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**Written submission from  
Cameco Corporation**

**Mémoire de  
Cameco Corporation**

In the Matter of the

À l'égard de

**Cameco Corporation, McArthur River  
Operation and Key Lake Operation**

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**Cameco Corporation, établissements de  
McArthur River et de Key Lake**

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Application for the renewal of uranium  
mine/mill licences for McArthur River  
Operation and Key Lake Operation

Demande visant le renouvellement des permis  
d'exploitation de mines et d'usines de  
concentration d'uranium pour les  
établissements de McArthur River et de  
Key Lake

**Commission Public Hearing**

**Audience publique de la Commission**

**June 7-8, 2023**

**7-8 juin 2023**

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## Executive Summary

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Cameco Corporation (Cameco) is seeking renewal of the Canadian Nuclear Safety Commission (CNSC) licence for the Key Lake Operation (Key Lake) and McArthur River Operation (McArthur River) for a 20-year term. Cameco was granted renewal of the current Canadian Nuclear Safety Commission (CNSC) licences for McArthur River and Key Lake following a public Commission hearing in October 2013. These current licences are valid for a 10-year term from November 1, 2013, to October 31, 2023.

This Commission Member Document (CMD) provides a high-level summary of the licensing basis and supports Cameco's request for a renewal of the McArthur River and Key Lake CNSC licences. Key Lake and McArthur River are two separate Cameco operations, each with an individual licence from the CNSC. However, these operations are operationally connected as ore mined at McArthur River is processed at the Key Lake mill. In order to reduce overlap and repetition, Cameco has prepared one CMD for the licence renewal of both operations.

Together, McArthur River and Key Lake are the world's largest uranium mine and mill with licensed production of 9.6 million kilograms uranium (kg U) per year. During its lifetime, the Key Lake mill has processed and packaged over 206 million kg U (end of 2021). That includes approximately 81 million kg U from the two former open pit mines and an additional 125 million kg U since 2000 from milling high-grade ore from McArthur River. Upgrades to mine and mill infrastructure made during the current licence term have positioned these operations for many more years of production, supporting Cameco's vision of energizing a clean-air world.

During the initial period of the current licence term, Key Lake and McArthur River safely produced uranium near the licensed capacity while maintaining the safety of workers and the public and protecting the environment. In late 2017, Cameco announced that Key Lake and McArthur River would be placed into a 10-month temporary state of safe care and maintenance as a result of ongoing uranium market conditions. Subsequently, in July 2018, Cameco announced that Key Lake and McArthur River would remain in a safe state of care and maintenance for an indeterminate period of time.

During this period, Cameco utilized the opportunities realized while the mine and mill were in shutdown to undertake improvements to equipment, with a focus on digitization and automation of existing processes. This included several automation improvements within the Key Lake mill, such as installing automated valves, modifications to the yellowcake packaging circuit and equipping workers with digital devices. At McArthur River, the most significant projects undertaken during care and maintenance were the upgrades to the surface batch plant used to produce concrete for underground activities.

In February 2022, Cameco announced an intent to begin the process of transitioning Key Lake and McArthur River from care and maintenance to production. The first product from the McArthur River mine milled and packaged at the Key Lake mill occurred in November 2022.

Consistent with our vision, values and measures of success, Cameco's highest priorities during all stages of our business are the safety and health of our workers and the public, protection of the environment and quality of our processes. Both Key Lake and McArthur River achieved strong performance in these areas during the current licence term. The CNSC staff did not note any concerns related to Safety and Control Areas (SCAs) at Key Lake or McArthur River, with all SCAs rated as satisfactory in annual regulatory oversight reports. Highlights in key SCAs from the current licence term include the following:

- No lost-time injuries (LTIs) recorded at Key Lake since 2016 and at McArthur River since 2017.
- Successful activation of our Corporate Crisis Management Plan during the COVID-19 pandemic, including implementation of a number of proactive measures to ensure a safe working environment for all our workers.
- Keeping radiation exposures to workers at both operations well below regulatory limits, with average effective doses at or below 1 mSv per year and maximum effective annual doses consistently below 10 mSv.
- Reductions in annual loadings of constituents of potential concern to the environment at both Key Lake and McArthur River.

With a focus on building and maintaining support from local communities, Cameco's goal is to provide benefits from resource development – specifically, workforce and business development opportunities, community investment initiatives, community engagement and environmental stewardship activities, which are considered pillars of Cameco's northern strategy. As part of this effort, there has been ongoing engagement with the rights-bearing Indigenous communities located in the vicinity of Key Lake and McArthur River considered primary audiences in accordance with Cameco's Collaboration Agreements and the operations' *Public Information Programs*. Engagement between Cameco and the Key Lake/McArthur River Collaboration Agreement communities occurs primarily through the Joint Engagement Subcommittee (JIES) and the Joint Engagement and Environment Subcommittee (JIEES) respectively. The Lac La Ronge Indian Band (LLRIB) has an established Traditional Lands and Resource Advisory Committee, and Cameco continues to engage with this group.

Specific to this licence application, Key Lake and McArthur River undertook engagement activities beginning in 2021 to make audiences aware of the upcoming licence renewal and to provide opportunities to communicate any concerns. Updates were provided through regular quarterly JIES, JIEES and LLRIB subcommittee meetings. In addition to the primary audiences for Key Lake and McArthur River, the Athabasca Joint Engagement and Environment Subcommittee (AJES), a subcommittee under the Ya'thi Néné Collaboration Agreement, was also updated on the upcoming licence renewals for Key Lake and McArthur River.

Further, CNSC staff and JIES, JIEES and LLRIB subcommittee members were provided the opportunity to tour Key Lake and McArthur River in 2022 and raise any questions or

concerns regarding Cameco's licence renewal. Cameco and CNSC staff also attended community meetings in Pinehouse, La Ronge and Patuanak in November 2022 as part of relicensing-specific engagement. These community meetings enabled leadership, as well as the general public, to engage in open discussions with Cameco and CNSC staff with respect to Cameco's requested licence renewal.

Cameco is an experienced operator in northern Saskatchewan with 35 years of operations in mining and milling of uranium ore in the Athabasca Basin. Key Lake and McArthur River have demonstrated strong health and safety measures, radiation protection and environmental performance throughout the current licence term through continuous improvement of their processes. As an experienced operator, Cameco has mature management systems in place to ensure continued safety of workers and the public, as well as protection of the environment.

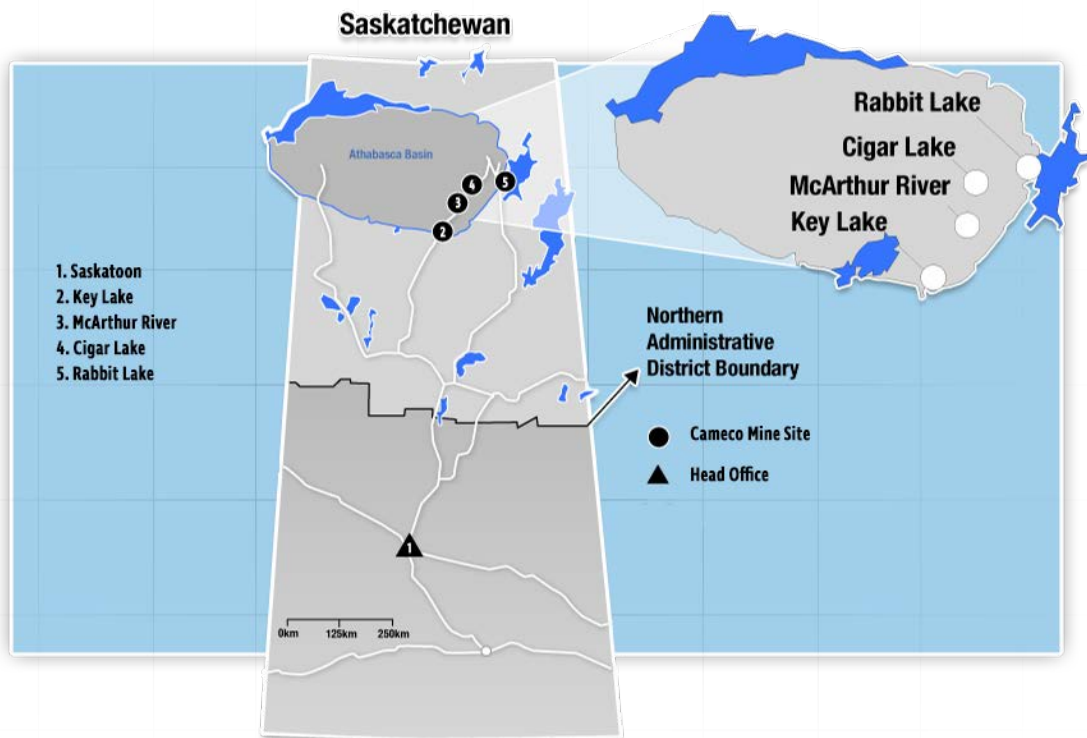
The proposed 20-year licence would provide Cameco with an increased level of regulatory certainty and predictability while continuing to protect the health and safety of the public, workers and the environment, as well as facilitate our ability to make longer-term plans and budgeting decisions for investment at our operations. The increased level of regulatory certainty provided to Cameco by a longer-term licence would, in turn, benefit the communities located in the vicinity of Key Lake and McArthur River through our ability to sustain our commitments into the future.

## 1.0 Introduction

### 1.1 Background

#### 1.1.1 Location

The Cameco Corporation (Cameco) Key Lake Operation (Key Lake) and McArthur River Operation (McArthur River) are located in the Athabasca Basin of northern Saskatchewan. Cameco respectfully acknowledges that Key Lake and McArthur River are located on Treaty 10 Territory, the traditional territory of the Cree and Dene Peoples and the homeland of the Métis. Key Lake is located approximately 570 km north of Saskatoon, while McArthur River is located an additional 80 km to the north (Figure 1.1-1). There are no permanent settlements in the immediate area of Key Lake or McArthur River. The Northern Village of Pinehouse is the nearest community, located 220 km to the southwest of Key Lake. Key Lake is accessible by vehicle via Saskatchewan public Highway 914, which is maintained year-round. Access to McArthur River by vehicle is by a semi-private road with access controlled at the Key Lake security gate.



**Figure 1.1-1: Key Lake and McArthur River Operation locations.**

McArthur River is the world's largest high-grade uranium mine, while Key Lake is the world's largest uranium mill. The ore produced at the McArthur River mine is currently processed at the Key Lake mill, with Cameco the operator of both facilities. Key Lake is

owned by a joint venture between Cameco (83.3%) and Orano Canada Inc. (Orano) (16.7%). Similarly, McArthur River is owned by a joint venture consisting of Cameco (69.8%) and Orano (30.2%).

## **1.1.2 History**

### **1.1.2.1 Key Lake**

Exploration began in the Key Lake area in 1970 and resulted in the discovery of the Gaertner and Deilmann orebodies in 1975 and 1976, which, at the time, were among the highest-grade uranium deposits ever discovered. Construction activities began in 1981 and processing of Gaertner ore at the Key Lake mill began in 1983. The Gaertner orebody was considered completely mined out by 1987, while the nearby Deilmann deposit was mined from 1989 to 1997. These two open-pit deposits produced approximately 80.8 million kg U (210 million pounds  $U_3O_8$ ), all of which was processed at the Key Lake mill. Tailings from milling of these orebodies were deposited within a purpose-built Above Ground Tailings Management Facility (AGTMF) located to the southwest of the Key Lake mill until 1996.

In 1994, Cameco prepared and submitted an environmental impact statement (EIS) to the provincial and federal regulatory agencies describing the conversion of the Deilmann open-pit mine to an in-pit tailings management facility. Regulatory approval was received in 1995 for sub-aerial deposition of tailings as well as special waste within the newly named Deilmann Tailings Management Facility (DTMF) (Figure 1.1-2). Placement of tailings into the eastern portion of the DTMF began in late 1995, while mining of the remaining ore in the pit continued through to 1997.



***Figure 1.1-2: Key Lake Deilmann Tailings Management Facility.***

Dewatering well infrastructure to keep the Gaertner/Deilmann pits dry during the open-pit mining period has remained in place and is currently used to control water levels in the DTMF during tailings placement. Water collected from the dewatering system is treated at the reverse osmosis (RO) water treatment plant that was constructed in 1995. The bulk neutralization water treatment circuit, located within the mill itself, treats the residual dissolved solids from the RO plant as well as other potentially contaminated water that is pumped to storage ponds adjacent to the mill from other areas of the site.

In 2001, sloughing of sand from the West Wall of the DTMF began when the rising water level reached the contact between sandstone and outwash sand at an elevation of about 470 metres above sea level (masl). Cameco's initial response to the sloughing problem was to reduce flooding rates and relocate infrastructure. However, a significant sloughing event occurred at the DTMF in 2003, after which flooding of the DTMF was postponed pending further study of the area. In the period from 2005 to 2008, Cameco completed a number of field and technical studies to establish safety protocols for working around the pit while also determining the failure mechanism and developing appropriate solutions to support the submission of a slope remediation plan. Following the results of the assessment, Cameco began work on the DTMF West Wall Stabilization project. Work was conducted from 2010 to 2013 that primarily consisted of excavation of outwash sand slopes to a permanent stable angle and constructing a waste rock toe buttress.

