and associated cost estimates (refer to section 4.4 for further details on the financial guarantee).

3.11.3 Summary

A summary of Cameco's past performance, challenges and proposed improvements are presented in the following subsections.

3.11.3.1 Past Performance

Through the review of waste management documentation and inspections during the licence period, CNSC staff concluded that Cameco's CLO waste management program meets regulatory requirements.

For the current licence period, CNSC staff rated Cameco's overall performance for the waste management SCA as satisfactory.

3.11.3.2 Regulatory Focus

During the review period, seven CNSC inspections included waste management compliance verification criteria. A focused inspection of the waste management program was conducted in August 2018.

CNSC staff will continue to monitor performance in this area through regulatory oversight activities including inspections and desktop reviews of Cameco's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.11.3.3 Proposed Improvements

There are no proposed improvements for this SCA.

3.11.4 Conclusion

Based on desktop reviews and inspections, CNSC staff have concluded that the overall performance for this SCA is satisfactory and that Cameco is qualified to carry out the authorized activities at the CLO in this SCA.

3.11.5 Recommendation

Two conditions in the proposed licence are associated with the waste management SCA. CNSC staff recommend that the existing licence conditions remain.

3.12 Security

The security SCA 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.

The specific areas that comprise this SCA are not addressed individually in this document.

3.12.1 Trends

The following table indicates the overall rating trends for the security SCA over the current licensing period:

TRENDS FOR SECURITY							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA

Comments

Cameco's Cigar Lake Operation has implemented a security program that meets regulatory requirements under the *General Nuclear Safety and Control Regulations* to prevent the loss or unauthorized removal of nuclear substances, radioactive sources, prescribed equipment or information. CNSC staff monitor Cameco's implementation of this program through compliance verification activities.

CNSC staff are satisfied with Cameco's security program and its implementation.

3.12.2 Discussion

Pursuant to the NSCA and its regulations, Cameco is obligated to protect the environment, the health and safety of persons, and maintain security.

Cameco maintains a security program (technical and administrative) at the CLO in order to minimize risk to the public, employees, the environment and to protect company assets from sabotage, theft, criminal acts by internal or external agents and potential vulnerabilities.

Based on review of Cameco's vulnerability at the CLO, the lack of incidents involving theft and sabotage to the operation, the remote location of the operation, the percentage of long-term employees, and the lack of evidence of any threats to the operation, the security risk is considered low. There is no change to the security threat at the CLO and the security measures currently in place are adequate.

During the current licensing period, no theft of nuclear material from the CLO was reported. A physical inventory of all uranium material is conducted annually by an external auditor, and monthly by Cameco personnel. There is no history of sabotage or any evidence of intent of actual or planned sabotage threats conveyed to CNSC.

CNSC staff monitor implementation of this program through compliance verification activities. Two inspections conducted during the licence period included criteria related to the security SCA. No non-compliances were identified related to this SCA.

CNSC staff have concluded that the security measures are sufficient to address the current threat level.

3.12.3 Summary

A summary of Cameco's past performance, challenges and proposed improvements are presented in the following subsections.

3.12.3.1 Past Performance

Cameco's CLO has implemented a security program that meets regulatory requirements. CNSC staff monitor implementation of this program through compliance verification activities.

During the current licence period, there have been no thefts or any evidence of malicious acts or planned sabotage against nuclear substances at the CLO.

3.12.3.2 Regulatory Focus

Cameco's CLO is required to meet the applicable requirements of sections 3 and 12 of the GNSCR and section 3(e) of the UMMR. The regulations require reasonable measures be in place to: maintain site security; implement means for alerting the licensee in the event of illegal use, illegal removal, sabotage or attempted sabotage; and, train workers on the security program at the licensed site.

CNSC's REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material*, Version 2.1, sets out the minimum security measures that must be implemented to prevent the loss, sabotage and illegal use, possession or illegal removal of sealed sources during its entire lifecycle.

3.12.3.3 Proposed Improvements

There are no proposed improvements or changes for this SCA.

3.12.4 Conclusion

CNSC staff assessed Cameco's documentation and analyses under the security SCA and have found it to be acceptable. CNSC staff concluded that the overall performance for this SCA is satisfactory and that Cameco is qualified to carry out the authorized activities at the CLO in this SCA.

CNSC staff also concluded that Cameco has acceptable security programs in place at the CLO that meet regulatory requirements and make adequate provisions for the maintenance of national security.

CNSC staff will continue ongoing compliance activities and monitoring activities in the security area to verify that Cameco's security programs at the CLO, including its implementation, continue to meet regulatory requirements.

3.12.5 Recommendation

One condition in the proposed licence is associated with the security SCA. CNSC staff recommend the condition remain.

3.13 Safeguards and Non-Proliferation

The safeguards and non-proliferation SCA covers the programs and activities required for the successful implementation of the obligations arising from the Government of Canada and the International Atomic Energy Agency (IAEA) safeguards agreements as well as other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons.*

The scope of the non-proliferation program for this licensee is limited to the tracking and reporting of foreign obligations and origins of nuclear material. This tracking and reporting assists the CNSC in the implementation of Canada's bilateral Nuclear Cooperation Agreements with other countries. The import and export of controlled nuclear substances, equipment and information identified in the *Nuclear Non-proliferation Import and Export Control Regulations* require separate authorization from the CNSC, consistent with subsection 3(2) of the GNSCR.

The specific areas that comprise this SCA are not addressed individually in this document.

3.13.1 Trends

The following table indicates the overall rating trends for the safeguards and non-proliferation SCA over the current licensing period:

TRENDS FOR SAFEGUARDS AND NON-PROLIFERATION							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation continues to implement and maintain an effective program for safeguards measures and nuclear non-proliferation commitments arising from Canada's international obligations under the *Treaty on the Non-Proliferation of Nuclear Weapons*. CNSC staff are satisfied with Cameco's program for safeguards measures and meeting nuclear non-proliferation commitments.							

3.13.2 Discussion

CNSC's regulatory mandate includes ensuring conformity with measures required to implement Canada's international obligations. Cameco has an effective safeguards program at the CLO that conforms to measures required by the CNSC to meet Canada's international safeguards obligations as well as other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*.

Pursuant to that treaty, Canada has entered into a Comprehensive Safeguards Agreement and Additional Protocol with the IAEA (here in after, the safeguards agreements). The objective of the safeguards agreements is for the IAEA to

provide annual assurance to Canada and to the international community that all declared nuclear material is in peaceful, non-explosive uses, and that there is no indication of undeclared nuclear material or activities.

The CNSC provides the mechanism, through the NSCA, regulations and a licence condition, for the IAEA to implement the safeguards agreements at the CLO. Conditions for the application of IAEA safeguards are contained in the operating licence and criteria in order to meet the conditions contained in the LCH and in CNSC's REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*. Compliance includes the timely provision of reports on the movement and location of all nuclear materials; operational requirements, and access and assistance to IAEA inspectors for safeguards activities.

To comply with the safeguards agreements, Cameco's CLO ensures that:

- controlled nuclear substances exports or imports follow appropriate permitting and licensing
- operational records are maintained
- required information is provided and an annual update for the IAEA protocol is submitted to the CNSC.

In May 2016, CNSC received a request from the IAEA for complementary access at the CLO. Assistance was provided to the IAEA to carry out the complementary access on May 18 to 19, 2016. No issues were identified by the IAEA as part of this activity.

3.13.3 Summary

A summary of Cameco's past performance, challenges and proposed improvements are presented in the following subsections.

3.13.3.1 Past Performance

During the current licence period, Cameco provided CNSC staff with documentation required for the implementation of safeguards agreements.

Cameco's program for safeguards and non-proliferation at the CLO continues to meet CNSC requirements and expectations.

3.13.3.2 Regulatory Focus

CNSC staff will continue to monitor performance through participation in IAEA activities and through CNSC regulatory oversight activities independent of the IAEA. Monitoring will include inspections and desktop reviews of Cameco's compliance with reporting and revisions to relevant program documentation pertaining to this SCA.

3.13.3.3 Proposed Improvements

There are no proposed improvements or changes for this SCA.

3.13.4 Conclusion

CNSC staff assessed the CLO documentation and performance under the safeguards and non-proliferation SCA and found it to be acceptable. CNSC staff concluded that the overall performance for this SCA is satisfactory and that Cameco is qualified to carry out the authorized activities at the CLO in this SCA.

3.13.5 Recommendation

There is one condition in the proposed licence associated with the safeguards and non-proliferation SCA. CNSC staff recommend the licence condition remain.

3.14 Packaging and Transport

The packaging and transport SCA covers programs for the safe packaging and transport of nuclear substances to and from the licensed facility. The specific areas that comprise this SCA at the CLO are not addressed individually in this document.

3.14.1 Trends

The following table indicates the overall rating trends for the packaging and transport SCA over the current licensing period:

TRENDS FOR PACKAGING AND TRANSPORT							
Overall Compliance Ratings							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA
Comments							
Cameco's Cigar Lake Operation has a packaging and transportation program that ensures compliance with the *Packaging and Transport of Nuclear Substances Regulations, 2015*, and the *Transportation of Dangerous Goods Regulations*. CNSC staff monitor Cameco's implementation of this program through compliance verification activities. CNSC staff have confirmed that the packaging and transport activities are conducted in a safe manner.							

3.14.2 Discussion

Cameco has developed and implemented a packaging and transport program for activities at all Cameco operated sites to ensure compliance with the *Packaging and Transport of Nuclear Substances Regulations, 2015*, and the *Transportation of Dangerous Goods Regulations* for all shipments to and from the site. Cameco's packaging and transport program also covers elements of package design and package maintenance as required by the regulations.

Uranium ore, in slurry form, is transported from Cameco's CLO to Orano's McClean Lake Operation for milling. Ore slurry transportation from the CLO to the McClean Lake mill is the responsibility of the CLO. Loaded vehicles proceed

directly from the CLO to the McClean Lake ore receiving facility where they are off-loaded. The requirements for radiation-related clearances of uranium ore slurry containers (figure 3.9) departing from CLO are described in the Cigar Lake RP program.

Ore slurry shipments from Cameco's Cigar Lake mine began in March 2014. The ore slurry is shipped in containers which are similar in design to the containers that have been safely used at Cameco's McArthur River and Key Lake Operations since 1999. These containers meet the regulatory requirements for industrial packages (IP-2) as defined in the *Packaging and Transport of Nuclear Substances Regulations, 2015*.

Figure 3.9: Uranium ore slurry containers

Source: Cameco Corporation

In support of the licence renewal, Cameco submitted documents related to the packaging and transportation for CNSC staff's review. CNSC staff concluded that Cameco's packaging and transportation documents meet applicable regulatory requirements.

During the review period, CNSC staff conducted compliance inspections that covered various aspects of CLO's transport and packaging program. In November 2018, CNSC staff conducted a focused transportation and packaging inspection at the CLO. CNSC staff reviewed procedures, workers' training records, transportation logs, package labelling and shipping documents. Packaging and loading of product and work practices were observed. CNSC staff concluded that

the transport and packaging program and associated procedures complied with regulatory requirements. Cameco addressed minor deficiencies identified during the inspection to CNSC staff's satisfaction.

During the licence term, minor packaging and transport incidents involving ore slurry containers slightly exceeding surface contamination limits were reported by Cameco for the CLO. None of the incidents resulted in health or radiological effects or releases to the environment. CNSC staff were satisfied with the corrective actions taken in response by the licensee.

3.14.3 Summary

A summary of Cameco's past performance, challenges and proposed improvements are presented in the following subsections.

3.14.3.1 Past Performance

Cameco is performing satisfactorily in the packaging and transport SCA at the CLO and continues to demonstrate compliance with the *Packaging and Transport of Nuclear Substances Regulations, 2015* and the *Transportation of Dangerous Goods Regulations*. For the current licence period, CNSC staff rated Cameco's overall performance for the packaging and transport SCA as satisfactory.

3.14.3.2 Regulatory Focus

CNSC staff conducted six inspections that included compliance verification criteria related to the packaging and transport SCA. In November 2018, a focused inspection of the packaging and transport program was conducted by CNSC staff. Three action notices and two recommendations were issued as a result of the focused inspection. The action notices were related to proper labelling, and documentation related to the packaging and transport of nuclear substances. All action notices were of low safety significance and were addressed by the licensee to the satisfaction of the CNSC.

CNSC staff will continue to monitor performance in this area including Cameco's commitment of continual improvement for the packaging system through regulatory oversight activities. Monitoring includes inspections and desktop reviews of Cameco's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.14.3.3 Proposed Improvements

There are no proposed improvements for this SCA.

3.14.4 Conclusion

CNSC staff concluded that Cameco has an effective program for the safe packaging and transport of radioactive materials at the CLO that meet regulatory requirements. CNSC staff rate this SCA as satisfactory.

3.14.5 Recommendation

One condition in the proposed licence is associated with the packaging and transport SCA. CNSC staff recommend this condition remain.

4. OTHER MATTERS OF REGULATORY INTEREST

4.1 Indigenous Engagement

The common law duty to consult with Indigenous peoples applies when the Crown contemplates actions that may adversely affect potential or established Indigenous and/or treaty rights. The CNSC ensures that all of its licensing decisions under the NSCA uphold the honour of the Crown and consider Indigenous peoples' potential or established Aboriginal and/or treaty rights pursuant to section 35 of the *Constitution Act, 1982*.

4.1.1 Discussion

CNSC staff have identified the First Nation and Métis groups who may have an interest in the proposed licence renewal of Cameco's CLO. These groups include: English River First Nation, Hatchet Lake First Nation, Black Lake First Nation, Fond-du-Lac Denesuline First Nation, Lac La Ronge Indian Band, Métis Nation of Saskatchewan, Ya'thi Néné Land and Resource Office, Prince Albert Grand Council and Northern Saskatchewan Environmental Quality Committee (NSEQC). These groups were identified because they all have previously expressed interest in being kept informed of CNSC licensed activities occurring in proximity to their traditional and/or treaty territories.

CNSC staff sent letters of notification in October 2020, to the Indigenous groups identified above, providing information regarding the proposed licence renewal application, the availability of participant funding to facilitate participation in the hearing process, and details on how to participate in the Commission's public hearing process proposed for April 2021.

CNSC staff conducted follow-up phone calls with the identified groups in November 2020, to ensure they had received the letters and to answer any questions about the regulatory process and how to get involved in the Commission proceedings. Additional communication with identified Indigenous groups conveyed updated information pertaining to the specific hearing dates and information on the participant funding opportunity through the CNSC's Participant Funding Program (PFP).

The CNSC awarded $120,930 to Indigenous groups through the PFP to participate in the regulatory process for Cameco's proposed licence renewal for the CLO. Participation is to provide value-added information to the Commission through informed and topic-specific interventions. CNSC staff engaged with Indigenous groups throughout the review period. Details on these engagement activities are described in the regulatory oversight report on uranium mines and mills for the year in which the engagement took place. In addition, CNSC staff had a video conference meeting with members of Indigenous leadership in Northern

Saskatchewan in September and November 2020 to provide updates on a number of CNSC regulated facilities and activities in their traditional territories, including discussions on the Cigar Lake licence renewal. To date, CNSC staff have not been made aware of any specific concerns regarding Cameco's licence renewal application for its CLO. CNSC staff are committed to continuing to address concerns and provide information pertaining to the CLO licence renewal.

CNSC's REGDOC-3.2.2, *Indigenous Engagement*, Version 1.1, published in August 2019, sets out requirements and guidance for licensees whose proposed projects may raise the Crown's duty to consult. While the CNSC cannot delegate its obligation, it can delegate procedural aspects of the consultation process to licensees, where appropriate. The information collected and measures proposed by licensees to avoid, mitigate or offset adverse impacts from the proposed licence renewal, may be used by CNSC staff in meeting its consultation obligations. Cameco's renewal application for a CNSC licence of their CLO does not raise the formal requirements of REGDOC-3.2.2. However, CNSC staff recognize that Cameco has a well-established engagement and communications program with interested Indigenous groups, and are committed to keeping CNSC staff informed of their engagement activities and any issues raised by the identified groups. CNSC staff encourage Cameco to continue engaging with these communities regarding their facilities and activities including the licence renewal application.

4.1.2 Conclusion

As Cameco is currently not proposing any changes to its Cigar Lake facility and operations, CNSC staff conclude that a licence renewal for the CLO will not cause any adverse impacts to any potential or established Indigenous and/or treaty rights.

The CNSC conducted a thorough engagement and outreach process in relation to this licence renewal application with all interested Indigenous groups and is committed to meaningful, ongoing engagement with Indigenous groups that have an interest in CNSC regulated facilities and activities.

4.2 Public Engagement

As per its normal public notification process for Commission proceedings, CNSC staff informed the public via the CNSC's website, email subscription list, social media channels, radio and print advertisements in local communities in northern Saskatchewan of the public Commission hearing and availability of participant funding.

Part of CNSC's mission is to provide objective scientific and regulatory information to the public concerning nuclear activities. The availability and clarity of information pertaining to nuclear activities is essential to establishing an atmosphere of openness, transparency and trust between the licensee and the public. Licensees have an important role to inform the public about their nuclear facility and activities. Since 2012, the CNSC requires major licensees to develop

and implement a public information and disclosure program (PIDP) supported by a robust disclosure protocol that addresses local communities and stakeholders' needs, discussed fully in section 4.2.

CNSC staff annually report to the Commission and the public on the regulatory oversight of all the uranium mines and mills in northern Saskatchewan, including the CLO. The list of regulatory oversight reports (ROR) is presented in the references within this CMD and are also available on the CNSC's website. The public has the opportunity to review, question and comment on the ROR and appear before the Commission. Through CNSC's PFP, financial support was made available for participation in the review of this CMD.

During the review period, the CNSC organized a CNSC 101 information session to over 100 participants in the Wollaston Post/Hatchet Lake First Nation community on October 11, 2016, including representatives from other northern Saskatchewan First Nation and Métis communities and organizations. This session summarized the CNSC and the work it does to ensure that nuclear facilities in northern Saskatchewan and across Canada are safe and how the public can participate in the licensing process. In addition, the CNSC hosted a CNSC 101 session for leadership and staff of the Prince Albert Grand Council and the Federation of Sovereign Indigenous Nations in Saskatoon, Saskatchewan on October 12, 2016.

CNSC staff engage with interested communities and their leadership. CNSC staff participated in various meetings and local community events to offer two-way discussion, clarity and explanation of the regulatory process and scientific data to key audiences interested in the uranium mines and mills in northern Saskatchewan (figure 4.1 to figure 4.3). For example, CNSC and licensee staff participated in Northern Saskatchewan Environmental Quality Committee (EQC) meetings and facility tours. The EQC represents over 30 communities throughout the greater northern Saskatchewan region. The EQC, established in 1995, enables northerners to learn more about uranium mining activities and to see first-hand the environmental protection measures being employed. Scheduled meetings of the Northern Saskatchewan EQC occurred throughout the licence period. CNSC staff also participate in EQC meetings when requested.

Figure 4.1: CNSC session with Environmental Quality Committee members

Source: CNSC

In 2019, as a result of recommendations from the Commission, CNSC staff took an initiative to meet with Indigenous groups and communities to provide information and seek opportunity for improvement on the ROR (figure 4.2). In addition, a teleconference meeting with northern community leadership was conducted in September 2020, which included information on the Cigar Lake licence renewal and the 2019 ROR. These information sessions were conducted prior to the ROR being presented at the Commission meetings.

Figure 4.2: CNSC staff outreach presentation, Prince Albert, Saskatchewan September 2019

Source: CNSC

During public engagement activities, the CNSC often staffs an information booth to provide important information on its regulatory role and mandate, as well as to answer any questions that community members may have. The CNSC is committed to keeping interested communities informed of regulatory activities occurring at the mines and mills and will continue to look for ways to enhance the involvement of interested groups.

Figure 4.3: CNSC information session at a Northern Community, 2015

Source: CNSC

4.2.1 Discussion

The CNSC made available up to C$100,000 through its PFP to assist members of the public, Indigenous groups, and other stakeholders in providing value-added information to the Commission through informed and topic-specific interventions. This funding was offered to review Cameco's licence renewal application and associated documents and to prepare for and participate in the Commission's public hearing.

The PFP application deadline was November 30, 2020. The Funding Review Committee (FRC), independent from CNSC staff, reviewed the applications received, and made recommendations on the allocation of funding to eligible recipients. Based on the recommendations from the FRC, the CNSC awarded a total of $124,094, in funding. Funding was provided to the following groups:

- Canadian Nuclear Workers' Council
- English River First Nation
- Métis Nation-Saskatchewan
- Saskatchewan First Nation Natural Resource Centre of Excellence
- Ya'thi Néné Land and Resource Office.

4.2.2 Conclusion

CNSC staff continued to inform the public of our regulatory activities through regular website updates, local magazine updates, publicly webcast Commission proceedings, social media and regular face-to-face discussion with key audiences in Northern Saskatchewan.

CNSC staff encourage the public to participate in the Commission's public hearing. The CNSC offered assistance to interested members of the public, Indigenous groups, and other stakeholders, through the PFP, to prepare for and participate in the Commission's public hearing.

4.3 Cost Recovery

It is a requirement of the NSCA under paragraph 24(2)(*c*), that the licence application is accompanied by the prescribed fee. The *CNSC Cost Recovery Fees Regulations* (CRFR) set out the specific requirements based on the activities to be licensed. An applicant for a uranium mines and mills licence is subject to "Part 2" of CRFR, which is based on "Regulatory Activity Plan Fees".

4.3.1 Discussion

Cameco is in good standing with respect to CRFR requirements for its CLO.

Cameco's licence renewal application is not an initial application, and as such, the applicant is not required to submit the initial fee of C$25,000 as described in paragraph 7(1)(a), which is only for initial applicants. In this case, Cameco is subject to subsection 5(2) of the CRFR, which relates to quarterly invoices sent to licensees.

4.3.2 Conclusion

After assessing CNSC records, CNSC staff conclude that Cameco is in good standing with respect to CLO meeting CRFR requirements.

No licence condition is required for this matter.

4.4 Financial Guarantees

Under subsection 24(5) of the NSCA, Cameco is required to provide a financial guarantee in a form that is acceptable to the Commission. *General Nuclear Safety and Control Regulations*, paragraph 3(1)(*l*) stipulates that, "an application for a licence shall contain a description of any proposed financial guarantee related to the activity for which a licence application is submitted." The CNSC's Regulatory Guide G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*, covers the provision of financial guarantees for decommissioning activities.

4.4.1 Discussion

As discussed in subsection 3.11.2, Cameco has revised its PDP and cost estimate for the decommissioning of the CLO. Cameco has proposed a revised financial guarantee of C$61.79 million which was approved by Commission on November 13, 2020 [2]. The updated financial guarantee is an increase of C$12.59 million from the previous C$49.2 million.

The updated amount of the cost estimate is reflecting all major decommissioning activities, including decommissioning of underground workings, surface and underground infrastructure, waste management, project management, regulatory

oversight, time and institutional control necessary to decommission the CLO as planned. It includes an annual discount rate, corrected for inflation and reflecting the published Government of Canada benchmark bond yields.

The Government of Saskatchewan, under *The Mineral Industry Environmental Protection Regulations, 1996*, also requires that mining and milling projects be covered by financial guarantees. The provincial review of Cameco's PDP and cost estimate is independent to CNSC staff's review. The MOU between CNSC and the Province of Saskatchewan allows a single PDP and financial assurance, subject to consultation and mutual acceptance. The MOU also specifies that the financial guarantee is conditional until approved by the Commission. The SMOE is the beneficiary of the financial guarantee for all the operating and decommissioned uranium mines and mills, and is the owner of the lands.

Cameco provided acceptable financial instruments for previously approved preliminary decommissioning plans. As stated in the Record of Decision of November 13, 2020, to approve the updated financial guarantee for Cigar Lake, Cameco is required to provide updated financial instruments, acceptable to the Commission, within 90 days of the decision.

4.4.2 Conclusion

Cigar Lake Operation currently has a valid financial guarantee that was approved by the Commission on November 13, 2020 [2].

4.5 Improvement Plan and Significant Future Activities

4.5.1 Discussion

Within section 2.8 of the Cigar Lake MFLM [5], Cameco identified that during the licence term, the CLO will continue to identify and pursue opportunities to improve operational efficiency while continuing to maintain the safety of workers and the public as well as protection of the environment. Such opportunities may include, but are not limited to:

- examination of opportunities to improve efficiency of current ground freezing and of mine ventilation practices
- examination of alternative mining methods
- ongoing evaluation of measures to improve environmental performance.

As is the case with all mines, brownfield exploration is conducted as a means of maximizing the return on investment. Continued exploration of the Cigar Lake ore body is considered an activity that is part of the licensing basis. As such, through additional exploration drilling, there is potential to identify ore reserves within the Cigar Lake ore body in areas which are not currently categorized as resources.

When sufficient information has been gathered and mine plans developed, including any additional information necessary to support the licensed activity within those areas, Cameco would provide notification, including supporting

information to the CNSC. Additional infrastructure to support ongoing mining may include, but is not limited to:

- expansion of waste rock Stockpile C
- expansion of surface lease to support additional surface infrastructure
- additional surface freeze plants and/or pads
- additional underground freeze infrastructure
- additional ventilation infrastructure
- additional slimes pond(s).

4.5.2 Conclusion

CNSC staff will continue to conduct regulatory oversight of these activities during inspections as part of compliance verification. CNSC staff will report to the Commission on these improvements through annual regulatory oversight reports. For any future significant activities and improvement plans, CNSC staff will review the information submitted by Cameco to determine if the proposed activity meets the licensing basis. Any proposed changes not within the licensing basis will be brought to the Commission for consideration.

4.5.3 Recommendation

There are no recommendations for this section.

4.6 Licensee Public Information Program

A public information and disclosure program (PIDP) is a regulatory requirement for licence applicants and licensees of Class I nuclear facilities, uranium mines and mills and certain Class II nuclear facilities. These requirements are found in CNSC's REGDOC-3.2.1, *Public Information and Disclosure*.

The primary goal of the PIDP 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 are effectively communicated to the public.

The program must include a commitment to, and protocol for ongoing, timely communication of information related to the licensed facility during the course of the licence period.

CNSC's expectations of a licensee's public information program and disclosure protocol are commensurate with the level of risk of the facility, as well as the level of public interest in the licensed activities. The program and protocol may be further influenced by the complexity of the nuclear facility's lifecycle and activities, and the risks to public health and safety and the environment perceived to be associated with the facility and activities.

4.6.1 Discussion

Cameco's CLO is required under its licence to maintain a PIDP as per CNSC's REGDOC-3.2.1, *Public Information and Disclosure*.

CNSC staff have reviewed the CLO's PIDP and determined that it:

- identifies clear goals and objectives in terms of dissemination of information to the Athabasca Basin Communities, the Northern Administrative District and the province of Saskatchewan
- is available to the public and is posted on the licensee's website
- provides information on the facilities requiring a CNSC licence for nuclear related activities.

Cameco provides this information in a variety of ways including:

- community information sessions, facility tours, technical briefings, social media, and its website
- targeting multiple audiences including the impacted communities as well as the broader regions
- providing contact information for those who want to obtain additional information.

4.6.2 Improvements to PIDP during the Current Licence Period

Cameco continues to conduct public opinion surveys, to help gain insight into specific community interests based on the geographical distribution of the population of northern Saskatchewan. The data collected serves as a baseline to identify topical areas of interest among the distributed population and to support incorporating modern communication practices. Communication products are created and distributed to local areas with the information of interest to the audience, helping solidify Cameco's relationships and openness among their multiple key audiences.

Social media has evolved significantly during the current licence period and Cameco has increased their online presence. As identified by their target audience polling, using a variety of social media platforms is beneficial to communicate directly to some primary audiences. Cameco uses these online tools to share information and monitor their public environment.

The compliance verification criteria included section G.4 of the draft LCH will be updated from RD/GD 99.3 *Public Information and Disclosure* to CNSCs REGDOC-3.2.1, *Public Information and Disclosure*.

4.6.3 Conclusion

CNSC staff conclude that Cameco's PIDP for the CLO meets the regulatory requirements for public information and disclosure. CNSC staff continue to oversee Cameco's implementation of the PIDP to ensure that it meets obligations regarding disseminating and notifying their target audiences of operational

changes, and impacts on health, safety and the environment specific to their licensed activities. CNSC staff also encourage Cameco to refine and update its PIDP on a regular basis to meet the changing information needs of its target audiences.

4.6.4 Recommendation

CNSC staff recommend that the licence condition remain unchanged.

4.7 Nuclear Liability Insurance

Cameco's CLO is not a designated facility under the *Nuclear Liability and Compensation Act* (NLCA). This is because Cameco only processes natural ore which is excluded from the definition of nuclear material under the NLCA. As a result, Cameco's CLO does not meet the criteria to be designated as a nuclear installation and is not under the purview of the NLCA. Cameco maintains industrial insurance as a commercial necessity.

4.8 Proposed Licence Period

Cameco has submitted an application [1] with a request to renew its CNSC-issued operating licence for the CLO for a period of 10 years.

4.8.1 Discussion

Cameco's CLO is a mature facility with established programs and a management system focused on continuous improvement. CNSC staff took into consideration that hazards associated with the proposed licensed activities are well characterized, impacts well predicted and within the scope considered in the EPR report (appendix E). A 10-year licence term is consistent with CNSC licences issued to similar facilities.

Through CNSC's compliance monitoring program, CNSC staff also verified Cameco's effective and proper implementation of program improvements over this period. Cameco has strong operating experience and demonstrated compliance in carrying out the activities under its CLO licence in a safe and environmentally sound manner. Cameco's CLO programs provide assurances that safety-related activities are examined and maintained. Cameco's performance in all SCAs has remained stable or improved during the current licence term.

Annual RORs are presented to the Commission at public proceedings to allow for updates regarding licensee performance and CNSC regulatory oversight activities. These RORs ensure routine reporting to the Commission and the public on licensee performance, important events and substantive changes to the facility.

CNSC staff will continue to engage regularly with communities in northern Saskatchewan to ensure ongoing communications on safety performance, and to facilitate discussion on any matters of concern as they relate to the regulated activities.

All activities, including proposed changes, will be governed by the licence and LCH. Any changes outside of the licensing basis will continue to require Commission review and approval through the Commission public hearing process.

4.8.2 Conclusion

Given the above analysis, CNSC staff conclude that a 10-year licence period will better align licensee submissions and CNSC staff's reviews. Cameco's performance has been consistent and adequate over the past licence period and reporting processes are in place to monitor performance over the proposed licensing period. Therefore, CNSC staff recommend that the Commission accept Cameco's request for a 10-year licence period.

4.8.3 Recommendation

It is recommended that the Commission grant a licence to Cameco's CLO for a period of 10 years.

4.9 Licence Conditions Handbook

The LCH associated with the CLO provides compliance verification criteria used to determine whether the conditions listed in the licence have been met. The LCH sets out how CNSC staff will assess Cameco's compliance with the licence. It provides details associated with each licence condition, such as: applicable CSA Group standards and CNSC regulatory documents, regulatory interpretation, compliance verification criteria, version-controlled documents, licensees' written notification documents and guidance. This structure allows more freedom for the facility to evolve and update its documentation within the licensing basis.

4.10 Delegation of Authority

The Commission may include in a licence any condition it considers necessary for the purposes of the NSCA. The Commission may delegate authority to CNSC staff with respect to the administration of licence conditions, or portions thereof.

There is one proposed licence condition in the proposed CLO licence, UML-MINE-CIGAR.00/2031 that contains the phrase "the Commission or a person authorized by the Commission":

- LC 3.2 Reporting Requirements

CNSC staff recommend the Commission delegate its authority for the purposes described in the above licence condition to the following staff:

- Director, Uranium Mines and Mills Division
- Director General, Directorate of Nuclear Cycle and Facilities Regulation
- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch.

5. OVERALL CONCLUSIONS AND RECOMMENDATIONS

CNSC staff conclusions and recommendations consider an overall assessment of Cameco's compliance with the NSCA and its regulations during the current licence period (2013 to 2021). Cameco has programs, resources, and measures in place at the CLO to ensure the health and safety of persons and the environment and of the measures related to security and Canada's international obligations during the proposed licence period.

5.1 Overall Conclusions

CNSC staff have concluded the following, with respect to paragraphs 24(4)(a) and (b) of the NSCA, in that Cameco Corporation:

1. Is qualified to carry on the activities authorized by the licence.
2. Will, in carrying out that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

5.2 Overall Recommendations

CNSC staff recommend the Commission:

1. Renew the uranium mine licence to authorize Cameco to operate the Cigar Lake Operation until June 30, 2031,
2. Issue the proposed uranium mine licence for the Cigar Lake Operation, UML-MINE-CIGAR.00/2031; and
3. Delegate authority as set out in section 4.10 of this CMD.

REFERENCES

1. Correspondence from A. Thorne (Cameco) to M. Leblanc (CNSC), titled Cigar Lake Operation: Request for Renewal of UML-MINE-CIGAR.00/2021, dated November 18, 2019 (e-Doc 6047897).
2. Record of Decision, DEC 20-H108, In the Matter of Cameco Corporation, *Application for Acceptance of a Revised Financial Guarantee and Licence Modernization Amendment for Cameco Corporation's Cigar Lake Operation*, dated November 13, 2020 (e-Doc 6407585).
3. CMD 16-M58, Event Initial Report, Cameco Corporation, *Worker injured due to animal attack at Cigar Lake uranium mine*, dated September 21, 2016 (e-Doc 5076775).
4. Cameco Corporation, Cigar Lake Operation, Mining Facility Description Manual, CGR-MFDM, dated December 2019 (e-DOC 6089551).
5. Cameco Corporation, Cigar Lake Operation, Request for Renewal of UML-MINE-CIGAR.00/2021 - Mining Facility Licensing Manual, CGR-MFLM, October 2019, dated November 18, 2019 (e-Doc 6047900).
6. CMD 19-M36, *Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2018*, dated October 11, 2019 (e-Doc 5939090).
7. *Uranium in Effluent Treatment Process*, March 2006. Prepared for the Canadian Nuclear Safety Commission by SENES Consultants Limited, (e-Doc 1306231).
8. Correspondence from K. Lamont (Cameco) to G. Groskopf (CNSC) and V. Bourhis (SMOE), titled *2017 Cigar Lake Human Health and Environmental Risk Assessment*, dated October 6, 2017 (e-Doc 5357937).
9. Correspondence from T. Hamilton (Cameco) to C. McGuire (SMOE) and G. Groskopf (CNSC) titled, *Addendum to 2017 Cigar Lake Environmental Risk Assessment* dated May 21, 2019 (e-Doc 5908811).
10. Correspondence from K. Lamont (Cameco) to C. McGuire (SMOE) and D. Schryer (CNSC) titled, C*igar Lake Operation: Environmental Performance Report (EPR) - 2011 to 2015*, dated November 24, 2016 (e-Doc 5130811).
11. Correspondence from K. Lamont (Cameco) to G. Groskopf (CNSC), titled *2016 Annual Report*, dated March 20, 2017 (e-Doc 5219645).
12. Correspondence from T. Hamilton (Cameco) to G. Groskopf (CNSC), titled *Cigar Lake Operation: 2019 Annual Report*, dated March 30, 2020 (e-Doc 6269268).
13. Correspondence from K. Lamont (Cameco) to Ms. S. Forbrich (Environment Canada) titled, *Cigar Lake Operation –Comprehensive Aquatic Monitoring Report*, dated June 1, 2017 (e-Doc 5264311).
14. Correspondence from T. Hamilton (Cameco) to C. McGuire (SMOE) and G. Groskopf (CNSC) titled, *Cigar Lake Operation – 2019 Comprehensive Aquatic Monitoring Report* dated June 1, 2020 (e-Doc 6315413).

15. Letter from B. Schmitke (Cameco) to M. Rinker (CNSC), titled *Cigar Lake Project – Construction, Operation and Decommissioning Environmental Assessment Study Report*. 2004 Environmental Assessment, Cameco Corporation, dated January 30, 2004 (e-Doc 1034719).
16. Correspondence from L. Mooney (Cameco) to L. Casterton (CNSC), titled *Cigar Lake Water Management Project – Environmental Impact Statement*. 2011 Environmental Impact Statement, Cameco Corporation dated January 31, 2011 (e-Doc 3675517 [cover letter], 3675536 [main report] and 3675538 [annexes]).
17. Correspondence from M. Seier (Cameco) to S. Akhter (CNSC), titled *Cigar Lake Project: Fire Hazard Assessment,* dated August 13, 2012 (e-Doc 3988680).
18. Memorandum of Understanding between Saskatchewan and AECB, Atomic Energy Control Board, September 1996 (e-Doc 3816864).
19. Correspondence from T. Hamilton (Cameco) to G. Groskopf (CNSC) and C. McGuire (SMOE) titled, ***CONFIDENTIAL*** *AND* ***PROPRIETARY****: Cigar Lake Operation Preliminary Decommissioning Plan and Cost Estimate* dated June 12, 2019 (e-Doc 5329312).
20. CNSC *Staff Report on the Performance of Uranium Mine and Mill Facilities: 2013*, May 2015 (e-Doc 4772516).
21. CMD 15-M35, *Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2014*, dated August 11, 2015 (e-Doc 4781834).
22. CMD 16-M49, *Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2015*, dated October 14, 2016 (e-Doc 5065732).
23. CMD 17-M47, *Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2016*, dated October 13, 2017 (e-Doc 5309714).
24. CMD 18-M48, *Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017*, dated October 12, 2018 (e-Doc 5561699).
25. CMD 20-M25, *Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2019,* dated October 2, 2020 (e-Doc 6358764).
26. Canada Labour Code, R.S.C., 1985, c. L-2.

GLOSSARY

For definitions of terms used in this document, see CNSCs 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. REGDOC-3.6 is provided for reference and information.

ACRONYMS

Acronym	Term
ALARA	As Low As Reasonably Achievable
BATEA	Best Available Technology Economically Available
BE	Below expectations
Cameco	Cameco Corporation
CLO	Cigar Lake Operation
CMD	Commission Member Document
CNSC	Canadian Nuclear Safety Commission
COPC	Constituents of Potential Concern
CRFR	*Cost Recovery Fees Regulations*
CSA	CSA Group (formerly Canadian Standards Association)
EIR	Event Initial Report
EIS	Environmental Impact Statement
EMP	Environmental Management Program
EMS	Environmental Management System
EPR	Environmental Protection Reviews
EQC	Environmental Quality Committee
ERA	Environmental Risk Assessment
ERT	Emergency Response Team
FG	Financial Guarantee
FHA	Fire Hazard Analysis
FPP	Fire Protection Program
FRC	Funding Review Committee
FS	Fully Satisfactory
FSP	Fire Safety Plan
FTE	Full-time equivalents
GNSCR	*General Nuclear Safety and Control Regulations*
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	Kilogram
LCH	Licence Conditions Handbook
LLRD	Long-lived Radioactive Dust
LRWS	Labour Relations and Workplace Safety
LTI	Lost-time Injury
MDMER	*Metal and Diamond Mining Effluent Regulations*
MFDM	Mining Facility Description Manual
MFLM	Mining Facility Licensing Manual
MKg	Million kilograms
MOU	Memorandum of Understanding
MRT	Mine Rescue Team
mSv	Millisievert
NEW	Nuclear Energy Worker
NLCA	*Nuclear Liability and Compensation Act*
NSCA	*Nuclear Safety and Control Act*
NSEQC	Northern Saskatchwan Environmental Quality Committee
OHSAS	Occupational Health and Safety Assessment Series
Orano	Orano Canada Inc.
PAD	Personal Alpha Dosimeter
PDCE	Preliminary Decommissioning Cost Estimate
PDP	Preliminary Decommissioning Plan
PFP	Participant Funding Program
PIDP	Public Information and Disclosure Program
p-mSv	Person millisievert
RCOP	Radiation Code of Practice
REGDOC	Regulatory Document
ROR	Regulatory Oversight Report

RnG	Radon Gas
RnP	Radon Progeny
RP	Radiation Protection
SA	Satisfactory
SAT	Systematic Approach to Training
SCA	Safety and Control Area
SMOE	Saskatchewan Ministry of Environment
SEQG	Saskatchewan Environmental Quality Guidelines
TEPCO	Tokyo Electric Power Company
TSP	Total Suspended Particulate
UA	Unacceptable
UMMR	*Uranium Mines and Mills Regulations*
µg	microgram
µSv	microSievert

A. RISK RANKING

The CNSC uses a risk-informed regulatory approach in the management and control of regulated facilities and activities. CNSC staff have therefore established an approach to identifying appropriate levels of regulatory monitoring and control for specific classes of licensed facilities and types of licensed activities based on risk ranking.

Risk ranking is applied to each SCA, and is determined by considering the probability and consequence of adverse incidents associated with each SCA as it relates to the given facility and activity types.

The methodology used to determine risk ranking is based on Canadian Standards Association guideline CAN/CSA-Q850, *Risk Management: Guideline for Decision Makers*. This guideline provides a description of the major components of the risk management decision process and their relationship to each other, and describes a process for acquiring, analyzing, evaluating, and communicating information that is necessary for making decisions.

In section 2.2 of the CMD, in the Relevant Safety Control Areas table, the "Risk Ranking" column shows a high (H), moderate (M) or low (L) indicator for each SCA that is relevant to the current facility and activities being addressed in this CMD. The risk rankings are not static and will change over time for a given facility and activities (e.g., facilities age, facilities and equipment are upgraded, activities cease or begin, licensees change, technology and programs mature, knowledge and understanding of impacts and probabilities increase, etc.).

The following matrix provides a high-level overview of risk ranking, and the management and monitoring approach associated with the various degrees of risk.

APPROACH TO ASSESSING AND MANAGING POTENTIAL RISK			
CONSEQUENCE	**MANAGEMENT/MONITORING APPROACH**		
Significant Impact	Considerable management of risk is required	Must manage and monitor risk with occasional control	Extensive management is essential. Constant monitoring and control
Moderate Impact	Occasional monitoring	Management effort is recommended	Management effort and control is required
Low Impact	Random monitoring	Regular monitoring	Manage and monitor
Probability of Occurrence	Unlikely to Occur	Might Occur	Expected to Occur

RISK RANKING SCALE					
L	Low Risk	**M**	Moderate Risk	**H**	High Risk

On this basis, a high-risk SCA would be subject to increased regulatory scrutiny and control while a low-risk SCA would generally require minor verification and control.

B. RATING LEVELS

Fully Satisfactory (FS)

Safety and control measures implemented by the licensee are highly effective. In addition, compliance with regulatory requirements is fully satisfactory, and compliance within the safety and control area (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.

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 meets requirements and CNSC expectations. Any deviation is minor and any issues are considered to pose a low risk to the achievement of regulatory objectives and CNSC 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 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 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 SCA 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 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.

C. BASIS FOR THE RECOMMENDATION(S)

C.1 Regulatory Basis

The recommendations presented in this CMD are based on compliance objectives and expectations associated with the relevant SCAs and other matters. The regulatory basis for the matters that are relevant to this CMD are as follows.

Management System

The regulatory foundation for the recommendation(s) associated with management system includes the following:

- The *General Nuclear Safety and Control Regulations* requires that an application for a licence shall contain, under paragraph:
  - 3(1)(*k*), the applicant's organizational management structure insofar as it may bear on the applicant's compliance with the Act and the regulations made under the Act, including the internal allocation of functions, responsibilities and authority.
- It is a requirement of the *General Nuclear Safety and Control Regulations* under section 15 that every applicant for a licence and every licensee shall notify the Commission of:
  - 15(*a*), the persons who have the authority to act for them (the applicant/licensee) in their dealings with the Commission.
  - 15(*b*), the names and position titles of the persons who are responsible for the management and control of the licensed activity and the nuclear substance, nuclear facility, prescribed equipment or prescribed information encompassed by the licence.
  - 15(c), any change in the information referred to in paragraphs (a) and (b) within 15 days after the change occurs.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(b) of the *General Nuclear Safety and Control Regulations*, in relation to the activity to be licensed:
  - 3(b)(v), the proposed quality assurance program for the activity.

Human Performance Management

The regulatory foundation for the recommendation(s) associated with human performance management includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under section 12, that every licensee shall:
  - 12(1)(*a*), ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the Act, the regulations made under the Act and the licence.
  - 12(1)(*b*), train the workers to carry on the licensed activity in accordance with the Act, the regulations made under the Act and the licence.
  - 12(1)(*e*), require that every person at the site of the licensed activity to use equipment, devices, clothing and procedures in accordance with the Act, the regulations made under the Act and the licence.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(d) of the *General Nuclear Safety and Control Regulations*, in relation to health and safety:
  - 3(d)(v), proposed training program for workers.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 10, in relation to operating procedures:
  - 10(b), that every licensee shall train its workers to perform their work in accordance with operating procedures.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 15, in relation to training program:
  - 15(1), that where a worker successfully completes the training program in basic radiation health and safety referred to in a licence, the licensee shall issue to the worker a certificate indicating that the worker has completed a training program in basic radiation health and safety that is acceptable to the Commission.
  - 15(2), that every licensee shall provide a copy of the training program referred to in the licence to a worker's representative.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 16, in relation to records to be kept and made available:
  - 16(1)(k), that every licensee shall keep a record of the training received by each worker.
  - 16(3), that every licensee shall retain a record of the training referred to in paragraph (1)(k) for the period that the worker is employed at the uranium mine or mill.

Operating Performance

The regulatory foundation for the recommendation(s) associated with operating performance includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under subsection 29(1), that every licensee who becomes aware of any of the following situations shall immediately make a preliminary report to the Commission of the location and circumstances of the situation and of any action that the licensee has taken or proposes to take with respect to it:
  - 29(1)(a), a situation referred to in paragraph 27(b) of the Act.
  - 29(1)(b), the occurrence of an event that is likely to result in the exposure of persons to radiation in excess of the applicable radiation dose limits prescribed by the *Radiation Protection Regulations*.
  - 29(1)(c) a release, not authorized by the licence, of a quantity of radioactive nuclear substance into the environment.
  - 29(1)(d), a situation or event that requires the implementation of a contingency plan in accordance with the licence.
  - 29(1)(f), information that reveals the incipient failure, abnormal degradation or weakening of any component or system at the site of the licensed activity, the failure of which could have a serious adverse effect on the environment or constitutes or is likely to constitute or contribute to a serious risk to the health and safety of persons or the maintenance of security.
  - 29(1)(h), a serious illness or injury incurred or possibly incurred as a result of the licensed activity.
  - 29(1)(i) the death of any person at a nuclear facility
- It is a requirement of the *General Nuclear Safety and Control Regulations* under subsection 29(2), that every licensee who becomes aware of a situation referred to in subsection (1) shall file a full report of the situation with the Commission within 21 days after becoming aware of it, unless some other period is specified in the licence, and the report shall contain the following information:
  - 29(2)(a), the date, time and location of becoming aware of the situation.
  - 29(2)(b), a description of the situation and the circumstances.
  - 29(2)(c), the probable cause of the situation.
  - 29(2)(d), the effects on the environment, the health and safety of persons and the maintenance of security that have resulted or may result from the situation.
  - 29(2)(e), the effective dose and equivalent dose of radiation received by any person as a result of the situation
  - 29(2)(f), the actions that the licensee has taken or proposes to take with respect to the situation.

- It is a requirement of the *Uranium Mines and Mills Regulations* under paragraphs 6(1)(a) and 6(2)(a), that an application for a licence in respect of a uranium mine and mill shall contain the results of any commissioning work.
- It is a requirement of the *Uranium Mines and Mills Regulations* under paragraphs 6(1)(c) that an application for a licence in respect of a uranium mine and mill shall contain the proposed policies, methods and programs for operating and maintaining the mine
- It is a requirement of the *Uranium Mines and Mills Regulations* under subsection 10(a), that every licensee shall establish, implement and maintain written operating procedures for the licensed activity.

Safety Analysis

The regulatory foundation for the recommendation(s) associated with safety analysis includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under paragraph 3(1)(i) an application for a licence shall contain a description and the results of any test, analysis or calculation performed to substantiate the information included in the application.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(c) of the *General Nuclear Safety and Control Regulations*, in relation to the environment and waste management, and (d) health and safety:
  - 3(c)(iii), effects on the environment that may result from the activity to be licensed and the measures that will be taken to prevent or mitigate those effects.
  - 3(d)(i) the effects on the health and safety of persons that may result from the activity to be licensed, and the measures that will be taken to prevent or mitigate those effects

Physical Design

The regulatory foundation for the recommendation(s) associated with physical design includes the following:

- Paragraph 3(1)(*d*) of the *General Nuclear Safety and Control Regulations* requires that an application for a licence shall contain a description of any nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(a) of the *General Nuclear Safety and Control Regulations*, in relation to the plan and description of the mine or mill:
  - 3(a)(ii), a surface plan indicating the boundaries of the mine or mill and the area where the activity to be licensed is proposed to be carried on.
  - 3(a)(iii), a plan showing existing and planned structures, excavations and underground development.
  - 3(a)(iv) a description of the mine or mill, including the installations, its purpose and capacity, and any excavations and underground development
- It is a requirement of the *Uranium Mines and Mills Regulations* under subsection 5(2), that an application for a licence to prepare a site for and construct a uranium mill shall contain the following information in addition to the information required by section 3 and subsection 4(2):
  - 5(2)(h), a description of all proposed laboratory facilities and programs.
- It is a requirement of the *Uranium Mines and Mills Regulations* under paragraphs 6(1)(b) and 6(2)(b), that an application for a licence to operate a uranium mine and mill shall contain a description of the structures, components, systems and equipment including any changes to its design and its design operating conditions as a result of the commissioning.
- It is a requirement of the *Uranium Mines and Mills Regulations* under paragraphs 16(1)(e) that every licensee shall keep a record of the design of the uranium mine or mill and of the components and systems installed at the mine or mill.

Fitness for Service

The regulatory foundation for the recommendation(s) associated with fitness for service includes the following:

- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(a) of the *General Nuclear Safety and Control Regulations*, in relation to the plan and description of the mine or mill:
  - 3(a)(vii), a description of the design of and the maintenance program for every eating area.
- It is a requirement of the *Uranium Mines and Mills Regulations* under paragraphs 16(1)(a) and 16(1)(h), that every licensee shall keep a record of its operating and maintenance procedures and the inspections and maintenance carried out in accordance with the licence or the regulations made under the Act.

Radiation Protection

The regulatory foundation for the recommendation(s) associated with radiation protection includes the following:

- The *General Nuclear Safety and Control Regulations* require, under subsection 3(1), that a licence application contain the following information under paragraphs:
  - 3(1)(*e*), the proposed measures to ensure compliance with the *Radiation Protection Regulations*.
  - 3(1)(*f*), any proposed action level for the purpose of section 6 of the *Radiation Protection Regulations*.
- The *General Nuclear Safety and Control Regulations* require, under subsection 17(b), that a worker comply with the measures established by the licensee to protect the environment and the health and safety of persons, maintain security, control the levels and doses of radiation, and control releases of radioactive nuclear substances and hazardous substances into the environment.
- It is a requirement for uranium mines and mills licensee to follow the *Radiation Protection Regulations*.
- It is a requirement of the *Uranium Mines and Mills Regulations* under subsection 4(2), that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain a proposed code of practice that includes:
  - 4(2)(a), any action level that the applicant considers appropriate for the purpose of this subsection.
  - 4(2)(b), a description of any action that the applicant will take if an action level is reached.
  - 4(2)(c), the reporting procedures that will be followed if an action level is reached.

- It is a requirement of the *Uranium Mines and Mills Regulations* under section 9, that every licensee shall post a copy of the code of practice referred to in the licence at a location within the uranium mine or mill that is accessible to all workers and where it is most likely to come to their attention.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 13, that no licensee shall rely on the use of a respirator to comply with the *Radiation Protection Regulations* unless the use of the respirator:
  - 13(a), is for a temporary or unforeseen situation.
  - 13(b), is permitted by the code of practice referred to in the licence.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 14, that every licensee shall:
  - 14(a), post signs at all entrances to each area where the dose rate of gamma radiation exceeds 25 µSv/h, designating the area as a radiation area and indicating the dose rate of gamma radiation in that area.
  - 14(b), provide every worker who is to enter an area where the dose rate of gamma radiation exceeds 100 µSv/h with a direct-reading dosimeter.
- It is a requirement of the *Uranium Mines and Mills Regulations* under subsection 16(1), that every licensee shall keep a record of:
  - 16(1)(f), the method and relevant data used to ascertain the doses of radiation received by the workers at the uranium mine or mill and the intake of radioactive nuclear substances by those workers.

Conventional Health and Safety

The regulatory foundation for the recommendation(s) associated with conventional health and safety includes the following:

- The *General Nuclear Safety and Control Regulations* require, under paragraph 12(1)(c), that every licensee shall take all reasonable precautions to protect the environment and the health and safety of persons and to maintain the security of nuclear facilities and of nuclear substances.
- The *General Nuclear Safety and Control Regulations* require, under subsection 16(1), that every licensee shall make available to all workers the health and safety information with respect to their workplace that has been collected by the licensee in accordance with the Act, the regulations made under the Act and the licence.

- It is a requirement of the *General Nuclear Safety and Control Regulations* under section 17, that every worker shall:
  - 17(a), use equipment, devices, facilities and clothing for protecting the environment or the health and safety of persons, or for determining doses of radiation, dose rates or concentrations of radioactive nuclear substances, in a responsible and reasonable manner and in accordance with the Act, the regulations made under the Act and the licence.
  - 17(b), comply with the measures established by the licensee to protect the environment and the health and safety of persons, maintain security, control the levels and doses of radiation, and control releases of radioactive nuclear substances and hazardous substances into the environment.
  - 17(c)(i), promptly inform the licensee or the worker's supervisor of any situation in which the worker believes there may be a significant increase in the risk to the environment or the health and safety of persons.
  - 17(e), take all reasonable precautions to ensure the worker's own safety, the safety of the other persons at the site of the licensed activity, the protection of the environment, the protection of the public and the maintenance of the security of nuclear facilities and of nuclear substances.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(d) of the *General Nuclear Safety and Control Regulations*, in relation to health and safety:
  - 3(d)(i), the effects on the health and safety of persons that may result from the activity to be licensed, and the measures that will be taken to prevent or mitigate those effects.
  - 3(d)(ii), the proposed program for selecting, using and maintaining personal protective equipment.
  - 3(d)(iii), the proposed worker health and safety policies and programs.

Environmental Protection

The regulatory foundation for the recommendation(s) associated with environmental protection includes the following:

- The *General Nuclear Safety and Control Regulations*, under paragraphs 12(1)(c) and (f), require that each licensee take all reasonable precautions to protect the environment and the health and safety of persons, and to control the release of radioactive nuclear substances and hazardous substances within the site of the licensed activity and into the environment.
- The *Radiation Protection Regulations* prescribe dose limits for the general public, which under subsection 1(3) is 1 mSv per calendar year.

- It is a requirement of the *General Nuclear Safety and Control Regulations* under section 17, that every worker shall:
  - 17(a), use equipment, devices, facilities and clothing for protecting the environment or the health and safety of persons, or for determining doses of radiation, dose rates or concentrations of radioactive nuclear substances, in a responsible and reasonable manner and in accordance with the Act, the regulations made under the Act and the licence.
  - 17(b), comply with the measures established by the licensee to protect the environment and the health and safety of persons, maintain security, control the levels and doses of radiation, and control releases of radioactive nuclear substances and hazardous substances into the environment.
  - 17(c)(i), promptly inform the licensee or the worker's supervisor of any situation in which the worker believes there may be a significant increase in the risk to the environment or the health and safety of persons.
  - 17(e), take all reasonable precautions to ensure the worker's own safety, the safety of the other persons at the site of the licensed activity, the protection of the environment, the protection of the public and the maintenance of the security of nuclear facilities and of nuclear substances.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(c) of the *General Nuclear Safety and Control Regulations*, in relation to the environment and waste management:
  - 3(c)(ii), the program to determine the environmental baseline characteristics of the site and the surrounding area.
  - 3(c)(iii), effects on the environment that may result from the activity to be licensed and the measures that will be taken to prevent or mitigate those effects.
  - 3(c)(iv), the proposed positions for and qualifications and responsibilities of environmental protection workers.
  - 3(c)(v), the proposed environmental protection policies and programs.
  - 3(c)(vi), the proposed effluent and environmental monitoring programs.
  - 3(c)(vii), the proposed location, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including its physical, chemical and radiological characteristics.
  - 3(c)(viii), the proposed measures to control releases of nuclear substances and hazardous substances into the environment.

    3(c)(ix), a description of the anticipated liquid and solid waste streams within the mine or mill, including the ingress of fresh water and any diversion or control of the flow of uncontaminated surface and ground water.

- It is a requirement of the *Uranium Mines and Mills Regulations* under subsection 4(2), that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain a proposed code of practice that includes:
  - 4(2)(a), any action level that the applicant considers appropriate for the purpose of this subsection.
  - 4(2)(b), a description of any action that the applicant will take if an action level is reached.
  - 4(2)(c), the reporting procedures that will be followed if an action level is reached.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 9, that every licensee shall post a copy of the code of practice referred to in the licence at a location within the uranium mine or mill that is accessible to all workers and where it is most likely to come to their attention.
- The Cigar Lake Operation operating licence requires Cameco to control, monitor and record releases of effluent concentrations from the facility and that the releases shall not exceed the limits found in the licence.

Emergency Management and Fire Protection

The regulatory foundation for the recommendation(s) associated with emergency management and response includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under subsection 12(1) that every licensee shall:
  - 12(1)(c), take all reasonable precautions to protect the environment and the health and safety of persons and to maintain security of nuclear facilities and of nuclear substances.
  - 12(1)(f), take all reasonable precautions to control the release of radioactive nuclear substances or hazardous substances within the site of the licensed activity and into the environment of the licensed activity.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(a) of the *General Nuclear Safety and Control Regulations*, in relation to the plan and description of the mine or mill:
  - 3(a)(ix), a description of the proposed emergency power systems and its capacities.

- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(c) of the *General Nuclear Safety and Control Regulations*, in relation to the environment and waste management:
  - 3(c)(viii), the proposed measures to control releases of nuclear substances and hazardous substances into the environment.
  - 3(c)(x), the proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of security, including measures to:
    - 3(c)(x)(A), assist off-site authorities in planning and preparing to limit the adverse effects of an accidental release.
    - 3(c)(x)(B), notify off-site authorities of an accidental release or the imminence of an accidental release.
    - 3(c)(x)(C), report information to off-site authorities during and after an accidental release.
    - 3(c)(x)(D), assist off-site authorities in dealing with the adverse effects of an accidental release.
    - 3(c)(x)(E), test the implementation of the measures to control the adverse effects of an accidental release.

Waste Management

The regulatory foundation for the recommendation(s) associated with waste management includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under paragraph 3(1)(j) that an application for a licence include the name, quantity, form and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed, or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by subsection 3(c) of the *General Nuclear Safety and Control Regulations*, in relation to the environment and waste management:
  - 3(c)(ix), a description of the anticipated liquid and solid waste streams within the mine or mill, including the ingress of fresh water and any diversion or control of the flow of uncontaminated surface and ground water.

- It is a requirement of the *Uranium Mines and Mills Regulations* under subsection 6(1), that an application for a licence to operate a uranium mine shall contain the following information in addition to the information required by section 3 and subsection 4(2):
  - 6(1)(c), the proposed policies, methods and programs for operating and maintaining the mine.
- It is a requirement of the *Uranium Mines and Mills Regulations* under subsection 5(2), that an application for a licence to prepare a site for and construct a uranium mill shall contain the following information in addition to the information required by section 3 and subsection 4(2):
  - 5(2)(f), a description of the proposed design, construction and operation of the waste management system, including the measures to monitor its construction and operation, the construction schedule, the contingency plans for construction and the measures to control the movement of water in existing waterways.
- It is a requirement of the *Uranium Mines and Mills Regulations* under subsection 6(2), that an application for a licence to operate a uranium mill shall contain the following information in addition to the information required by section 3 and subsection 4(2):
  - 6(2)(c), the proposed policies, methods and programs for operating and maintaining the mill.
  - 6(2)(g), a description of the proposed operation of the waste management system.
- It is a requirement of the *Uranium Mines and Mills Regulations* under subsection 16(1), that every licensee shall keep a record of:
  - 16(1)(d), the plans of every tailings-containment structure and area and every diversion structure and system associated with the waste management system.

Security

The regulatory foundation for the recommendation(s) associated with security includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under subsection 3(1), that an application for a licence shall contain the following information:
  - 3(1)(g), the proposed measures to control access to the site of the activity to be licensed and the nuclear substance, prescribed equipment or prescribed information.
  - 3(1)(h), the proposed measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information.

- It is a requirement of the *General Nuclear Safety and Control Regulations* under subsection 12(1), that every licensee shall:
  - 12(1)(g), implement measures for alerting the licensee to the illegal use or removal of a nuclear substance, prescribed equipment or prescribed information, or the illegal use of a nuclear facility.
  - 12(1)(h), implement measures for alerting the licensee to acts of sabotage or attempted sabotage anywhere at the site of the licensed activity.
- It is a requirement of the *General Nuclear Safety and Control Regulations* under section 17, that every worker shall:
  - 17(c), promptly inform the licensee or the worker's supervisor of any situation in which the worker believes there may be:
    - 17(c)(ii), a threat to the maintenance of the security of nuclear facilities and of nuclear substances or an incident with respect to such security.
    - 17(c)(iv), an act of sabotage, theft, loss or illegal use or possession of a nuclear substance, prescribed equipment or prescribed information.
- It is a requirement of the *General Nuclear Safety and Control Regulations* under subsection 29(1), that every licensee who becomes aware of any of the following situations shall immediately make a preliminary report to the Commission of the location and circumstances of the situation and of any action that the licensee has taken or proposes to take with respect to it:
  - 29(1)(f), information that reveals the incipient failure, abnormal degradation or weakening of any component or system at the site of the licensed activity, the failure of which could have a serious adverse effect on the environment or constitutes or is likely to constitute or contribute to a serious risk to the health and safety of persons or the maintenance of security.
  - 29(1)(g), an actual, threatened or planned work disruption by workers.
- It is a requirement of the *General Nuclear Safety and Control Regulations* under subsection 29(2), that every licensee who becomes aware of a situation referred to in subsection (1) shall file a full report of the situation with the Commission within 21 days after becoming aware of it, unless some other period is specified in the licence, and the report shall contain the following information:
  - 29(2)(d), the effects on the environment, the health and safety of persons and the maintenance of security that have resulted or may result from the situation.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by section 3 of the *General Nuclear Safety and Control Regulations*,
  - 3(e) in relation to security, the proposed measures to alert the licensee to acts of sabotage or attempted sabotage at the mine or mill.

Safeguards and Non-Proliferation

The regulatory foundation for the recommendation(s) associated with safeguards and non-proliferation includes the following:

- It is a requirement of the *General Nuclear Safety and Control Regulations* under paragraph 12(1)(i) that each licensee take all necessary measures to facilitate Canada's compliance with any applicable safeguards agreement.

- Under subsection 21(1) of the *General Nuclear Safety and Control Regulations*, information that concerns any of the following, including a record of that information, is prescribed information for the purposes of the Act:
  - 21(1)(a), a nuclear substance that is required for the design, production, use, operation or maintenance of a nuclear weapon or nuclear explosive device, including the properties of the nuclear substance.
  - 21(1)(b), the design, production, use, operation or maintenance of a nuclear weapon or nuclear explosive device.
  - 21(1)(c), the security arrangements, security equipment, security systems and security procedures established by a licensee in accordance with the Act, the regulations made under the Act or the licence, and any incident relating to security.
  - 21(1)(d), the route or schedule for the transport of Category I, II or III nuclear material, as defined in section 1 of the *Nuclear Security Regulations*.

- It is a requirement of the *General Nuclear Safety and Control Regulations* under subsection 30(1), that every licensee who becomes aware of any of the following situations shall immediately make a preliminary report to the Commission of the situation and of any action that the licensee has taken or proposes to take with respect to it:
  - 30(1)(a), interference with or an interruption in the operation of safeguards equipment or the alteration, defacement or breakage of a safeguards seal, other than in accordance with the safeguards agreement, the Act, the regulations made under the Act or the licence.
  - 30(1)(b), the theft, loss or sabotage of safeguards equipment or samples collected for the purpose of a safeguards inspection, damage to such equipment or samples, or the illegal use, possession, operation or removal of such equipment or samples.

- It is a requirement of the *General Nuclear Safety and Control Regulations* under subsection 30(2), that every licensee who becomes aware of a situation referred to in subsection (1) shall file a full report of the situation with the Commission within 21 days after becoming aware of it, unless some other period is specified in the licence, and the report shall contain the following information:
  - 30(2)(a), the date, time and location of becoming aware of the situation.
  - 30(2)(b), a description of the situation and the circumstances.
  - 30(2)(c), the probable cause of the situation.
  - 30(2)(d), the adverse effects on the environment, the health and safety of persons and the maintenance of national and international security that have resulted or may result from the situation.
- The Agreement between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the *Treaty on the Non-Proliferation of Nuclear Weapons*.
- The Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the *Treaty on the Non-Proliferation of Nuclear Weapons*.

Packaging and Transport

Cameco's Cigar Lake Operation is required to comply with the *Packaging and Transport of Nuclear Substances Regulations 2015* and Transport Canada's *Transportation of Dangerous Goods Regulations*.

Decommissioning Strategy and Financial Guarantees

The regulatory foundation for the recommendation(s) associated with Cameco's Cigar Lake Operation Decommissioning Strategy and Financial Guarantees includes:

- The *General Nuclear Safety and Control Regulations* requires under paragraph 3(1)(l) that a licence application contains a description of any proposed financial guarantee relating to the activity to be licensed.
- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by section 3 of the *General Nuclear Safety and Control Regulations*, in relation to the plan and description of the mine or mill:
  - 3(a)(viii), the proposed plan for the decommissioning of the mine or mill.

Licensee's Public Information Program

- It is a requirement of the *Uranium Mines and Mills Regulations* under section 3, that an application for a licence in respect of a uranium mine or mill, other than a licence to abandon, shall contain the following information in addition to the information required by section 3 of the *General Nuclear Safety and Control Regulations*, in relation to the environment and waste management:
  - 3(c)(i), the program to inform persons living in the vicinity of the mine or mill of the general nature and characteristics of the anticipated effects of the activity to be licensed on the environment and the health and safety of persons.

C.2 Technical Basis

The technical basis for recommendations, including several guidance documents, national standards and regulatory documents has been presented in this CMD and is addressed in detail in the LCH.

D. SAFETY AND CONTROL AREA FRAMEWORK

D.1 Safety and Control Areas Defined

The safety and control areas identified in section 2.2, and discussed in summary in sections 3.1 through 3.14 are comprised of specific areas of regulatory interest which vary between facility types.

The following table provides a high-level definition of each SCA. The specific areas within each SCA are to be identified by the CMD preparation team in the respective areas within section 3 of this CMD.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
Management	Management System	Covers the framework which establishes the processes and programs required to ensure an organization achieves its safety objectives and continuously monitors its performance against these objectives and fostering a healthy safety culture.
	Human Performance Management	Covers activities that enable effective human performance through the development and implementation of processes that ensure that licensee staff is sufficient in number in all relevant job areas and that licensee staff have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.
	Operating Performance	This includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.
Facility and Equipment	Safety Analysis	Maintenance of the safety analysis that supports that 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.
	Physical Design	Relates to activities that impact on the ability of systems, components and structures to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.
	Fitness for Service	Covers activities that impact on the physical condition of systems, components and structures to ensure that they remain effective over time. This includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
Core Control Processes	Radiation Protection	Covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. This program must ensure that contamination and radiation doses received are monitored and controlled.
	Conventional Health and Safety	Covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.
	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.
	Emergency Management and Fire Protection	Covers emergency plans and emergency preparedness programs which exist for emergencies and for non-routine conditions. This also includes any results of exercise participation.
	Waste Management	Covers internal waste-related programs which 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. Also covers the planning for decommissioning.
	Security	Covers the programs required to implement and support the security requirements stipulated in the regulations, in their licence, in orders, or in expectations for their facility or activity.
	Safeguards and Non-Proliferation	Covers the programs and activities required for the successful implementation of the obligations arising from the Canada/IAEA safeguards agreements as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*.
	Packaging and Transport	Programs that cover the safe packaging and transport of nuclear devices to and from the licensed facility.

D.2 Specific Areas for this Facility Type

The following table identifies the specific areas that comprise each SCA for a uranium mine or mill:

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Functional Area	**Safety and Control Area**	**Specific Areas**
Management	Management System	▪ Management System ▪ Organization ▪ Performance Assessment, Improvement and Management Review ▪ Change Management ▪ Safety Culture ▪ Records Management ▪ Management of Contractors
	Human Performance Management	▪ Personnel Training
	Operating Performance	▪ Not addressed individually
Facility and Equipment	Safety Analysis	▪ Hazard Analysis
	Physical Design	▪ Not addressed individually
	Fitness for Service	▪ Not addressed individually
Core Control Processes	Radiation Protection	▪ Estimated Dose to Public ▪ Application of ALARA ▪ Worker Dose Control ▪ Radiation Protection Program Performance ▪ Radiological Hazard Control
	Conventional Health and Safety	▪ Performance ▪ Practices ▪ Awareness
	Environmental Protection	▪ Effluent and Emissions Control (releases) ▪ Environmental Management System (EMS) ▪ Assessment and Monitoring ▪ Protection to the Public ▪ Environmental Risk Assessment

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Functional Area	**Safety and Control Area**	**Specific Areas**
Core Control Processes (cont.)	Emergency Management and Fire Protection	▪ Emergency Preparedness and Response ▪ Fire Emergency Preparedness and Response
	Waste Management	▪ Waste Rock Piles ▪ Solid and Liquid Wastes ▪ Decommissioning Plans
	Security	▪ Not addressed individually
	Safeguards and Non-Proliferation	▪ Not addressed individually
	Packaging and Transport	▪ Not addressed individually

E. ENVIRONMENTAL PROTECTION REVIEW REPORT

e-Doc# 6383583 (Word)

e-Doc# 6428204 (PDF)

Canada's Nuclear Regulator

Environmental Protection Review Report:
Application for Licence Renewal
Cameco Corporation – Cigar Lake Operation

April 2021

e-Doc: 6383583 (Word)
e-Doc: 6428204 (PDF)

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

REVISION HISTORY

The following table identifies the revision history of this document.