Since milling of McArthur River ore began in 2000, Key Lake has made a number of improvements to mill process circuits. This included successful commissioning of the



molybdenum and selenium removal circuit within existing bulk neutralization water treatment circuit to aid in removal of these elements from the treated water discharged to the environment. Key Lake also commissioned a product-recovery circuit that allows recovery of uranium from by-product materials from both the Cameco Blind River refinery and Port Hope conversion facility. Further, in 2012 and 2013, Key Lake executed the Mill Services Project which was the subject of a 2009 environmental assessment screening report. This project included construction and commissioning of new higher capacity acid, steam and oxygen plants.

### **1.1.2.2 McArthur River**

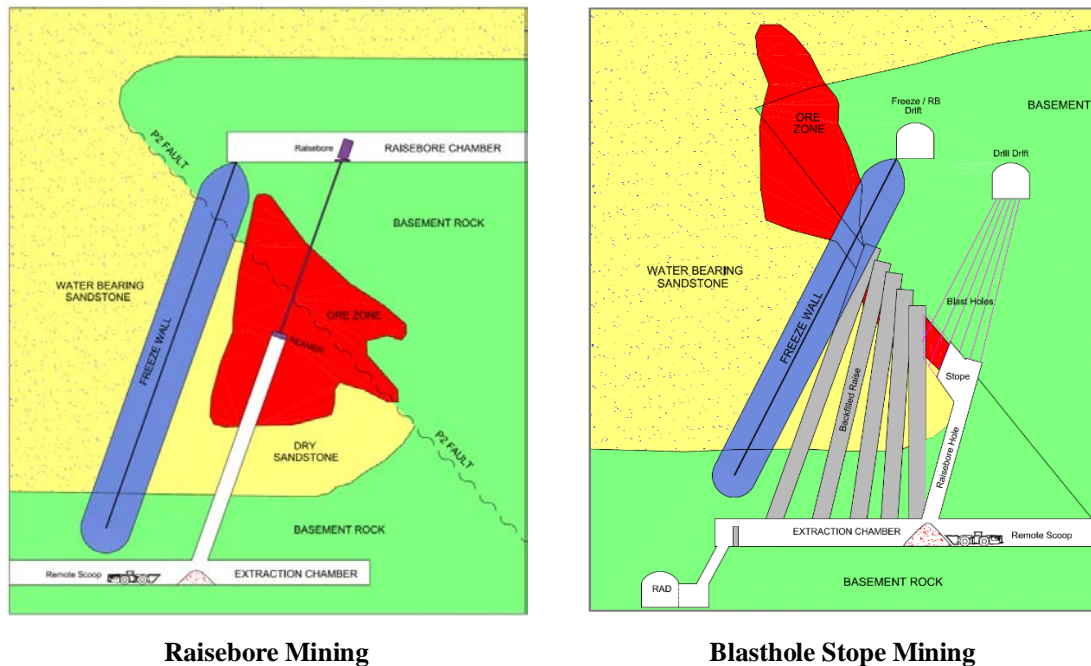
The McArthur River orebody was discovered in 1988 by Cameco. In 1995, the McArthur River Project EIS [1] was submitted, proposing the transportation of high-grade ore mined from the McArthur River mine to Key Lake (Figure 1.1-3), where it would be blended with existing Key Lake special waste and low-grade ore and subsequently milled. The resulting tailings would then be sub-aqueously deposited in the DTMF. Approval for mine construction and development for McArthur River was obtained in 1997, with construction completed in 1999.

During initial mining of the orebody, McArthur River identified larger than expected amounts of low-grade mineralization below the high-grade portion of the orebody. This material caused problems with the underground ore processing. To resolve this issue, McArthur River submitted an application to transport this low-grade mineralized material to Key Lake using highway haul trucks. This material is stored on engineered pads at Key Lake and is consumed as additional blend material.



***Figure 1.1-3: McArthur River to Key Lake ore slurry haul truck.***

There are currently three approved mining methods at McArthur River: raisebore mining; blasthole stope mining; and boxhole mining. However, only raisebore and blasthole stope mining remain in use (Figure 1.1-4).



**Figure 1.1-4: McArthur River mining methods.**

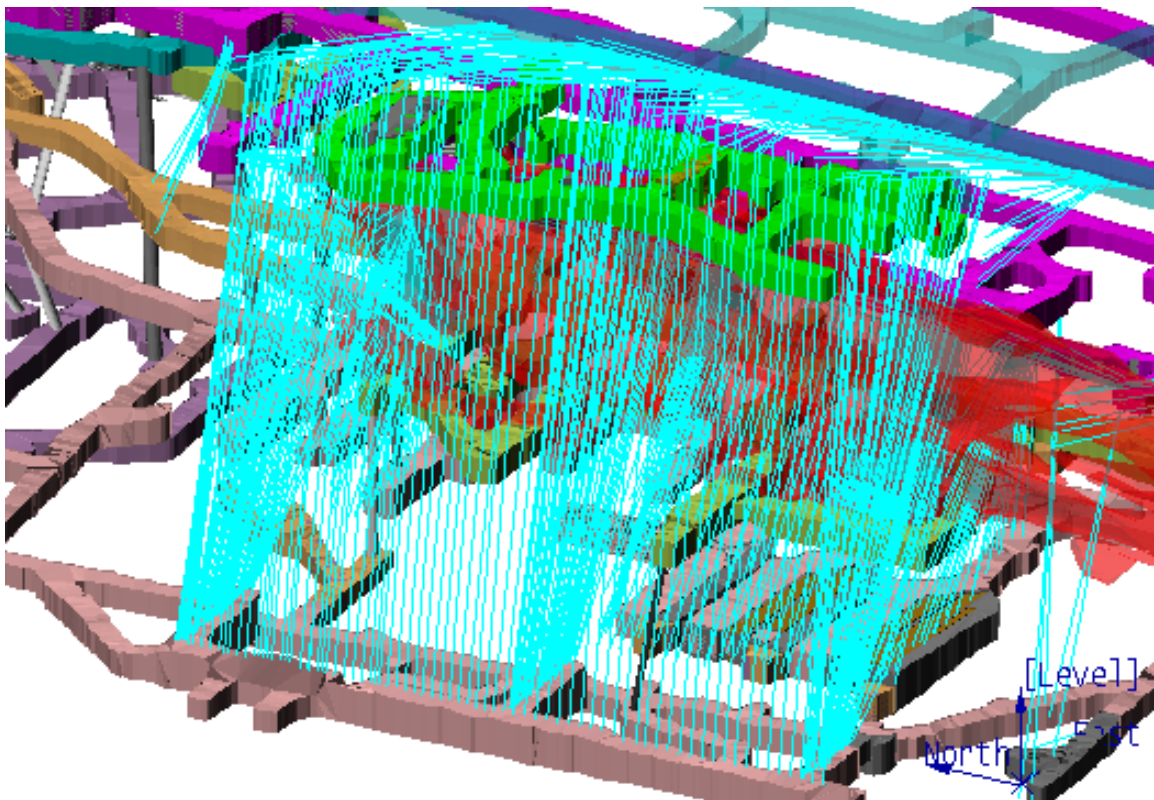
There has been one significant production interruption at McArthur River involving a ground failure in April 2003 that resulted in an inflow of water into the mine. Several actions were taken to respond to the inflow conditions, including sourcing and installing additional pumping capacity and modifying the water treatment process in order to treat the additional volume of water. After restoring control of the water inflow and taking action to backfill the fall of ground area, Cameco turned the focus to rehabilitating the mine and investigating the cause of the incident. Further, in 2004 and 2005, improvements were made to the minewater pumping and water treatment capacity to more quickly and effectively respond in the event of a future inflow event. These improvements included increased pumping rates, changes to the water treatment plant, and the construction of a contingency water treatment system.

From the mine's inception, Cameco has used freeze technology as one of the primary ways of protecting mine workings from the potential for water inflow from the Athabasca sandstone that overlies the unconformity where the high-grade ore is deposited. Ammonia freeze plants located on surface chill a calcium chloride brine distribution system, which is used to deliver freezing underground. Once underground, a secondary brine loop, chilled from the primary loop, circulates the brine to freeze pipes installed in the ground freezing zones of the mine.

Cameco has made significant advances in the use of freeze technology throughout McArthur River's mine life. Freeze methods used to date at McArthur River consists of mass freezing, as well as the creation of freeze shields and freeze walls.

Mass freezing is a method of bulk freezing the entire mining area, prior to the start of mining. Mass freezing is typically considered suitable for areas where the rock mass is exceptionally weak and at risk of uncontrolled cave-ins without strengthening by ground freezing. A freeze shield is a region of frozen ground that does not completely isolate a region from water-bearing ground. This type of freeze structure is typically used where simply impeding the flow of water through a water-bearing structure is sufficient.

A freeze wall (or shell) is a region of frozen ground that completely isolates a region of the underground workings or extraction areas from water-bearing ground. Ground within the freeze wall is distinguished by the lack of water re-charge once drained and by static water pressure significantly below the water-bearing ground outside the freeze wall. In order to achieve this, the freeze shell is made of interlocking freeze walls and is anchored into non-water-bearing basement rock (Figure 1.1-5). Freeze walls are planned for all the remaining undeveloped mine areas at McArthur River.



***Figure 1.1-5: McArthur River Zone 4 freeze wall.***

### **1.1.3 Activities During the Current Licence Term**

#### **1.1.3.1 Key Lake**

CNSC licence UMLOL-MILL-KEY.00/2013 was issued in October 2013. This licence was amended to UML-MILL-KEY.01/2023 in July 2020 to reflect the revised Key Lake financial guarantee.

In 2014, Key Lake submitted and received regulatory approval of an EIS for the Key Lake Extension Project (KLEP) [2]. The scope of the KLEP included the following:

- Increasing the capacity in the DTMF by raising the approved average consolidation tailings elevation from 466 masl to 505 masl.
- Increasing the nominal mill production capacity to 9.6 million kg U.
- Construction or modification of facility components to support the increased production capacity and to support milling of ores from other potential deposits in addition to McArthur River.

Additional activities completed on the Key Lake mill also included:

- Refurbishment of the existing vertical calciner, including replacement of the calciner shaft and brickwork as well as replacement of associated ducting.
- Refurbishment of ammonia storage tanks and associated infrastructure.
- Black Creek fish barrier project to prevent fish migration into Huey Lake.
- Restoration of the Hammer Lake outlet and replacement of culverts with an open channel to improve fish passage and fish habitat.

In November 2017, Cameco announced plans to temporarily suspend production at Key Lake and McArthur River, effective January 2018, transitioning the operations from production into a temporary state of safe care and maintenance. Subsequently, in July 2018, Cameco announced that Key Lake and McArthur River would remain in care and maintenance for an indeterminate period of time. During the care and maintenance period, Cameco utilized the opportunity, while the mill was in shutdown, to undertake improvements to equipment with a specific focus on digitization and automation of existing processes as listed below:

- Automation of the yellowcake packaging area, resulting in a system for yellowcake drums to automatically de-stack, fill, lid and clean, and weigh and label them.
- Additional recycle lines, pumps and chemical addition within the bulk neutralization circuit to mitigate gypsum scaling.
- Automation of discharge/recycle piping and valving within the treated water release pumphouses.
- Replacement of the tailings splitter box with a distribution header.
- Improvements to the crystallization and calciner scrubber systems.

- Installation of additional nuclear densometers to better analyze and monitor uranium grades within the mill process streams.
- Replacement of existing aspirators in lime handling with wet scrubbers.

In February 2022, Cameco announced an intent to begin the process of transitioning Key Lake and McArthur River from care and maintenance to production. The first pounds of uranium from the McArthur River mine were milled and packaged at Key Lake in November.

### **1.1.3.2 McArthur River**

CNSC licence UMOL- MINE-MCARTHUR.00/2023 was issued in October 2013. This licence was amended to UML- MINE-MCARTHUR.01/2023 in June 2019 to reflect the updated McArthur River financial guarantee. The current licence term has been focussed on activities to support ongoing operation of the facility. Significant activities completed during the current licence term included:

- Approval for production increase to 8.1 million kg U per year received in April 2014 with an additional production increase to 9.6 million kg U per year received in April 2015.
- Construction and modification of facility components to support the increased production capacity, such as:
  - Upgrades to Shaft 2 ventilation to increase the total mine ventilation capacity by optimizing existing infrastructure.
  - Increases in ground freeze capabilities, including expansion to the existing main freeze plant on surface and construction of a new south freeze plant and underground distribution system.
- Decommissioning of four bridges and five culverts along the Fox Lake road, which was used as the initial access road from Key Lake to McArthur River prior to construction of the current haul road. One bridge was removed and upgraded at the request of ERFN, which then assumed ownership of the new bridge.

Further, during the licence term, McArthur River undertook additional projects to improve water use and management at the operations. These included:

- Completion of the Shaft #3 industrial water use project, which enabled the use of clean Shaft #3 water for industrial use on site, reducing the amount of fresh water withdrawn from Toby Lake.
- Construction of the Read Creek conveyance channel, which bypasses Boomerang Lake and redirects treated water discharge to Read Creek.

In conjunction with Key Lake, McArthur River entered a state of safe care and maintenance in 2018. Also consistent with Key Lake, Cameco utilized the opportunities realized while the mine was in shutdown to undertake improvements to equipment, with a specific focus on digitization and automation of existing processes at McArthur River.

The most significant of these projects were the upgrades to the surface batch plant used to produce concrete for underground activities. The goal of the upgraded facility, commissioned in 2022, was to produce a lower-cost and more consistent product through increased process control, automation, and concrete recipe optimization.

## 1.2 Summary of Application

Cameco submitted the current application for Key Lake and McArthur River to the CNSC Commission Secretariat on April 20, 2021, requesting the current licenses be renewed prior to their current expiry date of October 31, 2023. The licensing basis for Key Lake and McArthur River is primarily established from the following:

- The regulatory requirements set out in the applicable laws and legislation.
- The conditions and safety and control measures described in the CNSC licence, licence conditions handbook (LCH) and the documents directly referenced in those documents:
  - The Key Lake and McArthur River *Mining Facility Licensing Manuals* (KEY-MFLM and MCA-MFLM).
  - Key Lake and McArthur River program documents and codes of practice.
  - Approved environmental impact statements (EISs).
  - Current environmental risk assessments (ERAs).

Cameco provided the KEY-MFLM and MCA-MFLM as well as supporting program level documents for both operations to CNSC staff for their review and acceptance in support of this application to the Commission.

### 1.2.1 Licence Term

Within the April 20, 2021, licence renewal request, Cameco requested the current licences be renewed for indefinite terms. An indefinite licence term would last until Cameco has made the decision to commence final decommissioning of Key Lake or McArthur River. In support of this decision to decommission, Cameco would prepare a detailed decommissioning plan for approval by the CNSC, as well as conduct engagement activities related to the plan.

Cameco is an experienced operator in northern Saskatchewan with 35 years of operations in mining and milling of uranium ore in the Athabasca Basin. Key Lake and McArthur River have demonstrated strong health and safety measures, radiation protection and environmental performance throughout the current licence term, with a commitment to continuous improvement in all of these areas. As an experienced operator, Cameco has mature management systems in place to ensure continued safety of workers and the public, as well as protection of the environment. Specifically, Key Lake and McArthur River have well established programs in all of the CNSC's Safety and Control Areas that not only have been reviewed and approved by the CNSC, but also rated as 'Satisfactory'

in performance throughout the licence term. A longer-term licence is expected to provide Cameco with an increased level of regulatory certainty and predictability while continuing to protect the health and safety of the public, workers and the environment, as well as facilitate our ability to make longer-term plans and budgeting decisions for investment at our operations.

Cameco has developed long-standing relationships with northern Indigenous communities. With a focus on building and maintaining support from local communities, Cameco's goal is to provide benefits from resource development – namely, workforce and business development opportunities, community investment initiatives, community engagement and environmental stewardship activities, which are considered pillars of our northern strategy. The increased level of regulatory certainty provided to Cameco by a longer-term licence would, in turn, benefit the communities through our ability to sustain these commitments into the future.

In support of the licence renewal process, Cameco has continued to emphasize early and proactive engagement with Indigenous communities that are located in the vicinity of Key Lake and McArthur River in accordance with Cameco's Collaboration Agreements. Community engagement at Key Lake and McArthur River is carried out in accordance with each operation's *Public Information Program* (KEY-PIP and MCA-PIP). During our engagement activities, representatives from some of these communities expressed uncertainty with what an indefinite licence term means and how it fits within existing regulatory and engagement frameworks.

In response to these concerns, Cameco submitted a revised application requesting a 20-year licence term on November 4, 2022. Although Cameco remains confident that the established management systems that we have in place to ensure that the health and safety of workers, the public and the environment will remain protected throughout an indefinite licence term, it is important to understand and respond to the questions and concerns of the communities in close proximity to our facilities. This is reflected in our revised request for a 20-year licence term.



## 2.0 Business Plan

### 2.1 General

Cameco's vision – "Energizing a clean-air world" – recognizes that we have an important role to play in enabling the vast reductions in global greenhouse gas emissions required to achieve a resilient net-zero carbon economy. We are invested across the nuclear fuel cycle. Our uranium and fuel services products are used around the world in the generation of safe, carbon-free, affordable, base-load nuclear energy.

Further, in December 2022, Canada finalized its Critical Minerals Strategy that included 31 minerals considered essential to Canada's economic security and which supply is threatened; required for our national transition to a low-carbon economy; or a sustainable source of highly strategic critical minerals for our partners and allies. Uranium is included as one of the 31 identified critical minerals. These critical minerals present a generational opportunity for Canada in many areas, including exploration, extraction, processing, downstream product manufacturing and recycling. The Critical Minerals List was developed in consultation with provincial, territorial, and industry experts and provides greater certainty to investors, developers, communities, and trading partners on national priorities. Further, the mining sector is the second-largest private sector employer of Indigenous Peoples in Canada. Our industry provides skills and employment training, contracting opportunities, job guarantees and community investments. Cameco's McArthur River and Key Lake operations play an important role in the Critical Minerals Strategy while also continuing to build on the opportunities it presents.

McArthur River is a high-grade uranium mine, with grades that are 100 times the world average. Since milling of McArthur River ore began in 2000, Key Lake has produced 126 million kg U (327 million pounds U<sub>3</sub>O<sub>8</sub>) to the end of 2022. Total remaining proven and probable reserves are estimated (end of 2022), as 152 million kg U (394 million pounds U<sub>3</sub>O<sub>8</sub>). Existing reserves, which form the basis for the estimated mine life, are the economically mineable portion of the McArthur River orebody. Changes in uranium price and/or operating costs can result in conversion of existing resources into reserves. Further, continued exploration may also identify additional resources or reserves within the McArthur River orebody. Based on current uranium prices, assumed mining rate and reserve estimates, Cameco has disclosed a projected mine/mill life for McArthur River and Key Lake to 2044.

As a result of many more years of anticipated operational life, McArthur River and Key Lake may undertake the following activities during the requested licence term:

- Key Lake:
  - Optimizing the bulk neutralization circuit to improve the quality of treated water released to the environment.
  - Evaluate upgrades to mill circuits to be able to safely produce up to the current licensed limit, including, but not limited to:
    - Review and assess operation of the horizontal kiln calciner.
    - Refurbish or replace the crystallization circuit.
  - Conduct work to the potentially contaminated water routing at site in order to improve the quantity of treated water released to the environment.
  - Upgrades to containment systems and associated inspection and maintenance programs.
  - Continued examination for opportunities to digitalize and/or automate processes.
  - Evaluation of ore blend strategies to optimize feed grade to the mill.
  - Optimizing water management strategies within the DTMF and Gaertner Pit to reduce energy consumption and the volume of clean water intercepted.
  - Demolish and dispose equipment and buildings made obsolete as a result of these efforts.
- McArthur River:
  - Continue to investigate and implement automation and digital technology.
  - Continue to investigate alternative mining methods.
  - Review and manage mine water pumping and water treatment capacity.
  - Continue to advance mine workings towards exploration targets for delineation drilling.
  - Upgrade and expand freeze capabilities for mining future zones.
  - Upgrade underground ventilation capacity to meet air volume requirements, including possible installation of a ventilation raise(s) as required.
  - Maintain, optimize or upgrade infrastructure to ensure safe operations.

These changes will be subject to the regulatory oversight of the CNSC and may require updates to the relevant Licence Conditions Handbook.

## 3.0 Safety and Control Areas

### 3.1 General

Cameco recognizes safety and health of our personnel and the public, protection of the environment and quality of our processes as the highest corporate priorities. As such, we strive to be a leading performer through a strong safety culture and our commitment to the following principles set out in our corporate Safety, Health, Environment and Quality (SHEQ) Policy:

- Preventing injury, ill health and pollution.
- Fulfilling regulatory, contractual and corporate requirements as well as commitments to local communities (defined as compliance obligations).
- Keeping risks at levels as low as reasonably achievable, taking into account economic and societal factors (ALARA).
- Ensuring quality of processes, products and services.
- Continually improving our overall performance.

During the licence term, the CNSC did not note any concerns related to Safety and Control Areas (SCAs) at Key Lake or McArthur River. All SCAs were rated as satisfactory in annual regulatory oversight reports prepared by CNSC staff.

Additionally, the CNSC conducted 47 inspections at Key Lake and 46 inspections at McArthur River (Table 3.1-1) during the current licence term. In accordance with our corrective action process, all issues identified during inspections were entered into the Cameco Incident Reporting System (CIRS) and addressed to the satisfaction of the CNSC. Regulatory oversight continued during the COVID-19 pandemic in 2020 and 2021 with the use of remote inspections due to travel restrictions.

**Table 3.1-1: CNSC inspections of SCAs.**

	<b>Key Lake</b>	<b>McArthur River</b>
2013	3	6
2014	5	6
2015	6	6
2016	6	6
2017	6	6
2018	5	5
2019	3	4
2020	4	3
2021	3	2
2022 (to end of Q3)	6	2

### 3.2 Management System

Cameco's corporate policies and programs provide guidance and direction for the site-based programs that support the KEY-MFLM and MCA-MFLM. Site management program documents, codes of practice, procedures and work instructions together comprise the Key Lake and McArthur River management systems. The Key Lake and McArthur River *Quality Management Program* (KEY-QMP and MCA-QMP) describes the overall site management system as part of the licensing basis.

The KEY-QMP and MCA-QMP address the requirements of Cameco's SHEQ Policy, as well as providing guidance to the management system aspects of the CNSC SCAs. These programs were built on the 'Plan-Do-Check-Act' model outlined in the International Standards Organization (ISO) management standards, including ISO 9001 and ISO 14001. This model is designed to ensure that processes are systematically identified, controlled, and monitored and that those processes, as well as the KEY-QMP and MCA-QMP, are continually improved.

Cameco regularly reviews and revises Key Lake and McArthur River program documents as required. Program documents require version control in accordance with the operation's LCHs. The KEY-QMP and MCA-QMP are reviewed annually for effectiveness through a management review process. Further, Cameco internal audits, as well as regulatory audits and inspections are conducted on a regular basis to determine the effectiveness of the quality management systems.

### 3.2.1 Discussion

#### 3.2.1.1 Incident Management

Incidents occurring at Key Lake and McArthur River are entered into CIRS and addressed through Cameco's nonconformance and corrective action process. Through CIRS, Key Lake and McArthur River are able to share relevant incident trends and corrective action results with the rest of the company to provide use of experience and facilitate collective improvement.

Cameco's corrective action process has an incident severity rating system of 1 to 5, with 5 being the most serious. Table 3.2-1 provides a summary of CIRS reporting. During the current licence term, there were no Level 5 incidents at Key Lake or McArthur River. The volume of events shown in Table 3.2-1 are indicative of a strong reporting culture at Key Lake and McArthur River.

*Table 3.2-1: CIRS reporting.*

	Key Lake		McArthur River	
	CIRS Events	CIRS Event per FTE	CIRS Events	CIRS Event per FTE
2013	1540	2.27	895	0.98
2014	1331	2.67	730	0.82
2015	1367	2.21	838	0.90
2016	1172	2.41	750	0.91
2017	1013	2.35	641	0.96
2018	586	3.80	295	1.85
2019	539	3.98	496	5.26
2020	592	4.02	376	3.72
2021	781	2.59	399	2.80
2022 (to end of Q3)	642	1.65	485	1.88

#### 3.2.1.2 Contractor Management

Oversight of contractors at Key Lake and McArthur River is guided by the Cameco corporate *Contractor Management Program* (CAM-CMP). The CAM-CMP is part of Cameco's integrated SHEQ management system and defines the general process and minimum SHEQ requirements for managing contractors across all of Cameco's facilities worldwide. The CAM-CMP ensures:

- Risks are evaluated to identify and eliminate or control hazards.

- Duties of contractors are clearly understood.
- Contractors are adequately trained and qualified for the work.
- Cameco maintains oversight.

The Key Lake and McArthur River contractor management processes are guided by a suite of documents within the KEY-QMP and MCA-QMP, respectively. These documents set out comprehensive requirements for contractors to ensure they are held to the same standards as employees, including safety elements, such as participation in job hazard analyses.

### **3.2.1.3 Resumption of Production**

The strength of management systems at Key Lake and McArthur River was fundamental in conducting operational readiness activities during resumption of production in 2022. Activities were managed through a formalized action plan and executed in line with the operations' management system programs. This included following a formal commissioning process for systems, facilities or devices taken offline during the extended period of care and maintenance. Operational readiness activities were conducted ensuring that all necessary approvals, training, personnel, operational procedures, materials, quality and safety systems were in place prior to full operation of commissioned systems. This enabled a safe resumption of production while continuing to protect workers and the environment.