Revision number	Change	Summary of changes	Date
000	Initial release	N/A	April 2021

EXECUTIVE SUMMARY

The Canadian Nuclear Safety Commission (CNSC) conducts Environmental Protection Reviews (EPR) for all facilities with potential project-environmental interactions, in accordance with its mandate under the *Nuclear Safety and Control Act* (NSCA), to ensure the protection of the environment and the health of persons. An EPR is a science-based environmental technical assessment conducted by CNSC staff. The fulfillment of other aspects of the CNSC's mandate, such as safety and security, are met through other regulatory oversight activities.

This EPR Report was written by CNSC staff for the Commission, Indigenous peoples and the public. It describes the scientific, evidence-based findings from CNSC staff's review of the application by Cameco Corporation (Cameco) to renew the Uranium Mine Licence (UML-MINE-CIGAR.01/2021) in order to continue its current activities at the Cigar Lake Operation in northern Saskatchewan.

CNSC staff's EPR Report focuses on items that are of Indigenous, public and regulatory interest, such as releases of radiological and hazardous substances to the receiving environment, valued ecosystem components and species at risk.

This EPR Report includes CNSC staff's assessment of documents submitted by the licensee for the Cigar Lake Operation from 2013 to 2020, as well as, but not limited to the following:

- Cameco's Preliminary Decommissioning Plan
- Cameco's annual reports
- Cameco's 2017 Environmental Risk Assessment (ERA)
- the results of CNSC's Independent Environmental Monitoring Program
- the results from other environmental monitoring programs and/or health studies (e.g., completed by other levels of government) in proximity to the Cigar Lake Operation

The information provided in this EPR Report supports the conclusions made by CNSC staff in Commission Member Document (CMD) 21-H2. Based on CNSC staff's assessment of Cameco's documentation, supporting documents and past performance, CNSC staff conclude that the potential risks from radiological and hazardous releases to the atmospheric, terrestrial, aquatic, geological, hydrogeological and human environments from Cameco's Cigar Lake Operation are negligible. The potential risks to the environment from these releases are not distinguishable from natural background and the potential risk to humans is similar to health outcomes in the general public. There is low probability that aquatic and terrestrial species in the immediate vicinity of the site may experience effects during operation when very conservative assumptions are used. The predicted effects are expected to return to pre-operational conditions over time after the site is closed and decommissioned. CNSC staff also conclude that Cameco continues to implement and maintain effective environmental protection measures to adequately protect the environment and the health of persons. Should the Commission decide to renew Cameco's Cigar Lake Operation licence, CNSC staff will continue to verify and evaluate, through ongoing licensing and compliance activities and reviews, that the environment and the health of persons are protected and will continue to be protected over the proposed licence period.

For more information on the Cigar Lake Operation and Cameco's licence renewal application, visit CNSC's webpage and Cameco's webpage.

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1.0 INTRODUCTION

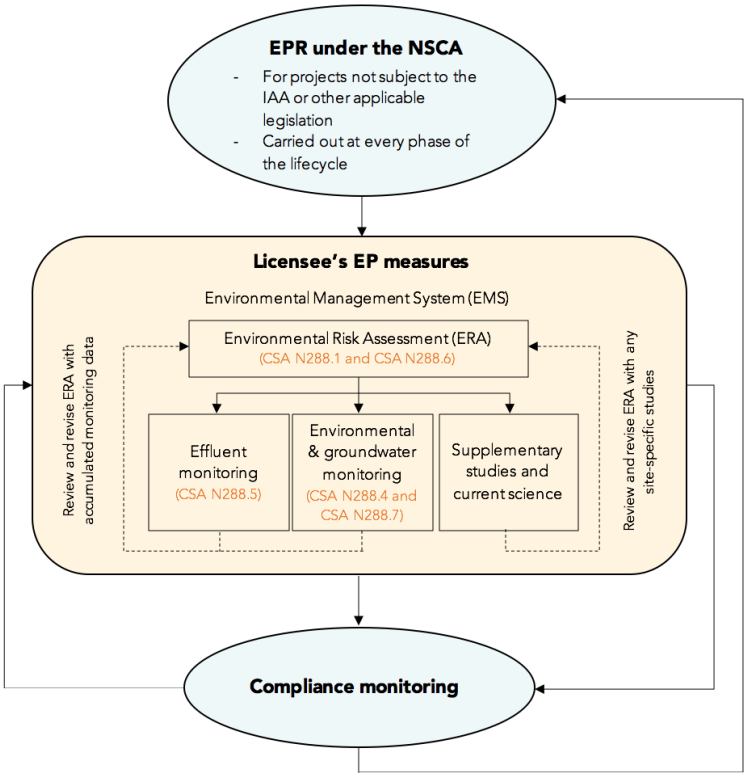
1.1 Purpose

The purpose of this Environmental Protection Review (EPR) is to report the outcome of the Canadian Nuclear Safety Commission (CNSC) staff's regulatory activities conducted under the *Nuclear Safety and Control Act* (NSCA). This review serves to assess whether Cameco Corporation (Cameco) has made, and will continue to make, adequate provisions to protect the environment and the health of persons at the Cigar Lake Operation.

This EPR Report presents information that supports CNSC staff's recommendations in Commission Member Document (CMD) 21-H2 [1] regarding the proposal to renew the Uranium Mine Licence, UML-MINE-CIGAR.01/2021 [2], as it pertains to environmental protection (EP). Cameco has requested that the CNSC licence issued for the Cigar Lake Operation, which is set to expire on June 30, 2021, be renewed [3].

CNSC staff assess the environmental and health effects of nuclear facilities and activities at every phase of its lifecycle. As shown in figure 1.1, this EPR Report was developed to document CNSC staff's assessment of Cameco's implementation of its environmental protection measures and its performance of the Cigar Lake Operation relating to EP. The fulfillment of other aspects of the CNSC's mandate, such as safety and security, can be found in CNSC staff's CMD 21-H2.

Figure 1.1: EPR framework



This EPR Report is based on information submitted by Cameco, as well as on compliance, technical assessment, and independent verification activities completed by CNSC staff, including the following:

- CNSC staff's review of Cameco's EP measures (summarized in section 2.0)
- CNSC staff's review of Cameco's Preliminary Decommissioning Plan (PDP) [4]
- CNSC staff's review of Cameco's annual reports ([5] to [11])
- CNSC staff's review of Cameco's Environmental Risk Assessment [12] [13]
- CNSC's Independent Environmental Monitoring Program (IEMP) results (section 4.0)
- Health studies and regional monitoring programs in proximity to the Cigar Lake Operation (sections 5.0 and 6.0)

This EPR Report can be read as a stand-alone document that focuses on topics related to the environmental performance of the Cigar Lake Operation, such as releases of radiological and hazardous substances to the receiving environment, as well as effects on valued components, including human and non-human biota. A review has been conducted for all valued components related to the project, but only a selection of topics is presented in detail in this report. The selected valued components and topics are based on licensing requirements, as well as those that have historically been of interest to the Commission, Indigenous peoples and the public. CNSC staff also present information on any relevant monitoring (regional, environmental or health) or relevant studies conducted by the CNSC (e.g., IEMP) or other levels of government.

1.2 Project Background

This section of the report provides general information on the Cigar Lake Operation, including a description of the site location and a basic history of site activities and licensing. This information is intended to provide context for later sections of this report, which discuss completed and ongoing regulatory oversight activities.

1.2.1 Site Description

The Cigar Lake Operation is a high-grade underground uranium mine located within the Athabasca basin of northern Saskatchewan, approximately 660 kilometres north of Saskatoon (see figure 1.2). Operated by Cameco, the Cigar Lake Operation is a joint venture owned by Cameco (50%), Orano Canada Inc. (37%), Idemitsu Canada Resources (8%) and TEPCO Resources (5%). The closest permanent communities, Wollaston Lake and Hatchet Lake First Nations, are located about 80 kilometres from the site. The Cigar Lake Operation is situated near other uranium mining and/or milling facilities, including Cameco's Rabbit Lake, McArthur River, and Key Lake facilities, as well as Orano Canada Inc.'s McClean Lake facility.

The Cigar Lake surface lease is comprised of 1042 hectares (10.42 square kilometres), of which only about 20% is currently developed and disturbed. The environment surrounding the Cigar Lake Operation predominantly consists of hills, bogs and coniferous forests interspersed with lakes, rivers and streams. The Cigar Lake site lies southeast of Waterbury Lake and is accessible year-round by air and temporary access road.

1.2.2 Project Overview

The Cigar Lake site has been active for about four decades. Before the mine became operational in 2014, the Cigar Lake Operation developed in stages, as follows:

- 1981 – 1986: Cigar Lake ore discovery and deposit delineation
- 1988 – 2000: Two testing mining phases
- 1998 – 2004: Pre-commercial construction
- 2005 – 2013: Commercial construction
- 2014: Beginning of ore production

The Cigar Lake Operation is a CNSC-licensed uranium mining facility with an annual production rate of 7.0 million kilograms of uranium per year [14]. High-grade ore is mined underground, pumped to the surface in a slurry form and transported by truck to the McClean Lake Mill, approximately 70 kilometres away, for processing into uranium ore concentrate (U_3O_8). All tailings derived from the processing of Cigar Lake ore are placed within the McClean Lake JEB in-pit tailings management facility. Thus, there is no tailings management facility at the Cigar Lake site.

Onsite facilities and infrastructure include an underground mine, waste rock stockpiles, settling ponds, a water treatment plant, warehouses, a workers camp, an office and administrative buildings. Figure 1.3 below shows an aerial view of the Cigar Lake Operation.

Cameco's current licence (UML-MINE-CIGAR.01/2021) expires on June 30, 2021 [2]. In November 2019, Cameco submitted an application [3] requesting a licence renewal to continue its current activities, which consist of operations for the mining of uranium ore. Cameco has not requested to carry out any new activities.

Figure 1.2: Location of the Cigar Lake Operation [4]

Figure 1.3: Aerial view of the Cigar Lake Operation

2.0 REGULATORY OVERSIGHT

The CNSC regulates nuclear facilities and activities in Canada to protect the environment and the health and safety of persons in a manner that is consistent with Canadian environmental policies, acts and regulations, and with Canada's international obligations. The CNSC assesses the environmental and health effects of nuclear facilities and activities at every phase of its lifecycle.

To meet CNSC's regulatory requirements, Cameco is responsible for implementing and maintaining EP measures that identify, control and, where necessary, monitor releases of radiological and hazardous substances and effects on human health and the environment from the Cigar Lake Operation. These EP measures must comply with, or have implementation plans in place to comply with the regulatory requirements included in Cameco's licence and Licence Conditions Handbook (LCH). This section of the EPR Report discusses the CNSC's regulatory oversight of EP measures at Cameco's Cigar Lake Operation.

2.1 Previous Environmental Protection Reviews and Assessments

Under the NSCA, an assessment of the environment is part of the ongoing EP framework, whereby EPR Reports, such as this one, are produced. No decision is made on the EPR itself, as the information is intended to inform and support the regulatory decision being sought from the Commission by the licensing matter explained in the body of CNSC staff's CMD 21-H2 [1].

Depending on the scope and impact of project activities, other legislation such as the *Impact Assessment Act of Canada* [15], the former *Canadian Environmental Assessment Act, 2012* (CEAA 2012) [16] or its predecessor, the *Canadian Environmental Assessment Act, 1992* (CEAA 1992) [17], may require or have required the completion of an impact assessment (IA) or environmental assessment (EA). The purpose of any one of those assessments is to identify the possible effects of a proposed project on the environment, and determine whether these effects can be adequately mitigated to protect the environment and the health of persons. An IA or EA decision by the Commission, concluding no significant adverse environmental effects, is required before a licence can be granted.

The Cigar Lake Operation has undergone several EAs since the discovery of the ore at the Cigar Lake site in the 1980s. Table 2.1 below lists all federal EAs carried out to date with respect to activities at the Cigar Lake site. Subsection 2.1.1 provides a description of the two most recently completed EAs, whereas subsection 2.1.2 provides information on the ongoing EA follow-up program for the Cigar Lake Operation.

Table 2.1: Federal EAs completed for the Cigar Lake site

Project	Applicable EA process and/or legislation	EA start date	EA decision date
Cigar Lake Uranium Mine Project	Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan, appointed under the *Environmental Assessment and Review Process Guidelines Order* (EARPGO)	1995	1998
Disposal of Cigar Lake Waste Rock in the McClean Lake Operation's Sue C pit	EA under CEAA 1992	2001	2003
Construction and Operation of the Cigar Lake Uranium Mine	EA under CEAA 1992	2002	2004
Cigar Lake Water Inflow Management Project	EA under CEAA 1992	2009	2011

2.1.1 Recent EAs completed under CEAA 1992

Construction and Operation of the Cigar Lake Uranium Mine

In 2002, Cameco applied for authorization from the CNSC to construct and operate a commercial-scale uranium mining facility at the Cigar Lake site. The proposed project included the construction and development of underground mine workings, ore handling and transport

systems, waste water treatment systems, waste rock management systems, and ancillary facilities.

At that time, CNSC staff reviewed the application and determined that a screening-level EA under CEAA 1992 [17] was required. Pursuant to subsection 17(1) of CEAA 1992, the conduct of the technical support studies, public consultation program and preparation of an EA Study Report [18] was delegated to Cameco. Cameco submitted the EA Study Report to CNSC staff, who reviewed and accepted it as the basis for the development of CNSC staff's EA Screening Report [19].

In 2004, following the Commission's consideration of CNSC staff's EA Screening Report, the Commission issued a Record of Proceedings, including Reasons for Decision for the Construction and Operation of the Cigar Lake Uranium Mine EA [20], concluding that the project, taking into account the implementation of mitigation measures, would not likely cause significant adverse environmental effects.

The EA process identified the need for an EA follow-up program for the Construction and Operation of the Cigar Lake Uranium Mine Project. The EA follow-up program [21] included wildlife field surveys, as well as data collection, analysis and monitoring for molybdenum and polonium-2010 in nearby waterbodies to assess their potential impact on local aquatic species. The majority of these activities were integrated into the most recent EA follow-up program, which was developed for the Cigar Lake Water Inflow Management Project (see next subsection). More information about this ongoing program is available in subsection 2.1.2.

Cigar Lake Water Inflow Management Project

In 2008, Cameco applied for authorization from the CNSC to construct and operate a new water management system. The proposed project consisted of building, operating and decommissioning two new parallel discharge pipelines that would deliver treated water from the Cigar Lake Operation to a common deep-water discharge location in Seru Bay, within Waterbury Lake. The proposal also included minor modifications to the current water handling and mine water treatment release facilities to connect the proposed discharge pipelines to the existing water treatment infrastructure and ponds.

At that time, CNSC staff reviewed the application and determined that a screening-level EA under CEAA 1992 [17] was required, as well as a provincial EA under the *Saskatchewan Environmental Assessment Act* [22]. A harmonized federal-provincial EA was carried out by the Province of Saskatchewan and the CNSC. Pursuant to subsection 17(1) of CEAA 1992, the conduct of the technical support studies, public consultation program and preparation of an EA Study Report [23] was delegated to Cameco. Cameco submitted the EA Study Report to CNSC staff, who reviewed and accepted it as the basis for the development of CNSC staff's EA Screening Report[24].

In 2011, following the Commission's consideration of CNSC staff's EA Screening Report, the Commission issued a Record of Proceedings, including Reasons for Decision for the Cigar Lake Water Inflow Management Project EA [25], concluding that the project, taking into account the implementation of mitigation measures, would not likely cause significant adverse environmental effects.

The EA process identified the need for an EA follow-up program for the Cigar Lake Inflow Management Project. The EA follow-up program [23] included water sampling, monitoring of fish population, fish chemistry and benthic invertebrates, and wildlife field surveys, among other activities. More information about this ongoing program is available in subsection 2.1.2.

2.1.2 Current EA Follow-up Program

EA follow-up programs are designed to validate the predicted environmental effects and the effectiveness of mitigation measures. The CNSC ensures that EA follow-up programs that are within CNSC's mandate are incorporated into licensing and compliance activities.

In 2011, to fulfill the requirements of the EA for the Cigar Lake Water Inflow Management Project, Cameco submitted an EA follow-up program to the CNSC [23]. This program integrated any active EA follow-up program activities identified in the 2004 EA (see subsection on the Construction and Operation of the Cigar Lake Uranium Mine above). CNSC staff reviewed the EA follow-up program and subsequently approved it [26]. Table 2.2 below lists all activities included in the current EA follow-up program.

Cameco has been informing the CNSC of the status and results of EA follow-up program activities through annual reports ([5] to [11]). Some activities have been completed for having met the established EA objectives, while other activities are still ongoing (see table 2.2 below). Many of the activities have been integrated into Cameco's Environmental Management Program (see section 2.3) to be continued as Cameco's routine monitoring. CNSC staff continue to review the detailed monitoring activities pertaining to the EA follow-up program to ensure that objectives are being met.

Table 2.2: Activities under the current EA follow-up program ([5] to [11], [26])

Environmental component	Activity and objective(s)	Sampling locations	Parameters	Frequency and status
Water quality	Water samples to verify water quality in fish sampling areas	Seru Bay, Seru Bay Outlet, Longyear Bay, East Brown Bay	Metals, metalloids, radium-226, nutrients and general chemistry	Every three years Conducted in 2013, 2016, 2019
Aquatic environment – fish	Lethal fish population survey to verify predictions on fish	Seru Bay, Seru Bay Outlet, Longyear Bay, East Brown Bay	Meristics: fish health characteristics Chemistry: metals, metalloids and percent moisture	Every three years Conducted in 2013, 2016, 2019
Aquatic environment – fish	Fish chemistry samples to verify predictions on fish	Seru Bay, Longyear Bay, Cigar Lake	Meristics: fish health characteristics Chemistry: metals, metalloids and radionuclides	Every three years Conducted in 2013, 2016, 2019
Sediment quality	Sediment samples to verify the predicted mine waster dispersion	Lake B, Mad Dog Lake, Seru Bay, Seru Bay Outlet, Longyear Bay, East Brown Bay	Metals, metalloids, radionuclides percent moisture, particle size and total organic carbon	Every three years Conducted in 2013, 2016, 2019
Sediment quality	Tessier extraction (geochemistry samples) to verify model input assumptions	Seru Bay (deep area), Seru Bay Outlet, Longyear Bay, East Brown Bay (deep area)	Metals, metalloids and radionuclides	Once Completed (2010)
Water quality	Water samples to verify water quality at benthic invertebrate collection stations	Lake B, Mad Dog, Lake, Seru Bay, Seru Bay Outlet, Longyear Bay, East Brown Bay	Metals, metalloids, radium-226, nutrients and general chemistry	Every three years Conducted in 2013, 2016, 2019
Aquatic environment – benthic invertebrates	Depositional benthic invertebrate study to verify predictions on benthic invertebrates	Lake B, Mad Dog Lake, Seru Bay, Seru Bay Outlet, Longyear Bay, East Brown Bay	Community composition, abundance, and biomass	Every three years Conducted in 2013, 2016, 2019
Aquatic environment – benthic invertebrates	Benthic invertebrate chemistry samples to verify model input assumptions	Seru Bay, East Brown Bay	Metals, metalloids and percent moisture	Every six years Conducted in 2016

Environmental component	Activity and objective(s)	Sampling locations	Parameters	Frequency and status
Terrestrial environment	Habitat suitability assessment	20 x 20 km area centered on site and including shoreline of Seru Bay	Ecosite mapping	Once Completed (2009 – 2010)
Terrestrial environment	Ungulate density study	20 x 20 km area centered on site and including shoreline of Seru Bay	Ungulate aerial survey, winter tracking survey, and ungulate pellet group and browse availability	Once Completed (2009 – 2010)
Terrestrial environment	Song bird and amphibian prevalence study	Shoreline of Seru Bay	Breeding song bird survey and amphibian call count survey	Once Completed (2010)
Terrestrial environment	Small mammal trapping study	Shoreline of Seru Bay	Trapping of voles, mice and shrews and sample collection	Once Completed (2010)
Terrestrial environment	Muskrat trapping for hair samples and collection of muskrat flesh, bone, liver, kidney from incidental mortalities Opportunistic sampling of muskrat scat	Aline Drainage, Seru Bay, Reference Area	Physical characteristics (tail length, body length, body weight, ex, age, stomach contents, internal condition and external condition), non-radionuclides and radionuclides.	Once Completed (2010)
Terrestrial environment	Semi-aquatic furbearers and waterfowl prevalence around Seru Bay	Shoreline of Seru Bay	Semi-aquatic furbearer and waterfowl shoreline survey	Every five years Conducted in 2010 and 2015 Not conducted in 2020 due to COVID-19 pandemic. Cameco completed similar work in 2017, which they plan to present in the 2020 Annual Report.
Traditional land and resource use	Monitor traditional land and resource use of Seru Bay and the greater Waterbury Lake area and communicate the potential for unsafe ice conditions	Seru Bay and the greater Waterbury Lake area	Interview with local trappers	Annually for three years Completed (2014 – 2016)

2.2 Planned End-State

The following section provides high-level information with respect to the end-state of the Cigar Lake Operation following decommissioning activities and provides a narrative of how the interactions between the project and the environment will change over time. This section is informed by Cameco's PDP for the Cigar Lake Operation [4].

The CNSC requires that planning for decommissioning take place throughout the lifecycle of a nuclear facility. Planning for decommissioning is an integral part of the lifecycle of a facility and is an ongoing process. A PDP is developed by the licensee and submitted to the CNSC for review and acceptance as early as possible in the lifecycle of the facility or the conduct of the licensed activities. The PDP must be updated and submitted to the CNSC every five years, when further operational experience is gained, technological advancements are made, or when requested by the Commission or a person authorized by the Commission. Prior to the commencement of any decommissioning activities and to support an application for a licence to decommission, a Detailed Decommissioning Plan (or DDP) is developed by the licensee and submitted to the CNSC for review and acceptance.

The PDP documents the decommissioning strategy and end-state objectives, the major decontamination, dismantling and remediation steps, the approximate quantities and types of waste generated, the principal hazards and protection strategies, and an estimate of costs associated with these activities. The PDP is developed for planning purposes only and the associated cost estimate is used to develop dedicated decommissioning funding in the form of a financial guarantee. The PDP is not meant to be implemented and does not provide sufficient details for the assessment of environmental impacts during decommissioning. This information is required to be submitted at a later date in support of an application for a licence to decommission. As a lifecycle regulator, the CNSC will continue to carry out regulatory oversight until the planned end-state is achieved and the facility is released from CNSC's regulatory control.

The decommissioning strategy and end-state objectives for the Cigar Lake Operation are documented in the 2019 Cigar Lake Operation Preliminary Decommissioning Plan [4]. Cameco has selected a prompt decommissioning strategy for the Cigar Lake Operation. The end-state is to reclaim all structures and disturbed areas to an ecological and radiological condition that is as similar as possible to the surrounding environment.

At the end of operations, the site would safely transition to an inactive site, and when regulatory approvals are obtained, the facility would transition into formal decommissioning. According to Cameco's current PDP (which is subject to change), the two mineshafts would be backfilled to surface with waste material and remaining water from the surface would be collected and treated before release. The final stage would consist of removing all surface buildings, facilities and services. Cameco's current preference is for contaminated decommissioning waste to be placed in the underground workings and for clean waste rock and overburden material to be used as landfill and/or cover material in order to establish adequate drainage and provide a media for vegetative growth. No radiological material or waste exceeding site-specific decommissioning criteria would remain on surface at the Cigar Lake site.

Ultimately, the objective is for the Cigar Lake site to be released into the Province of Saskatchewan's Institutional Control Program after being adequately decommissioned and

released from CNSC's regulatory control. Once accepted into the Institutional Control Program, the province would manage and monitor the site, as well as oversee or maintain controls to limit human and environmental exposure, as necessary, over the long-term.

Environmental monitoring would take place during all stages of active decommissioning, as well as during the transitional period between active decommissioning and release into the provincial Institutional Control Program. This monitoring period will be key to confirming the success of decommissioning activities and demonstrating that the site is in a stable or improving condition.

Cameco expects that the release of contaminants to the atmospheric, aquatic and terrestrial environment at the Cigar Lake site to be significantly lower during decommissioning than during operational activities. Risks to workers involved in decommissioning activities would be similar to current risks to workers: surface decommissioning workers would be exposed to risks typically encountered during heavy construction, while underground decommissioning workers would be exposed to risks typically encountered during normal underground mining operations. Risks to the public would be negligible, since members of the public would not be permitted to freely visit the Cigar Lake site during decommissioning.

Once decommissioning activities have concluded, the current plan is for the site to be re-vegetated with tree species and seed mixtures that are appropriate for the Cigar Lake climate and soil characteristics. Cameco expects that following decommissioning and acceptance into the provincial Institutional Control Program, the Cigar Lake site will be suitable for traditional land use with no access restrictions.

2.3 Environmental Regulatory Framework and Protection Measures

The CNSC has a comprehensive EP regulatory framework which includes both radiological and hazardous substances, as well as physical stressors (e.g., noise), and provides for the protection of Indigenous peoples, the public and the environment. Public dose is considered under the EP framework, as well as from a radiation protection standpoint. Human exposure is a result of interactions with the environment (i.e., members of the public are part of the environment). The focus of this section of the EPR Report is on the EP regulatory framework and the status of Cameco's Environmental Management Program for the Cigar Lake Operation. The results obtained from this program are detailed in section 3.0 of this report.

The Environmental Management Program at Cameco's Cigar Lake Operation is designed and implemented in accordance with REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures* (2017) [27], as well as the environmental protection standards from the Canadian Standards Association (CSA) listed below. The implementation status for these items is shown in table 2.3 below.

Table 2.3: Status of EP measures to implement regulatory documents and standards

Regulatory document or standard	Status
CSA N288.4-10, *Environmental monitoring programs at class I nuclear facilities and uranium mines and mills* [28]	Implemented
CSA N288.5-11, *Effluent monitoring program at class I nuclear facilities and uranium mines and mills* [29]	Implemented
CSA N288.6-12, *Environmental risk assessment at class I nuclear facilities and uranium mines and mills* [30]	Implemented
CSA N288.7-15, *Groundwater protection programs at class I nuclear facilities and uranium mines and mills* [31]	Implemented
CSA N288.8-17, *Establishing and implementing action levels to control releases to the environment from nuclear facilities* [32]	Implemented
CNSC Regulatory Document REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures, version 1.1* (2017) [27]	Implemented

CNSC staff confirm that Cameco has implemented programs according to the relevant EP regulatory documents or standards.

Licensees are also required to regularly report on the results of their Environmental Protection/Management Programs. Reporting requirements are specified within REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills* [33], the *Radiation Protection Regulations* [34] (e.g., for action levels (AL) or dose limit exceedances), the licensees' approved programs and manuals, or the LCH [14].

Cameco is required to submit environmental monitoring and measurement results in quarterly reports and annual reports. These reports are reviewed by CNSC staff for compliance and verification, as well as trending. Summaries of the environmental data in Cameco's quarterly and annual reports are available on Cameco's Cigar Lake webpage [35].

CNSC staff regularly report on the licensee's performance to the Commission for activities conducted at the Cigar Lake Operation. Regulatory Oversight Reports (RORs) are the CNSC's standard mechanism for annually updating Indigenous peoples, the public and the Commission on the operation and regulatory performance of licensed facilities. RORs are available on CNSC's website [36].

2.3.1 Environmental Protection Measures

To meet CNSC's regulatory requirements under REGDOC-2.9.1 [27], Cameco is responsible for implementing and maintaining EP measures that identify, control and monitor releases of radioactive and hazardous substances and effects on human health and the environment from the Cigar Lake Operation. EP measures are an important component of the overall requirement of licensees to make adequate provision to protect the environment and health of persons.

This, and the following subsections, provide a brief summary of Cameco's Environmental Management Program for the Cigar Lake Operation and the status of each specific EP measure, relative to the requirements or guidance outlined in the latest regulatory document or CSA

standard. Section 3.0 summarizes the results of these programs or measures against relevant regulatory limits and environmental quality objectives or guidelines, and discusses, where applicable, any interesting trends.

Cameco is required to implement an Environmental Management System (EMS) that conforms to REGDOC-2.9.1 and submit an Environmental Management Program. Cameco's Environmental Management Program is in compliance with and includes the following components to meet the requirements and guidance outlined in REGDOC-2.9.1 [27]:

- EMS (subsection 2.3.2)
- Environmental Risk Assessment (subsection 2.3.3)
- Effluent Emissions Control and Monitoring (subsection 2.3.4)
- Environmental Monitoring Program (EMP) (subsection 2.3.5)

2.3.2 Environmental Management System

An EMS refers to the management of an organization's environmental policies, programs and procedures in a comprehensive, systematic, planned and documented manner. It includes the organizational structure, planning and resources to develop, implement and maintain a policy for EP. The EMS serves as a management tool to integrate all of the licensee's EP measures in a documented, managed and auditable process in order to:

- identify and manage non-compliances and corrective actions within the activities, through internal and external inspections and audits
- summarize and report the performance of these activities both internally (licensee management) and externally (Indigenous peoples, the public, and the Commission)
- train personnel involved in these activities
- ensure the availability of resources (i.e., qualified personnel, organizational infrastructure, technology and financial resources)
- define and delegate roles, responsibilities and authorities essential to effective management

Cameco established and implemented an EMS for the Cigar Lake Operation in accordance with REGDOC-2.9.1 [27], and is also registered and certified under the International Organization for Standardization's (ISO) 14001:2015 standard[1]. CNSC staff review Cameco's annual internal audits, management reviews, and environmental goals, targets and objectives to ensure compliance with REGDOC-2.9.1 during environment-focused compliance inspections. CNSC staff also review the status of Cameco's annual goals, targets and objectives and the implementation of the EMS as part of annual reports.

The results of these reviews demonstrate that Cameco's EMS for the Cigar Lake Operation meets CNSC's requirements as outlined in REGDOC-2.9.1 [27]. Cameco continues to maintain an EMS to improve environmental performance at the Cigar Lake Operation.

[1] ISO 14001:2015 is a standard that helps an organization achieve the intended outcomes of its EMS.

2.3.3 Environmental Risk Assessment

An ERA of nuclear facilities is a systematic process used to identify, quantify and characterize the risk posed by contaminants and physical stressors in the environment on human and other biological receptors, including the magnitude and extent of the potential effects associated with a facility. The ERA serves as the basis for the development or improvement of limits, controls, and EMPs. The results of these programs, in turn, inform and refine future revisions of the ERA.

Cameco submitted an updated ERA in October 2017 [12] based on CSA standard N288.6-12, *Environmental risk assessment at Class I nuclear facilities and uranium mines and mills* [30]. CNSC staff reviewed the ERA and determined it to be compliant with the standard. In 2019, Cameco provided an Addendum to the 2017 ERA [13], which provided revised risk assessment predictions to reflect Cameco's optimization of water handling and treatment circuits to limit the release of arsenic in the effluent. A summary of the 2017 ERA and 2019 Addendum is posted on Cameco's website [37].

Cameco also previously submitted ERAs as part of the 2004 EA for the Construction and Operation of the Cigar Lake Uranium Mine [18] and the 2011 EA for the Cigar Lake Water Management Project [23]. Cameco assessed the accuracy of these ERA predictions in the Cigar Lake Operation Environmental Performance Report for 2011 to 2015 [38] and 2017 ERA [12], which also included 2016 environmental performance data.

The objective of the 2017 ERA and 2019 Addendum was to provide an update of the assessment of the risks from the emissions of current and future anticipated site operations on human health and the environment. The purpose of the ERA was to refine model inputs to conduct a multi-tier human health and ecological risk assessment for radiological and non-radiological (i.e., chemical) contaminants of potential concern (COPCs) and compare the results to previous predictions. Further, the updated ERA is a method to identify opportunities for continual improvement and the need for additional mitigation measures, if required.

The predicted ecological and human health risks due to releases to air and water from the Cigar Lake Operation are similar to the overall conclusions of the 1995 EA [39], 2004 EA [18] and 2011 EAs [23] that the overall risk to the environment and human health from the Cigar Lake Operation is low to negligible. Minimal effects are predicted to be limited in spatial extent to Seru Bay and are predicted to decline when the release of treated effluent ceases. The ERA predictions resulting from the 2017 ERA and 2019 Addendum are detailed in subsections 3.2.4 (for risks to non-human biota) and subsection 3.2.5 (for risks to human health).

CNSC staff reviewed the 2017 ERA [12] and 2019 Addendum [13] and confirmed that, despite the potential for some risks of low probability and limited extent (see subsections 3.2.4 and 3.2.5), the overall risk to the environment and human health from the Cigar Lake Operation is low to negligible. Cameco is expected to revise and submit an updated ERA every five years, or if there is a change to the facility's operations or in the scientific understanding and methodology of the ERA. The next update of the Cigar Lake ERA is expected at the end of 2021.

2.3.4 Effluent and Emissions Control and Monitoring

Controls on environmental releases are established to provide protection to the environment and to respect the principles of sustainable development and pollution prevention. The effluent and emissions prevention and control measures are established on the basis of industry best practice,

the application of optimization (e.g., in design) and *As Low As Reasonably Achievable* (ALARA) principles, the Canadian Council of Ministers of the Environment (CCME) guidelines, as well as ERA results.

Cameco's Environmental Management Program for the Cigar Lake Operation [40] was reviewed and approved by CNSC staff. This program contains licence limits and site-specific ALs to control radiological and hazardous effluent. Limits in CNSC's licences for uranium mines and mills are adopted from schedule 4 of the *Metal and Diamond Mining Effluent Regulations* (MDMER) [41].

The Effluent Monitoring Program for the Cigar Lake Operation has been reviewed and approved by CNSC staff, and found to be compliant with REGDOC-2.9.1 [27] and relevant standards, including CSA Standard N288.5-11, *Effluent Monitoring Program at Class I Nuclear Facilities and Uranium Mines and Mills* [29].