### **3.2.2 Future Plans**

Key Lake and McArthur River will continue to verify systematically that the controls of the respective management system elements are being effectively implemented. Processes, such as audit and management review, will ensure that enhancements to systems are realized.

### **3.2.3 Conclusion**

The KEY-QMP and MCA-QMP ensure that the management system aspects of all programs are meeting the requirements of CNSC SCAs. Specifically, CNSC REGDOC-2.1.2, *Safety Culture* was implemented by Key Lake and McArthur River during the current licence term. The ongoing improvements reflect the operations' focus on fulfilling the commitments in Cameco's SHEQ Policy and ensuring a quality management approach is reflected in programs that ensure the quality of our processes and protect the health and safety of persons, and the environment.

## **3.3 Human Performance Management**

Human performance at Key Lake and McArthur River is managed through various processes and systems implemented through the *Key Lake Training Development Program* (KEY-TDP) and the *McArthur River Training Development Program* (MCA-

TDP). Human performance management covers the activities that enable effective performance and ensure there are sufficient personnel in all relevant job areas that have the necessary knowledge, skills, procedures, and tools in place to safely carry out their duties. Key Lake and McArthur River have adopted a systematic approach to training (SAT) to ensure these requirements are being met.

### **3.3.1 Discussion**

#### **3.3.1.1 Training**

Key Lake and McArthur River recognize that skilled, knowledgeable, and qualified workers, at all stages of our activities, are an integral component of an efficient, safe, and environmentally responsible operation. During the licence term, Cameco focussed on standardization of training specific to radiation protection measures and implementation of core safety standards, such as control of hazardous energy and confined space entry.

Key Lake and McArthur River have continued to implement SAT as a key component of the KEY-TDP and MCA-TDP. Implementation of SAT ensures workers are competent based on appropriate education, skills, experience, and behaviours and provides a means of measuring, monitoring, and improving the performance of workers. This has resulted in improved training effectiveness and efficiency and has assisted in the continuous improvement of the KEY-TDP and MCA-TDP. Compliance to these training items is tracked by Cameco's Learning Management System (LMS). The LMS also enables Key Lake and McArthur River to produce a list of mandatory qualifications where there is an expectation of 100% compliance.

During the recent transition from care and maintenance to production, Key Lake and McArthur River added approximately 500 workers to the approximately 265 that remained during the care and maintenance period. In addition to operations and corporate training staff, Key Lake and McArthur River relied on workers who remained on site during care and maintenance to participate in training of new hires and rehired workers with the fundamental goal that an adequate number of trained staff were available to safely conduct licensed activities. This was achieved by completion of the following in accordance with the applicable requirements of CNSC REGDOC-2.2.2, *Personnel Training*, Version 2:

- All new hires/rehired workers received required critical safety training (e.g., radiation protection, confined space, control of hazardous energy).
- All workers completed the necessary training and recertifications for the specific activities required under their position.
- Training plans were updated to reflect current positions as well as to reflect the current state of equipment/areas taking into consideration any alterations made during care and maintenance as a result of Cameco's focus on digital and automation technology projects.

- Training records were updated to reflect training completed for all workers and will continue to be updated as additional workers are hired.

Verification of training comprehension is completed by examination (for specific positions identified through the SAT process) as well as an on-the-job practical assessment. Further, ongoing job task observations (JTOs) and training evaluations are a key control as part of the training and development programs for each operation. During the initial phases of preparation activities for resumption of production, the number of JTOs completed was increased. Additionally, job hazard analyses (JHAs) were and will continue to be performed for any non-routine or new tasks as part of activities associated with the preparation of the operations for production.

### **3.3.2 Future Plans**

Key Lake and McArthur River will work within the corporation to continue to standardize training and training requirements. Through digital transformation, remote training opportunities are becoming more effective and will be evaluated for implementation, where practicable. These opportunities will ensure continued compliance with the recently implemented requirements of CNSC REGDOC-2.2.2.

### **3.3.3 Conclusions**

During the current licence term, Key Lake and McArthur River have made significant advancements using SAT to document training and ensure all people on site have the training they require to do their jobs safely. The KEY-TDP and MCA-TDP ensures all workers at Key Lake and McArthur River, have training requirements assigned to them based on their role within the organization.

## **3.4 Operating Performance**

Operating performance at Key Lake and McArthur River tracks how the licensed activities are being conducted, which is then used to inform effective performance management of the facility. Cameco has developed and implemented programs to mitigate potential risks, maintain integrity of facilities and apply managed processes for operations and control. Key Lake and McArthur River report operational performance, including safety performance, to the CNSC staff annually. Radiation and environmental protection results are reported quarterly to the CNSC staff and yearly in the operation's Annual Report. Key Lake and McArthur River also provide notification to the CNSC staff of any significant event that occurs outside of normal operations as well as posting these events on our website in accordance with our approved *Public Information Programs* and CNSC REGDOC-3.2.1, *Public Information and Disclosure*.

Operating limits for the site are specified in the KEY-MFLM and MCA-MFLM. Each operations' activities must meet the requirements of their respective *Radiation Code of Practice* (RCOP) and *Environmental Code of Practice* (ECOP). Further, Cameco utilizes a formal change management process to improve workflow processes, material



management, operator care and engineering reliability with these activities being tracked and documented through the KEY-QMP and MCA-QMP. This formal approach is part of a larger corporate operational improvement effort.

### **3.4.1 Discussion**

#### **3.4.1.1 Production (2013-2017)**

The McArthur River *Mining Operations Program* (MCA-MOP) describes the development and production mining processes at the operation, which ensures risks in each area of the mine are identified, reduced and mitigated through assessments that encompass minewater inflow potential, radiation protection, and ground stability. Through this program, McArthur River evaluates area-specific risks, develops ground support models, co-ordinates activities between organizational departments, and facilitates third-party reviews of proposed ground support and development parameters. In addition, the McArthur River *Ore Processing Program* (MCA-OPP) outlines the specific steps, equipment and procedures used to process uranium ore safely through the underground processing circuit and the surface loadout facility. Through this program, Cameco has controls in place to ensure that people and the environment are protected.

The Key Lake *Facilities Program* (KEY-FP) supports the milling operations by ensuring safety, radiation, environmental and product quality risks are identified and managed. This program explains the milling process in detail, supported by process flow sheets. The KEY-FP also details the ventilation systems and other ancillary services, such as the electrical system.

From 2013 to 2017, McArthur River safely produced uranium ore and Key Lake safely produced uranium concentrate (yellowcake) at approximately 80% of the licensed capacity while maintaining the safety of workers and the public and protecting the environment (Table 3.4-1). Operating processes and criteria for production at these rates are well understood and documented. On November 8, 2017, Cameco made an initial announcement of a 10-month temporary suspension of production at the Key Lake and McArthur River operations. Subsequently, on July 25, 2018, Cameco announced that Key Lake and McArthur River would remain in a safe state of care and maintenance for an indeterminate period of time.

**Table 3.4-1: Key Lake and McArthur River annual production rates (100% basis).**

	Annual Production (million kg U)	
	Key Lake	McArthur River
2013	7.74	7.79
2014	7.37	8.02
2015	7.35	7.58
2016	6.95	7.04
2017	6.20	6.48
2018	0.06	0.18
2019	0.01 <sup>1</sup>	0
2020	0	0
2021	0	0
2022	0.44	0.25

<sup>(1)</sup> 0.01 million kg U from calciner clean-out and disposal of laboratory samples.

### 3.4.1.2 Care and Maintenance (2018-2022)

During the period of care and maintenance at Key Lake and McArthur River, authorized activities as noted in the respective Licence Conditions Handbooks (LCHs), directly related to the mining and processing of uranium ore were suspended. Associated facilities and equipment were shutdown in a systematic fashion and maintained in a safe condition during the care and maintenance period. In general, the transition from operations into care and maintenance focused on three key areas:

- Maintaining compliance of the operations to applicable regulations, approvals and licensed programs.
- Preserving facilities and equipment to ensure future availability.
- Collecting and treating contaminated water from various areas of the operations continued.

There were a number of changes implemented across the operations in order to complete the safe transition into care and maintenance. In relation to Key Lake, a large portion of the mill, specifically production related areas and circuits, were made inactive during this period. The main function of the mill during care and maintenance was the ongoing treatment of water collected from various locations across site. The mill bulk neutralization water treatment circuit continued to be operated with existing limits, action levels and targets maintained.

Each of the production circuits, including tanks/clarifiers, piping, sumps and associated equipment, were systematically drained as part of the mill shutdown process. Where possible, process materials were removed from the equipment and some tanks were refilled with water as part of preservation plans. Additional equipment preservation plans were developed and implemented to preserve and protect the critical mill assets and mobile equipment during the care and maintenance period.

The DTMF continued to operate throughout the care and maintenance period. No uranium ore tailings were discharged to the DTMF during the care and maintenance period; however, solids generated through the bulk neutralization water treatment process and sediment from the planned reservoir pond clean outs (representing a fraction of the normal tailings volumes generated during production) were deposited to the facility. The Deilmann and Gaertner dewatering systems continued to operate and water continued to be collected and transferred to the reverse osmosis plant for treatment.

At McArthur River, Cameco reduced activities in the mine with the focus during care and maintenance on continued pumping of water from the mine. In order to safely transition the mine into care and maintenance, Cameco completed the following activities:

- All development headings were secured with primary ground support installed.
- All production stopes were backfilled.
- Water collection and dewatering systems were simplified and centralized for continued dewatering of the mine.
- Inactive areas were roped off.
- Mobile equipment not required during care and maintenance was preserved and stored in a heated ventilated location within the mine.
- All explosives were removed from underground magazines.

Mine ventilation at McArthur River was reduced and maintained at levels appropriate to facilitate routine inspections of underground infrastructure and equipment (e.g., pumps, ventilation, refuge stations and electrical systems). Minimum ventilation requirements outlined in the provincial *The Mines Regulations, 2018* as well as the McArthur River RCOP were maintained throughout the care and maintenance period.

During the period of suspended production, the operations continued to maintain the necessary resources and essential services to maintain compliance to all legal requirements, including specific licence and approval conditions. While staffing and activities were reduced, Cameco retained essential staff to ensure critical activities were maintained.

### **3.4.1.3 Resumption of Production (2022)**

On February 9, 2022, Cameco formally announced our intention to begin the process of transitioning the McArthur River mine and Key Lake mill from care and maintenance to

production. Cameco achieved first packaged production achieved in November 2022 with a total of 0.25 million kg U (1.1 million pounds  $U_3O_8$ ) produced at Key Lake in 2022.

As detailed in Cameco's operational readiness plan submitted to CNSC staff, Cameco developed and followed a formal commissioning process for all systems, facilities or devices taken offline during the extended period of care and maintenance. This process is described, at a high level, within the Key Lake and McArthur River *Quality Management Programs*. All commissioning-related activities were guided by a commissioning team. The team consisted of a manager, lead/general supervisor, specialist, tradespeople and area operators that were experienced, knowledgeable and capable of understanding the practical areas of the system being commissioned. Meetings were held regularly to plan activities, discuss issues and review progress.

In support of planning for and execution of commissioning for the mill process circuits at Key Lake (e.g., crushing and grinding, ore receiving, acid plant, remaining mill processing areas), Cameco retained a third-party subject matter expert to assist. The commissioning team divided the facility into sub-systems with clear boundary limits to ensure commissioning was completed in an efficient manner.

Specific to the McArthur River mine, Cameco completed ground control inspections of previously inactive areas of the mine and re-established ongoing routine (annual) inspections of these areas. These inspections included both annual internal and external inspections. Based on results of the recent inspections, a list of rehabilitation requirements was created and prioritized. All mine dewatering activities and controls related to inflow prevention continued to be completed throughout care and maintenance. In support of resumption of production, Cameco completed an annual internal dewatering assessment, which identified no significant issues required to be addressed prior to resuming mining activities.

### **3.4.2 Future Plans**

Throughout 2023, Key Lake and McArthur River will undertake all activities necessary to ensure the operations are ready to achieve planned production goals. During the licence term, Key Lake and McArthur River 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, improvements to efficiency of current McArthur River mine freezing and mine ventilation practices, as well as continued opportunities for improvement of processes in the Key Lake mill through a focus on digitization and automation of existing processes.

### **3.4.3 Conclusions**

During the current licence term, Key Lake and McArthur River transitioned into a safe state of care and maintenance and have recently transitioned towards a resumption of production. Inspections are conducted by the CNSC to verify that both Key Lake and

McArthur River's return to production is occurring in a safe manner and the environment continues to be protected. Throughout these transitions, Cameco has demonstrated that the processes and activities necessary to remain compliant with applicable approvals and licensed programs have remained in place and that the safety of workers and the public and protection of the environment is maintained.

### **3.5 Safety Analysis**

Safety analysis is the systematic evaluation of the potential hazards associated with an activity or facility and considers the effectiveness of preventative measures and strategies in reducing the effects of such hazards. Safety analysis supports the overall safety case for the operation.

The safety analysis for Key Lake and McArthur River is derived from the past environmental assessments and ecological risk assessments as well as the respective MFLMs and their supporting program documents. Together, these programs and mitigation features are meant to ensure the operations comply with all regulations and will be protective of people and the environment. To that end, Key Lake and McArthur River systematically assesses risk using risk analysis tools to ensure sustainable and safe operation. These tools include hazards and operability assessments (HAZOPs); job hazard analyses (JHAs); and field level risk assessments (FLRAs). These measures are used to assess new tasks, processes, or equipment.

Additionally, the approach to risk management is guided by the Cameco corporate standard for the systematic identification and management of risk. The specific risk management tools within the Key Lake and McArthur River pre-existing risk management system were adapted to fit under the ISO 31000 standards that guide Cameco's Risk Policy and Risk Management Program. These documents are designed to provide a consistent approach to how risks are evaluated, mitigated and managed throughout the corporation. The program also includes clear specifications on the responsibilities and accountabilities for various levels of risk.

#### **3.5.1 Discussion**

##### **3.5.1.1 Environmental Assessments**

The most recent environmental impact statement for Key Lake, the KLEP EIS was submitted in 2014 [2]. The KLEP EIS included Cameco's proposed plans to:

- Increase the capacity in the DTMF by raising the approved average consolidation tailings height from 466 metres above sea level (masl) to 505 masl.
- Increase the annual mill production capacity to 9.6 million kg U.
- Construct or modify facility components to support the increased production capacity and to support milling of ores from other potential deposits in addition to McArthur River.

The KLEP EIS assessed potential operational and decommissioning scenarios for Key Lake and provides the framework for the safety analysis of key facilities at Key Lake, such as the DTMF and the AGTMF as well as ongoing operation of the bulk neutralization and reverse osmosis water treatment plants. The initial 1995 McArthur River Project EIS [1] remains the foundation for the operation's safety analysis. Ongoing risk analysis (Section 3.5.2) continues to be the primary tool to ensure risks at Key Lake and McArthur River remain within the licensing basis as described in these environmental assessments.

Cameco has submitted Environmental Risk Assessments (ERAs) as part of the environmental assessment process. As required, Cameco now reviews and updates these ERAs on a five-year cycle in accordance with Canadian Standards Association (CSA) N288.6:12 *Environmental risk assessments at Class 1 nuclear facilities and uranium mines and mills*. Further, Cameco prepares an Environmental Performance Report (EPR) on a similar 5-year cycle that provides an update, assessment and summary of the operationally relevant environmental data and other information relating to performance of our operations. The EPR also provides comparison of the current study period results to predictions made in the relevant EIS documents, including the ERAs. The Key Lake and McArthur River ERA and EPR are discussed further in Section 3.10.

### **3.5.2 Risk Analysis**

Cameco identifies hazards at Key Lake and McArthur River using risk analysis tools, such as HAZOPs, JHAs, and FLRAs. These analyses ensure changes to the facility are controlled and that risks posed are acceptable. Identification and analysis of risk was an important part of activities supporting resumption of production in 2022:

- HAZOPs were completed to identify hazards and potential operability issues for restart of idled circuits within the Key Lake mill; specifically, the leaching circuit and ammonia handling as well as for the commissioning and operation of the new batch plant at McArthur River.
- A risk assessment was completed to evaluate the likelihood and consequence of a wildland fire directly impacting site.
- JHAs were completed on maintenance and projects activities such as installing new duct insulation within the acid plant and replacement of fire water lines in the administration building.
- FLRAs were used during project maintenance and construction tasks including the construction of the automated yellowcake packaging system at Key Lake and installation of new instrumentation and valving underground at McArthur River.

Further, Cameco maintains ongoing vigilance with respect to underground conditions at McArthur River necessary to maintain a safe mining environment by implementing regular corporate technical reviews in the areas of ground control, ventilation, and dewatering/ hydrogeology. Through continual improvement and lessons learned during production, Cameco continually updates the mine plan, including the minewater

management strategy to ensure that risk is managed appropriately. Routine mine dewatering at McArthur River is conducted via conventional sump, pump, and treatment infrastructure. Water from the underground workings is pumped to the surface where it is treated and either recycled for further use in mining operations or treated and discharged to the environment. In addition to the routine dewatering system, McArthur River also maintains infrastructure for use in the event of a non-routine inflow of water into the mine.

Specific to the tailings management facilities at Key Lake, Cameco had a dam safety review completed in 2020 for the AGTMF in accordance with Canadian Dam Association guidelines. The goal of this review is to assess and evaluate the safety of a dam against potential failure modes. The review was conducted by a third-party subject matter expert and is based on current knowledge and guidelines, which might be different than at the time of construction. This review found the Key Lake AGTMF to be generally in sound condition without evidence of any dam safety issues, and that it is being managed consistent with sound engineering and good industry practice. In addition to the AGTMF dam safety review, Cameco had a third-party subject matter expert conduct a Failure Modes and Effects Analysis (FMEA) for the AGTMF as well as the DTMF in 2021 and 2022, respectively. FMEA is a systematic, proactive method to identify potential credible failure modes, assess the likelihood and consequence of failure and the controls in place to address them. The FMEA process was able to highlight critical controls for each facility, areas of risk that were well managed, and areas of risk that could be reduced further through additional study or implementation of mitigative actions. From this process, Cameco developed a risk register that presents the current known risks and ranking, and that can be updated to reflect changes to existing risks and to add new risks as they become known.

### **3.5.3 Future Plans**

Risks at Key Lake and McArthur River are well understood and controlled. During the current licence term, improvements in infrastructure and risk assessment processes have reduced the potential risks to the McArthur River mine from minewater inflow. Other infrastructure and process changes at both operations are contributing to improved environmental performance.

### **3.5.4 Conclusions**

Various forms of risk assessment have been completed during the current Key Lake and McArthur River licence term and the risk assessment process continues to be refined and improved. Through these assessments, Cameco continues to better understand the risks at our operations and ensures adequate mitigation and management of these risks. As a result, Cameco's risk management at Key Lake and McArthur River is effective in ensuring continued safe operation while maintaining protection of the environment.

## 3.6 Physical Design

Physical design relates to activities that impact on the ability of systems, structures 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 principal facilities at Key Lake are comprised of the mill itself, which produces yellowcake and, within the mill, a bulk neutralization circuit for treating water prior to release to the environment. A separate reverse osmosis water treatment plant treats water collected from the Deilmann and Gaertner dewatering systems prior to release to the environment. Key Lake also manages the wastes generated from the historic open-pit mining of uranium ore and the current production of yellowcake. Primarily, these are waste rock, and tailings.

For McArthur River, the principal facilities comprise an underground mine, which produces uranium ore, and surface support facilities, including large capacity freeze plants, ore slurry loadout facility, water treatment plant and lined waste rock storage pads.

Cameco utilizes facility change control and design control at both operations to ensure that any physical changes to the facility are reviewed and approved by appropriate personnel before implementation. The operations employ an electronic system, which ensures site management is aware of proposed changes and associated risks and controls. It also ensures those responsible are made aware of the changes so that required approvals, including regulatory approvals, are in place prior to the change being implemented.

### 3.6.1 Discussion

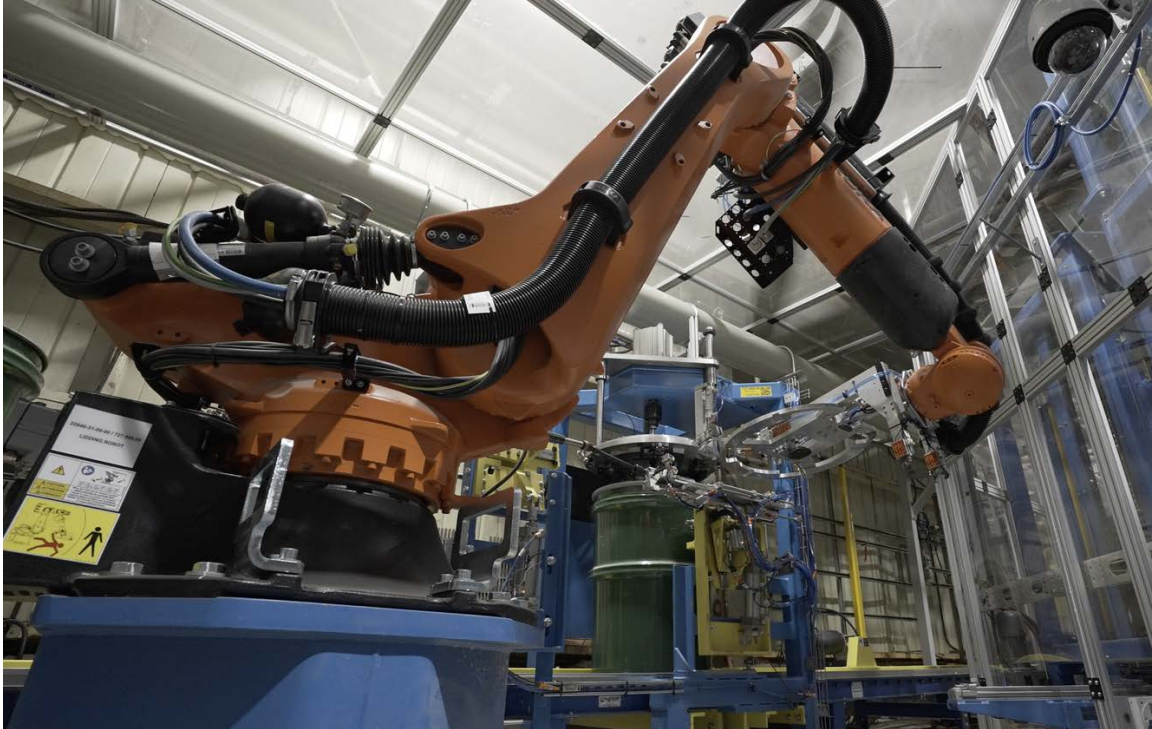
During the previous licence term, Key Lake undertook a project to cut back the slope of the west wall of the DTMF to improve slope stability and prevent future incidents of sand sloughing from this area, protecting the future capacity of the DTMF. The work was predominantly executed between 2010 and 2013 with a total slope excavation volume of approximately 2.4 million m<sup>3</sup> of material as well as placement of an approximately 300,000 m<sup>3</sup> toe buttress rock. Work in the DTMF area continued under the current licence term, beginning with relocation of the west wall office building. Other work completed on the DTMF in support of stabilization efforts included:

- Flattening and compacting of slopes at the former location of the west wall office, in the south-central area of the DTMF.
- Further flattening of the northeast slope and placement of rockfill to prevent wave erosion of the slope to ensure stability.
- Resumption of controlled flooding of the DTMF in October 2016.

During the period of care and maintenance from 2018 to 2022, Cameco placed specific emphasis on digitization and automation of existing processes across all our operations. At Key Lake, this involved a number of automation improvements within the mill, such as replacing manual operated valves with automated valves as well as equipping workers



with digital devices to replace filling out paper forms. The most significant modifications to process circuits occurred in the yellowcake packaging area of the Key Lake mill. Cameco submitted an application to the CNSC in May 2021 for a new automated packaging system that is designed to automatically de-stack drums, fill drums with yellowcake to the required weight, lid and clean the drums, complete final weighing of the drums and apply the necessary labelling. The main anticipated benefit through automation of this area is to reduce the amount of worker interaction with the yellowcake product and the drums themselves during packaging. This system was commissioned in 2022 in support of the planned resumption of production.



***Figure 3.6-1: Key Lake yellowcake packaging area lidding robotic arm.***

At McArthur River, a second freeze plant was constructed and commissioned in 2017 to ensure sufficient freeze capacity to support future ground freezing of the southern areas of the McArthur River mine. The new south freeze plant is located near Shaft #3 and has 750 tonnes of installed refrigeration capacity. Two new boreholes were also drilled from surface to circulate the brine to the underground workings. Presently, the new freeze plant remains in a safe state of care and maintenance until it will be required when freezing in the southern area of the mine begins.

Also, in line with Cameco's emphasis on digitization and automation of existing processes, McArthur River undertook work in 2021 and 2022 to upgrade the existing concrete batch plant. Concrete is delivered underground at McArthur River using slick lines located in Shafts 1 and 3 and boreholes drilled parallel to Shaft 2. Once underground, the concrete is delivered for various uses, including backfill; tight filling drill and extraction chambers; construction; and shotcrete. The upgraded batch plant

involved the construction of a new structure to the west of the existing plant to contain new aggregate feed bins, a feed conveyor, a wet mixer, and an overhead concrete chute to feed cement trucks. The upgraded plant is intended to improve recipe quality control, lower operating costs and mitigating downstream issues, such as line plugging.



**Figure 3.6-2: McArthur River concrete batch plant.**

### **3.6.2 Future Plans**

Over the term of the next licence, Key Lake and McArthur River will continue to identify and pursue opportunities to improve processes at these operations. Such opportunities may include, but are not limited to, improvements to efficiency of current McArthur River mine freezing and mine ventilation practices, as well as continued opportunities for improvement of processes at McArthur River and Key Lake through a focus on digitization and automation of existing equipment and processes. For any new or changes to existing infrastructure, Cameco will follow the current design controls that have been shown to be effective at these operations.