Under section 4 of CNSC's *Uranium Mines and Mills Regulations* [42], Cameco is required to implement an Environmental Code of Practice (ECOP) as part of its Effluent Monitoring Program. The objectives of an ECOP are to ensure that releases to the environment are kept ALARA, and that any potential loss of control events are identified so that corrective actions can be taken, if warranted. The ECOP contains ALs that serve as an early warning of a potential loss of control to prevent a licence limit exceedance. ALs are derived from actual performance data from the mine water treatment plant. This follows the methodology outlined in CSA standard N288.8-17, *Establishing and implementing action levels to control releases to the environment from nuclear facilities* [32]. The ECOP also contains actions that would be taken if an AL were to be exceeded, such as reporting the incident within 24 hours, immediately performing an investigation to determine whether a loss of control has occurred, taking immediate action to restore the effectiveness of the Environmental Management Program, and submitting a report explaining the actions taken to correct the situation and prevent recurrence.

Based on compliance and technical assessment activities, CNSC staff have concluded that Cameco continues to implement and maintain an effective Effluent Monitoring Program, including an ECOP, for the Cigar Lake Operation that adequately protects the environment and the health of persons.

2.3.5 Environmental Monitoring Program

CNSC requires licensees to design and implement an EMP that is specific to the monitoring and assessment requirements of the licensed facility and its surrounding environment. The program is required to:

- measure contaminants in the environmental media surrounding the facility or site
- determine the effects, if any, of the facility or site operations on people and the environment
- serve as a secondary support to emission monitoring programs in order to demonstrate the effectiveness of emission controls

More specifically, the program must gather the necessary environmental data to show that the facility is operating within the bounds predicted in the ERA. The program must also address the potential environmental interactions identified at the facility or site. Hazardous substances are the major focus at the Cigar Lake Operation, though radionuclides are included within monitoring activities associated with liquid discharges and air emissions. Cameco's EMP for the Cigar Lake Operation consists of the following components:

- ambient air monitoring (radon and particulates)
- soil and lichen monitoring
- aquatic biota monitoring (fish and benthic invertebrates)
- sediment monitoring
- surface water monitoring
- groundwater monitoring

Monitoring frequency is specified in the EMP. Ambient air, surface water, and groundwater monitoring is conducted regularly throughout each year, while soil and lichen, aquatic biota and sediment monitoring are conducted every three or six years depending on the sampling media and location. Cameco's EMP also contains a requirement to perform annual inspections of synthetic and/or concrete liners.

Cameco is required to maintain its EMP to be in compliance with REGDOC-2.9.1 [27] and relevant standards, including CSA Standard N288.4-10, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [28].

Based on compliance activities and technical assessments, CNSC staff have concluded that Cameco is in compliance with REGDOC-2.9.1 and continues to implement and maintain an effective EMP for the Cigar Lake Operation that adequately protects the environment and the health of persons.

2.4 Reporting of Airborne Emissions under Other Federal or Provincial Legislation

A core element of CNSC's requirement for an EMS is the identification of all regulatory requirements applicable to the facility, whether pursuant to the NSCA or other federal or provincial legislation. The EMS must ensure that programs are in place to respect these requirements.

2.4.1 Greenhouse Gases

While there are a range of broadly applicable federal environmental regulations (e.g., petroleum products storage tanks, environmental emergency regulations), the management of greenhouse gas (GHG) emissions has been identified as a national priority.

Under the federal *Canadian Environmental Protection Act, 1999* (CEPA 1999) [43], Cameco is required to monitor and report on GHG emissions [44]. Nuclear facilities that emit more than the CO_2 equivalent (CO2e) emission reporting threshold on an annual basis must report their GHG emissions to Environment and Climate Change Canada (ECCC). In 2017, the reporting threshold was lowered. As a result, the Cigar Lake Operation reported GHG emissions to ECCC in 2017, 2018 and 2019.

The CNSC maintains a collaborative working relationship with ECCC through a formal Memorandum of Understanding, which includes a notification protocol. An exceedance of the GHG emission threshold would be included under this notification protocol. This ensures a coordinated regulatory approach is achieved to meet all federal requirements associated with EP, including the management of GHG emissions.

2.4.2 Halocarbons

In accordance with the *Federal Halocarbon Regulations, 2003* [45], Cameco is required to provide a semi-annual halocarbon release report to ECCC for the Cigar Lake Operation. Between 2013 and 2019, Cameco reported one halocarbon release of 11.4 kilograms of the R-22 refrigerant in 2014, and the same quantity of the R-22 refrigerant was reported in 2017. The releases were in accordance with ECCC's *Federal Halocarbon Regulations*, and therefore, CNSC staff conclude that there was little environmental impact from the R-22 releases.

2.4.3 Sulphur Dioxide Emissions

Under the authority of CEPA 1999 [43], Cameco is also required to estimate the total sulphur dioxide (SO_2) emissions from the Cigar Lake Operation and report to the National Pollutant Release Inventory (NPRI) [46], provided that the reporting requirements are met. Between 2013 and 2019, the SO_2 emissions from the Cigar Lake Operation were consistently below the 20 tonne reporting threshold, and thus, were not reported to the NPRI.

3.0 STATUS OF THE ENVIRONMENT

This section provides a summary of the status of the environment around the Cigar Lake Operation. It first includes a description of the radiological and hazardous releases to the environment (section 3.1), followed by an assessment of any potential effects to the different components of the environment, as a result of exposure to these contaminants (section 3.2).

It should be noted that environmental components are regularly reviewed through annual reporting requirements and CNSC compliance verification activities, as detailed in other areas of this report. These are reported to the Commission in the EP Safety and Control Area of licensing CMDs and annual RORs.

3.1 Releases to the Environment

Radioactive and hazardous substances that have the potential to cause an adverse effect to ecological or human receptors are identified as "contaminants of potential concern" (COPCs). Once COPCs are emitted from a facility or licensed site, they are considered a release to the environment and how they find their way to the different receptors considered by the ERA are called pathways. Figure 3.1 below illustrates a conceptual model of the environment around a generic mine site to illustrate the relationship between releases (airborne emissions or waterborne effluent) and human and ecological receptors or exposure pathways. The movement of the releases through the environment to the receptors are termed exposure pathways. This graphic is meant to provide an overall conceptual model of the releases, exposure pathways and receptors for the Cigar Lake Operation, and thus, should not be interpreted as a complete depiction of the Cigar Lake site and its surrounding environment. The specific releases and COPCs associated with the Cigar Lake Operation are explained in detail in the following subsections.

Figure 3.1. Conceptual model of a generic mine site

3.1.1 Licensed Release Limits

All operating uranium mines and mills in Canada are regulated at both the provincial and federal levels. At the provincial level, the Saskatchewan Ministry of Environment issues an Approval to Operate a Pollutant Control Facility Licence, which consists of release limits adopted from Saskatchewan's *Mineral Industry Environmental Protection Regulations* [47]. At the federal level, under the *Fisheries Act* [48], metal and diamond mines must adhere to the requirements of the MDMER [41], which contain release limits that are enforced by ECCC. In addition, under the NSCA, uranium mines and mills are issued a CNSC licence, which includes licence limits from the MDMER.

Table 3.1 below shows the current and upcoming MDMER-based licence limits for waterborne effluent applicable to the Cigar Lake Operation. Starting in June 2021, the MDMER will come into force to include more stringent licence limits for arsenic and lead. The MDMER will also include new licence limits for un-ionized ammonia. These new licence limits are already in the proposed LCH [14] with an implementation date of June 2021. It is worth noting that Cameco is already in compliance with the more stringent licence limits and the new MDMER requirements, as will be demonstrated in table 3.2 hereafter.

Table 3.1: Authorized licence limits for waterborne effluent at the Cigar Lake operation, adopted from the MDMER until and after May 2021 [41][49]

Deleterious Substance [(a)]	Maximum authorized monthly mean concentration [(b)]		Maximum authorized concentration in a composite sample [(c)]		Maximum authorized concentration in a grab sample [(d)]	
	Until May 2021	After May 2021	Until May 2021	After May 2021	Until May 2021	After May 2021
Arsenic (mg/L)	0.50	0.30	0.75	0.45	1.00	0.60
Copper (mg/L)	0.30	0.30	0.45	0.45	0.60	0.60
Lead (mg/L)	0.20	0.10	0.30	0.15	0.40	0.20
Nickel (mg/L)	0.50	0.50	0.75	0.75	1.00	1.00
Zinc (mg/L)	0.50	0.50	0.75	0.75	1.00	1.00
Un-ionized ammonia (mg/L)	N/A[(e)]	0.50	N/A[(e)]	N/A[(e)]	N/A[(e)]	1.00
Total suspended solids (mg/L)	15.00	15.00	22.50	22.50	30.00	30.00
Radium-226 (Bq/L)	0.37	0.37	0.74	0.74	1.11	1.11
Acid balance (H_3O^+) reported as pH	In a range of 6.0 to 9.5					
Acutely lethal effluent	0%					

(a) Units are in milligrams per litre (mg/L) or becquerels per litre (Bq/L).
(b) "Monthly Mean Concentration" means the average value of the concentrations in composite or grab samples collected over a calendar month, in accordance with the MDMER [41].
(c) Based on the LCH [14], a "composite sample" means (i) a quantity of undiluted effluent consisting of a minimum of three equal volumes of effluent, or three volumes proportionate to flow, that has been collected at approximately equal time intervals over a sampling period of not less than 7 hours, and not more than 24 hours, or (ii) a quantity of undiluted effluent collected continually at an equal rate, or at a rate proportionate to flow, over a sampling period of not less than 7 hours, and not more than 24 hours.
(d) Based on the LCH [14], a "grab sample" means a quantity of undiluted effluent collected at any given time.
(e) N/A stands for "not available". Prior to May 2021, the MDMER did not include release limits for un-ionized ammonia. It has only recently been identified (based on new or updated science) as a contaminant that could cause effects on the environment.

There are currently no MDMER limits for selenium, uranium and molybdenum, and thus, there are no limits for these parameters in the CNSC licence issued for the Cigar Lake Operation. The limits for selenium and uranium shown in this EPR Report come from the Province of Saskatchewan, and are presented herein to place CNSC's regulatory expectations into perspective. While the CNSC expects licensees to meet other federal and provincial regulatory

requirements, the CNSC reserves the right to place more stringent expectations where deemed necessary. New science and site-specific ERAs have demonstrated that these provincial limits are not adequately protective for site-specific receiving environments. To address this, the CNSC has required uranium mine and mill licensees to implement additional treatment technologies and process optimization techniques, where necessary, to demonstrate the application of the principles of ALARA and *Best Available Technology Economically Available* (also known as BATEA), as well as to ensure site-specific environmental protection related to selenium, uranium and molybdenum. As a result, releases have been substantially lower than those authorized by the Province of Saskatchewan.

The CNSC has an interim objective for uranium of 0.1 milligrams per litre (mg/L) used as a benchmark to demonstrate the current application of ALARA and BATEA. This value is based on a 2006 review of uranium treatment within the uranium mining and milling sector [50], which was prepared under contract for the CNSC.

No provincial or federal licence limits currently exist for molybdenum. In the 2000s, the CNSC required that uranium mines and mills with high molybdenum releases upgrade their effluent management and water treatment processes to treat molybdenum. This resulted in a significant reduction of molybdenum loadings to the environment. In the absence of a licence limit, licensees have implemented administrative and ALs to effectively manage and control molybdenum.

REGDOC-2.9.2, *Controlling Releases to the Environment from Nuclear Facilities* is a new regulatory document currently being developed by CNSC staff and scheduled for public review in March 2021. With the publication and implementation of REGDOC-2.9.2, formal licence release limits will be developed for selenium, uranium and molybdenum, as necessary.

3.1.2 Airborne Emissions

Cameco controls and monitors airborne emissions from the Cigar Lake Operation to the environment under its Environmental Management Program. This program is based on CSA N288.5-11, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [29], where both radiological and hazardous emissions are monitored and controlled.

The sources of possible airborne releases at the Cigar Lake Operation include:

- unpaved road dust from the mine site roads
- grading of unpaved roads
- drilling surface freeze holes
- concrete batch plant operations
- incineration of food waste
- diesel and propane fuel combustion
- underground mine ventilation exhaust
- surface stockpiles (material handling, wind erosion, bulldozing and radon emissions)

The emission sources have the potential to emit:

- particulate matter (PM) from the underground ventilation exhaust (i.e., total suspended particulate (TSP), PM less than 10 microns in diameter (PM_{10}) and PM less than 2.5 microns in diameter ($PM_{2.5}$))

- gaseous COPCs from fuel combustion (i.e., nitrogen oxides (NO_X), sulphur dioxide (SO_2) and carbon monoxide (CO))
- metals from the underground mine ventilation exhaust (i.e., arsenic, cobalt, copper, lead, molybdenum, selenium, uranium and zinc)
- radon gas from the underground mine ventilation exhaust and waste rock stockpiles

Air emissions sources identified for the Cigar Lake Operation were modelled in the Cigar Lake Air Quality Modelling Assessment [51]. The results showed that there were no significant risks to the environment and persons from the identified emission sources.

Conclusion

Based on CNSC staff's review of the results of the Environmental Management Program and the Cigar Lake Air Quality Modelling Assessment, CNSC staff conclude that Cameco's air emissions to the environment from the Cigar Lake Operation are very low. CNSC staff also conclude that Cameco continues to provide adequate protection of people and the environment from air emissions.

3.1.3 Waterborne Effluent

Cameco controls and monitors liquid (waterborne) effluent from the Cigar Lake Operation to the environment under its Environmental Management Program. This program is based on CSA N288.5-11, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [29], where radiological and hazardous releases are monitored.

The mine water treatment plant, described in the Mining Facility Licensing Manual [52], treats wastewater generated by the facility, such as from drainages, sumps and the underground mine. One exception is sewage, which is treated by the sewage treatment system. The mine water treatment plant includes the following components:

- a first stage water treatment circuit that precipitates molybdenum from contaminated water, adjusts the pH of treated water, and removes precipitated solids
- a second stage water treatment circuit that precipitates residual trace metals and radionuclides from contaminated water, adjusts the pH of treated water, and removes precipitated solids
- monitoring ponds, where treated water is pumped, a composite sample[2] is taken as the pond fills up, and treated water is discharged to the environment provided that lab results indicate that COPCs in the sample are within licence limits and internal targets, otherwise the treated water is recycled back to the mine water treatment plant for further treatment
- a contingency water treatment that is used to treat mine water in case of an emergency mine water inflow into the underground mine

The treated effluent from the mine water treatment plant is piped to Seru Bay and is batch-released to the environment through a diffuser. As treated water is pumped from the monitoring

[2] A composite sample is a quantity of effluent consisting of three equal volumes of effluent, or three volumes proportional to flow, that has been collected at approximately equal time intervals over a period of between 7 to 24 hours.

ponds to the environment, it is sampled again to confirm that it meets the release criteria. If the results are outside of release criteria, the release is immediately stopped and the water is pumped back to a collection pond to be returned to the mine water treatment plant for further treatment. The Cigar Lake Operation also records the flow rate and total volume of each batch release. With this information, the Cigar Lake Operation calculates and reports the total mass loadings of COPCs to the environment.

Cameco monitors temperature, conductivity, pH, metals (e.g., arsenic, copper, lead, molybdenum, nickel, selenium, uranium, unionized ammonia and zinc) and radionuclides (e.g., radium-226, thorium-230, polonium-210, and lead-210) in effluent released from the Cigar Lake Operation.

Table 3.2 summarizes the annual monthly mean concentrations of liquid effluent discharged to Seru Bay from 2013 to 2019, before dilution occurred at the end of pipe. In addition to licence limits, the Cigar Lake Operation has established liquid effluent ALs and internal control levels (also known as administrative levels), which are used to prevent AL exceedances. Exceedances of licence limits and ALs are reported to the CNSC, documented, investigated, and appropriate corrective actions are taken where warranted. As shown in table 3.2, all of the COPCs in the effluent discharged from the Cigar Lake Operation remain at a very small fraction of licence limits and no AL at the mine water treatmant plant has been exceeded over the previous licence term.

Table 3.3 summarizes the annual waterborne loadings to the environment and demonstrates that the loadings of COPCs remained within the benchmarks established in the 2017 ERA [12] and 2019 Addendum [13].

Table 3.2: Annual monthly mean concentrations of waterborne effluent from the Cigar Lake Operation (2013 – 2020) ([5] to [11], [53])

Parameter [a]	Licence limit	2013	2014	2015	2016	2017	2018	2019	2020 [c]
Arsenic (mg/L)	0.5	0.0007	0.0033	0.0565	0.0919	0.0750	0.0603	0.0952	0.0793
Copper (mg/L)	0.3	0.0036	0.0008	0.0004	0.0004	0.0006	0.0008	0.0014	0.0012
Lead (mg/L)	0.2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002
Nickel (mg/L)	0.5	0.0018	0.0020	0.0041	0.0027	0.0008	0.0009	0.0013	0.0010
Zinc (mg/L)	0.5	0.0089	0.0275	0.0083	0.0241	0.0259	0.0271	0.0232	0.0490
pH [b]	6.0 to 9.5	7.3	7.1	6.8	6.8	7.3	7.3	7.3	7.3
Radium-226 (Bq/L)	0.37	0.010	0.007	0.010	0.007	0.007	0.006	0.008	0.008
Total suspended solids (mg/L)	15	1	1	1	1	1	1	2	1
Selenium (mg/L)	0.6 [d]	0.0005	0.0009	0.0041	0.0062	0.0042	0.0044	0.0041	0.0025
Uranium (mg/L)	2.5 [e]	0.0023	0.0166	0.059	0.0063	0.0018	0.0005	0.0004	0.0002
Molybdenum (mg/L)	N/A [f]	0.0099	0.0360	0.0763	0.0369	0.0640	0.1030	0.1069	0.1022

(a) Units are in milligrams per litre (mg/L) or becquerels per litre (Bq/L). Results show the mean of the concentrations for each month in one year.
(b) pH is taken from every discharge samples. It is not measured in monthly composite samples.
(c) 2020 values are based on data from January to June 2020.
(d) This is the provincial limit that is not in the CNSC licence.
(e) This is the provincial limit that is not in the CNSC licence. As discussed in subsection 3.1.1, in the absence of a CNSC licence limit for uranium, the CNSC uses the interim objective for uranium of 0.1 mg/L as a bencmark to demonstrate the application of ALARA and BATEA.
(f) Refer to subsection 3.1.1 for an explanation of why no provincial or federal licence limits currently exist for molybdenum.

Table 3.3: Annual waterborne loadings from the Cigar Lake Operation (2013 – 2019) ([5] to [11], [53])

Parameter [(a)]	2013	2014	2015	2016	2017	2018	2019
Arsenic (kg)	0.214	1.231	14.952	36.016	31.606	21.183	33.436
Copper (kg)	1.384	0.313	0.125	0.139	0.224	0.311	0.447
Lead (kg)	0.040	0.042	0.034	0.049	0.043	0.059	0.056
Nickel (kg)	1.128	0.704	1.870	1.013	0.332	0.326	0.600
Zinc (kg)	2.906	11.149	2.526	9.837	10.779	10.261	8.448
Radium-226 (MBq)	2.917	2.740	3.125	2.707	3.045	2.330	2.805
Total suspended solids (TSS) (kg)	431.8	381.2	443.1	537.0	528.0	463.6	619.8
Selenium (kg)	0.190	0.363	1.271	2.397	1.769	1.582	1.310
Uranium (kg)	0.227	6.628	37.959	2.355	0.719	0.181	0.244
Molybdenum (kg)	6.706	12.707	48.317	14.958	28.192	37.386	36.783

(a) Units are in kilograms (kg) or megabecquerels (MBq).

With the start of high-grade ore mining in 2015, there was an expected increase in concentrations and loading of arsenic, molybdenum, selenium, and uranium. Values were elevated in comparison to previous years, but were still within the predictions made in the ERA.

Uranium concentrations were elevated in the first four months of 2015, at levels above the CNSC interim uranium objective of 0.1 mg/L, but within the established provincial licence limit. Cameco performed investigations and determined that these increased concentrations were the result of processing significantly higher ore grades, further compounded by pH fluctuations in process waters. In response to the increase in uranium concentrations, Cameco implemented some process changes in the mine water treatment plant. This resulted in uranium concentrations decreasing below the CNSC interim uranium objective, and lower loadings for the rest of 2015 and subsequent years.

In response to the increase in arsenic, Cameco conducted investigations and implemented several administrative, operational and/or engineering solutions. Examples of changes included monitoring and controlling the pH of underground water to minimize the mobilization of organic arsenic, as well as improving the recycling of process water captured onsite for reuse in underground processes with the goal of reducing effluent release volumes. The implementation of these solutions resulted in arsenic levels steadily decreasing since 2016, with the exception of 2019, where an increase is attributed to variation in operational activities.

In recent years, both selenium and molybdenum have been the focus of increased regulatory oversight by the CNSC. This is because ERAs completed in the mid-2000s indicated that releases of selenium and molybdenum have the potential to cause adverse environmental effects. As a result of this finding and upon request by the Commission [54] [55], licensees added administrative controls and upgrades to their effluent treatment systems, and improved engineering controls and treatment technologies to reduce effluent releases. These actions have been successful to date for the uranium mining sector, where molybdenum and selenium releases have substantially decreased since the mid-2000s, and continue to be effectively controlled and closely monitored.

In this latter context and in response to the increase in selenium and molybdenum, Cameco implemented process optimization techniques in the mine water treatment plant to more effectively control selenium and molybdenum in effluent. This resulted in more stable loadings to the environment.

Cameco is also required by the MDMER to perform quarterly acute lethality testing on the treated effluent at the final point of discharge using Rainbow Trout (*Oncorhynchus mykiss*) and water fleas (*Daphnia Magna*) as test organisms in accordance with ECCC's procedures [41]. These are are recognized standard aquatic toxicity tests used in concert with effluent limits to assess compliance with MDMER. Acute lethality, as defined in the MDMER, means that the effluent at 100% concentration kills more than 50% of the test organisms over a 96-hour test period. During the previous licensing period (2013 to 2019), results showed that the treated effluent discharged from the Cigar Lake Operation met the MDMER requirements by passing the acute lethality testing. In July 2013, there was one test failure on water fleas, but an investigation determined that the sample temperature during shipment may have caused this unusual result. A follow-up effluent sample was taken a few days later and passed the test for water fleas.

Conclusion

CNSC staff conclude that Cameco's reported liquid effluent discharged to Seru Bay from the Cigar Lake Operation remained below CNSC's approved licence limits throughout the reported period (2013 to 2019). CNSC staff conclude that the loadings of COPCs are within the benchmarks established in the 2017 ERA and 2019 Addendum. CNSC staff also conclude that the treated effluent is not acutely lethal to aquatic organisms in Seru Bay.

CNSC staff are satisfied that the Cigar Lake Operation is taking the appropriate above-mentioned measures to effectively control and reduce concentrations and loadings of arsenic, molybdenum, uranium and selenium in waterborne effluent.

3.2 Environmental Effects Assessment

This section presents an overview of the assessment of predicted effects from licensed activities on the environment and the health of persons. CNSC staff reviewed Cameco's assessment of current and predicted effects on the environment and health of persons due to licensed activities included in the ERA (see subsection 2.3.3). The ERA was performed in a stepwise manner as follows:

- quantify the releases (COPCs) to the environment from current (section 3.1) and future activities

- identify the environmental interactions of the current and expected releases of COPCs, and COPC exposure pathways in the environment
- identify predicted COPC exposure for ecological and human receptors
- identify potential effects to receptors
- determine whether the environment and health of persons is and will continue to be protected

To inform this section of the report, CNSC staff reviewed Cameco's 2017 ERA [12] and 2019 Addendum [13], along with Cameco's Environmental Performance Report for 2011 to 2015 [38], and the annual reports submitted between 2016 and 2019, inclusively ([5] to [8]).

While CNSC staff conducted a review for all environmental components, only a selection of components is presented in detail in the following subsections. The environmental components were selected based on licensing requirements, as well as those that have historically been of interest to the Commission, Indigenous peoples and the public.

3.2.1 Atmospheric and Terrestrial Environment

Atmospheric Environment

The Cigar Lake Operation is located in the continental subarctic region of northern Saskatchewan, which is classified as having a subhumid high boreal climate. The climate of this region is characterized by cold, dry winters and short, cool, moist summers. Mean monthly temperatures range from 15 degrees Celsius in July to -24.4 degrees Celsius in January.

Between 2011 and 2015, average annual precipitation at the Cigar Lake site was approximately 384.7 millimetres with 72% occurring as rain. Between 2016 and 2019, total annual precipitation ranged from 414.5 to 613.7 millimetres. Between 2011 and 2015, prevailing winds blew from the west-northwest with an average wind speed of 12 kilometres per hour.

Cameco predicted and assessed the potential impacts to ambient air quality at the Cigar Lake site by using air dispersion modeling, based on emissions data from the facility, to predict air deposition [12]. Overall, the predicted influence on ambient air quality from the Cigar Lake Operation activities is minimal. While some exceedances of TSP, PM_{10}, and one-hour nitrogen dioxide (NO_2) standards are predicted in the immediate vicinity (within 500 metres) of the site and access road, the predictions are based on conservative background concentrations and operational scenarios. Within five kilometres of the Cigar Lake Operation, all COPC concentrations are predicted to be near background levels.

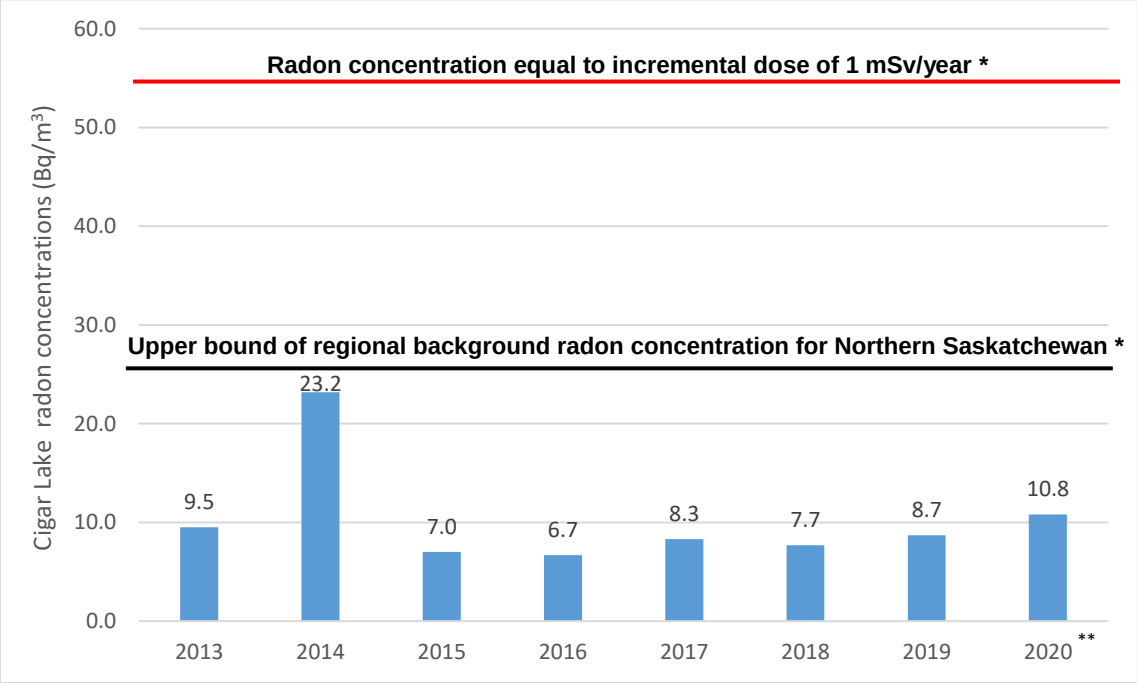
Air Quality Monitoring

Cameco conducts ambient air quality monitoring to confirm that airborne emissions from the Cigar Lake site are within the ERA predictions and remain at levels that are protective of the environment.

Air quality monitoring at the Cigar Lake Operation includes ambient radon and TSP. Radon concentrations are monitored using the passive method of track-etched cups. Eight monitoring stations are located around the site's lease boundary. Figure 3.2 shows that the average radon concentrations in ambient air between 2013 and 2020 were below the reference level for radon. Radon concentrations were also typical of northern Saskatchewan's regional baseline (which range

from < 7.4 becquerels per cubic metre (Bq/m^3) to 25 Bq/m^3). An increase in radon concentrations is discernable for the year 2014. This spike was expected as it coincides with the year the Cigar Lake Operation began ore production.

Figure 3.2: Radon concentrations in ambient air at the Cigar Lake site (2013 – 2020) ([5] to [11], [53])

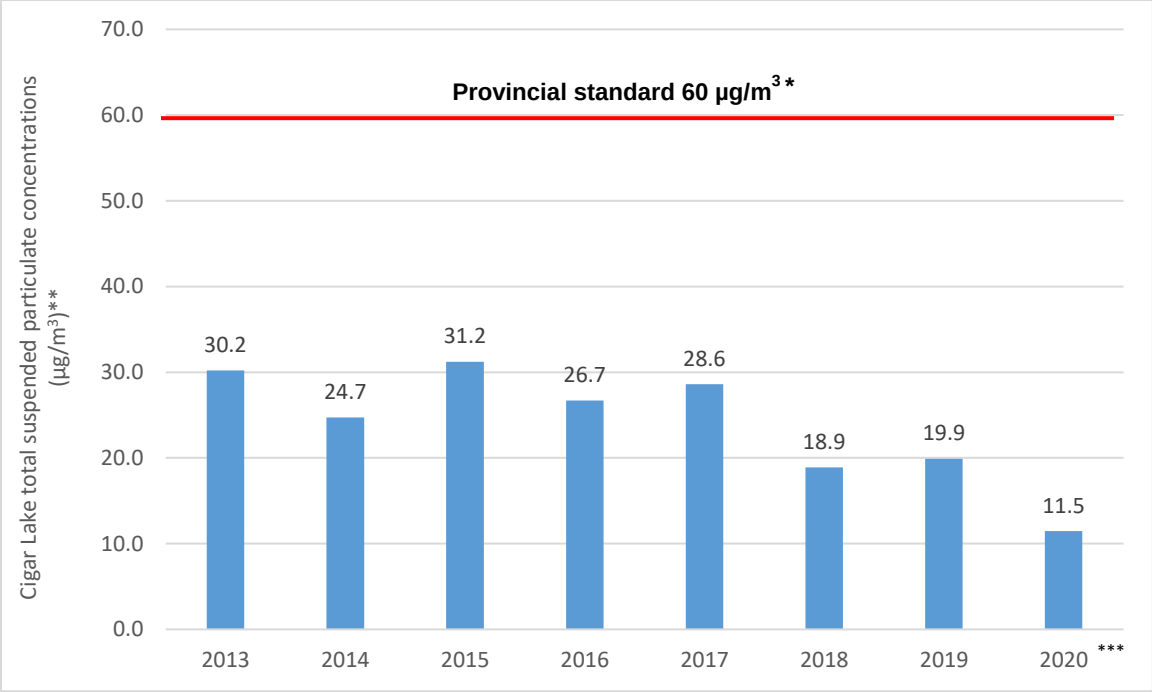


* Upper bound of the incremental dose of 1 millisievert (mSv) per year above background (i.e., an incremental radon concentration of 30 becquerels per cubic metre (Bq/m^3) above natural background) is based on publication 115 by the International Commission on Radiation Protection (ICRP) [56]. Values are calculated as geometric means.

** 2020 values are based on data from January to June 2020.

TSP (i.e., dust, particulates and associated contaminants) are monitored using a high-volume sampling unit located approximately 150 metres from the facility in the prevailing downwind direction. Figure 3.3 demonstrates that TSP values remained low and well below the provincial standard of 60 micrograms per cubic metre (µg/m^3) between 2013 and 2020.

Figure 3.3: TSP concentrations in ambient air at the Cigar Lake site (2013–2020) ([5] to [11], [53])



* Provincial standard contained in the Province of Saskatchewan's current Approval to Operate Pollutant Control Facilities.

** Values are calculated as geometric mean and are presented in micrograms per cubic metre (µg/m^3).

*** 2020 values are based on data from January to June 2020.

TSP samples are also analyzed for concentrations of metals and radionuclides. Table 3.4 shows that the mean concentrations of metal and radionuclides adsorbed to TSP remained low and below reference annual air quality levels between 2013 and 2020.

Table 3.4: Metal and radionuclide concentrations in ambient air at the Cigar Lake site (2013 – 2020) ([5] to [11], [53])

Parameter [a]	Reference levels [b]	2013	2014	2015	2016	2017	2018	2019	2020 [c]
Arsenic ($\mu g/m^3$)	0.06 [d]	0.00025	0.00025	0.00031	0.00030	0.00039	0.00023	0.00026	0.00016
Copper ($\mu g/m^3$)	9.6 [d]	--- [f]	--- [f]	--- [f]	--- [f]	--- [f]	0.0046	0.0034	0.0013
Molybdenum ($\mu g/m^3$)	23 [d]	0.00021	0.00010	0.0001	0.0002	0.0002	0.0003	0.0002	0.0001
Nickel ($\mu g/m^3$)	0.04 [d]	0.00104	0.00067	0.00062	0.00105	0.00103	0.00083	0.00060	0.00026
Lead ($\mu g/m^3$)	0.10 [d]	0.0007	0.0013	0.0009	0.0009	0.0008	0.0008	0.0007	0.00035
Selenium ($\mu g/m^3$)	1.9 [d]	0.00003	0.00003	0.00003	0.00003	0.00004	0.00003	0.00003	0.00002
Zinc ($\mu g/m^3$)	23 [d]	--- [f]	--- [f]	--- [f]	--- [f]	--- [f]	0.0149	0.0123	0.00305
Lead-210 (Bq/m^3)	0.021 [e]	0.000268	0.000248	0.000315	0.000305	0.000360	0.000365	0.000250	0.000315
Polonium-210 (Bq/m^3)	0.028 [e]	0.000074	0.000086	0.000095	0.000099	0.000123	0.000133	0.000089	0.000102
Radium-226 (Bq/m^3)	0.013 [e]	0.000004	0.000008	0.000014	0.000020	0.000031	0.000026	0.000013	0.000024
Thorium-230 (Bq/m^3)	0.0085 [e]	0.000011	0.000010	0.000014	0.000012	0.000023	0.000018	0.000009	0.00001
Uranium ($\mu g/m^3$)	0.06 [d]	0.00007	0.00008	0.00055	0.00113	0.00151	0.00103	0.00096	0.00054

(a) Units are in micrograms per cubic metre ($\mu g/m^3$) or becquerels per cubic metre (Bq/m^3).
(b) Reference annual air quality levels from the Province of Ontario and the ICRP are shown for reference only, as no limits have been established by the federal government or the Province of Saskatchewan.
(c) 2020 values are based on January to June 2020 data.
(d) Reference annual air quality levels have been derived from the Ontario 24-hour Ambient Air Quality Criteria [57].
(e) Reference level has been derived from publication 96 by the ICRP [58].
(f) Analysis of copper and zinc in air samples started in 2018, which is why no data is available between 2013 and 2017.