### **3.6.3 Conclusions**

Cameco has proven mine and mill designs, methods and infrastructure that are effective in protecting the environment and the health and safety of people while mining and milling high-grade uranium ore. Cameco expects that further innovations in mining and milling processes will continue to allow for safe production, while continuing to maintain the safety of workers and the public, as well as protection of the environment.

## **3.7 Fitness for Service**

Key Lake and McArthur River continue to advance opportunities to improve the overall maintenance and reliability of their respective operations, so that all equipment is available to perform its intended design function. The Key Lake *Maintenance Program*

(KEY-MP) and McArthur River *Maintenance Program* (MCA-MP) describe the testing, inspection schedules and work procedures required to ensure that the physical condition of systems, components and structures remain in good operating condition.

The KEY-MP and MCA-MP manage routine maintenance, inspection and testing to ensure the availability, reliability and effectiveness of facilities and equipment. The programs help increase equipment availability through more efficient planning, predictive maintenance techniques, training, and documentation.

### **3.7.1 Discussion**

During the licence term, Cameco, including Key Lake and McArthur River, began a journey towards operational excellence. This encompasses many things, including asset management and reliability, which Cameco strives to be an industry leader in. Asset management and reliability helps Key Lake and McArthur River achieve excellence in operational asset management by developing and continuously improving programs, processes, and standards in the area.

Throughout the transition into and out of care and maintenance, Key Lake and McArthur River managed maintenance activities appropriate to the status of the infrastructure or equipment with the objective to ensure that the operating condition of systems, equipment and devices are preserved, so that they can perform their functions reliably. During care and maintenance, activities were primarily restricted to routine inspections, preventative maintenance, and repairs of operating infrastructure and equipment (e.g., water treatment plants, freeze systems). In addition to the routine activities noted above, there are some minor non-routine maintenance activities executed, such as cleaning out lined containment facilities at Key Lake.

As part of the formal commissioning process in place to transition Key Lake and McArthur River back into production, Cameco re-implemented maintenance plans for systems, equipment and devices taken off-line during care and maintenance. Cameco will continue our focus on asset management and reliability, through the implementation of robust maintenance plans, as the operations continue to transition to planned production capacity.

### **3.7.2 Future Plans**

The KEY-MP and MCA-MP provide the framework for Cameco to effectively manage existing infrastructure at Key Lake and McArthur River, respectively, which ensures the operations can safely execute licensing activities. A large part of the continued evolution of Key Lake and McArthur River's maintenance and operational reliability programs is digital transformation, where personnel will have easy access to information in the field. To support this, workers are being outfitted with a digital device and trained on its use. This ensures that the best data will be used in decision making, leading to operational excellence.

### 3.7.3 Conclusions

The KEY-MP and MCA-MP have shown to be effective in ensuring proper maintenance schedules and procedures are followed to ensure the integrity of infrastructure at Key Lake and McArthur River. The KEY-MP and MCA-MP have also been effective in adopting technology to improve the preventative and predictive maintenance approach. Cameco has been deploying reliability engineering tools to assess components that are more failure prone. These efforts are improving equipment longevity and increasing the time between failures on equipment, helping to ensure continued production that maintains the safety of worker and the public while protecting the environment.

## 3.8 Radiation Protection

The Key Lake *Radiation Protection Program* (KEY-RPP) and the McArthur River *Radiation Protection Program* (MCA-RPP) outline how the operations manage radiation protection issues in accordance with the *Radiation Protection Regulations* with the goal of keeping radiation exposures to workers “as low as reasonably achievable, social and economic factors taken into account” (the ALARA principle). Cameco’s periodic audits, reviews and self-assessments help identify improvements and provide assurance that both the KEY-RPP and MCA-RPP are functioning effectively and efficiently.

Radiation exposures are mitigated through a combination of engineering and administrative controls that include non-entry mining methods; ventilation; shielding; training; zone control; radiation work permits; and personal protective equipment (e.g., respiratory protection). Cameco monitors and confirms the effectiveness of these controls through area monitoring, direct reading dosimeters, optically stimulated luminescence dosimeters and personal alpha dosimeters.

### 3.8.1 Discussion

#### 3.8.1.1 Radiation Monitoring

The KEY-RPP and MCA-RPP have been effective in controlling the potential hazards during both production and care and maintenance as demonstrated by the results of the radiation monitoring of Nuclear Energy Workers. Monitoring data is reviewed, consolidated, and analyzed regularly to inform work practices and optimize controls. Results are submitted to the CNSC monthly and quarterly for review. The effective and maximum doses received by workers during the licence period are summarized in Table 3.8-1.

**Table 3.8-1: Summary of dose statistics during licence term.**

	Average Effective Dose (mSv)		Maximum Effective Dose (mSv)	
	Key Lake	McArthur River	Key Lake	McArthur River
2013	0.62	0.89	5.67	7.58
2014	0.63	1.03	6.21	7.91
2015	0.55	1.00	7.56	7.40
2016	0.62	0.85	5.37	7.02
2017	0.66	0.79	5.39	5.73
2018	0.19	0.15	2.02	2.67
2019	0.27	0.33	1.64	2.82
2020	0.35	0.27	2.11	2.94
2021	0.52	0.25	3.13	3.06
2022 (to end of Q3)	0.29	0.22	4.41	3.35

As set out in the above table, average and maximum effective doses over the licence period remain far below the regulatory limits of 50 mSv per year and 100 mSv over a five-year period, respectively. Average effective doses are at, or below 1 mSv per year and no member of the workforce received an annual effective dose in excess of 10 mSv during the licence period.

### 3.8.1.2 Radiation Code of Practice

Both Key Lake and McArthur River maintain RCOPs within their respective RPPs. The RCOPs specifies action levels that, if exceeded, may indicate the potential for a loss of control of the KEY-RPP or MCA-RPP. Within the RCOP, there are specific actions to be taken in response to an exceedance of an action level. In the current licence term, there were five events resulting in action level exceedances at Key Lake and three such events at McArthur River. These incidents were characterized for their significance, entered into CIRS and addressed in accordance with the Cameco corrective action process:

- In January 2015, a McArthur River raisebore operator received a calculated dose exceeding the quarterly action level of 5 mSv per quarter as well as the weekly action level of 1 mSv per week. The most likely cause of the exposure was an upcasting raisebore hole while operating the drill. Cameco completed updated work instructions to reduce reoccurrence of such exposures by preventing upcasting of contaminated air from open raises into the work area.
- In January 2015, a hole in the Key Lake main calciner shaft allowed calcined yellowcake to enter and pass through to the crystallization circuit. When the release was discovered, all workers were evacuated from the area and the mill was safely

shutdown. Five workers had a calculated dose that was greater than the action level of 1 mSv per week.

- In February 2015, one Key Lake worker had a calculated dose that was greater than the action level of 1 mSv per week. The action level exceedance was attributed to calcined yellowcake found on the fourth floor of the yellowcake building caused by a leak in the calciner exhaust duct. The area was immediately restricted to entry with a radiation work permit and the mill was shut down safely. An investigation (combined with the January incident above) was initiated. Plans were made to repair the problem area and to inspect all welds on this ducting as well as all other piping related to the conveyance of exhaust. Follow-up inspections were conducted by CNSC staff to verify implementation of the corrective actions and preventative measures. Further, in response to the events, CNSC staff also requested pursuant to 12(2) of the *General Nuclear Safety and Control Regulations*, that all operating uranium mill facilities complete follow-up actions to prevent similar occurrences.
- In April 2015, a Key Lake worker was performing tasks to obtain the target weights on packaged yellowcake drums. The worker failed to complete all of the steps on the work instruction and on the radiation work permit before removing the required personal protective equipment, which resulted in a calculated dose that was greater than the action level of 1 mSv per week.
- In September 2015, five McArthur River workers received calculated doses in excess of 1 mSv per week. A review of the work records of the workers involved indicated that the workers likely received their exposure while performing remediation activities around a sloughing raise. There was not a procedure in place for the method being performed and a documented hazard assessment was not completed.
- In February 2016, January monitoring results returned two McArthur River long hole drillers with combined radon progeny and LLRD doses greater than the 1 mSv per week action level. Workers were drilling in the Zone 4 area and radon progeny was released to the work heading. As a result of these two incidents in January, Cameco conducted two safety stand downs focused on radiation hazards. Further increased administrative controls for Zone 4 areas were implemented.
- In May 2016, a worker failed to submit the required post entry urine sample following an entry into the Key Lake calciner room to perform maintenance on the drag-link conveyor. As a result of the missed sample, the worker was not given credit for the use of a powered air purifying respirator and an uncredited committed effective dose greater than the action level of 1 mSv per week was assigned.
- In June 2022, Key Lake workers completed entry into the counter-current decantation tank to complete cleanup activities following tank integrity inspections. Post-work sample analysis results for one of the workers indicated an elevated uranium concentration. It is suspected that the exposure occurred when the worker handled their contaminated PPE (disposable gloves and coveralls) after removal of their respirator.

### 3.8.2 Future Plans

Key Lake and McArthur River will continue to look for opportunities to continually improve the performance of the KEY-RPP and the MCA-RPP in the next licence term. Cameco's periodic audits, reviews and self-assessments help identify improvements and provide assurance that the respective programs have and continue to function effectively and efficiently. Specific activities are noted below and will continue during the next licence term:

- Implementation of Bluetooth enable direct reading dosimeters that allow for wireless data download and DRD tracking.
- Evaluation of a potential upgrade to the radon progeny monitoring prisms for improved sample time resolution and Wi-Fi communication for remote monitoring.

### 3.8.3 Conclusions

The KEY-RPP and MCA-RPP are both working as intended to keep worker exposures ALARA. During the current licence term, radiation protection measures remained effective and maximum yearly doses remain consistently well below the regulatory limit. In accordance with our corrective action process, all radiation protection incidents were characterized for their significance, entered into CIRS and appropriate corrective actions were put in place.

## 3.9 Conventional Health and Safety

Cameco strives to be a leading performer in conventional health and safety through development of a strong safety culture. Cameco's safety culture framework is a set of high-level principles and associated traits or characteristics that articulate the desired behaviours associated with a strong safety culture. Cameco conducts periodic safety culture assessments in accordance with CNSC REGDOC-2.1.2, *Safety Culture*. These assessments are used by the Cameco management teams to improve and strengthen safety culture at the site.

Workplace safety hazards are managed as part of the processes described within the Key Lake *Safety and Health Management Program* (KEY-SHMP) and the McArthur River *Safety and Health Management Program* (MCA-SHMP). In general, risks to workers are controlled through the adoption of a safety system comprised of five elements:

- Site inspections: formal and informal hazard identification programs by supervisors, Occupational Health Committee, and safety department personnel.
- Safety meetings: once every shift with each department to discuss safety topics, review safety-related procedures, and discuss incidents.
- Daily contact card: a daily practice for supervisors and workers to initiate dialogue regarding safety topics, to identify risks associated with assigned tasks and to track any safety-related issues encountered in the workplace.

- Daily safety huddles: discussion of a daily safety topic, review of previous incidents, daily duties, environmental issues or specific hazards and controls in the work area.
- Job task observations: in-person, third party observation of a worker performing a specific task.
- Work permits: activity-specific approvals required before tasks, such as those required for confined space entry or involving hot work (welding).

Cameco also manages hazards using JHAs conducted prior to completing non-routine tasks. During the current licence term, Cameco increased the focus on the development of standardized practices for core safety aspects, such as control of hazardous energy and confined space entry.

The effectiveness of these controls is assessed through indicators, such as audits, preventative and predictive maintenance plans and compliance to program requirements. Specific to worker safety, measures include first aids, medical incident injuries, lost-time injuries (LTI) and the total recordable injury rate (TRIR). Results are routinely reviewed internally and reported externally on a monthly and annual basis.

### **3.9.1 Discussion**

#### **3.9.1.1 Safety Statistics**

Table 3.9-1 and Table 3.9-2 provide a summary of the safety statistics for Key Lake and McArthur River over the licence term. As is shown, injuries have been controlled with no significant incidents despite the changes in work activity associated with the transition into care and maintenance and back into production. Overall, the systems and controls in place to prevent injuries and ensure the health and safety of all workers are sufficiently robust. Specifically, Key Lake has not recorded an LTI since 2016 and McArthur Rive in 2017. In recognition of strong safety performance in the current licence term, Key Lake and McArthur River have recently received the following safety awards:

- McArthur River received the Canadian Institute of Mining, Metallurgy and Petroleum John T. Ryan national safety trophy for metal mines in 2014 and 2015.
- Key Lake and McArthur River received the 2020 Saskatchewan Mining Association (SMA) Safety Award for achieving an injury rating of zero.
- McArthur River received the 2021 SMA Safety Award for achieving an injury rating that was below both the median SMA rating for that year and the previous seven-year average median.



**Table 3.9-1: Key Lake safety statistics during the licence term.**

	<b>Total FTE Workers<sup>1</sup></b>	<b>Number of LTIs<sup>2</sup></b>	<b>TRIR</b>	<b>Frequency Rate<sup>3</sup></b>	<b>Severity Rate<sup>4</sup></b>
2013	679	0	2.21	0	8.5
2014	499	0	3.21	0	0
2015	619	0	3.23	0	0
2016	486	2	6.17	0.41	71.0
2017	430	0	3.48	0	0
2018	154	0	2.59	0	0
2019	135	0	2.22	0	0
2020	147	0	2.04	0	0
2021	301	0	1.99	0	0
2022 (to end of Q3)	518	0	0.77	0	0

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

<sup>(2)</sup> 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.

<sup>(3)</sup> 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 reporting period) / # of hours worked in reporting period] x 200,000.

<sup>(4)</sup> 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 reporting period)/# of hours worked in reporting period] x 200,000.

**Table 3.9-2: McArthur River safety statistics during the licence term.**

	<b>Total FTE Workers<sup>1</sup></b>	<b>Number of LTIs<sup>2</sup></b>	<b>TRIR</b>	<b>Frequency Rate<sup>3</sup></b>	<b>Severity Rate<sup>4</sup></b>
2013	914	1	2.95	0.11	0
2014	891	1	4.04	0.11	13.2
2015	943	0	2.89	0	8.1
2016	828	2	5.19	0.24	0
2017	669	1	5.53	0.15	10.9
2018	159	0	5.02	0	22.6 <sup>5</sup>
2019	94	0	2.12	0	0
2020	101	0	1.98	0	0
2021	142	0	0.70	0	0
2022 (to end of Q3)	344	0	2.33	0	0

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

<sup>(2)</sup> 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.

<sup>(3)</sup> 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 reporting period) / # of hours worked in reporting period] x 200,000.

<sup>(4)</sup> 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 reporting period)/# of hours worked in reporting period] x 200,000.

<sup>(5)</sup> Severity rates at McArthur River in 2017 and 2018 are predominantly related to a single LTI that was recorded in 2017.

### **3.9.1.2 Key Lake 2016 Worker Fall from Height**

In April 2016, a truck delivering sulphur arrived at the Key Lake gatehouse and proceeded to the sulphur unloading bay. The truck driver and the Key Lake operator began the process to unload the sulphur. During the unloading, the truck driver fell from the rear sulphur trailer and was injured. The worker sustained serious injuries that required hospitalization greater than 72 hours. Comprehensive investigations were completed by both Cameco and the trucking company that included a third-party safety assessment of the procedure to unload sulphur. Based on these investigations, Key Lake implement the following corrective actions:

- Fall arrest is required when accessing the sulphur trailers.

- A full-face passive respirator with protection against both sulphur dioxide and hydrogen sulfide is required for truck drivers when opening the hatches on the sulphur trailer.
- Additional reviews of all bulk goods unloading were completed, and additional safety measures implemented for the unloading procedure for bulk lime delivered to Key Lake.

### **3.9.1.3 Occupational Health Committee**

The Occupational Health Committee (OHC) at Key Lake and McArthur River consists of employee and employer representatives who are responsible for reviewing past health and safety incidents, conducting safety inspections, evaluating safety programs, and recommending health and safety improvements. Cameco management openly seeks and encourages worker involvement and consultation through daily work assignment meetings, regular safety meetings, town hall meetings and written communications.

### **3.9.1.4 COVID-19 Response**

Cameco closely monitored the developments related to the COVID-19 pandemic during the licence term. Cameco's priority remained the protection of the health and well-being of our employees, their families and their communities. The Cameco Corporate Crisis Management Plan was activated, which includes our Pandemic Plan and our various Local and Corporate Business Continuity Plans. Following the precautions and restrictions enacted by all levels of government where we operate and considering the unique circumstances at each of our operating sites, we proactively implemented a number of measures and made a number of decisions to ensure a safe working environment for all our employees, including:

- Transitioning eligible employees to begin working remotely from home.
- Mandating that meetings be conducted by phone or videoconference where possible.
- Suspending all business travel, unless approved by the CEO.
- Restricting non-essential contractors, visitors and deliveries at all locations.
- Adopting screening protocols for access to our facilities that aligned with the directives of government and public health authorities.
- Implementing a number of additional protective measures in the workplace, including increased sanitization, physical distancing and use of face masks.
- Setting up and awarding COVID-19 Relief Funds totaling \$1.25 million to support our northern Saskatchewan and Ontario communities impacted by the pandemic.

In 2021, building upon our established Exposure Control Plan, we commenced rapid antigen screening on all incoming personnel and, implemented a requirement that all workers and visitors to our Cameco facilities must be fully vaccinated. To support this requirement, we ran a series of vaccination clinics at our site health care centres. With the

help of the provincial health authority, our nursing staff administered close to 700 doses to workers at our northern Saskatchewan operations.

Reflecting on the current guidance from provincial and federal health authorities, and the implementation of our vaccination requirement, we have been able to systematically roll back many of our protocols in 2022, while ensuring the protection of our workers.

### **3.9.2 Future Plans**

Efforts during the next licence term will continue to build a culture focused on safety and accountability as production continues. Site personnel will continue to be encouraged to report all incidents, no matter how minor, into CIRS.

An example of ongoing safety culture improvement is the continued implementation of the Field Leadership Program. This program is designed to ensure that all personnel on site understand how they promote a safe, productive work environment. This is accomplished through having management present at the workface to ensure that policies, programs, standards, and regulatory requirements are implemented and effective for Key Lake and McArthur River. Additionally, the program works to ensure that all workers understand the hazards of the work they are undertaking and the controls in place to mitigate those hazards. Cameco implements this through in-the-field discussions between management and workers that not only allow for verification of safe work practices, but also provides coaching opportunities where improvements can be made.

### **3.9.3 Conclusions**

Safety is a core value at Key Lake and McArthur River, and one of Cameco's highest corporate priorities. Further, a safe, healthy, and rewarding workplace is one of our organizational measures of success. Promoting a strong safety culture at Key Lake and McArthur River is achieved through continuous improvement and consistent application of the KEY-SHMP and MCA-SHMP, including ongoing education and training, as well as inspections and improvements to processes and safety equipment to ensure all people working at site are equipped to work safely.

## **3.10 Environmental Protection**

The Key Lake *Environmental Protection Program* (KEY-EPP) and McArthur River *Environmental Protection Program* (MCA-EPP) both formalize the approach to environmental protection at the sites. The KEY-EPP and MCA-EPP both include details for identifying, controlling, and monitoring potential impacts to the environment. The programs include the ECOP that describes required measures to be taken in response to exceedance of an environmental action level for treated water. During the current licence term, Key Lake and McArthur River worked with the CNSC to implement changes to treated water action levels in accordance with CSA N288.8-17, *Establishing and Implementing Action Levels for Releases to the Environment from Nuclear Facilities*.

Implementation was completed in April 2022. Additional environmental protection regulatory documents and standards implemented during the licence term are listed below:

- CSA N288.4-10, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*
- CSA N288.5-11, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*
- CSA N288.6-12, *Environmental Risk Assessment at Class I Nuclear Facilities, and Uranium Mines and Mills*
- CSA N288.7-15, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills*
- CNSC REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.2*

Cameco maintains a corporate ISO 14001 certification for our operation's environmental management systems. The ISO 14001 certification ensures that Key Lake and McArthur River both meet the requirements of Cameco's integrated SHEQ Policy, including:

- Identifying and mitigating environmental risks.
- Complying with applicable laws and regulations.
- Monitoring and measuring operational impacts.
- Reducing and effectively managing waste.
- Minimizing potential impacts to the environment.

Cameco's periodic audits, reviews and self-assessments help identify improvements and provide assurance that both the KEY-EMP and MCA-EMP are functioning effectively. Deficiencies or findings identified through these efforts are documented and addressed. As one form of self-assessment, Cameco conducts annual management reviews where minutes and follow-up actions to outstanding issues from the audits and reviews are documented. Further, within the operations' annual reports, discussion is provided on annual environmental management objectives, goals, and targets.

Two key areas of environmental focus at both Key Lake and McArthur River are preventing uncontrolled releases to the environment and collecting and treating potentially contaminated water.

### **3.10.1 Treated Water**

#### **3.10.1.1 Key Lake**

As mentioned above, a key area of environmental control at Key Lake is treating potentially contaminated water prior to discharge to the environment. The groundwater

collected from the Deilmann and Gaertner dewatering systems is treated in the reverse osmosis water treatment plant and is discharged directly to Horsefly Lake (Station 1.2, see Table 3.10-1). Water treated in the mill's bulk neutralization circuit is discharged to Wolf Lake (Station 1.4, see Table 3.10-2). All treated water released to the environment is sampled to ensure that regulatory requirements are met.

**Table 3.10-1: Reverse osmosis treated water loadings to the receiving environment (Key Lake Sta 1.2).**

	Total Water Discharged (m <sup>3</sup> )	Total Loadings (kg) <sup>1</sup>			
		Uranium	Molybdenum	Selenium	Arsenic
2013	4,326,661	14.7	0.43	3.89	0.43
2014	3,480,171	9.4	0.35	3.13	0.35
2015	3,355,481	13.1	0.34	0.34	0.34
2016	3,823,505	15.3	0.38	0.38	0.38
2017	3,813,456	6.5	0.38	0.38	0.38
2018	4,999,381	8.5	0.50	0.50	0.50
2019	4,035,425	14.1	0.40	0.40	0.40
2020	4,964,584	27.3	0.50	0.50	0.50
2021	4,333,802	20.8	0.43	0.43	0.43
2022 (to end of Q3)	2,513,304	16.6	0.31	0.25	0.25

<sup>(1)</sup> Total loadings (kg) are calculated as annual mean concentration multiplied by the total water discharged (m<sup>3</sup>). When annual mean concentrations are below detection limit, detection limit value is used for total loadings calculation.

**Table 3.10-2: Bulk neutralization treated water loadings to the receiving environment (Key Lake Sta 1.4).**

	Total Water Discharged (m <sup>3</sup> )	Total Loadings (kg) <sup>1</sup>			
		Uranium	Molybdenum	Selenium	Arsenic
2013	1,218,206	9.5	175.6	2.0	10.5
2014	1,133,317	6.0	186.4	20.1	8.9
2015	940,012	7.6	82.0	15.7	5.5
2016	770,189	4.8	58.4	12.9	5.0
2017	790,228	7.3	102.0	12.2	6.6
2018	1,331,290	17.9	83.4	13.6	9.2
2019	1,223,837	29.7	60.0	12.5	9.2
2020	1,481,253	38.4	82.5	15.5	16.7
2021	1,184,475	28.3	46.3	11.8	12.9
2022 (to end of Q3)	278,925	5.9	3.2	2.6	0.5

<sup>(1)</sup> Total loadings (kg) are calculated as annual mean concentration multiplied by the total water discharged (m<sup>3</sup>). When annual mean concentrations are below detection limit, detection limit value is used for total loadings calculation.

During the current licence term, Key Lake has monitored the quality of treated water and implemented process enhancements to facilitate continual improvement. The key focus of these activities was to reduce total loadings of COPCs to the environment. This was achieved by a combination of optimizing water usage (total use and recycling) as well as improving treatment effectiveness.

With the commissioning of the molybdenum and selenium removal circuit in 2009, the concentration of these constituents (and associated loadings) continued to be reduced in the final treated water from the mill bulk neutralization circuit. Mean loadings of selenium, molybdenum, and uranium in the treated water decreased by 54%, 86% and 60%, respectively, between the 2005 to 2009 and 2010 to 2014 periods. Mean annual concentrations of molybdenum and selenium have decreased by 62% and 44% respectively since 2010.

During the care and maintenance period, Cameco successfully implemented adjustments to the bulk neutralization circuit to improve treatment of water, including a reduction of reagent addition and exclusion of the molybdenum and selenium removal circuit. Through this period, monitoring results continued to demonstrate stable or improving molybdenum and selenium loadings to the receiving environment.

### 3.10.1.2 McArthur River

Potentially contaminated water collected at McArthur River is primarily generated from underground dewatering of the mine. Water treatment at McArthur River consists of primary and secondary water treatment circuits as part of the overall water treatment plant. The function of the primary circuit is to precipitate and remove molybdenum from the water. The purpose of the secondary circuit is to precipitate radium and other metals, as well as remove solids from the wastewater. McArthur River manages the inputs to the primary and secondary circuits in order to efficiently treat the potentially contaminated water generated on site. Treated water from the water treatment plant is pumped to one of the four monitoring ponds where it is sampled prior to release to the environment (Station 1.2, see Table 3.10-3).

Process changes were implemented in the previous licence term that resulted in molybdenum and selenium in the final treated mine water decreasing by approximately 95% and 67% from historical values. During the current licence term, McArthur River has routinely monitored the quality of its treated water discharges and implemented process enhancements to facilitate continual improvement. The key focus of these activities was to reduce total COPC loadings to the environment. Loadings of many constituents decreased in the 2015 to 2019 period as compared the 2010 to 2014 period, including reductions of 67% for molybdenum, 42% for uranium and 22% for selenium.