Terrestrial Environment

The Cigar Lake Operation is located in the Churchill Upland ecoregion of the Boreal Shield ecozone. Ground moraines and drumlin formations consisting of glacial till are characteristic landforms in the ecoregion. The soils, vegetation and wildlife in the region surrounding the Cigar Lake Operation are typical of the Boreal Shield ecozone. Upland soils are generally formed on sorted glaciofluvial deposits or unsorted moraines, which produce well-drained Brunisolic soils [18]. Lowland areas, such as bogs and fens, are generally characterized by organic soils.

The terrestrial habitat in the region surrounding the Cigar Lake Operation is dominated by coniferous forests and shrubs, with smaller areas of lowland habitat (e.g., bogs, fens, marshes and riparian vegetation) [59]. Fire plays a significant role in shaping the northern terrestrial environment. There is a predominance of immature and mature jack pine forest stands, interspersed with bogs and open fens. Lichens form a significant ground cover in mature upland jack pine and black spruce stands.

Breeding bird surveys completed in 2009 [23] and 2010 [59] identified 16 and 43 breeding bird species respectively that were typical of the region, with no species at risk identified.

In 2010, various wildlife surveys confirmed the presence of shrews, voles, mice, red squirrel, showshoe hare, grouse, moose, wolf, black bear, red fox ermine, mink, American Marten and Canada Lynx in the vicinity of the Cigar Lake Operation [59].

Wildlife surveys confirmed the limited presence of caribou in the area surrounding the Cigar Lake site [59]. The Cigar Lake Operation is located within the overwintering range of the barren ground caribou (for the Beverly and Quamanirjuak herds), which make occasional southerly migrations into the northern portions of the region during the winter [23]. The Cigar Lake Operation is also within the range of the woodland caribou [23]. Woodland caribou are not migratory and inhabit much of Saskatchewan's northern forest year round.

The presence of reptiles and amphibians is restricted in northern Saskatchewan due to climate, and as such, represents the northern limit for most species. Cameco identified that one species of reptiles and four species of amphibians have ranges that intersect with the Cigar Lake site, including the Northern Leopard Frog, a species of special concern under the federal *Species at Risk Act* (SARA) [60] although it was not observed during field surveys in 2009 and 2010 [18] [59].

To comply with SARA, and as part of the 2017 ERA [12], Cameco conducted an assessment of federal species at risk that could potentially be present on or around the Cigar Lake site. Table 3.5 lists the three terrestrial species at risk that were identified as potentially present around the Cigar Lake site, and that were assessed in the 2017 ERA. However, none of these species at risk are known to reside in, or frequently visit the area within or immediately surrounding the Cigar Lake site.

Table 3.5: Status of terrestrial species at risk present around the Cigar Lake site [12]

Species	SARA Schedule 1 status [60]	Notes
Northern Leopard Frog (*Lithobates pipiens*) Western Boreal/Prairie Population	Special concern	This species was not found during onsite surveys; however, portions of the site are considered to be suitable habitat for this species.
Rusty Blackbird (*Euphagus carolinus*)	Special concern	This species was not identified in breeding bird surveys, but was noted as "abundant" in the Seru Bay area based on observed occurrences made during a semi-aquatic survey in 2015.
Woodland Caribou (*Rangifer tarandus*) Boreal Population	Threatened	This species has not been directly observed in the area, but signs of habitat use were observed during a wildlife trail and pellet survey in 2011.

Terrestrial Monitoring

Cameco's terrestrial monitoring program at the Cigar Lake Operation aims to determine if atmospheric releases have an impact on the environment, especially as soil, lichen and associated ecological receptors could be affected by the atmospheric deposition of particulate and adsorbed metals and radionuclides attributed to onsite activities. Cameco executes terrestrial monitoring programs every three years in accordance with the facility's EMP [40]. During the previous licensing period (2013 to 2019), Cameco collected terrestrial monitoring data in 2013, 2016 and 2019.

Soil monitoring

Results from soil samples collected in 2013, 2016 and 2019 showed that concentrations in soil metal parameters were below the *Canadian Environmental Quality Guidelines* [61] for residential/parkland land use. Radionuclide concentrations in soils were also low, near, or at background levels and analytical detection limits. CNSC staff conclude that the level of airborne particulate contaminants produced by the Cigar Lake Operation is acceptable and does not pose a risk to ecological receptors in the vicinity of the facility.

Lichen monitoring

Lichen samples are analyzed to determine the level of airborne particulate contaminants deposited on the surface of lichen, as a means of ensuring that a significant level of contamination is not entering lichen consumers, such as caribou. There are no federal or provincial environmental quality guidelines for lichen. Quantitative predictions of contaminant concentrations in lichen were not included in ERAs, given that lichen were not expected to accumulate constituents, and therefore, were predicted to be largely unaffected by the construction and operation activities at the Cigar Lake site.

Results from lichen samples collected in 2013, 2016 and 2019 indicated overall similarities in metal and radionuclide concentrations between exposure and reference stations. Mean concentrations were comparable over time and generally fell within the range of baseline concentrations for all contaminants, except nickel. Nickel concentrations measured at the reference station were higher than the historical mean values for this station in 2019, and higher than the exposure stations. CNSC staff conclude that the level of airborne particulate contaminants produced by the Cigar Lake Operation is acceptable and does not pose a risk to lichen consumers, such as caribou.

Conclusion

Based on the review of the ERA and the results of atmospheric and terrestrial monitoring programs for the Cigar Lake Operation, CNSC staff conclude that airborne emissions from the Cigar Lake Operation and their deposition to the terrestrial environment remain within the ERA predictions and at levels that are protective of the environment.

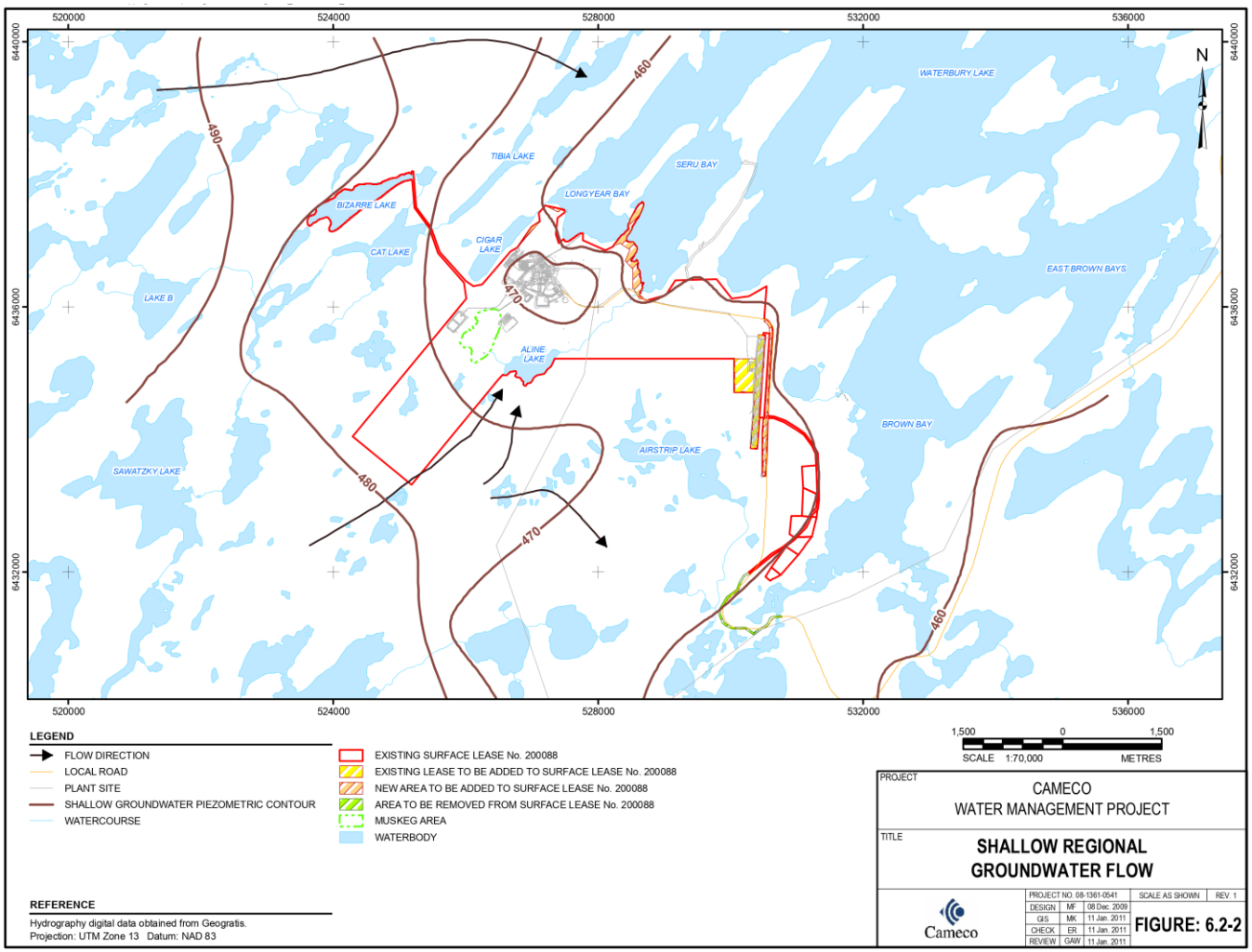
3.2.2 Geological and Hydrogeological Environment

An assessment of the hydrogeological environment at the Cigar Lake site consists of identifying potential sources of groundwater contamination on the site, determining the extent of contamination, if any, which could lead to an exposure pathway for human and/or non-human receptors, and determining the significance of any exposure from this pathway. Additionally, the hydrogeological assessment confirms whether control measures in place continue to remain effective in protecting the environment.

Geologically, the Cigar Lake site lies within the Churchill Province of the Canadian Shield, in the physiographic division of the Athabasca Plain. The regional surficial geology is dominated by glacial deposits of the Quaternary Period overlying Precambrian sedimentary rocks (sandstone) of the Athabasca Group [23]. The glacial till thickness is typically in excess of 25 metres [5]. The Helikian age (upper Paleoproterozoic to Mesoproterozoic) Athabasca Group is unconformably underlain by the highly deformed and metamorphosed Aphebian age (Paleoproterozoic) basement rocks of the Wollaston Group, consisting of metasediments and plutonic rocks (more than 1,750 to 2,500 million years old).

The glacial till overburden surrounding the Cigar Lake site has the hydraulic conductivity representative of sand (1×10^{-5} metres per second) [39]. The upper 10 metres of the sandstone bedrock is somewhat more permeable (with a hydraulic conductivity of approximately 1×10^{-4} metres per second). Groundwater generally flows northward in the upper part of the sandstone, and directionally towards Aline Lake, Cigar Lake and Waterbury Lake. All groundwater in the area of the Cigar Lake Operation ultimately discharges into Waterbury Lake. Figure 3.4 illustrates shallow regional groundwater flow [23].

Figure 3.4: Groundwater flow directions at the Cigar Lake site [23]



Groundwater in the vicinity of the Cigar Lake Operation is not used for human consumption. Groundwater is an integral component of the hydrologic cycle, interacting with streams, lakes and wetlands, and supporting their ecosystems. Prior to test mine development, a limited number of groundwater samples were collected from the shallow overburden overlying the ore body in the vicinity of the development. In general, the waters had low conductivities and low concentrations of COPCs (e.g., less than 0.05 micrograms per litre (µg/L) for uranium, less than 0.2 µg/L for arsenic, between 0.02 to 0.04 becquerels per year (Bq/L) for radium-226) [18].

Groundwater Monitoring

Cameco's groundwater monitoring program consists of shallow and deep groundwater monitoring wells. Forty-one shallow groundwater monitoring wells, located around waste rock stockpile C, the mine water treatment plant, the landfill, the northern site boundary and east of Seru Bay, are screened within the overburden till to identify potential groundwater contamination resulting from surface facilities [5]. These wells monitor both the level and quality of groundwater. Some groundwater monitoring wells are screened within the upper sandstone bedrock to monitor groundwater conditions (including quality and water level) in the upper sandstone, and improve the understanding of the interaction between groundwater in overburden

and upper sandstone [5]. Deep groundwater monitoring wells, located in the lower sandstone, alteration zones, ore body, and basement rock, monitor the water level and pressure around the ore body and underground mine workings.

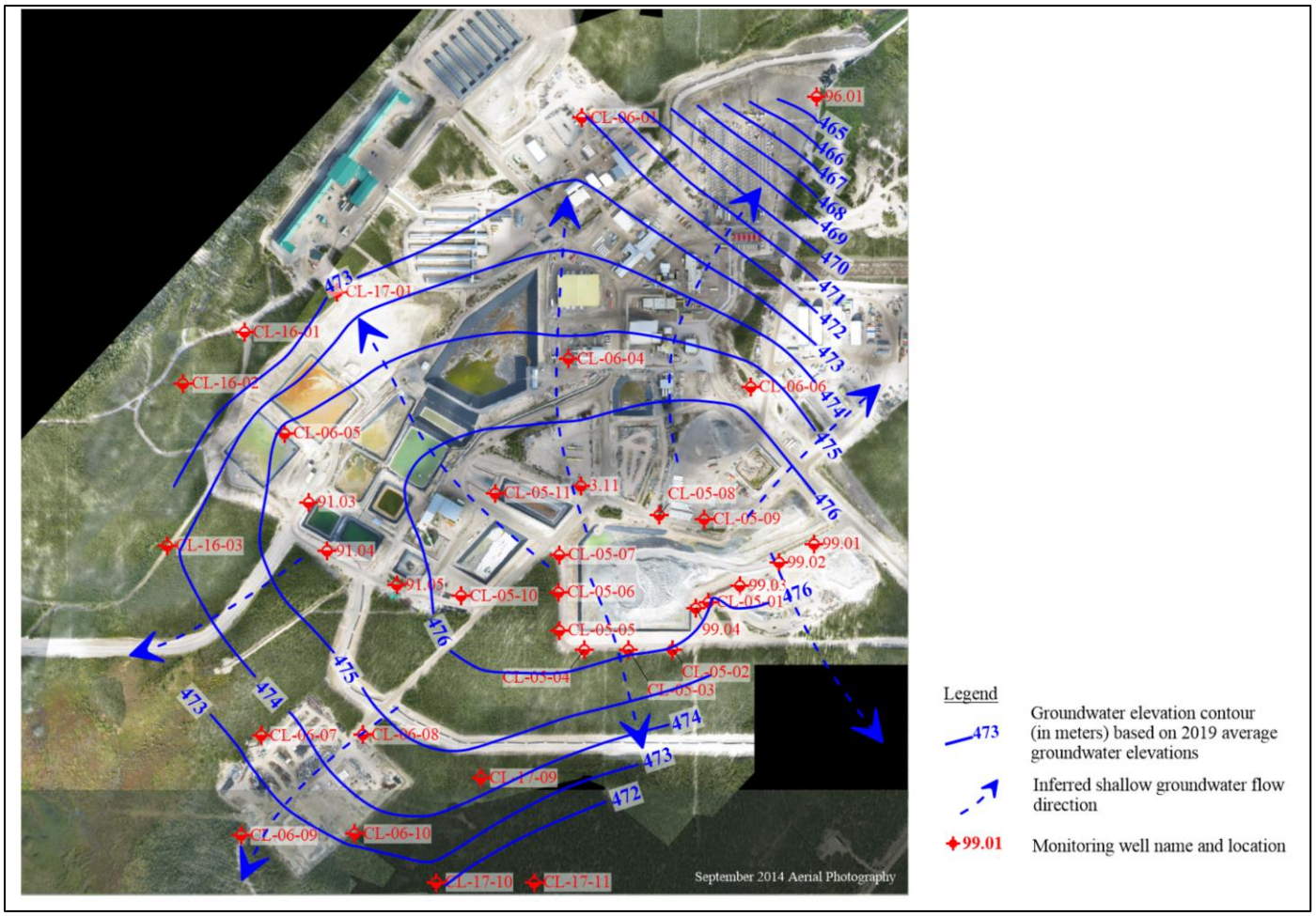
Groundwater Flow

Managing groundwater inflows to the underground mine workings is necessary at the Cigar Lake Operation. Water that flows into the underground mine is pumped to the surface, where it is treated and then released to the environment. The Cigar Lake Operation has a water-handling system (with adequate pumping capacity, water treatment capacity and water discharge capacity) capable of managing both expected routine flows and potential non-routine flows, while continuing to protect the environment [12][23].

According to the Environmental Performance Report from 2011 to 2015 [38], underground operations (e.g., routine dewatering) appear to have resulted in a decrease of as much as 2 metres in overburden groundwater elevations around the Cigar Lake site, particularly to the south of the mine shafts. Decreases in pressure head have also occurred in the deep system over this time period, based on the vibrating wire data.

According to the 2019 Annual Report [5], no noteworthy changes occurred in the groundwater elevations of sandstone monitoring wells in 2019, and groundwater elevations remain consistent with recent historical results and trends (from 2012 onward). Figure 3.5 shows the inferred shallow groundwater flow directions, which are based on average annual groundwater levels measured in 2019.

Figure 3.5: Groundwater elevation contours and inferred shallow flow directions (2019) [5]



Groundwater Quality

According to the Environmental Performance Report from 2011 to 2015 [38], only minor influences to groundwater quality were observed over the reporting period. Increasing solute concentrations have been observed downgradient of waste rock stockpile C, south of the monitoring ponds, south of the slimes ponds, and south/southwest of the landfill. Overall influences to groundwater quality from surface facilities are minor, and in almost all cases, limited to increases in major ions. Metals, metalloids and radionuclides remain within assessed baseline concentration ranges. Observations from recent years, including those provided in the 2019 Annual Report [5], are generally consistent with ranges and trends seen in the data over the 2011 to 2015 reporting period.

Conclusion

Based on the review of hydrogeological conditions and monitoring results included in Cameco's latest Environmental Performance Report and 2019 Annual Report, CNSC staff conclude that the overall influences to groundwater flow and quality from the Cigar Lake Operation are not significant, and that Cameco continues to protect the environment and human health.

3.2.3 Surface Water and Aquatic Environment

Aquatic Environment

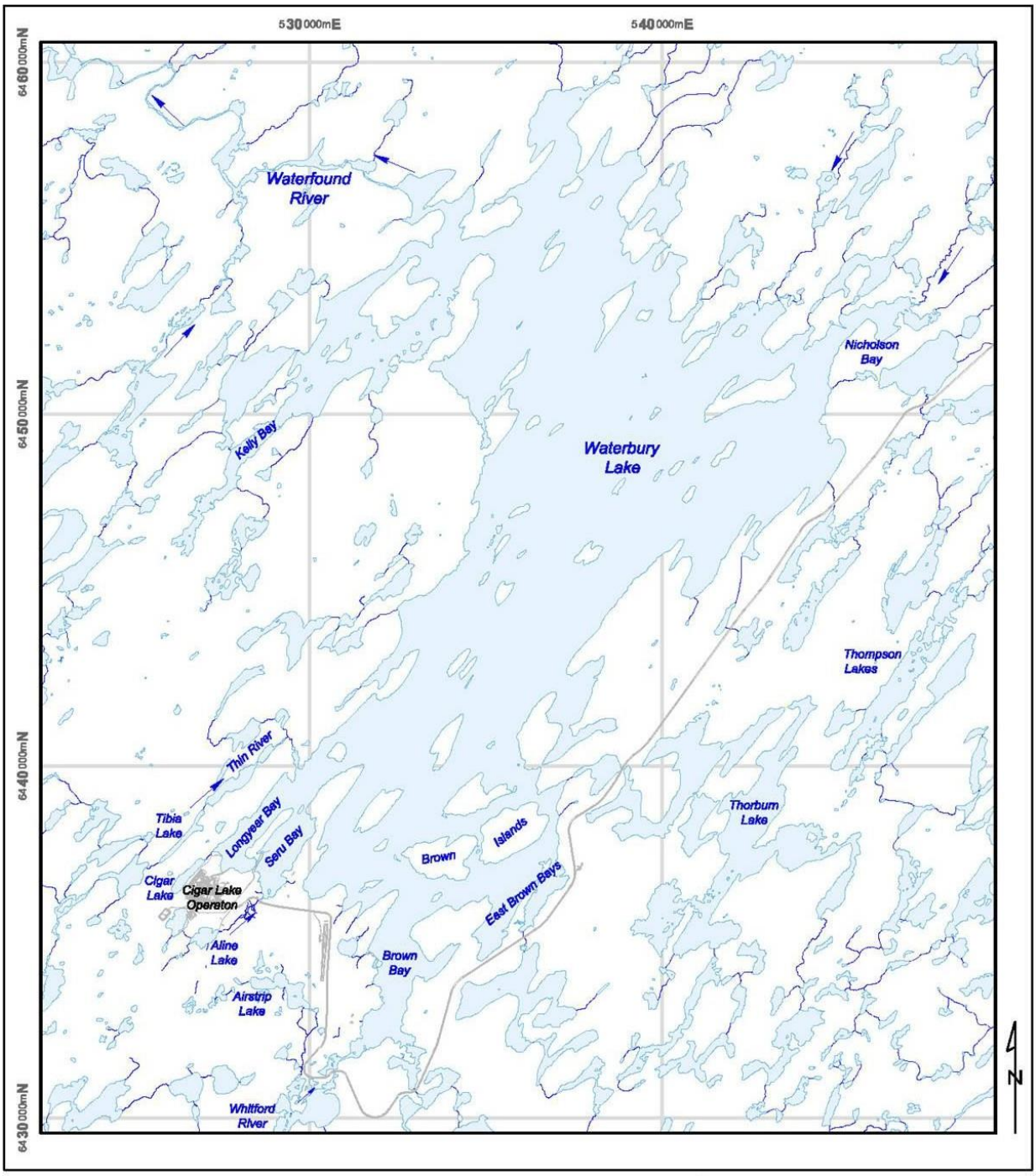
The Cigar Lake Operation is located on the southeast shore of Waterbury Lake (see figure 3.6). Waterbury Lake is the headwater for the Waterfound River, a tributary to the Fond du Lac River. The Waterfound River basin is part of the larger MacKenzie River basin.

The Cigar Lake Operation property is located in both the Aline Creek and Cigar Creek drainage basins, which discharge into Seru and Longyear Bays of Waterbury Lake. The 2011 EA for the Cigar Lake Water Management Project supported changing the discharge location of treated effluent [23]. Prior to 2013, treated effluent was discharged into a muskeg area to the southwest, where it dispersed and travelled to the east, eventually discharging via small channels into Aline Lake. From Aline Lake, the treated effluent discharged into Seru Bay. As of July 2013, treated effluent is discharged directly into Seru Bay via a pipeline and multi-port diffusers on the bottom of the bay, which encourage the mixing of treated effluent. Therefore, during the previous licensing term (2013 to 2019), treated effluent was discharged directly to Seru Bay.

Lakes located in northern Saskatchewan are typical of nutrient-poor Canadian Shield lakes, with circumneutral pH (6.5 to 8.0), low hardness, low alkalinity, low dissolved organic carbon and low phosphate levels. These lakes typically have abundant and diverse phytoplankton communities; the dominant phytoplankton division is *Chrysophyta* (also known as golden-brown algae) or *Chlorophyta* (also known as green algae). The dominant zooplankton taxa are *Cladocera, Copepoda* and *Rotatoria*. The dominant macrophyte species is *Carex* (commonly known as sedge), and the benthic composition includes diptera, molluscs and chironomids. Common fish species found near the Cigar Lake site include northern pike, lake whitefish, white sucker, lake trout, ciscoes, ninespine stickleback and lake chub.

No federal aquatic species at risk have been identified in the area within or immediately surrounding the Cigar Lake Operation. A search within the Species at Risk Public Registry [62] and a review of the Aquatic Species at Risk Map developed by Fisheries and Oceans Canada [63] confirmed the absence of federally-listed aquatic species at risk in the area.

Figure 3.6: Waterbodies near the Cigar Lake Operation [12]



Aquatic Monitoring

Cameco's aquatic monitoring program at the Cigar Lake Operation aims to determine if treated effluent releases to Seru Bay have an impact on the environment, as surface water quality, sediment quality and associated terrestrial and ecological receptors could be affected by metals and radionuclides in the effluent. Cameco conducts monitoring for surface water quality, sediment quality, benthic invertebrate community, fish population and fish tissue chemistry to

confirm that treated effluent release are within the ERA predictions and remain at levels that are protective of the environment.

Surface Water Monitoring

Cameco regularly performs surface water monitoring throughout each year in accordance with the facility's EMP [40]. Cameco collects surface water samples from eleven locations around the site at various intervals. Samples are taken at exposure stations (i.e., locations that could potentially be impacted by onsite activities) and at reference stations (i.e., locations that are not impacted by onsite activities). These samples are submitted to an accredited laboratory to be analyzed for pH, temperature, conductivity, total suspended solids (TSS), metals, radionuclides, nutrients and general chemistry. The results are then compared against the Saskatchewan Environmental Quality Guidelines (SEQG) [64], and are reported to the CNSC on a quarterly basis. Table 3.6 contains the annual monthly mean concentrations of COPCs in surface water at the centre of Seru Bay, one of the exposure stations (station 3.5). Annual monthly mean concentrations of COPCs from 2013 to 2020 were below the SEQG, which is protective of aquatic life. CNSC staff reviewed the surface water quality results for all exposure stations, confirmed they were below the SEQG and/or reference station concentrations, and concluded that there is minimal risk to the environment.

Table 3.6: Annual monthly mean concentrations of COPCs in surface water at the centre of Seru Bay (2013 – 2019) ([5] to [11], [53])

Parameter[a]	SEQG [b]	2013	2014	2015	2016	2017	2018	2019	2020[g]
Arsenic (mg/L)	0.005	0.0001	0.0001	0.0002	0.0008	0.0007	0.0006	0.0006	0.0010
Copper (mg/L)	0.002[c]	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Molybdenum (mg/L)	31	0.0009	0.0010	0.0015	0.0010	0.00095	0.0013	0.0012	0.0014
Nickel (mg/L)	0.025[d]	< 0.0001	< 0.0001	< 0.0001	0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Lead (mg/L)	0.001[e]	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Selenium (mg/L)	0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0001	< 0.0001	< 0.0001	< 0.0001
Uranium (mg/L)	0.015	< 0.0001	0.0001	0.0003	0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Zinc (mg/L)	0.03	0.001	0.001	< 0.0005	< 0.0005	0.0005	< 0.0005	0.0007	0.0006
Lead-210 (Bq/L)	N/A[f]	< 0.02	< 0.02	< 0.02	0.04	< 0.02	< 0.02	< 0.02	--- [g]
Polonium-210 (Bq/L)	N/A[f]	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	--- [g]
Radium-226 (Bq/L)	0.11	0.006	0.005	0.006	0.005	0.007	0.005	0.006	0.005
Thorium-230 (Bq/L)	N/A[f]	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	--- [g]

(a) Units are in milligrams per litre (mg/L) or becequerels per litre (Bq/L).
(b) SEQG stands for Saskatchewan Environmental Quality Guidelines [64].
(c) Copper objective: 0.002 mg/L where hardness is 0 – 120 mg/L; 0.003 mg/L where hardness is 120 – 180 mg/L; 0.004 mg/L where hardness is > 180 mg/L.
(d) Nickel objective: 0.025 mg/L where hardness is 0 – 60 mg/L; 0.065 mg/L where hardness is 60 – 120 mg/L; 0.110 mg/L where hardness is 120 – 180 mg/L; 0.150 mg/L where hardness is > 180 mg/L.
(e) Lead objective: 0.001 mg/L where hardness is 0 – 60 mg/L; 0.002 mg/L where hardness is 60 – 120 mg/L; 0.004 mg/L where hardness is 120 – 180 mg/L; 0.007 mg/L where hardness is > 180 mg/L.
(f) There are no SEQGs for lead-210, polonium-210 and thorium-230, and therefore, CNSC staff assess trends over time [64].
(g) 2020 values are based on data collected quarterly from January to June 2020, except for lead-210, polonium-210 and thorium-230, for which surface water is analyzed once per year. 2020 values for these parameters were not available at the time this report was written.

Sediment Monitoring

Cameco collects sediment samples at exposure and reference stations every three years in accordance with the facility's EMP [40]. Cameco submits the samples to an accredited laboratory, where they are analyzed for metals, radionuclides, nutrients and general chemistry. The results are then compared to the reference station concentrations and against the Canadian Interim Sediment Quality Guidelines for the Protection of Aquatic Life (ISQG) [61], the Canadian Probable Effects Level Sediment Quality Guidelines (PSQG) [61], and the Lowest Effects Levels (LEL) and Severe Effects Levels (SEL) derived for uranium mining areas in Canada [65].

During the previous licensing period (2013 to 2019), sediment monitoring data were collected in 2013 [66], 2016 [67] and 2019 [68]. Table 3.7 contains the mean concentrations of COPCs in sediment near the centre of Seru Bay, one of the exposure stations (station 13.2). Most mean concentrations of COPCs from 2013 to 2019 were slightly elevated compared to the reference station in west East Brown Bay (REF in table 3.7), but most were below the available ISQG and the LEL. All COPC concentrations were below the PSQG and SEL. The 2011 EA [23], 2017 ERA [12] and 2019 Addendum [13] predicted that over time, there could be increases in COPCs in sediment and a corresponding change in the benthic invertebrate species present in Seru Bay due to the release of treated effluent. However, the densities of invertebrate species are naturally low, the changes are unlikely to be measureable at the population-level, and will be limited in extent to Seru Bay. Therefore, the increase in COPCs in sediment and associate change in invertebrate species present is unlikely to represent an adverse impact, and is therefore of minimal or low risk.

CNSC staff reviewed the sediment quality results for all exposure stations between 2013 to 2019, and concluded that there is minimal risk to the environment from the COPCs concentrations in sediment. Cameco will continue to monitor sediment quality and benthic invertbrate species composition every three years under their Environmental Monitoring Program to track changes over time, as well as compare and assess the results relative to the ERA predictions. CNSC staff will review the results from the sediment quality and benthic invertbrate community monitoring to ensure that the risk to ecological receptors in the vicinity of the Cigar Lake Operation remains low.

Table 3.7: Mean concentrations of COPCs in sediments near the centre of Seru Bay (2013, 2016, 2019) [66][67][68]

Parameter[a]	REF[b]	ISQG[c]	PSQG[d]	LEL[e]	SEL[f]	2013	2016	2019
Arsenic (µg/g)	5.9	5.9	17	9.8	346.4	6.3	7.9	8.7
Copper (µg/g)	7.4	35.7	197	22.2	268.8	7.2	8.2	8.3
Molybdenum (µg/g)	12	-	-	13.8	1238.5	10	17	15
Nickel (µg/g)	8.2	-	-	23.4	484	9.4	11	10
Lead (µg/g)	13	35	91.3	36.7	412.4	13	13	12
Selenium (µg/g)	1.6	-	-	1.9	16.1	1.7	1.8	1.9
Uranium (µg/g)	1.4	-	-	104.4	874.1	1.6	7.2	8.9
Zinc (µg/g)	49	123	315	-	-	72	78	77
Lead-210 (Bq/g)	0.7	-	-	0.9	20.8	0.94	1.1	1.1
Polonium-210 (Bq/g)	0.72	-	-	0.8	12.1	0.93	1	0.98
Radium-226 (Bq/g)	0.05	-	-	0.6	14.4	0.094	0.094	0.096
Thorium-230 (Bq/g)	0.01	-	-	-	-	0.01	0.02	0.01

(a) Units are in micrograms per gram (µg/g) or becquerels per gram (Bq/g) .
(b) REF refers to the 2019 mean concentration at the west East Brown Bay reference station.
(c) ISQG stands for the "Canadian Interim Sediment Quality Guidelines for the Protection of Aquatic Life [61].
(d) PSQG stands for the "Canadian Probable Effects Level Sediment Quality Guidelines" [61].
(e) LEL stands for "Lowest Effects Levels" [65].
(f) SEL stands for "Severe Effects Levels" [65].

Aquatic Environment Monitoring

Aquatic environment monitoring is necessary for uranium mines and mills to meet the requirements of the MDMER, as well as any additional requirements from the CNSC and the Saskatchewan Ministry of Environment. Cameco's aquatic environment monitoring programs are executed every three years in accordance with the facility's EMP [40]. Cameco collects and analyzes benthic invertebrate community, fish population and fish tissue chemistry data. During the previous licensing period (2013 to 2019), aquatic monitoring data were collected in 2013 [66], 2016 [67] and 2019 [68], providing a comprehensive understanding of the aquatic environment surrounding the Cigar Lake Operation and its current environmental performance.

Between 2013 and 2019, benthic invertebrate communities in exposure areas in Seru Bay were different than those in the reference area, but these differences were attributed to habitat differences in the exposure and reference areas. Metal and radionuclide fish tissue concentrations in Seru Bay and Longyear Bay were low and remained similar from 2013 to 2019. Selenium concentrations in fish flesh and whole bodied fish in Seru Bay were assessed in a 2019 study required by the MDMER. Selenium concentrations in fish tissue were well below reproductive effects benchmarks.

CNSC staff reviewed the aquatic monitoring data and analysis, along with any other routine or special investigations, and confirmed that the impacts to the receiving aquatic environment and biota were within the predictions of the 2011 EA [23] and/or the 2017 ERA [12] and 2019 Addendum [13], and concluded that there is minimal risk to the aquatic environment.

Conclusion

Based on CNSC staff's review of the ERA and aquatic monitoring program results for the Cigar Lake Operation, CNSC staff conclude that treated effluent releases from the Cigar Lake site remain within the ERA predictions and at levels that are protective of the environment.

3.2.4 Non-Human Biota

The most recent assessment of potential effects on terrestrial and aquatic biota near the Cigar Lake Operation was provided by Cameco in the 2017 ERA [12] and 2019 Addendum [13]. As discussed in subsection 2.3.3, the ERA fully complied with requirements of CSA N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills* [30] and incorporated recent environmental monitoring data.

Cameco selected a total of twenty-four valued ecosystem components (VECs) as ecological receptors for the assessment based on knowledge of the Cigar Lake site and its surrounding environment, and relevant field observations. The chosen VECs reflect a variety of diets or feeding habits, cover a variety of trophic levels, are representative of the potential species present in the area, and include species identified as important to Indigenous communities and/or stakeholders during the EA process for the Cigar Lake Inflow Management Project [23]. They include terrestrial vegetation communities, benthic invertebrates, fish species, terrestrial and aquatic bird species, semi-aquatic mammal species and terrestrial mammal species. The three species at risk identified as potentially occurring in the area (i.e., Woodland Caribou, Rusty Blackbird and Northern Leopard Frog) are also included as VECs.

Radiological Effects

The potential radiological effects to VECs were assessed by comparing the estimated radiation dose received by each ecological receptor from radiological COPCs through all applicable pathways (i.e., external and internal exposure due to radionuclides in air, soil, water, sediment, and gamma radiation) to the recommended benchmark values (i.e., dose limits to non-human biota).

The overall radiation dose, which included all internal and external doses form all exposure pathways, were significantly below the radiological dose benchmarks recommended in CSA 288.6-12 [30], i.e., 100 microgray per hour (µGy/h) for terrestrial receptors and 400 µGy/h for aquatic receptors. This result indicates no potential for adverse effects and no need for further (detailed) assessment.

Non-Radiological Effects

The potential hazardous effects to VECs were assessed by comparing the estimated exposure concentration received by each ecological receptor from hazardous COPCs through all applicable pathways (i.e., exposure to hazardous contaminants in air, soil, lichen, vegetation, water, sediment, benthic invertebrates, phytoplankton, zooplankton and aquatic vegetation) to the recommended benchmark values (i.e., toxicity reference values for non-human biota).

The 2017 ERA [12] and 2019 Addendum [13] predicted that over time there could be a change in the benthic invertebrate species present in Seru Bay due to the release of treated effluent and the accumulation of COPC in sediment. However, the densities of invertebrate species are naturally low, the changes are unlikely to be measureable at the population-level and will be limited in extent to Seru Bay. Therefore, this change in invertebrate species present is unlikely to represent an adverse impact. Cameco continues to monitor sediment quality and benthic invertbrate species composition every three years under their Environmental Monitoring Program to track changes over time, as well as compare and assess the results relative to the ERA predictions. Cameco also assesses benthic invertebrate chemistry samples every 6 years, as part of the EA follow-up program (see subsection 2.1.2), to verify the model input assumptions used in the ERA predictions.

There is a low probability for potential effects to terrestrial wildlife species that use the aquatic environment due to exposure to selenium (i.e., for Rusty Blackbird and mink) and molybdenum (i.e., for muskrat) in Seru Bay for the expected effluent release scenario. The predicted effects are limited to Seru Bay and are expected to return to pre-operational conditions over time after the treated effluent is no longer released. Cameco continues to conduct opportunistic monitoring for the potential presence of Rusty Blackbird in the habitat surrounding Seru Bay. Cameco also conducts surveys for semi-aquatic furbearers (e.g., fox, muskrat) and waterfowl prevalence around Seru Bay every 5 years, as part of the EA follow-up program (see subection 2.1.2).

No additional adverse effects are expected from most non-radiological COPCs for the upper bound of volume of effluent released scenario, with the exception of a low probability for potential effects to terrestrial wildlife species that use the aquatic environment due to exposure to selenium (i.e., for the fox), as well as zinc and molybdenum (i.e., for Rusty Blackbird) in Seru Bay. For the upper bound effluent release scenario, there is a low probability of potential effects from exposure to molybdenum (i.e., for muskrat) in areas of Waterbury Lake adjacent to Seru

Bay. The predicted effects are expected to return to pre-operational conditions over time after the treated effluent is no longer released. The volume of effluent and concentrations of COPCs are measured by Cameco as effluent is released to Seru Bay and reported annually to the CNSC. Therefore the upper bound scenario will be documented and reviewed by CNSC staff should it occur.

Conclusion

Based the review of Cameco's ERA, CNSC staff conclude that the overall risk to non-human biota from current and future activities at the Cigar Lake Operation are low to negligible, and the environment remains protected. There is low probability that benthic invertebrates and wildlife species in the immediate vicinity of the site may experience minor changes or effects during operation when very conservative assumptions are used, particularly for the upper bound of volume of effluent released scenario. The predicted changes or effects are expected to return to pre-operational conditions over time after the site is closed and decommissioned.

3.2.5 Human Environment

Cameco's 2017 ERA [12] included a Human Health Risk Assessment (HHRA) to assess the risk to humans from both radioactive and hazardous substances released from activities at the Cigar Lake Operation. In general, human receptors may be exposed to contaminants through four primary routes: dermal (i.e., skin), inhalation, incidental ingestion (e.g., soil) and ingestion of food and water. Cameco's HHRA consisted of identifying representative persons located within or in proximity to the site, and determining whether radiological or hazardous COPCs could impact their health by breathing the air, being on the land, drinking and swimming in surface water, and eating plants, fish and wildlife from Cigar Lake area.

Representative persons are those individuals who, because of their location and habits, are likely to receive the highest exposures to radiological or hazardous substances from a particular source. Selected representative human receptors were an adult working at the Cigar Lake Operation camp (e.g., cook, security officer) and a range of receptor age groups (i.e., adult, child, and toddler) residing for four months a year while working at the Waterbury Lodge, which is located on Waterbury Lake, less than 10 kilometres southeast of the facility. Waterbury Lodge is a fly-in fishing and hunting lodge that is no longer operating, and therefore, the receptors were identified as hypothetical. The adult camp workers and Waterbury Lodge workers were determined to be the most exposed individuals for potential radiological and hazardous contaminant exposures [12].

Human Exposure – Radiological Substances

The CNSC's *Radiation Protection Regulations* [34] prescribe radiation dose limits to protect workers and the public from exposure to radiation from licensed activities. Doses are either monitored by direct measurement or by estimation of the quantities and concentrations of any nuclear substance released as a result of the licensed activities. The annual effective dose limit for a member of the public is 1 millisievert (mSv) per year.

Although Waterbury Lake Lodge is currently unoccupied and no community is located in the vicinity of the Cigar Lake Operation, doses to receptors occupying this location 4 months per year were calculated as a conservative approach in Cameco's 2017 ERA [12]. Doses to an adult camp worker were also calculated, as mentioned above. CNSC staff reviewed Cameco's

assessment and concluded that all estimated annual doses were below the annual public effective dose limit of 1 mSv per year, which is protective of human health. If the lodge were occupied, doses would be low and would not be expected to be more than 4% of the annual dose limit for the public in most circumstances. The highest estimated annual dose, which was 0.169 mSv per year for the toddler staying at the Waterbury Lake Lodge, was also below the annual public effective dose limit of 1 mSv per year. This dose was calculated to provide context and would only be expected in the upper-bound loading scenario. Annual doses to Cigar Lake Camp workers are not expected to exceed 15% of the annual public effective dose limit. Results indicate that there are no expected risks to human health from radionuclides. Doses to individuals hypothetically occupying the Waterbury Lake Lodge are mainly due to the consumption of local food, namely fish and mallard duck, while doses to the Cigar Lake Camp worker are mainly due to radon progeny inhalation.

Over the licensing period (2013 to 2019), Cameco continued to ensure protection of members of the public in accordance with the *Radiation Protection Regulations* [34].

Human Exposure – Hazardous Substances

In Cameco's HHRA [12], the exposure of representative receptors to hazardous substances was evaluated by calculating daily intakes of COPCs from drinking water, soil contact, and food obtained from both local sources (e.g., wildlife, fish, berries) and store-bought food. The HHRA concluded that the incremental increase in exposure to hazardous substances in water and food from the Cigar Lake Operation would not add significantly to overall exposure to these contaminants, which are naturally present in the environment and in store-bought food. It was concluded that the contribution of hazardous COPC releases from the Cigar Lake Operation would not result in adverse effects, and therefore, pose a negligible risk to human health.

Conclusion

In the last four years (2016 to 2020), the estimated radiological doses for the selected human receptors have constantly remained well below the highest predicted dose in the HHRA (i.e., 0.169 mSv). Over the last licensing period (2013 to 2019), estimated radiological doses have also remained well below the annual public dose limit of 1 mSv per year, indicating that activities at the Cigar Lake Operation pose a negligible risk to human health (i.e., potential risk to humans is similar to health outcomes in the general public).

With respect to hazardous substances, CNSC staff's review of the HHRA indicated that activities at the Cigar Lake Operation would not add significantly to overall exposure, and therefore, also pose a negligible risk to human health (i.e., potential risk to humans is similar to health outcomes in the general public).

Based on assessments conducted for the Cigar Lake Operation, including the review of the 2017 ERA and 2019 Addendum, annual reports, and annual environmental monitoring data, CNSC staff conclude that impacts to the human environment from radiological and hazardous substances released from the Cigar Lake Operation are negligible, and that people living and working near the facility remain protected.

3.2.6 Additive Cumulative Impacts

CNSC staff considered the additive cumulative effects of site-specific factors in a risk informed manner within the context of its overall assessment of environmental protection. Additive

cumulative effects are one type of cumulative effect that the federal guidance document titled *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* [69] defines as "the sum of individual effects of two or more physical activities". CNSC staff continually assess additive cumulative effects through the cyclical nature of ERAs, the monitoring data in annual reports, data from regional monitoring programs, the IEMP, and through health studies. For the Cigar Lake Operation, based on the data assessed thus far and presented in this EPR Report, CNSC staff conclude that no additive cumulative effects are occurring in the surrounding environment.

4.0 CNSC INDEPENDENT ENVIRONMENTAL MONITORING PROGRAM

The CNSC has implemented its IEMP as an additional verification that the public and the environment around licensed nuclear facilities are protected. It is separate from, but complementary to the CNSC's ongoing compliance verification program. The IEMP involves taking samples from public areas around the facilities, and measuring and analyzing the amount of radiological and hazardous contaminant substances in those samples. For the uranium mines and mills in northern Saskatchewan, CNSC staff, with the assistance of an accredited contractor, collect the samples and send them to an accredited laboratory for testing and analysis.

4.1 IEMP at the Cigar Lake Site

In 2020, an accredited contractor conducted IEMP sampling around the Cigar Lake site, marking the first IEMP sampling campaign to be conducted around this licensed nuclear facility. CNSC staff were unable to sample alongside the contractor due to travelling restrictions and safety protocols in place during the COVID-19 pandemic. Nonetheless, the contractor followed CNSC staff's site-specific sampling plan [70], which focused on radiological and hazardous contaminants and was based on Cameco's EMP and CNSC's regulatory knowledge of the site.

The contractor collected the following samples in publicly accessible areas outside the perimeter of the Cigar Lake site:

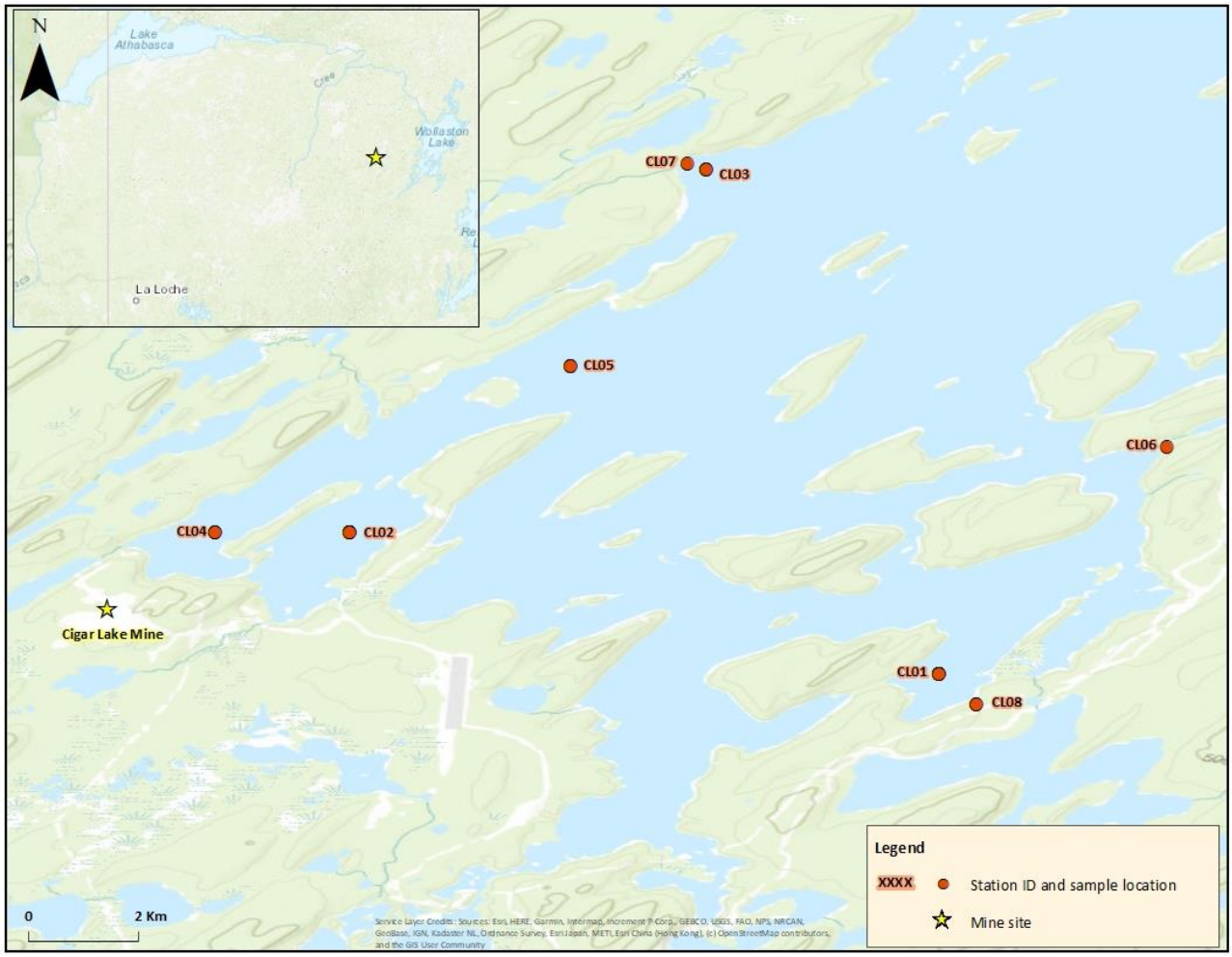
- water (4 locations, 2 to 3 samples per location)
- fish (3 locations)
    - 9 samples at East Brown Bay (3 specimens per species of trout, lake whitefish and northern pike)
    - 6 samples at Seru Bay (3 specimens per species of Lake whitefish and northern pike)
    - 3 samples at Waterbury Lake, near the inlet (3 specimens of trout)
- Labrador tea (2 locations, 1 sample per location)
- blueberries (2 locations, 1 sample per location)

Samples collected were analyzed by qualified laboratory specialists in an accredited laboratory, using appropriate protocols. As requested by CNSC staff, the laboratory specialists measured radionuclides (i.e., radium-226, thorium-230, polonium-210 and lead-210), as well as hazardous substances (i.e., arsenic, copper, lead, molybdenum, nickel, selenium, uranium and zinc) in the collected samples. Water samples were analyzed for hardness, pH, and temperature. Fish, Labrador tea, and blueberry samples were also analyzed for moisture content in order for CNSC

staff to convert the results from dry weight into wet weight, and compare against the screening levels.

Figure 3.7 provides an overview of the sampling locations for the 2020 IEMP sampling campaign at the Cigar Lake site. The IEMP results will be published on the CNSC's IEMP webpage [71] prior to the Commission hearing.

Figure 3.7: Overview of the 2020 sampling locations [70]



4.2 Indigenous Participation in the IEMP

It is a priority for the CNSC that IEMP sampling reflects Indigenous traditional land use, values and knowledge, where possible. In addition to routine IEMP sampling activities, the CNSC consulted with two local Indigenous groups in 2020: the Ya'thi Néné and the Métis Nation of Saskatchewan.

In February 2020, notification emails were sent to all Indigenous groups near the Cigar Lake site, inviting suggestions for species of interest, valued components or potential sampling locations where traditional practices and activities may take place.

CNSC staff are committed to sharing community-specific information in advance of publishing the 2020 results on the IEMP website and will notify communities of such publication. CNSC

staff are also committed to discussing the results at community meetings or during teleconferences.

The following subsections summarize CNSC staff`s collaboration with each Indigenous group during the 2020 sampling campaign.

4.2.1 Engagement with Ya'thi Néné

CNSC staff held teleconferences with the Ya'thi Néné to discuss the draft IEMP sampling plan. The Ya'thi Néné is an organization that represents seven communities located in the Athabasca Basin. The Ya'thi Néné was awarded funding from the CNSC's Participant Funding Program to review the draft IEMP sampling plan. As part of their review, the Ya'thi Néné shared the draft IEMP sampling plan with Chief and Council members and traditional land users in Wollaston Lake and Hatchet Lake Denesułiné First Nation. The Chief and Council members and traditional land users provided input with regards to which species should be sampled and where. CNSC staff incorporated Ya'thi Néné's suggestions where logistically possible. The following locations were suggested by the Ya'thi Néné:

- Centre of Waterbury Lake (CL03)
- Longyear Bay (CL04)
- Waterbury Lake, near the inlet (CL05)
- Shore of eastern Waterbury Lake, northeast of the Brown Islands (CL06)
- West shoreline of Waterbury Lake, near the centre (CL07)

The Ya'thi Néné also contributed by identifying some of the species of interest in the final IEMP sampling plan. In addition, the Ya'thi Néné suggested to take trout samples, in addition to Lake whitefish and Northern pike samples. Finally, the Ya'thi Néné identified locations where traditional land users gather Labrador tea and berries.

4.2.2 Engagement with Métis Nation of Saskatchewan

CNSC staff held teleconferences with the Métis Nation of Saskatchewan to discuss the draft IEMP sampling plan. The Métis Nation of Saskatchewan reviewed the draft IEMP sampling plan and asked questions about the sampling methodology, to which CNSC staff responded. Unfortunately, due to time constraints and the COVID-19 pandemic, the Métis Nation of Saskatchewan were unable to provide direct input into the IEMP sampling plan. However, CNSC staff look forward to collaborating with the Métis Nation of Saskatchewan on future IEMP sampling campaigns in northern Saskatchewan.

4.3 Summary of Results

The levels of radioactivity, hazardous substances and other measured parameters were below available guidelines and CNSC screening levels in all 2020 samples, with the exception of selenium and polonium-210 in fish. The exceedances of the selenium screening levels occurred in samples collected at both the reference and exposure stations, and therefore, were not attributable to the Cigar Lake Operation. Given the very conservative nature of CNSC's screening levels, the consumption of surface water, fish, Labrador tea and blueberries is not expected to result in any adverse health effects from radiological and hazardous contaminants. These results are consistent with those submitted by Cameco, demonstrating that the licensee's EP program protects the health and safety of people and the environment.

For more information, including the 2020 sampling results, please visit the CNSC's IEMP webpage [71].

5.0 HEALTH STUDIES

This section draws from the results of regional health studies, reports and other studies to provide further independent verification on whether the health of people living near, or working at the Cigar Lake Operation, in northern Saskatchewan, are protected. Various organizations, such as the Saskatchewan Health Authority and the Northern Inter-Tribal Health Authority, monitor the health of people living near the Cigar Lake Operation. Disease rates of communities living near the Cigar Lake Operation are compared to similar populations to detect any potential health outcomes that may be of concern.

Cancer is the main health concern for occupational and environmental radiation exposures, and thus, is the focus of health studies of workers and people living near nuclear facilities, such as the Cigar Lake Operation. The following subsections discuss several health studies and reports that have assessed the health of people living near the Cigar Lake Operation, including studies conducted by the CNSC to assess the health effects of workplace radiation exposure among Saskatchewan uranium workers.

CNSC staff continue to carefully monitor and conduct health studies to ensure the protection of human health. CNSC staff keep abreast of any new publications and data related to the health of populations living near nuclear facilities. For additional information on health studies related to nuclear facilities, visit the CNSC's webpage on Health Studies [72].

5.1 Population and Community Health Studies and Reports

5.1.1 The Northern Saskatchewan Population Health Unit Reports

The Northern Saskatchewan Health Indicators Reports developed by the Northern Saskatchewan Population Health Unit (the Health Unit), provide an overview of the population of northern Saskatchewan. These reports include important community characteristics, determinants of health (i.e., personal, social, economic and environmental factors that influence health status), as well as health status and well-being indicators. The Health Unit published two Northern Saskatchewan Health Indicators Reports, one in 2004 [73] and another one in 2011 [74], and updates and publishes health monitoring chapters on its website [75]. In addition, older reports (from 1998) are also available on the website for the Athabasca Health Authority, Keewatin Yatthe Health District, and Mamawetan Churchill River Health District.

According to data collected by the Health Unit for a number of health indicators, including income, smoking, life expectancy, and obesity, northern Saskatchewan fares poorly compared to Saskatchewan as a whole. The leading causes of death in northern Saskatchewan from 2005 to 2014 were injuries, cancer, circulatory diseases and respiratory diseases. Some of the main specific causes of death in northern Saskatchewan include ischemic heart disease, intentional self-harm, lung cancer, motor vehicle collisions, cerebrovascular disease, and chronic obstructive pulmonary disease [76].

Cancer rates for all cancers combined in northern Saskatchewan are lower for males, and similar for females when compared to southern Saskatchewan. The leading causes of cancer incidence (i.e., new cancer cases) are breast and lung cancer in females, and prostate and lung cancer in males, while lung cancer is by far the leading cause of cancer deaths for both males and females. Importantly, lung cancer rates (both cases and deaths) are greater in northern Saskatchewan compared to the province. Cigarette smoking is the leading cause of lung cancer. The number of daily cigarette smokers is significantly higher in northern Saskatchewan compared to the provincial average. The rates of breast and colorectal cancer are slightly lower. Rates of prostate cancer are significantly lower in northern Saskatchewan. Cervical cancer rates are decreasing.

The total number of children (aged 0 to 14 years old) diagnosed with cancer in Saskatchewan from 1990 to 2016 was 833. This included 23 children from northern Saskatchewan (about one child or less a year), thus childhood cancer rates are low [77].

A recent prenatal biomonitoring study [78] looked for over 200 environmental chemicals in the blood of pregnant women in northern Saskatchewan and compared them to pregnant women in Alberta. Overall, most of the testing for northern Saskatchewan revealed levels lower than, or comparable to levels in Alberta. Only the levels of lead, mercury (in the far northern area), and cotinine, a breakdown product of nicotine, were higher in northern Saskatchewan women.

5.1.2 Northern Inter-Tribal Health Authority Health Reports

The Northern Inter-Tribal Health Authority (NITHA) is a First Nations partnership organization between the Prince Albert Grand Council, Meadow Lake Tribal Council, Peter Ballantyne Cree Nation and Lac La Ronge Indian Band. NITHA provides and maintains health services and public health programs in 33 First Nation communities in northern Saskatchewan. NITHA's Public Health Unit provides advice and expertise for various public health programs, including population health assessment, disease surveillance, health promotion, health protection, and diseases and injury prevention. NITHA's Public Health Unit also develops health-related resources, including health status reports, for its partner community members. These resources are available on NITHA's website [79]. According to the latest health status report from 2017, the leading causes of death for NITHA's partner communities from 2010 to 2015 were cancer (32%), heart diseases (16%), accidental deaths (15%) and diabetes (8%) [80]. Lung cancer was the most common cause death from cancer, representing 32% of all cancer deaths [79].

5.1.3 Saskatchewan Health Status Reports

The Province of Saskatchewan produces health status reports which describe the health of the population, offer regional comparisons and, where possible, national comparisons. The health status reports draw from a variety of sources of information, including the provincial Ministry of Health's administrative health services databases, vital statistics, census data, and survey data, such as the Canadian Community Health Survey. According to the latest Saskatchewan Health Status Report [81], the leading causes of mortality in Saskatchewan in 2009 were circulatory diseases, cancer, injuries and respiratory disease.[3]

[3] The Province of Saskatchewan's website does not indicate when the latest report was published, but the data used is older than 2011, with most data ranging from 1995 to 2009.

5.1.4 Saskatchewan Cancer Agency

From 2014 to 2017, the Saskatchewan Cancer Agency (SCA) collaborated with the Federation of Sovereign Indigenous Nations and Métis communities on a three-year cancer surveillance program to gain insight into how to serve First Nations and Métis communities better [82]. In partnership with five Indigenous communities across the province, the SCA collected information within these communities to ensure they have access to appropriate cancer care programs and services. Working closely with communities was essential to this project, particularly in northern Saskatchewan, where engaging community members is so important for the proper communication of cancer prevention and for early detection, cancer awareness, education, and surveillance, as well as to find ways to support cancer patients and their families [83]. Youth engagement was also an important focus of this work.

The SCA also conducts Cancer Control Reports, which profile cancer in regional health authorities. These reports provide a valuable window into the health of people within the province and the influences of age and population size on the burden of cancer. The most recent Saskatchewan Cancer Control Report from 2017 [84] combines the three northernmost health authorities (i.e., Mamawetan Churchill River, Keewatin Yatthé and Athabasca) into one region called “the North”. This region of the province is unique because its population is small and much younger than in the rest of the province. The Northern Saskatchewan Health Indicators Reports use the data in these reports. Cancer is most common in people over age 50. Ninety per cent of new cancer cases diagnosed in 2014 were in people aged 50 years and over and 96% of cancer deaths occur among those aged 50 and over. This age group is growing in Saskatchewan, and continues to comprise an increasing proportion of Saskatchewan’s population. Thus, as the northern Saskatchewan population ages, one can expect to see more cancer cases and deaths. This has important implications for planning cancer screening, diagnostic and treatment services.

5.2 Health Studies of Uranium Mine Workers

The Saskatchewan Uranium Miners’ Cohort (SUMC) Study is a two-part project conducted by the CNSC, the Saskatchewan government and industry stakeholders in the early 2000s.

The CNSC, Saskatchewan government, University of Saskatchewan, and industry stakeholders are currently working in partnership to conduct the new Canadian Uranium Workers Study (CANUWS), which will follow up the health of about 80,000 past and present uranium workers, including miners, millers and processing workers. This new study will consider workers from previous Canadian uranium worker studies, as well as present day workers from northern Saskatchewan and Ontario.

The following subsections provide more information on the SUMC Study and the CANUWS.

5.2.1 Saskatchewan Uranium Miners' Cohort Study

Part one of the SUMC Study [85][86] looked at the relationship between lung cancer (deaths and new cancer cases) and exposure from radon and its decay products in a group of Eldorado uranium workers who worked at the Beaverlodge and Port Radium uranium mine sites and Port Hope radium and uranium facility from 1932 to 1980. Workers’ mortality and cancer incidence were followed-up until 1999. This study represents an update of the original Eldorado study

group (or cohort) that looked at mortality at the Beaverlodge [87] and Port Radium [88] mine sites.

Part one of the SUMC Study makes the following conclusions:

- Overall, uranium mining, milling, and processing workers were as healthy as the general Canadian male population.
- Lung cancer was the only disease that consistently showed significantly higher death and cancer incidence rates among uranium workers.
- Overall, the excess risk of lung cancer death and cancer incidence increased linearly with increasing radon exposure.
- There was no relationship between radon exposure and any other disease, other than lung cancer.

Part two of the SUMC Study [89] determined if it was scientifically possible to assess the number of excess lung cancers from the relatively low radon exposure in modern miners from 1975 onward. The type of risk assessed is the increased risk of lung cancer due to radon exposure. The study considered factors such as smoking and residential radon exposure as potential confounding factors of the relationship between lung cancer and radon.

Part two of the SUMC Study made the following conclusions:

- Today's Saskatchewan uranium miners have radon exposures that are significantly lower than those of past miners because of dose limits, improved mining techniques and other radiation protection practices.
- By the year 2030, about 24,000 workers will have spent time working at a uranium mine. During this time, 141 miners are expected to develop lung cancer, primarily from tobacco smoking. Only one additional miner could expect to get lung cancer from exposure to radon in the workplace.
- It is not feasible to investigate the risk of excess lung cancer in modern miners because exposures are so low. It is also practically impossible to correct for the effects of smoking and residential radon, factors that could greatly affect the study results.

However, the CNSC continues to monitor the occupational exposures of uranium miners to ensure they remain at low levels. The National Dose Registry maintains exposure records indefinitely.

5.2.2 The Canadian Uranium Workers Study

The CANUWS is a multi-year project initiated by the CNSC in 2017 to assess the health effects of occupational radiation exposure among uranium workers. The project involves researchers from the CNSC, Health Canada and the University of Saskatchewan. This retrospective cohort study will assess the information of over 80,000 Canadian uranium mine, mill and processing workers with occupational radiation exposure rates from 1932 to 2017. The study will follow-up workers' mortality (1950 to 2017) and cancer incidence (1969 to 2017).

The main objective of the CANUWS is to study the radon-lung cancer relationship, especially the potential health effects of low cumulative exposures and exposure rates. This is possible due to high-quality exposure measurements and the long-term follow-up of workers' health outcomes, with the consideration of workers employed after radiation protection measures were

in place. The findings of the study will help to assess the adequacy of occupational radiation safety standards and support future licensing recommendations.

The CANUWS should be complete by 2022/23. In September 2020, CNSC staff presented an update of the study's progress at the Engagement Meeting with Indigenous Communities and Organizations in Northern Saskatchewan [90].

5.3 Summary of Health Studies

Reviewing and conducting health studies and reports is an important component of ensuring that the health of people living near or working in nuclear facilities is protected. The population and community health studies and reports indicate that the most common causes of death among the Saskatchewan populations are heart disease and cancer. This is similar to the rest of Canada, where heart disease and cancer are the two leading causes of death, aside from Nunavut, where heart and respiratory diseases are the leading causes of death [91].

In northern Saskatchewan, cancer is predominantly seen in people that are 50 years of age and older, which is not atypical given that cancer rates tend to increase as a population ages. Overall, cancer rates for all cancers combined in northern Saskatchewan are lower for males, and similar for females, when compared to southern Saskatchewan. However, lung cancer rates are greater in northern Saskatchewan compared to the provincial average, and lung cancer is the most common cause of cancer death in First Nation communities in northern Saskatchewan. To put this into perspective, lung cancer is projected to continue to be the most commonly diagnosed cancer and the leading cause of cancer death in Canada in 2020, accounting for one in four of all cancer deaths [92].

According to the Canadian Cancer Society, about 72% of lung cancer cases are due to smoking tobacco in Canada [93]. Other factors include second-hand smoke, radon, asbestos, occupational exposure to certain chemicals, outdoor air pollution, family history and radiation. The number of daily smokers in northern Saskatchewan is significantly higher than the provincial average [73][74]. Additionally, the proportion of Saskatchewan residents who reported daily or occasional smoking was significantly higher than that of Canadian residents [94]. In Canada, exposure to indoor radon is the second leading cause of lung cancer [95]. Research from the Saskatchewan Cancer Agency has demonstrated that community work is essential to cancer control, particularly in northern Saskatchewan, where the focus should be on cancer prevention and education, including ways to support cancer patients and their families [82].

Studies of uranium workers help us assess workers' health and understand the relationship between workplace radiation and health. Part one of the SUMC showed that the overall health of workers employed at mines between 1932 and 1980 was similar to the public, except for lung cancer incidence and mortality, which were significantly greater in workers compared to the general male population. The risk of lung cancer increased linearly with increasing radon exposure. Part 2 of the SUMC demonstrated that assessing the risk of excess lung cancer due to radon exposure in modern miners from 1975 onward is not feasible because exposure is too low and correcting for the effects of smoking and residential radon would be practically impossible. However, strict radiation protection measures exist, including the ongoing monitoring of occupational exposure, to ensure the protection of uranium workers' health. Most recently, CNSC and other stakeholders started a new study of all past and present Canadian uranium

workers. This large study will add to the understanding of radon and lung cancer, especially at the low cumulative exposure and exposure rates of today's workers.

Based on exposure and health data, CNSC staff have not observed and do not expect any adverse health outcomes due to the presence of the Cigar Lake Operation.

6.0 OTHER ENVIRONMENTAL MONITORING PROGRAMS

Several monitoring programs are carried out by other levels or bodies of government, and are reviewed by CNSC staff to confirm that the environment and the health of persons around the facility in question are protected. A summary of the findings of these programs is provided below.

6.1 Eastern Athabasca Regional Monitoring Program

The Eastern Athabasca Regional Monitoring Program (EARMP) is an environmental monitoring program designed to gather data on potential cumulative impacts downstream of uranium mining and milling operations. In the fiscal year 2017/2018, the CNSC became a funding partner in the EARMP by signing a five-year funding agreement (from 2018/2019 to 2022/2023) with the Saskatchewan government and the uranium mining and milling industry. The EARMP is made up of two programs: the community program and the technical program. The community program monitors the safety of traditionally harvested country foods through analysis of water, fish, berries and wild meat, (e.g., grouse, rabbit, caribou and moose) from northern Saskatchewan communities. Samples are collected from areas identified by community members, who then either assist in sample collection or provide samples from their own harvesting activities. The technical program monitors the aquatic environment at reference and far-field stations to determine if there are any cumulative impacts to aquatic communities.

The results of the program showed that concentrations of chemicals of interest have been relatively consistent over time and generally within the regional reference range. This indicates that there is no evidence of long-range transport of contaminants associated with uranium mining and milling. Thus, the EARMP concludes that water and country foods are safe for consumption. CNSC staff reviewed the EARMP technical reports and data and agree with the EARMP's conclusions.

The EARMP technical reports and data are available on the EARMP's website [96].

6.2 National Pollutant Release Inventory

As discussed in section 2.4 of this report, ECCC operates the NPRI [46], which is Canada's public inventory of pollutant releases, disposals and transfers, tracking over 320 pollutants from over 7,000 facilities across the country. Reporting facilities include factories that manufacture a variety of goods, mines, oil and gas operations, power plants and sewage treatment plants. Information that is collected includes:

- releases from facilities to air, water or land
- disposals at facilities or other locations
- transfers to other locations for treatment and recycling
- facilities' activities, location and contacts

- pollution prevention plans and activities [97]

CNSC staff conducted a search of the NPRI database and found that the uranium mines and mills (i.e., Cigar Lake, Key Lake, McArthur River, Rabbit Lake and McClean Lake) are the only facilities from the Athabasca basin that report to the NPRI. While reviewing the data, CNSC staff did not notice any trends or unusual results. It is also worth noting that radionuclides are not included in the inventory of pollutants in the NPRI database. The CNSC receives radionuclide loadings from the uranium mine and mill licensees through other means, i.e., annual and quarterly reports. This information has been used in this report, but the complete dataset is available for download on the CNSC's Open Government Portal [98].

7.0 RECOMMENDATIONS AND CONCLUSIONS

CNSC staff reviewed Cameco's licence application and the documents submitted in support of the application, such as the PDP, ERA and annual reports, all of which are satisfactory and meet CNSC's regulatory requirements with respect to EP. CNSC staff also reviewed the results from various relevant health studies and regional monitoring programs conducted by other levels or bodies of government, which substantiate CNSC staff's conclusion that the environment and health of persons are protected from ongoing activities at the Cigar Lake Operation. In addition, CNSC staff conducted IEMP sampling around the Cigar Lake Operation in 2020. IEMP results support CNSC staff's conclusions that the public and the environment around the Cigar Lake Operation are protected and that there are no health impacts as a result of ongoing activities. These results are also consistent with the results submitted by Cameco, demonstrating that the licensee's environmental programs protect the health of persons and the environment.

This EPR focused on items of current public and regulatory interest, including airborne and waterborne releases from ongoing operations. CNSC staff conclude that the potential risks from radiological and hazardous releases to the atmospheric, geological, hydrogeological and human environments from Cameco's Cigar Lake Operation are negligible. The potential risks to the environment for these releases are not distinguishable from natural background and the potential risk to humans is similar to health outcomes in the general public. There is low probability that aquatic and terrestrial species in the immediate vicinity of the site may experience effects during operation when very conservative assumptions are used. The predicted effects are expected to return to pre-operational conditions over time after the site is closed and decommissioned.

The EPR conducted for the licence application to renew Cameco's Uranium Mine Licence (UML-MINE-CIGAR.01/2021) for the Cigar Lake Operation concludes that Cameco has and will continue to make adequate provision for the protection of the environment and the health of persons. CNSC staff will continue to verify and ensure that, through ongoing licensing and compliance activities and reviews, the environment and the health of persons are protected and will continue to be protected over the proposed licence period.

The information provided in this EPR Report supports the recommendation by CNSC staff in CMD 21-H2 to renew Cameco's Uranium Mine Licence (UML-MINE-CIGAR.01/2021) for the Cigar Lake Operation.

ABBREVIATIONS

Acronym	Term
AL	Action Level
ALARA	As Low As Reasonably Achievable
BATEA	Best Available Technology Reasonably Achievable
Bq/L	Becquerels per year
Bq/m^3	Becquerels per cubic metre
CCME	Canadian Council of Ministers of the Environment
CEAA	*Canadian Environmental Assessment Act*
CEPA	*Canadian Environmental Protection Act*
CMD	Commission Member Document
CNSC	Canadian Nuclear Safety Commission
COPC	Contaminant of potential concern
CSA	Canadian Standards Association
EA	Environmental assessment
EARMP	Eastern Athabasca Regional Monitoring Program
EARPGO	Environmental Assessment and Review Process Guidelines Order
ECCC	Environment and Climate Change Canada
ECOP	Environmental Code of Practice
EMP	Environmental Monitoring Program
EMS	Environmental Management System
EP	Environmental protection
EPR	Environmental Protection Review
ERA	Environmental Risk Assessment
GHG	Greenhouse gas
HHRA	Human Health Risk Assessment
IA	Impact assessment
ICRP	International Commission on Radiation Protection
IEMP	Independent Environmental Monitoring Program
ISO	International Organization for Standardization
ISQG	Interim Sediment Quality Guidelines for the Protection of Aquatic Life
LCH	Licence Conditions Handbook
LEL	Lowest Effects Levels

MDMER	*Metal and Diamond Mining Effluent Regulations*
MBq/L	Megabecquerels per litre
mg/L	Milligrams per litre
mSv/year	Millisievert per year
NPRI	National Pollutant Release Inventory
NSCA	*Nuclear Safety and Control Act*
PDP	Preliminary Decommissioning Plan
PSQG	Probable Effects Level Sediment Quality Guideline
ROR	Regulatory Oversight Report
SARA	*Species At Risk Act*
SEL	Severe Effects Levels
SEQG	Saskatchewan Environmental Quality Guidelines
SO_2	Sulphur dioxide
TSS	Total suspended solids
VEC	Valued ecosystem component

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PART TWO

Part Two provides all relevant information pertaining directly to the licence, including:

1. Any proposed changes to the conditions, licensing period, or formatting of an existing licence;
2. The proposed licence;
3. The proposed licence conditions handbook; and
4. The current licence.

PROPOSED LICENCE CHANGES

Overview

There are no changes to the licence conditions or format. The licence term recommended is for a 10-year period.

Licence Conditions

There are no changes to the existing licence conditions.

Licence Format

The licence format was updated previously as part of "CMD 20H-108, Cameco Corporation Cigar Lake Operation Financial Guarantee Review and Licence Modernization Amendments." No new changes to the licence format for this CMD.

Licence Period

In Cameco's application to renew the CNSC-issued licence, a 10-year licence term was requested. CNSC has a standardized licence and licence conditions handbook (LCH) framework which provides for effective regulatory oversight of operating facilities. Cameco is required by its licence to report on the CLO compliance performance through annual compliance reports, including significant changes to its operations. CNSC staff verify compliance through desktop reviews, inspections and event reviews. In addition, CNSC staff report compliance performance of the CLO annually to the Commission in public meetings through the regulatory oversight reports for uranium mines and mills in Canada that ensures adequate oversight of the licensee. Therefore, CNSC staff recommend that the Commission accept Cameco's request for a 10-year licence for uranium mining at the CLO.

PROPOSED LICENCE

e-Doc# 6327069 (Word)

e-Doc# 6327190 (PDF)

DRAFT

URANIUM MINE LICENCE
CAMECO CORPORATION
CIGAR LAKE OPERATION

I) LICENCE NUMBER: UML-MINE-CIGAR.00/2031

II) LICENSEE: Pursuant to section 24 of the *Nuclear Safety and Control Act*, this licence is issued to:

Cameco Corporation
2121 – 11th Street West
Saskatoon, Saskatchewan S7M 1J3
Corporate Number 332981-0

III) LICENCE PERIOD:

This licence is valid from July 1, 2021 to June 30, 2031, unless otherwise suspended, amended, revoked or replaced.

IV) LICENSED ACTIVITIES:

This licence authorizes the licensee to:

a) prepare a site for and construct, operate, modify and decommission a nuclear facility (hereinafter "the facility") for the milling of uranium ore at a site known as the Cigar Lake Operation in the province of Saskatchewan as shown on the drawing referenced in appendix A to this licence;

b) mine a nuclear substance (uranium ore);

c) possess, transfer, import, use, store, and dispose of nuclear substances; and

d) possess, transfer, import, use prescribed equipment that is required for or associated with laboratory studies, field studies, fixed gauge usage and borehole logging devices in relation to (a) and (b).

V) EXPLANATORY NOTES:

a) Nothing in this licence shall be construed to authorize non-compliance with any other applicable legal obligation or restriction.

b) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and its associated Regulations.

c) The UML-MINE-CIGAR.00/2031 Licence Conditions Handbook (LCH) identifies the criteria that will be used by Canadian Nuclear Safety Commission staff to assess the licensee's compliance with the conditions listed in this licence. The LCH also provides information regarding delegation of authority and applicable version control of documents comprising compliance verification criteria.

VI) CONDITIONS:

G. GENERAL

G.1 Licensing Basis for Licensed Activities

The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) the regulatory requirements set out in the applicable laws and regulations;

(ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence;

(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (hereinafter "the Commission").

G.2 Notification of Changes

The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

G.3 Financial Guarantee

The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

G.4 Public Information and Disclosure

The licensee shall implement and maintain a public information and disclosure program.

1. MANAGEMENT SYSTEM

1.1 Management System

The licensee shall implement and maintain a management system.

2. HUMAN PERFORMANCE MANAGEMENT

2.1 Training Program

The licensee shall implement and maintain a training program**.**

3. OPERATING PERFORMANCE

3.1 Operations Program

The licensee shall implement and maintain an operating program, which includes a set of operating limits.

3.2 Reporting Requirements

The licensee shall implement and maintain a program for reporting to the Commission or a person authorized by the Commission.

3.3 Nuclear Substances and Radiation Devices

The licensee shall implement and maintain a program for nuclear substances and radiation devices.

4. SAFETY ANALYSIS

4.1 Safety Analysis Program

The licensee shall implement and maintain a safety analysis program.

5. PHYSICAL DESIGN

5.1 Design Program

The licensee shall implement and maintain a design program.

6. FITNESS FOR SERVICE

6.1 Fitness for Service Program

The licensee shall implement and maintain a fitness for service program.

7. *RADIATION PROTECTION*

7.1 Radiation Protection Program

The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within 24 hours.

8. *CONVENTIONAL HEALTH AND SAFETY*

8.1 Conventional Health and Safety Program

The licensee shall implement and maintain a conventional health and safety program.

9. ENVIRONMENTAL PROTECTION

9.1 Environmental Protection Program

The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within 24 hours.

10. EMERGENCY MANAGEMENT AND FIRE PROTECTION

10.1 Emergency Preparedness Program

The licensee shall implement and maintain an emergency preparedness program.

10.2 Fire Protection Program

The licensee shall implement and maintain a fire protection program.

11. WASTE MANAGEMENT

11.1 Waste Management Program

The licensee shall implement and maintain a waste management program.

11.2 Decommissioning Plan

The licensee shall maintain a decommissioning plan.

12. SECURITY

12.1 Security Program

The licensee shall implement and maintain a security program.

13. SAFEGUARDS AND NON-PROLIFERATION

13.1 Safeguards Program

The licensee shall implement and maintain a safeguards program.

14. PACKAGING AND TRANSPORT

14.1 Packaging and Transport Program

The licensee shall implement and maintain a packaging and transport program.

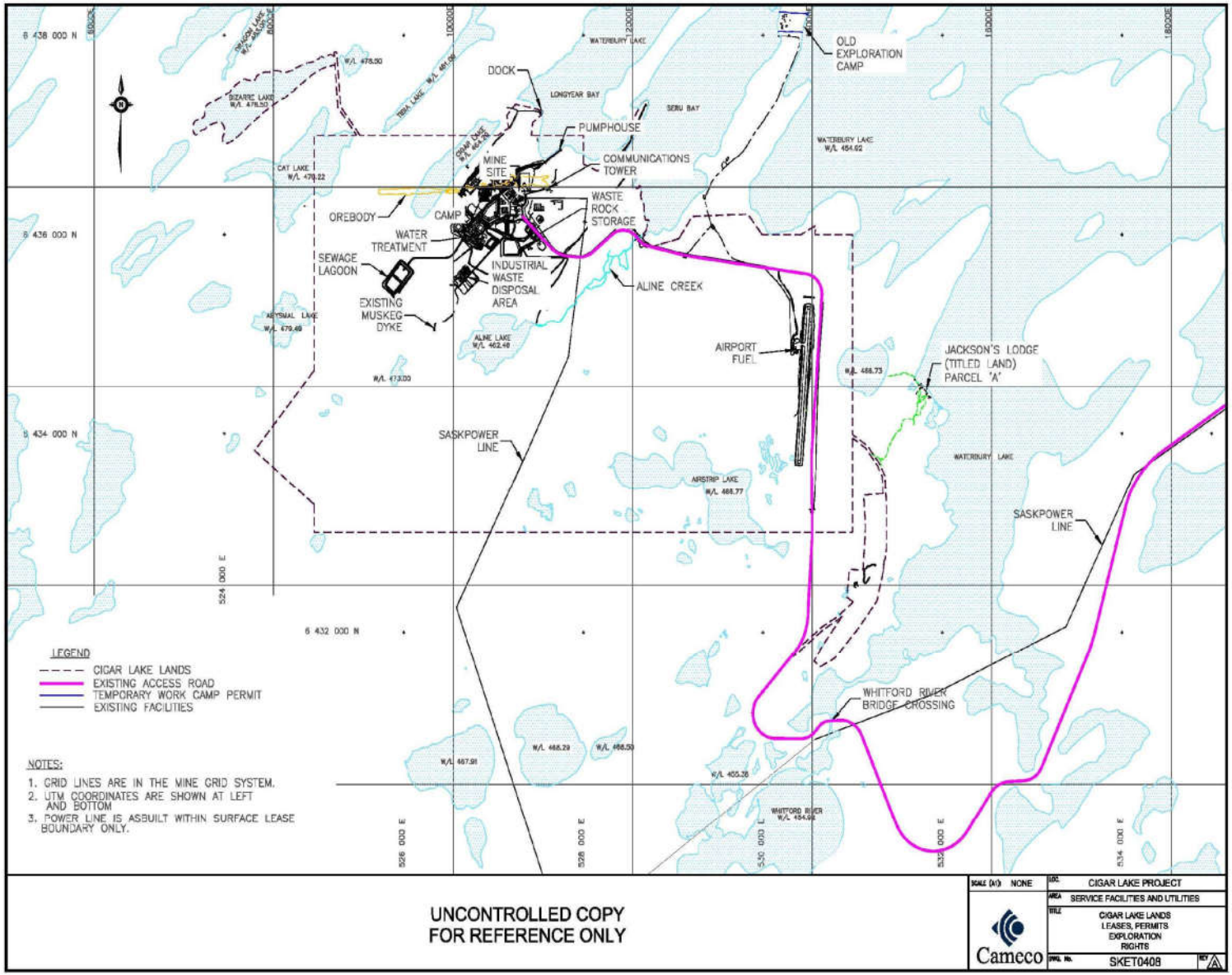
SIGNED at OTTAWA, this _____ day of _____, 2021.

_____
Rumina Velshi, President
on behalf of the Canadian Nuclear Safety Commission

APPENDIX A

LOCATION OF CAMECO'S OPERATION AT CIGAR LAKE

The location of the Cameco's operation at Cigar Lake is shown on Drawing SKET0408, Rev A.



e-Doc 6327069 (Word)
e-Doc 6327190 (PDF)

PROPOSED LICENCE CONDITIONS HANDBOOK

e-Doc # 6327194 (Word)

e-Doc # 6327196 (PDF)

Canada's Nuclear Regulator

DRAFT

e-Doc 6327194 (Word)
e-Doc 6327196 (PDF)

LICENCE CONDITIONS HANDBOOK

LCH-MINE-CIGAR.00/2031

CIGAR LAKE OPERATION
URANIUM MINE LICENCE

UML-MINE-CIGAR.00/2031

Revision 3

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

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Licence Conditions Handbook **Effective: Month xx, 2021**

LCH-MINE-CIGAR.00/2031, Revision 3

Cigar Lake Operation

Uranium Mine Licence

UML-MINE-CIGAR.00/2031
(Effective: date licence signed)

SIGNED at OTTAWA this _____ day of _____, 2021

_____

Peter Fundarek, Director
Uranium Mines and Mills Division
Directorate of Nuclear Cycle and Facilities Regulation
CANADIAN NUCLEAR SAFETY COMMISSION

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Revision History:

Effective Date	Revision	Section(s) changed	Description of the Changes	eDoc #
July 9, 2013	0	N/A	Original document.	4056563 (Word) 4068688 (PDF)
January 23, 2014	1	1.2, 1.3, 4.1, 4.3, 10.2, 14.1, Appendix A & C	Formatting changes, updated text on delegation of authority for consistency between UMM LCH's, updated text on reporting for consistency, updated references, added table of radiation devices.	4170399 (Word) 4068688 (PDF)
Month xx, 2021	2	All	Licence and LCH modernization: new standard licence conditions and updated LCH text and format. Revised financial guarantee value.	6274206 (Word) 6286325 (PDF)
Month xx, 2021	3		Licence renewal: updated standards and CNSC regulatory documents.	6327194 (Word) 6327196 (PDF)

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TABLE OF CONTENTS

PART I: INTRODUCTION

The purpose of the licence conditions handbook (LCH) is to identify and clarify the relevant parts of the licensing basis for each licence condition (LC). This will help ensure that the licensee will maintain facility operations in accordance with the licence and the intent of the licensing basis. The LCH also provides information regarding delegation of authority, document version control and conflict resolution. The LCH should be read in conjunction with the licence.

The LCH has three parts under each LC: the Preamble, Compliance Verification Criteria (CVC), and Guidance. The Preamble explains the regulatory context, background, and/or history related to the LC. CVC are used by Canadian Nuclear Safety Commission (CNSC) staff to oversee compliance with the LC. Guidance is non-mandatory information, including direction, on how to comply with the LC.

The statement "a person authorized by the Commission" in the LCs or the LCH indicates that the Commission may delegate certain authority to CNSC staff. Unless otherwise specified, the delegation of authority by the Commission to act as a person authorized by the Commission (Delegated Officer) is only applied to incumbents in the following positions:

- Director, Uranium Mines and Mills Division
- Director General, Directorate of Nuclear Cycle and Facilities Regulation
- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch

PART II: FRAMEWORK FOR EACH CONDITION

G. GENERAL

G.1 Licensing Basis for Licensed Activities

The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) the regulatory requirements set out in the applicable laws and regulations;

(ii) the conditions and safety control measures described in the facility's or activity's licence and the documents directly referenced in that licence;

(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (hereafter "the Commission").

Preamble

Licence condition G.1 requires activities (defined in Part IV of the licence) be conducted in accordance with the licensing basis. Further information on the licensing basis is available in CNSC regulatory document, REGDOC-3.5.3, *Regulatory Fundamentals*.

The licensing basis, established by the Commission at the time the licence is issued, sets the boundary conditions for a regulated activity, and establishes the basis for the CNSC's compliance program for that regulated activity.

Part (i) of licence condition G.1 includes, but is not limited to, the following:

- *Nuclear Safety and Control Act*
- *Uranium Mines and Mills Regulations*
- *Radiation Protection Regulations*
- *Packaging and Transport of Nuclear Substances Regulations, 2015*
- *Nuclear Substances and Radiation Devices Regulations*
- *Metal and Diamond Mining Effluent Regulations*
- Canada/International Atomic Energy Agency (IAEA) Safeguards Agreements

The safety and control measures mentioned under Parts (ii) and (iii) of LC G.1 have the potential to affect the health and safety of people, the environment, security or international obligations to which Canada agrees. These measures may be found in high-level programmatic documents but might also be found in lower-level supporting documentation. Safety and control measures can also be found in licensing basis publications such as CNSC regulatory documents, CSA Group standards or licensee documentation submitted in support of a licence.

The CNSC licence authorizes Cameco Corporation (Cameco) to conduct the following undertakings at the Cigar Lake Operation, for which the CNSC provides regulatory oversight:

- operation and changes to the underground mine, underground ore-processing facility and surface ore load-out facility
- transfer of the treated uranium ore to another facility, by use of a surface load-out system, authorized by the CNSC to accept the nuclear substance
- mining up to 7.0 million kilograms of uranium per year, with a production flexibility up to 9.25 million kilograms of uranium per year
- operation and changes to the dewatering and water management systems, including water treatment plant
- disposal of contaminated wastes, including off-site
- storage of clean and special-waste rock
- authorized decommissioning and reclamation
- handling and storage of hazardous materials and disposal of hazardous wastes, including disposal off site
- possession, storage, transfer, importation, use and disposal of nuclear substances and radiation devices.

Environmental assessments, first carried out in 1995 and most recently in 2017, have evaluated the environmental effects from Cameco's operation at Cigar Lake at an annual production rate up to 7.0 million kilograms of uranium. Production flexibility allows the licensee to recoup production shortfalls experienced throughout the mine operation. An increase above the authorized annual production rate of 7.0 million kilograms of uranium per year, or above the production flexibility of 9.25 million kilograms of uranium per year, would need to be reviewed by CNSC staff.

Compliance Verification Criteria

Licensing Basis Documents

Licensing basis documents are listed in Appendix B and C in addition to tables under the most relevant LC. All "shall" or normative statements in licensing basis publications are considered CVC unless stated otherwise. If any "should" or informative statements in licensing basis publications are also considered CVC, this is provided under the most relevant LC.

In the event of any inconsistency between two elements of the licensing basis, the licensee shall consult CNSC staff to determine the approach to resolve the issue.

For operational activities that are not in accordance with the licensing basis, the licensee shall take action as soon as practicable to return to a state that is compliant with the licensing basis, taking into account the risk significance of the situation. Reporting requirements are outlined in CNSC's REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills* and discussed under LC 3.2 of this LCH.

Changes to documentation or activities that result in operational activities not being in accordance with the licensing basis must be approved by the Commission prior to implementation.

Guidance

When the licensee becomes aware that a proposed change or activity might not be in accordance with the licensing basis, it should first seek direction from CNSC staff regarding the potential acceptability of this change or activity. The licensee should take into account that certain types of proposed changes might require significant lead times before CNSC staff can make recommendations and/or the Commission can properly consider them. Guidance for notifications to the CNSC related to licensee changes are discussed under LC G.2.

G.2 Notification of Changes

The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

Preamble

During the course of licensed activities, it is expected that the licensee may make changes to implement improvements or to address changes in operational needs. While making these changes, it is imperative the licensee remains within the bounds of the licensing basis.

Appendix B provides a list of licensee documents that require notification of change. CNSC staff track the current version of these documents in a document separate from the LCH (e-Doc 6339027).

Compliance Verification Criteria

Licensee Documents that Require Notification of Change

Changes to the design, operating conditions, policies, programs and methods that have the potential to be outside of the licensing basis require prior written notification to the CNSC. CNSC staff will confirm the change remains within the licensing basis and notify the licensee prior to implementation of the change by the licensee. The licensee shall allow sufficient time for the CNSC to review change proportionate to its complexity and the importance of the safety and control measures being affected. Regular communication between the CNSC and the licensee should ensure review timelines are established prior to submission of prior written notification. It remains the responsibility of the licensee to ensure that the Cigar Lake Operation continues to operate within the bounds of the licensing basis.

Prior written notification shall include:

- a summary description of the change
- the rationale for the change
- expected duration (if not a permanent change)
- a summary explanation for the licensee supporting the conclusion that the change remains in accordance with the licensing basis

Ongoing regular communication shall be maintained between the CNSC and licensee.

Guidance

A list of criteria to determine if a change would be in accordance with the licensing basis is provided in Appendix A of CNSC process document *Overview of: Assessing licensee changes to documents or operations* (e-Doc 4055483).

G.3 Financial Guarantee

The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

Preamble

The licensee is responsible for all costs of decommissioning at the facility. All such costs are included in the licensee's decommissioning cost estimates and are covered by the licensee's financial guarantee for decommissioning. The licensee's decommissioning cost estimate is provided in the facility's preliminary decommissioning plan. The facility's current financial guarantee is covered by specific financial instruments as listed below.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CSA Group	Decommissioning of facilities containing nuclear substances	N294-19

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Preliminary Decommissioning Plan and Cost Estimate	5329312	Yes
Cameco	Financial Instruments – to be added when confirmed	XXXXXXX	Yes

The financial guarantee for decommissioning the Cigar Lake Operation shall be reviewed and revised by the licensee every five years; when required by the Commission; or following a revision of the preliminary decommissioning plan that significantly impacts the financial guarantee. The next financial guarantee update is expected in 2022.

The licensee shall submit annually to the Commission, a written report confirming that the financial guarantees for decommissioning costs remain valid and in effect and sufficient to meet the decommissioning needs. The licensee shall submit this report by the end of March of each year, or at any time as the Commission may request.

Guidance

Guidance Publications

Source	Document Title	Document Number
CNSC	Financial Guarantees for the Decommissioning of Licensed Activities	G-206
CNSC	Decommissioning Planning for Licensed Activities	G-219

G.4 Public Information and Disclosure

The licensee shall implement and maintain a public information and disclosure program.

Preamble

The public information and disclosure program ensures that information related to the health and safety of persons and the environment and other issues associated with the lifecycle of the nuclear facility is effectively communicated to the public. In addition, the program shall include a commitment to and protocol for ongoing timely communications regarding emissions, effluent releases, unplanned events and other incidents and activities related to the licensed facility that may be of interest to the public.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CNSC	Public Information and Disclosure	REGDOC-3.2.1*

* Cameco to post summaries of Environmental Risk Assessments on their website, rather than the entire document, in accordance with Cameco's June 4, 2020 letter to the CNSC (L. Mooney to H. Tadros, e-Doc 6318384) and Cameco's June 12, 2020 email (K. Nagy to R. Snider, e-Doc 6316951).

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Public Information Program	4276652	Yes

Guidance

There is no guidance provided for this licence condition.

1. MANAGEMENT SYSTEM

Licence Condition 1.1

The licensee shall implement and maintain a management system.

Preamble

The "management system" safety and control area covers the framework which 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.

The management system must satisfy the requirements set out in the NSCA, regulations made pursuant to the NSCA, the licence and the measures necessary to ensure that safety is of paramount consideration in implementation of the management system. An adequately established and implemented management system provides the evidence that the licensing basis remains valid.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CSA Group	Management system requirements for nuclear facilities (except sections identified under other license conditions)	N286-12
CNSC	Safety Culture* (section 2)	REGDOC-2.1.2

* Elements relating to security culture will not be implemented until 2022.

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Quality Management Program	4043422	Yes

Guidance

Guidance Publications

Source	Document Title	Document Number
CNSC	Safety Culture (excluding section 2)	REGDOC-2.1.2

2. HUMAN PERFORMANCE MANAGEMENT

Licence Condition 2.1

The licensee shall implement and maintain a training program.

Preamble

The "human performance management" safety and control area covers activities that enable effective human performance through the development and implementation of processes that ensure a sufficient number of licensee workers are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely perform their duties.

Compliance Verification Criteria

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Training Development Program	4040583	Yes

Licensing Basis Publications

Source	Document Title	Document Number
CNSC	*Personnel Training,* Version 2, December 2016	REGDOC-2.2.2

Guidance

There is no guidance provided for this licence condition.

3. OPERATING PERFORMANCE

Licence Condition 3.1

The licensee shall implement and maintain an operating program, which includes a set of operating limits.

Preamble

The "operating performance" safety and control area includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CSA Group	Management system requirements for nuclear facilities	N286-12

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Mine Facility Description Manual	4069696	Yes
Cameco	Environmental Code of Practice (Appendix A of the Environmental Protection Program – Code of Practice)	4200759	Yes
Cameco	Radiation Code of Practice (Appendix 4 of Radiation Protection Program – Code of Practice)	4036630	Yes
Cameco	Mine Ventilation Code of Practice	4224647	Yes
Cameco	Quality Management Program	4043422	Yes
Cameco	Waste Management Program	4040582	Yes
Cameco	Mining Operations Program	4043427	Yes
Cameco	Process Operations Program	4036654	Yes

Guidance

There is no guidance provided for this licence condition.

Licence Condition 3.2

The licensee shall implement and maintain a program for reporting to the Commission or a person authorized by the Commission.

Preamble

This LC requires the licensee to implement and maintain a process for reporting information to the CNSC. This includes monitoring results, changes to facilities or approved activities, performance assessments and the occurrence of unusual events. Sections 29 and 30 of the *General Nuclear Safety and Control Regulations,* section 38 of the *Nuclear Substances and Radiation Devices Regulations* and section 16 of the *Radiation Protection Regulations* provides further insight into reportable events.

The statement "a person authorized by the Commission" in the LCs or the LCH indicates that the Commission may delegate certain authority to CNSC staff. Unless otherwise specified, the delegation of authority by the Commission to act as a person authorized by the Commission (Delegated Officer) is only applied to incumbents in the following positions:

- Director, Uranium Mines and Mills Division
- Director General, Directorate of Nuclear Cycle and Facilities Regulation
- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CNSC	Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills	REGDOC-3.1.2

The licensee shall report effluent concentrations that reach or exceed the discharge limits in the *Metal and Diamond Mining Effluent Regulations* in addition to requirements outlined in CNSC's REGDOC-3.1.2.

The licensee shall submit to the CNSC within 90 days after the end of each quarter of a calendar year, the results of the:

- radiation monitoring program
- environmental monitoring program

Results from the above monitoring programs are also to include quality assurance and quality control information. More frequent reporting may be requested on a case-by-case basis.

The licensee shall issue worker radiation dose records within 90 days after the end of each quarter of a calendar year, to:

- the worker
- the CNSC
- the National Dose Registry (NDR)

The licensee shall submit to the CNSC an annual compliance report by March 31 of each year, covering the operation for the 12-month period from January 1 to December 31 of the previous year.

Guidance

Guidance Publications

Source	Document Title	CNSC e-Access Document Number
CNSC/SK	CNSC – Saskatchewan Harmonized Annual Reporting Requirements, August 2010	3678482

Licence Condition 3.3

The licensee shall implement and maintain a program for nuclear substances and radiation devices.

Preamble

Licensees must ensure they receive CNSC authorization before the possession, use, storage, transfer, or disposal of nuclear substances and radiation devices, except as specified in the tables for this section. It is the responsibility of the licensee to ensure that they have CNSC authorization for the import or export of any nuclear substances and radiation devices.

The possession limits for unsealed nuclear substances does not apply to natural uranium and its decay products which originate in the mining or ore-treatment streams.

It is also important to note that there is no possession limit on the number of sealed nuclear sources or radiation devices.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CNSC	*Licence Application Guide: Nuclear Substances and Radiation Devices* (excluding section 2)	REGDOC-1.6.1

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Radiation Protection Program (Appendix 3 – Authorized Nuclear Substance List)	4036630	Yes

The authorized possession limits for unsealed nuclear substances are:

Nuclear Substance	Maximum Total Quantity in Possession
Barium-133	4 MBq
Radium-226	0.4 MBq

The maximum authorized quantity of nuclear substances per sealed source is:

Nuclear Substance	Maximum Quantity per Sealed Source
Americium-241	0.037 MBq
Cesium-137	7.4 GBq
Cobalt-60	3.7 MBq
Curium-244	0.037 MBq
Plutonium-238	0.037 MBq
Radium-226	0.037 MBq
Strontium-90	0.037MBq
Thorium-230	0.037 MBq
Thallium-204	3.7 MBq
Uranium-238	5 kBq

The authorized make and model of radiation devices and the maximum quantity of nuclear substance per each device are:

Radiation Device Make and Model	Nuclear Substance	Maximum Quantity per Radiation Device
Ronan Engineering - SA-1	Cesium-137	7.4 GBq
Mount Sopris - LLP-2676	Americium 241/Be	111 GBq

Note: The above table includes provision for replacement sources for these radiation devices.

The management of nuclear substances and radiation devices will be evaluated against:

3.3.1 A radioisotope safety poster approved by the Commission or a person authorized by the Commission, which corresponds to the classification of the area, room or enclosure, is posted in a readily visible location in areas, rooms or enclosures where these listed nuclear substances are handled.

3.3.2 When in storage, radioactive nuclear substances or radiation devices are accessible only to persons authorized by the licensee; the dose rate at any occupied location outside the storage area, room or enclosure resulting from the substances or devices in storage does not exceed 2.5 mSv/h and measures are in place to ensure that the dose limits in the *Radiation Protection Regulations* are not exceeded as a result of the substances or devices in storage.

Guidance

There is no guidance provided for this licence condition.

4. SAFETY ANALYSIS

Licence Condition 4.1

The licensee shall implement and maintain a safety analysis program.

Preamble

The "safety analysis" safety and control area includes the systematic evaluation of the potential hazards associated with the proposed activity or facility and considers the effectiveness of preventative measures and strategies in reducing the effects of such hazards.

Compliance Verification Criteria

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Environmental Management Program	4200759	Yes
Cameco	Waste Management Program	4040582	Yes
Cameco	Safety and Health Management Program	4064102	Yes

The safety analysis program will be evaluated against the following principles:

4.1.1 A process has been implemented and maintained to identify, assess, and eliminate or control health and safety and environmental risks associated with existing and new processes or changes to work procedures, equipment, organizational structure, staffing, products, services and suppliers.

4.1.2 Risks to health, safety and the environment have been identified, assessed, eliminated or controlled for existing and new processes or for changes to work procedures, equipment, organizational structure, staffing, products, services and suppliers.

4.1.3 Appropriate methodologies are used to identify potential hazards and consider the effectiveness of preventative measures and strategies in reducing the effects of such hazards.

4.1.4 Modeling is regularly updated using measured values to replace important assumptions and to increase the certainty of predicted long-term behaviour of contaminants.

Job hazard assessments conducted when planning non-routine and complex work activities are discussed under operating performance.

Guidance

There is no guidance provided for this licence condition.

SAFETY ANALYSIS

5. PHYSICAL DESIGN

Licence Condition 5.1

The licensee shall implement and maintain a design program.

Preamble

The "physical design" safety and control area 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.

The design basis is the range of conditions and events taken into account in the design of structures, systems and components of a facility according to established criteria, such that the facility can withstand them without exceeding authorized limits for the planned operation of safety systems.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CNSC	Design of Uranium Mines and Mills: Ventilation Systems*	REGDOC-2.5.4
CSA Group	Management system requirements for nuclear facilities	N286-12

* Applicable when applying for a CNSC licence to prepare a site for and construct, operate or decommission a uranium mine or mill.

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Mining Facility Description Manual	4069696	Yes
Cameco	Quality Management Program	4043422	Yes
Cameco	Mining Operations Program	4043427	Yes
Cameco	Process Operation Program	4036654	Yes

Guidance

There is no guidance provided for this licence condition.

6. FITNESS FOR SERVICE

Licence Condition 6.1

The licensee shall implement and maintain a fitness for service program.

Preamble

The "fitness for service" safety and control area 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 equipment is available to perform its intended design function when called upon to do so.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CSA Group	Management system requirements for nuclear facilities	N286-12

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Maintenance Program	4036658	Yes

The fitness for service program will also be assessed against:

6.1.1 Systems, equipment, and devices are maintained in good working order such that they can perform their design function.

6.1.2 Instruments, controls and associated indicators are maintained operational and in calibration. Method and interval of calibrations are defined, and records of calibrations are kept.

6.1.3 Preventative and corrective maintenance processes and systems have been implemented and are maintained.

6.1.4 Regular inspection and testing of critical infrastructure and equipment are carried out.

6.1.5 A process has been implemented to identify, plan and schedule maintenance activities.

6.1.6 Maintenance, testing, surveillance and inspection backlogs are monitored and minimized.

6.1.7 Methods are used to show the current acceptance and operating status, and to prevent the use of systems, equipment or devices that are inaccurate, uncalibrated or not in working order.

6.1.8 When deviations beyond accuracy limits are found or suspected, their consequence on past results, and on present performance is evaluated.

6.1.9 A process exists to verify that changes to calibration, testing and maintenance requirements due to system and equipment modifications and replacements are implemented.

Guidance

There is no guidance provided for this licence condition.

7. RADIATION PROTECTION

Licence Condition 7.1

The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within 24 hours.

Preamble

The "radiation protection" safety and control area covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. This program must ensure that contamination and radiation doses received are monitored, controlled, kept as low as reasonably achievable (ALARA), and social and economic factors are being taken into account.

Compliance Verification Criteria

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Radiation Protection Program	4036630	Yes

The radiation protection (RP) program will be assessed against the following principles:

7.1.1 Radiological conditions are monitored and sources of internal and external radiation exposures are controlled. Access and work in radiological areas are controlled so that collective and individual radiation exposures are kept in accordance with the ALARA principle.

7.1.2 RP instrumentation and equipment are calibrated, maintained and used so that radiation levels are accurately determined. Uncalibrated equipment is removed from use.

7.1.3 The personal dosimetry program ensures that external and internal radiation doses to individuals are accurately determined and recorded.

7.1.4 Appropriate contamination control measures are implemented to control and minimize the contamination of areas, equipment and personnel.

7.1.5 Effective decontamination control measures are implemented to control and prevent the contamination of areas, equipment and personnel.

Action levels (AL) are designed to alert licensees before regulatory dose limits are reached. By definition, if an AL referred to in a licence is reached, a loss of control of some part of the associated RP program may have occurred and specific action is required, as defined in the *Radiation Protection Regulations*, the licence and the applicable code of practice.

Action Level	Dose (mSv)
Weekly Action Level	1
Quarterly Action Level	5

The weekly AL is assessed against official dosimetry results or engineering monitoring data. The quarterly AL is assessed against official dosimetry results. The licensee is expected to review and, if necessary, revise the ALs specified above at least once every five years in order to validate their effectiveness. The results of such reviews should be provided to the CNSC.

Guidance

Guidance Publications

Source	Document Title	Document Number
CNSC	Measuring Airborne Radon Progeny at Uranium Mines and Mills	G-4
CNSC	Ascertaining and Recording Radiation Doses to Individuals	G-91
CNSC	Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"	G-129
CNSC	Preparing Codes of Practice to Control Radiation Doses at Uranium Mines and Mills	G-218
CNSC	Developing and Using Action Levels	G-228
CNSC	Technical and Quality Assurance Requirements for Dosimetry Services	S-106
CNSC	Making Changes to Dose-Related Information Filed with the National Dose Registry	S-260

8. CONVENTIONAL HEALTH AND SAFETY

Licence Condition 8.1

The licensee shall implement and maintain a conventional health and safety program.

Preamble

The "conventional health and safety" safety and control area covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.

The regulation of non-radiological health and safety at uranium mines and mills is governed by the *Canada Labour Code Part II*, which is administered by Employment and Social Development Canada (ESDC). However, the *Saskatchewan Uranium Mines and Mills Exclusion Regulations* (SOR/2001-115) defer the regulation of occupational health and safety in Saskatchewan uranium mines and mills to the province of Saskatchewan in accordance with the requirements of *The Mines Regulations, 2018* Part II *Revised Regulations of Saskatchewan*.

The CNSC also has regulatory responsibilities for the oversight of the protection of the health and safety of workers. The CNSC harmonizes the oversight of conventional health and safety with the Saskatchewan Ministry of Labour Relations and Workplace Safety.

Compliance Verification Criteria

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Safety and Health Management Program	4064102	Yes

The conventional health and safety program will be assessed against the following principles:

8.1.1 Housekeeping standards have been identified and are enforced to ensure that work areas are kept clean and organized.

8.1.2 Facilities, processes and procedures have been implemented to ensure the safe management of hazardous materials.

8.1.3 Employees and contractors actively participate in the management of conventional health and safety.

8.1.4 Management verifies that employees and contractors actively participate in the management of health and safety in their workplace.

8.1.5 A process has been established and maintained to monitor, measure and record conventional health and safety performance and the effectiveness of the occupational health and safety program on a regular basis.

8.1.6 Routine inspections are performed by workers, supervisors, senior staff and/or safety professionals to identify any potential safety issues.

8.1.7 Processes and procedures are established and maintained to investigate accidents and incidents, to identify root causes, to implement corrective actions and to verify that corrective actions have been completed and will effectively prevent recurrence.

8.1.8 Procedures have been implemented and maintained for reporting work-related injuries, illnesses, fatalities and conventional health and safety incidents including near misses.

8.1.9 The causes of injuries are investigated, corrective actions implemented, and the effectiveness of corrective actions verified.

8.1.10 A preventative and corrective action procedure has been established and maintained to address non-conformances and inadequately controlled risks.

Guidance

There is no guidance provided for this licence condition.

9. ENVIRONMENTAL PROTECTION

Licence Condition 9.1

The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within 24 hours.

Preamble

The "environmental protection" safety and control area 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.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CNSC	Environmental Protection: Environmental Principles, Assessments and Protection Measures	REGDOC-2.9.1
CSA Group	Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills	N288.4-10
CSA Group	Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills	N288.5-11
CSA Group	Environmental risk assessments at Class I nuclear facilities and uranium mines and mills	N288.6-12
CSA Group	Groundwater protection programs at Class I nuclear facilities and uranium mines and mills	N288.7-15
CSA Group	Establishing and implementing action levels for releases to the environment from nuclear facilities	N288.8-17

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	6047900	Yes
Cameco	Environmental Management Program	6377613	Yes
Cameco	Waste Management Program	6257688	Yes
Cameco	Cigar Lake Human Health and Environmental Risk Assessment (2017) and Addendum (2019)	5357937 5908811	Yes

To ensure the applicable environmental protection measures have been established, implemented and maintained, the environmental protection program will also be assessed against:

9.1.1 Action levels specified in the environmental code of practice. When the licensee becomes aware that an action level has been triggered, the licensee shall notify the Commission within 24 hours and take specific action as defined in the *Uranium Mines and Mills Regulations* and the environmental code of practice.

9.1.2 The authorized release limits as specified below. When the licensee becomes aware that an authorized release limit has been reached or exceeded, the licensee shall immediately notify the Commission, investigate and take corrective action to ensure that the releases are maintained below the authorized release limits.

The authorized liquid effluent release limits until May 31, 2021 are:

Deleterious Substance	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Arsenic (mg/L)	0.50	0.75	1.00
Copper (mg/L)	0.30	0.45	0.60
Lead (mg/L)	0.20	0.30	0.40
Nickel (mg/L)	0.50	0.75	1.00
Zinc (mg/L)	0.50	0.75	1.00
Total Suspended Solids (mg/L)	15.00	22.50	30.00
Radium-226 (Bq/L)	0.37	0.74	1.11

Acid balance (as H_3O^+) reported as pH	In a range of 6.0 to 9.5

Acutely Lethal Effluent	0%

Note: In accordance with the *Metal and Diamond Mining Effluent Regulations,* these are the current limits for the Cigar Lake Operation until May 31, 2021.

The authorized liquid effluent release limits after May 31, 2021 are:

Deleterious Substance	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Arsenic (mg/L)	0.30	0.45	0.60
Copper (mg/L)	0.30	0.45	0.60
Lead (mg/L)	0.10	0.15	0.20
Nickel (mg/L)	0.50	0.75	1.00
Zinc (mg/L)	0.50	0.75	1.00
Un-ionized ammonia (mg/L)	0.50	N/A	1.00
Total Suspended Solids (mg/L)	15.00	22.50	30.00
Radium-226 (Bq/L)	0.37	0.74	1.11

Acid balance (as H_3O^+) reported as pH	In a range of 6.0 to 9.5

Acutely Lethal Effluent	0%

Note: In accordance with the *Metal and Diamond Mining Effluent Regulations,* these limits will come into effect on June 1, 2021.

Notes:

1) Authorized release limits have been harmonized, where available, with those required under the *Metal and Diamond Mining Effluent Regulations* (MDMER).

2) Definition of Units: mg/L = milligrams per litre
Bq/L = becquerels per litre

3) All concentrations and activities are total values.

4) "Monthly mean concentration" means the average value of the concentrations measured in all composite or grab samples collected from the final discharge point during each month when liquid effluent is released.

5) "Composite sample" means:
   a) a quantity of effluent consisting of not less than three equal volumes or three volumes proportionate to flow that have been collected at approximately equal time intervals over a period of not less than seven hours and not more than 24 hours; or
   b) a quantity of effluent collected continuously at a constant rate or at a rate proportionate to the rate of flow of the effluent over a sampling period of not less than seven hours and not more than 24 hours.

6) "Grab sample" means a quantity of undiluted effluent collected at any given time.

7) *"Acutely lethal"* (Source MDMER), in respect of an effluent, means that the effluent at 100% concentration kills.

ENVIRONMENTAL PROTECTION

a) more than 50% of the rainbow trout subjected to it for a period of 96 hours, when tested in accordance with the acute lethality test set out in section 14.1; or

b) more than 50% of the threespine stickleback subjected to it for a period of 96 hours, when tested in accordance with the acute lethality test set out in section 14.2. (*létalité aiguë*).

This definition will be updated in June of 2021 when the new requirement for daphnia magna testing comes into effect.

Guidance

Guidance Publications

Source	Document Title	Document Number
CSA Group	Environmental management systems – requirements with guidance for use	ISO 14001:2015

10. EMERGENCY MANAGEMENT AND FIRE PROTECTION

Licence Condition 10.1

The licensee shall implement and maintain an emergency preparedness program.

Preamble

The "emergency management and fire protection" safety and control area covers emergency plans and emergency preparedness programs which exist for emergencies and for non-routine conditions. It also includes any results of exercise participation.

Licensees are required to continually maintain and enhance their emergency management programs.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CNSC	Nuclear Emergency Preparedness and Response Version 2*	REGDOC-2.10.1

* Off-site reporting timelines accepted by CNSC staff for Saskatchewan uranium mine and mill sites are described in January 30, 2020 letter from Cameco to the CNSC (L. Mooney to H. Tadros, e-Doc 6109667).

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Emergency Preparedness and Response Program	4036659	Yes

The emergency management and fire protection program will be assessed against the following principles:

10.1.1 Potential emergency situations are identified.

10.1.2 Pre-incident plans for response to emergencies are developed and are maintained.

10.1.3 Resources, including facilities and equipment required to respond to emergencies are identified and maintained.

10.1.4 Emergency communication protocols are established and understood.

10.1.5 Organization and responsibilities are identified.

10.1.6 Workers are trained to fulfill duties and responsibilities with respect to emergency management and fire plans and procedures.

10.1.7 Procedures are implemented and maintained to prevent, prepare for, and respond to emergencies.

10.1.8 Response plans are periodically tested.

Guidance

There is no guidance provided for this licence condition.

Licence Condition 10.2

The licensee shall implement and maintain a fire protection program.

Preamble

Licensees are required to implement and maintain a fire protection program (a set of planned, coordinated, controlled and documented activities) to ensure that the licensed activities do not result in an unreasonable risk to the health and safety of persons and to the environment due to fire and to ensure that the licensee is able to efficiently and effectively respond to emergency fire situations.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
NRC	National Building Code of Canada (2010)	N/A
NRC	National Fire Code of Canada (2010)	N/A

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Fire Protection Program	4040579	Yes

Guidance

Guidance Publications

Source	Document Title	Document Number
CSA Group	Fire protection for facilities that process, handle, or store nuclear substances	N393-13

11. WASTE MANAGEMENT

Licence Condition 11.1

The licensee shall implement and maintain a waste management program.

Preamble

The "waste management" safety and control area 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.

CNSC regulatory document REGDOC-2.11, *Framework for Radioactive Waste Management and Decommissioning in Canada* defines radioactive waste as any material (liquid, gaseous or solid) that contains a radioactive "nuclear substance," as defined in section 2 of the NSCA, and which the owner has declared to be waste. In addition to containing nuclear substances, radioactive waste may also contain non-radioactive "hazardous substances," as defined in section 1 of the *General Nuclear Safety and Control Regulations*.

Waste management facilities include at the Cigar Lake Operation include:

- clean waste rock and overburden piles
- mineralized and non-mineralized waste piles
- site run-off containment ponds
- drill core storage areas
- contaminated industrial waste storage
- storage and recycling facilities for hazardous wastes
- landfill for uncontaminated industrial and domestic waste
- domestic sewage treatment.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CNSC	Waste Management, Volume II: Management of Uranium Mine Waste Rock and Mill Tailings*	REGDOC-2.11.1

* Applicable to new uranium mine or mill projects and/or of new waste management facilities at existing uranium mines and mills.

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Waste Management Program	4040582	Yes

The waste management program will be assessed against the following principles:

11.1.1 A radioactive waste management program is implemented to control and minimize the volume of radioactive waste.

11.1.2 The volume of waste is minimized by applying the waste hierarchy.

11.1.3 Work is carried out in a manner that minimizes waste and prevents pollution.

11.1.4 Waste is stored or disposed of in the appropriate manner.

11.1.5 Wastes are managed in a manner that does not compromise reclamation or decommissioning plans.

11.1.6 The effectiveness of waste management practices is monitored, measured and recorded on a regular basis.

11.1.7 Routine inspections are performed to identify any potential waste management issues and to verify the condition of containment structures and waste management facilities.

11.1.8 The safety of embankments/dams is inspected and evaluated.

11.1.9 Records are kept of the quantities and types of waste generated and the method of disposal or management.

11.1.10 Wastes are managed to control the present and future releases of contaminants to the environment.

11.1.11 Surface water is managed to prevent or minimize the volume that is contaminated.

Guidance

Guidance Publications

Source	Document Title	Document Number
Canadian Dam Association	Canadian Dam Association, Canadian Dam Safety Guidelines	N/A

Licence Condition 11.2

The licensee shall maintain a decommissioning plan.

Preamble

This LC requires that the licensee maintain a preliminary decommissioning plan (PDP).

A PDP provides an overview of the proposed decommissioning approach that is sufficiently detailed to assure that the proposed approach is, in the light of existing knowledge, technically and financially feasible, and appropriate in the interests of health, safety, security and the protection of the environment. The PDP defines areas to be decommissioned and the general structure and sequence of the principle work packages. The PDP forms the basis for establishing and maintaining a financial arrangement (financial guarantee) that will assure adequate funding of the decommissioning plan.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number
CSA Group	Decommissioning of facilities containing nuclear substances	N294-19

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Preliminary Decommissioning Plan and Cost Estimate	5329312	Yes

The PDP is to be revised at a minimum every five years or when required by the Commission; however, is to be kept current to reflect any changes in the site or nuclear facility. The Cigar Lake Operation PDP was initially submitted to the CNSC in 2017 and finalized in 2019. The Cigar Lake PDP is next scheduled for submission to the CNSC in 2022, at which time it will be reviewed against the current version of the CSA Group Standard.

Guidance

Guidance Publications

Source	Document Title	Document Number
CNSC	Financial Guarantees for the Decommissioning of Licensed Activities	G-206
CNSC	Decommissioning Planning for Licensed Activities	G-219

12. SECURITY

Licence Condition 12.1

The licensee shall implement and maintain a security program.

Preamble

The "security" safety and control area 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.

Compliance Verification Criteria

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Security Program	4037602	Yes

The security program will be assessed against the following principles:

12.1.1 The security program addresses the risks identified in an industrial security threat and risk assessment.

12.1.2 Measures are implemented and maintained to prevent the loss of nuclear substances or prevent acts of sabotage at the facility.

12.1.3 Measures are taken to prevent unauthorized access to the mining facility and to areas within the facility where nuclear substances are stored.

12.1.4 The industrial security threat and risk assessment is periodically reviewed and updated.

Guidance

Guidance Publications

Source	Document Title	Document Number
CNSC	Security of Nuclear Substances: Sealed Sources	REGDOC-2.12.3

13. SAFEGUARDS AND NON-PROLIFERATION

Licence Condition 13.1

The licensee shall implement and maintain a safeguards program.

Preamble

The "safeguards and non-proliferation" safety and control area 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 *Treaty on the Non-Proliferation of Nuclear Weapons*.

Compliance Verification Criteria

Source	Document Title	Document Number
CNSC	Safeguards and Nuclear Material Accountancy	REGDOC-2.13.1

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Security Program	4037602	Yes

The safeguards and non-proliferation program will be assessed against CNSC's REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy,* and the following principles:

13.1.1 Reasonable services and assistance are provided to the IAEA to enable the IAEA to carry out its duties and functions.

13.1.2 Prompt access to all locations at the facility is granted to the IAEA at all reasonable times where such access is required for the purposes of carrying on an activity pursuant to a safeguards agreement. Health and safety services and escorts are provided as required in order to facilitate activities.

13.1.3 Records that must be kept or any reports that are required to be made under a safeguards agreement are disclosed to the CNSC and the IAEA.

13.1.4 Reasonable assistance is provided to the IAEA to enable sampling and removal or shipment of samples.

13.1.5 Reasonable assistance is provided to the IAEA to enable measurements, tests and removal or shipment of equipment.

13.1.6 Measures are implemented to prevent damage to, or the theft, loss or sabotage of samples collected pursuant to a safeguards agreement or the illegal use, possession or removal of such samples.

13.1.7 Reports and information, that is required to facilitate Canada's compliance with any applicable safeguards agreement, is provided to the Commission.

Guidance

There is no guidance provided for this licence condition.

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14. PACKAGING AND TRANSPORT

Licence Condition 14.1

The licensee shall implement and maintain a packaging and transport program.

Preamble

The "packaging and transport" safety and control area covers the safe packaging and transport of nuclear substances to and from the licensed facility.

Every person who transports radioactive material, or requires it to be transported, shall act in accordance with the requirements of the *Transportation of Dangerous Goods Regulations* and the *Packaging and the Transport of Nuclear Substances Regulations, 2015*.

The *Packaging and Transport of Nuclear Substances Regulations, 2015* and the *Transportation of Dangerous Goods Regulations* provides specific requirements for the design of transport packages, the packaging, marking and labeling of packages and the handling and transport of nuclear substances.

Compliance Verification Criteria

Licensee Documents that Require Notification of Change

Source	Document Title	CNSC e-Access Document Number	Prior Notification Required
Cameco	Mining Facility Licensing Manual	4026013	Yes
Cameco	Transportation Program	4036649	Yes

The licensee shall implement and maintain a packaging and transport program that will ensure compliance with the requirements set out in the *Transportation of Dangerous Goods Regulations* and in the *Packaging and Transport of Nuclear Substances Regulations, 2015.*

Guidance

There is no guidance provided for this licence condition.

15. FACILITY SPECIFIC

There are no facility specific requirements.

APPENDIX A CHANGE CONTROL PROCESS

A.1 Change Control Process

A change control process is applied to the LCH to ensure that:

- preparation and use of the LCH are properly controlled
- all referenced documents are correctly identified and maintained
- procedures for modifying the LCH are followed.

A request to change this LCH can be initiated by either CNSC staff or the licensee. The licensee will be consulted on any changes to the LCH that are proposed by CNSC staff.

CNSC staff will take the following steps to update the LCH:

1. the CNSC receives or initiates written notification of proposed change
2. initiate a change request using the Change Request Form
3. complete a technical review of the proposed change, if required
4. consult the licensee and in case of disagreement on the proposed change, the dispute resolution process outlined in section A.3 will apply
5. obtain consent and signature from a Delegated Officer
6. update the LCH in accordance with the Change Request Form and send the updated document to the parties identified on the distribution list (section A.5).

Change Request Form

1. GENERAL INFORMATION			
File Plan #		**e-Doc #(s) for Change Request Form**	
Licensee	**Licence Number**	**LCH #, Rev/Version**	**Request Date**
Licensing Officer			

2. CHANGE(S) TO THE LCH			
#	**Description and Purpose**	**Proposed Change**	**References**
1	<initiator, nature, reason for change, e.g. administrative, change to a licensee doc, etc.>	<identify modifications, such as by track changes, highlighting, etc.>	<LC, page, section #, etc.>
2			

3. ASSESSMENT (text and/or e-Doc #s)			
#	**Division/Org**	**Comment**	**Disposition**
1	<division>		
	<division>		
	<licensee>		
	<division>		
2	etc.		

4. CONSENT TO MODIFY		
#	**Agreed**	**Comment**
1		
2		

Name	**Title**	**Signature**	**Date**

5. LCH DOCUMENTATION AND DISTRIBUTION		
New LCH Number	**LCH Effective Date**	**e-Doc #** (include version number)
CNSC Outgoing Notification	**e-Doc #**	**Date Sent**

APPENDIX A

A.2 Review Criteria for Proposed Changes to Licensing Basis Documents

The licensee must provide the CNSC with written notification of a proposed significant change to key licensee documents before the licensee implements the change. The notification must be accompanied by sufficient information to demonstrate that the change is within the intent of the licensing basis. Written notification of minor or administrative changes may be made in batches after the changes have been implemented.

The following criteria will be used by CNSC staff to determine if the proposed change is acceptable:

1. The submission includes the appropriate level and quality of information with regards to:
   a) The description of the proposed change including:
      - a summary of the change, including the purpose or need for the change
      - a preliminary finding of whether this proposal or notification is required under the NSCA, a regulation made under the Act or the licence, or has implications under the *Impact Assessment Act*, or whether a licence amendment or other licensing action would likely be required
      - where applicable, the alternatives evaluated and the reasons for selection of the chosen option
      - any changes to the inventories of nuclear substances on site related to the proposed change
      - the construction, commissioning and operating schedule for the proposed change including hold points or progress reports for regulatory review and approval (as appropriate)
      - expected impacts, if any, on the proposed decommissioning or closure plans
      - results of any risk analysis or hazard operability studies performed, and a summary of the identified hazards and the mitigation measures identified to control potential hazards
   b) The description of the design control, operating specifications and criteria including:
      - the design basis and criteria, and performance specifications
      - the design drawings such as the general arrangement, process and instrumentation diagrams, and process flow sheets
      - the quality management program for the various key stages of the change (e.g., design, construction, commissioning, etc.)

c) The assessment of both the short and long term impacts with the mitigation measures in place on:
   - worker's health and safety, including potential radiological and non-radiological exposures
   - the environment
   - security
   - Canada's international obligations

d) The planned administrative controls including:
   - changes to the organization, roles and responsibilities
   - changes to applicable programs and procedures
   - a description of the proposed monitoring, inspection and test plans, including locations and frequency proposed to evaluate both positive and negative results

e) Changes to contingency plans including "full-stop measures"

f) Evidence that the licensee's internal reviews and approvals have been completed, including meeting the requirements of the licensee's change management procedure and consultation with the onsite occupational health and environmental committees, where applicable

g) Identification of the documents and training programs that may require revision when the proposed change is implemented

2. The effects of the proposed change or action remain within the licensing basis.
3. Following the implementation of the change the licensee will remain in compliance with the requirements set out in the applicable acts, regulations, and LCs.

A.3 Dispute Resolution

In case of a dispute between the licensee and CNSC staff regarding changes to the LCH, both parties will meet to discuss the dispute and reach a decision on the path forward. The decision, including its rationale will be documented. If any party is not satisfied with the decision, the resolution process will proceed up to the Director, Director General or Executive Vice-President and Chief Regulatory Operations Officer level. If any party is still not satisfied with the decision, the issue will be brought to the attention of the Commission at a Commission meeting. The decision made by the Commission will be final.

A.4 Records Management

In order to track changes to the LCH, the document change request and accompanying documentation will be archived in records and referenced in the revision history of the LCH. Electronic communication related to the change, such as comments from reviewers will be stored in the CNSC information management system.

APPENDIX A

A.5 Distribution

A copy of the updated version of the LCH will be distributed to the following parties:

- Uranium Mines and Mills Division, CNSC
- Cameco Corporation

A.6 Reporting to the Commission

CNSC staff will report on the changes made to the LCH during the previous year in their annual report to the Commission.

APPENDIX B LICENSEE DOCUMENTS THAT REQUIRE NOTIFICATION OF CHANGE

Document Title	e-Doc
Mining Facility Licensing Manual	4026013
Mining Facility Description Manual	4069696
Maintenance Program	4036658
Environmental Management Program	4200759
Waste Management Program	4040582
Radiation Protection Program	4036630
Safety and Health Management Program	4064102
Security Program	4037602
Emergency Preparedness and Response Program	4036659
Quality Management Program	4043422
Training Development Program	4040583
Public Information Program	4052377
Transportation Program	4036649
Fire Protection Program	4040579
Preliminary Decommissioning Plan and Cost Estimate	5329312

APPENDIX C LIST OF DOCUMENTS USED AS GUIDANCE OR COMPLIANCE VERIFICATION CRITERIA

Document	Document Title	Document Number
Canadian Dam Association	Canadian Dam Association, Canadian Dam Safety Guidelines	N/A
CNSC	Change Control Process	19-318-07
CNSC	Measuring Airborne Radon Progeny at Uranium Mines and Mills	G-4
CNSC	Ascertaining and Recording Radiation Doses to Individuals	G-91
CNSC	Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"	G-129
CNSC	Financial Guarantees for the Decommissioning of Licensed Activities	G-206
CNSC	Preparing Codes of Practice to Control Radiation Doses at Uranium Mines and Mills	G-218
CNSC	Decommissioning Planning for Licensed Activities	G-219
CNSC	Developing and Using Action Levels	G-228
CNSC	Environmental Protection: Environmental Protection Policies, Programs and Procedures	REGDOC-2.9.1
CNSC	Nuclear Emergency Preparedness and Response, Version 2	REGDOC-2.10.1
CNSC	Safeguards and Nuclear Material Accountancy	REGDOC-2.13.1
CNSC	Public Information and Disclosure	REGDOC 3.2.1
CNSC	Licence Application Guide Nuclear Substances and Radiation Devices	REGDOC-1.6.1
CNSC	Safety Culture	REGDOC-2.1.2
CNSC	Design of Uranium Mines and Mills: Ventilation Systems	REGDOC-2.5.4
CNSC	Framework for Radioactive Waste Management and Decommissioning in Canada	REGDOC-2.11
CNSC	Waste Management, Volume II: Management of Uranium Mine Waste Rock and Mill Tailings	REGDOC-2.11.1
CNSC	Security of Nuclear Substances: Sealed Sources	REGDOC-2.12.3

Document	Document Title	Document Number
CNSC	Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills	REGDOC-3.1.2
CNSC	Regulatory Fundamentals	REGDOC-3.5.3
CNSC	Technical and Quality Assurance Requirements for Dosimetry Services	S-106
CNSC	Making Changes to Dose-Related Information Filed with the National Dose Registry	S-260
CNSC/SK	CNSC – Saskatchewan Harmonized Annual Reporting Requirements, August 2010	e-Doc 3678482
CSA Group	Fire protection for facilities that process, handle, or store nuclear substances	N393-13
CSA Group	Management system requirements for nuclear facilities	N286-12
CSA Group	Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills	N288.4-10
CSA Group	Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills	N288.5-11
CSA Group	Environmental risk assessments at Class I nuclear facilities and uranium mines and mills	N288.6-12
CSA Group	Groundwater protection programs at Class I nuclear facilities and uranium mines and mills	N288.7-15
CSA Group	Establishing and implementing action levels for releases to the environment from nuclear facilities	N288.8-17
CSA Group	Decommissioning of facilities containing nuclear substances	N294-19
CSA Group	Environmental management systems – requirements with guidance for use	ISO 14001:2015
National Research Council	National Building Code of Canada	N/A
National Research Council	National Fire Code of Canada	N/A

Note: For CNSC documents, the most recent version of a referenced document shall be implemented following review and agreement between Cameco and the Canadian Nuclear Safety Commission.

APPENDIX C

CURRENT LICENCE

e-Doc # 6278488 (Word)

e-Doc # 6284709 (PDF)

URANIUM MINE LICENCE
CAMECO CORPORATION
CIGAR LAKE OPERATION

I) LICENCE NUMBER: UML-MINE-CIGAR.01/2021

II) LICENSEE: Pursuant to section 24 of the *Nuclear Safety and Control Act*, this licence is issued to:

Cameco Corporation
2121 – 11th Street West
Saskatoon, Saskatchewan S7M 1J3
Corporate Number 332981-0

III) LICENCE PERIOD:

This licence is valid from July 1, 2013 to June 30, 2021, unless otherwise suspended, amended, revoked or replaced.

IV) LICENSED ACTIVITIES:

This licence authorizes the licensee to:

a) prepare a site for and construct, operate, modify and decommission a nuclear facility (hereinafter "the facility") for the milling of uranium ore at a site known as the Cigar Lake Operation in the province of Saskatchewan as shown on the drawing referenced in appendix A to this licence;

b) mine a nuclear substance (uranium ore);

c) possess, transfer, import, use, store, and dispose of nuclear substances; and

d) possess, transfer, import, use prescribed equipment that is required for or associated with laboratory studies, field studies, fixed gauge usage and borehole logging devices in relation to (a) and (b).

V) EXPLANATORY NOTES:

a) Nothing in this licence shall be construed to authorize non-compliance with any other applicable legal obligation or restriction.

b) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and its associated Regulations.

c) The UML-MINE-CIGAR.01/2021 Licence Conditions Handbook (LCH) identifies the criteria that will be used by Canadian Nuclear Safety Commission staff to assess the licensee's compliance with the conditions listed in this licence. The LCH also provides information regarding delegation of authority and applicable version control of documents comprising compliance verification criteria.

VI) CONDITIONS:

G. GENERAL

G.1 Licensing Basis for Licensed Activities

The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) the regulatory requirements set out in the applicable laws and regulations;

(ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence;

(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (hereinafter "the Commission").

G.2 Notification of Changes

The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

G.3 Financial Guarantee

The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

G.4 Public Information and Disclosure

The licensee shall implement and maintain a public information and disclosure program.

1. MANAGEMENT SYSTEM

1.1 Management System

The licensee shall implement and maintain a management system.

2. HUMAN PERFORMANCE MANAGEMENT

2.1 Training Program

The licensee shall implement and maintain a training program**.**

3. OPERATING PERFORMANCE

3.1 Operations Program

The licensee shall implement and maintain an operating program, which includes a set of operating limits.

3.2 Reporting Requirements

The licensee shall implement and maintain a program for reporting to the Commission or a person authorized by the Commission.

3.3 Nuclear Substances and Radiation Devices

The licensee shall implement and maintain a program for nuclear substances and radiation devices.

4. SAFETY ANALYSIS

4.1 Safety Analysis Program

The licensee shall implement and maintain a safety analysis program.

5. PHYSICAL DESIGN

5.1 Design Program

The licensee shall implement and maintain a design program.

6. FITNESS FOR SERVICE

6.1 Fitness for Service Program

The licensee shall implement and maintain a fitness for service program.

7. *RADIATION PROTECTION*

7.1 Radiation Protection Program

The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within 24 hours.

8. *CONVENTIONAL HEALTH AND SAFETY*

8.1 Conventional Health and Safety Program

The licensee shall implement and maintain a conventional health and safety program.

9. ENVIRONMENTAL PROTECTION

9.1 Environmental Protection Program

The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within 24 hours.

10. EMERGENCY MANAGEMENT AND FIRE PROTECTION

10.1 Emergency Preparedness Program

The licensee shall implement and maintain an emergency preparedness program.

10.2 Fire Protection Program

The licensee shall implement and maintain a fire protection program.

11. WASTE MANAGEMENT

11.1 Waste Management Program

The licensee shall implement and maintain a waste management program.

11.2 Decommissioning Plan

The licensee shall maintain a decommissioning plan.

12. SECURITY

12.1 Security Program

The licensee shall implement and maintain a security program.

13. SAFEGUARDS AND NON-PROLIFERATION

13.1 Safeguards Program

The licensee shall implement and maintain a safeguards program.

14. PACKAGING AND TRANSPORT

14.1 Packaging and Transport Program

The licensee shall implement and maintain a packaging and transport program.

SIGNED at OTTAWA, this 4th day of November, 2020.

Velshi, Rumina

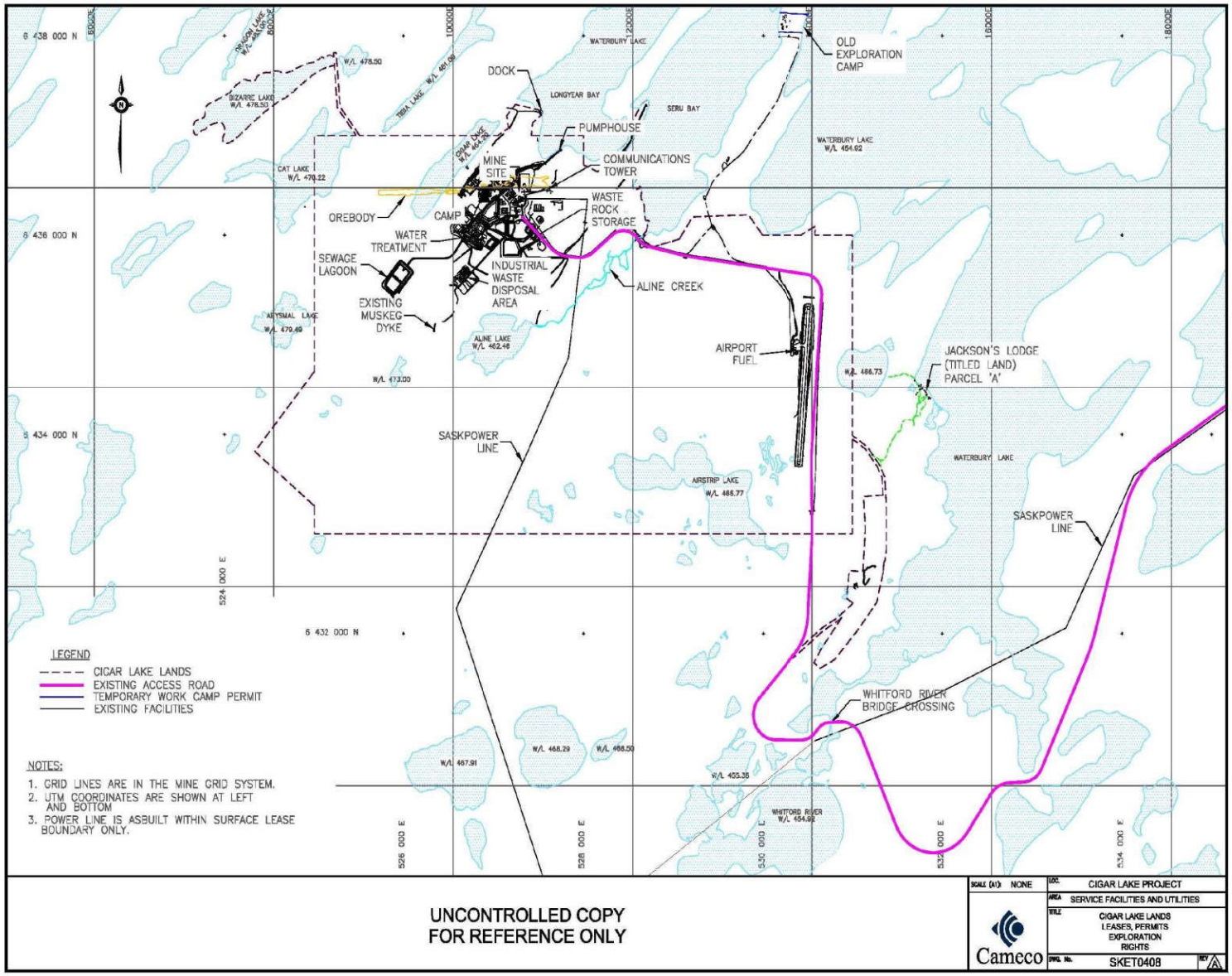
Digitally signed by Velshi, Rumina
DN: C=CA, O=GC, OU=CNSC-CCSN, CN="Velshi, Rumina"
Reason: I am the author of this document
Location: your signing location here
Date: 2020-11-04 09:41:53
Foxit PhantomPDF Version: 9.7.1

Rumina Velshi, President
on behalf of the Canadian Nuclear Safety Commission

APPENDIX A

LOCATION OF CAMECO'S OPERATION AT CIGAR LAKE

The location of the Cameco's Operation at Cigar Lake is shown on Drawing SKET0408, Rev A (e-Doc 4053034).



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