During the period of care and maintenance from 2018 to 2022, COPC loadings to the environment were significantly reduced as the operation had ceased all mining activities. Cameco will continue to monitor COPC concentrations within treated water as the operation transitions back into production.



**Table 3.10-3: Water treatment plan treated water loadings to the receiving environment (McArthur River Sta. 2.1).**

	Total Water Discharged (m <sup>3</sup> )	Total Loadings (kg) <sup>1</sup>			
		Uranium	Molybdenum	Selenium	Arsenic
2013	2,273,613	24.4	426.9	3.3	3.8
2014	2,265,810	22.9	412.8	4.1	3.1
2015	2,359,586	21.2	336.4	5.2	2.4
2016	2,483,864	12.7	450.4	5.4	1.6
2017	2,447,728	12.9	361.4	3.9	1.8
2018	2,367,280	15.7	38.3	0.63	0.24
2019	2,370,659	20.8	27.0	0.65	0.24
2020	2,339,336	19.6	22.8	0.69	0.23
2021	2,268,460	17.8	19.2	0.55	0.23
2022 (to end of Q3)	1,663,649	17.2	16.0	0.49	0.17

<sup>(1)</sup> Total loadings (kg) are calculated as annual mean concentration multiplied by the total water discharged (m<sup>3</sup>). When annual mean concentrations are below detection limit, detection limit value is used for total loadings calculation.

In 2009, McArthur River commissioned the Shaft #3 dewatering station. Water originating from the Shaft #3 dewatering station has low concentrations of COPCs and is approved for discharge directly to the environment, reducing the load on the site water treatment plant. Shaft #3 water can also be diverted for use in industrial water applications across the site as this water does not come into contact with underground mine process areas. As shown in Table 3.10-4, loadings to the receiving environment from Shaft #3 water have remained consistently low throughout the licence term.

**Table 3.10-4: Shaft #3 loadings to the receiving environment (McArthur River Sta. 2.7).**

	Total Water Discharged (m <sup>3</sup> )	Total Loadings (kg) <sup>1</sup>			
		Uranium	Molybdenum	Selenium	Arsenic
2013	358,837	0.36	2.20	0.072	0.036
2014	258,048	0.28	2.08	0.068	0.034
2015	130,249	0.10	0.76	0.026	0.013
2016	95,913	0.08	0.53	0.019	0.010
2017	214,437	0.20	1.01	0.043	0.045
2018	333,830	0.30	1.77	0.050	0.059
2019	435,631	0.36	1.65	0.044	0.044
2020	515,073	0.38	2.26	0.052	0.052
2021	480,389	0.72	2.33	0.048	0.048
2022 (to end of Q3)	389,211	0.51	1.74	0.041	0.039

<sup>(1)</sup> Total loadings (kg) are calculated as annual mean concentration multiplied by the total water discharged (m<sup>3</sup>). When annual mean concentrations are below detection limit, detection limit value is used for total loadings calculation.

### 3.10.2 Environmental Code of Practice

As noted previously, Key Lake and McArthur River worked with the CNSC to implement changes to treated water action levels in accordance with Canadian Standards Association N288.8-17 *Establishing and Implementing Action Levels for Releases to the Environment from Nuclear Facilities*. Implementation was completed in April 2022. At Key Lake, there were two pH limit exceedances and one environmental action level exceedances during the licence term.

In December 2013, approximately 200 m<sup>3</sup> of reverse osmosis treated groundwater with a pH of 10.8 was released to Horsefly Lake at the discharge location following an upset condition in the RO plant. The pH was above the upper pH limit (9.5) specified in the *Metal Mining Effluent Regulations* and the maximum grab sample limit within the provincial operating approval (9.5). Following the release, Cameco investigated and then identified and implemented corrective actions. Downstream monitoring confirmed that pH continued to meet all regulatory requirements and that there was no impact to the receiving environment.

In October 2018, approximately 10 m<sup>3</sup> of effluent was released from the reverse osmosis treatment plant with an elevated pH value. The field pH measured 10.16 and was above the upper pH limit specified in the *Metal and Diamond Mining Effluent Regulations* and the maximum grab sample limit within the provincial operating approval. An investigation was completed, and corrective actions were subsequently implemented to

prevent reoccurrence. Supplementary monitoring downstream confirmed there was no impact to the receiving environment.

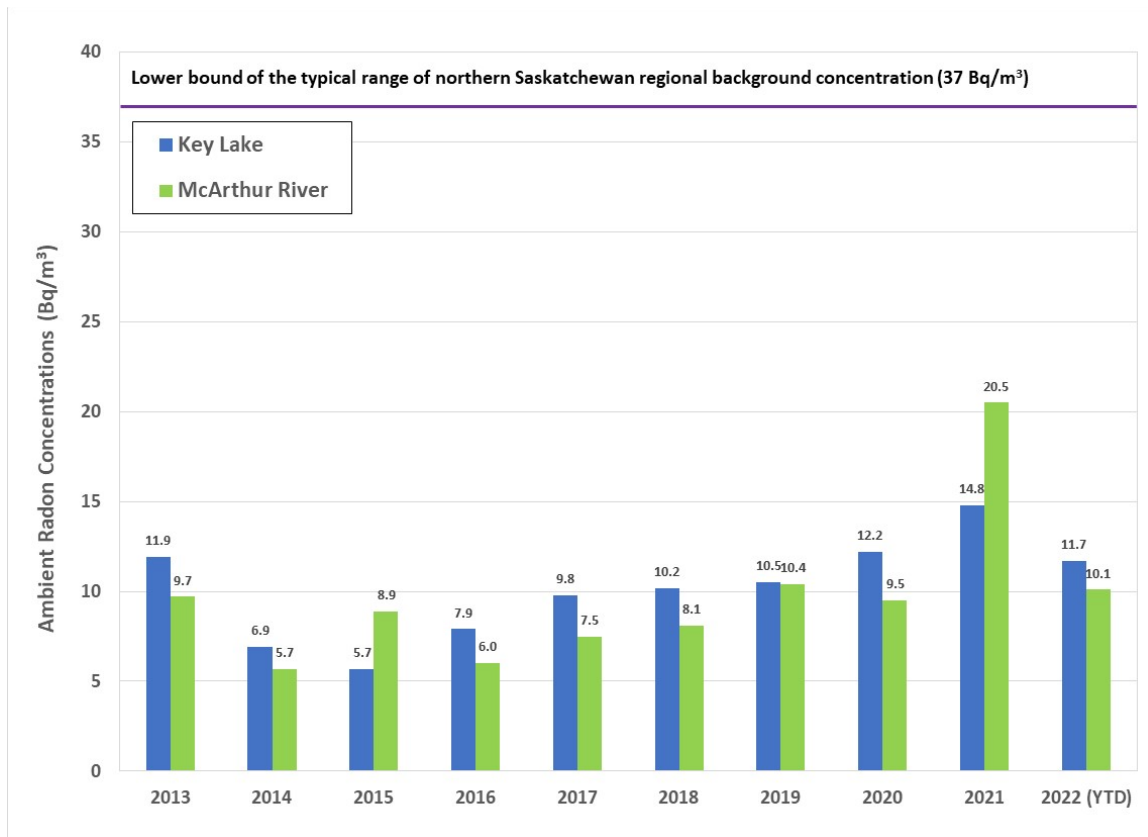
In October 2022, the environmental action level for uranium concentration in treated water was exceeded for a single pond released at Station 1.4. The pond fill composite uranium concentration was 81 ug/L, which exceeds the 80 ug/L action level. This event is currently under investigation.

There was one environmental action level exceedance that occurred at McArthur River during the licence term. In February 2018, a discrepancy was noted between test results on samples of treated water from the McArthur River laboratory and results from other laboratories. Test results from other laboratories confirmed that the action level for radium in treated water was exceeded during February. Cameco conducted an investigation to determine the cause of the discrepancy. Testing was completed at other laboratories until the cause of the discrepancy was identified and procedures updated to prevent a reoccurrence. There was no effect on the environment or the health and safety of personnel. The corrective actions from this incident were:

- McArthur River relied on Key Lake laboratory results for pond releases until the McArthur River analysis issue was resolved.
- Adjusted the analytical methodology at the site lab to include the pre-treatment of the samples to allow the consistent analysis of Radium-226 and enhanced QA/QC program and internal audits at all site labs, where required.
- Enhanced cross-site and cross-functional training during the care and maintenance period.
- Revised and provided awareness of water treatment plant procedures that cover anticipated operational scenarios.
- Evaluated triggers set in the environmental database.
- Reviewed the volumes of reagents on hand.

### **3.10.3 Air Quality**

Ambient air quality monitoring is an integral part of the environmental monitoring programs at Key Lake and McArthur River. Environmental monitoring for ambient radon concentrations is conducted semi-annually using passive sampling units (i.e., track etch cups). Monitoring is conducted at representative locations surrounding the Key Lake and McArthur River lease boundaries. During the current licence term, the ambient radon concentrations shown in Figure 3.10-1 were less than the typical range of northern Saskatchewan regional background concentrations, which range from 37 to 74 Bq/m<sup>3</sup>.



**Figure 3.10-1: Ambient air quality radon monitoring concentrations.**

In addition to radon sampling, both operations utilize high-volume air samplers for monitoring of particulate matter, metals and radionuclides. Table 3.10-5 and Table 3.10-6 provide a summary of the annual mean concentrations of particulate matter and select metals for Key Lake and McArthur River, respectively. The results show that the ambient air quality at both operations was well below the reference criteria during the current licence term.

**Table 3.10-5: Key Lake ambient air quality monitoring annual mean concentrations.**

	Particulate Matter ( $\mu\text{g}/\text{m}^3$ ) <sup>1</sup>	Metals ( $\mu\text{g}/\text{m}^3$ ) <sup>2</sup>		
		Arsenic	Nickel	Uranium
2013	14.1	0.0017	0.0012	0.0065
2014	15.1	0.0044	0.0034	0.0079
2015	13.8	0.0016	0.0013	0.0080
2016	10.8	0.0008	0.0007	0.0076
2017	11.9	0.0043	0.0029	0.0085
2018	8.8	0.0021	0.0011	0.0012
2019	6.9	0.0021	0.0017	0.0008
2020	6.0	0.0008	0.0006	0.0002
2021	6.7	0.0006	0.0007	0.0003
2022 (to end of Q3)	6.7	0.0003	0.0003	0.0003
<b>Reference Value</b>	<b>60</b>	<b>0.04</b>	<b>0.06</b>	<b>0.06</b>

<sup>(1)</sup> Reference value from SMOE, Table 20: *Saskatchewan Ambient Air Quality Standards (SAAQS)*. Values are calculated as geometric means.

<sup>(2)</sup> Metal reference annual air quality levels derived from the Ontario Ministry of Environment's *Ontario's Ambient Air Quality Criteria* and are shown for reference only.

**Table 3.10-6: McArthur River ambient air quality monitoring annual mean concentrations.**

	Particulate Matter ( $\mu\text{g}/\text{m}^3$ ) <sup>1</sup>	Metals ( $\mu\text{g}/\text{m}^3$ ) <sup>2</sup>		
		Arsenic	Nickel	Uranium
2013	5.5	0.00010	0.00070	0.00050
2014	4.9	0.00010	0.00085	0.00050
2015	5.1	0.00010	0.00067	0.00030
2016	2.2	0.00009	0.00070	0.00040
2017	3.2	0.00010	0.00070	0.00030
2018	1.7	0.00006	0.00060	0.00010
2019	2.5	0.00004	0.00054	0.00010
2020	1.3	0.00005	0.00049	0.00009
2021	2.2	0.00005	0.00064	0.00009
2022 (to end of Q3)	2.9	0.00005	0.00046	0.00014
<b>Reference Value</b>	<b>60</b>	<b>0.04</b>	<b>0.06</b>	<b>0.04</b>

<sup>(1)</sup> Reference value from SMOE, Table 20: *Saskatchewan Ambient Air Quality Standards (SAAQS)*. Values are calculated as geometric means.

<sup>(2)</sup> Metal reference annual air quality levels derived from the Ontario Ministry of Environment's *Ontario's Ambient Air Quality Criteria* and are shown for reference only.

Additional air and terrestrial monitoring are also conducted at the operations as part of the approved environmental monitoring programs. At Key Lake, this includes point source (stack) monitoring at two locations from the Key Lake mill as well as ambient monitoring for sulphur dioxide (when in operation). Both Key Lake and McArthur River also conduct soil and vegetation sampling to assess potential impacts from air emissions (see Section 3.10.5.2).

### 3.10.4 Environmental Risk Assessment

In accordance with CSA N288.6-12 *Environmental risk assessments at Class 1 nuclear facilities and uranium mines and mills*, environmental risk assessments (ERAs) for Key Lake and McArthur River are reviewed or updated on a five-year cycle. During the current licence term, Cameco completed two ERAs (2015 and 2020) for McArthur River. Assessments were completed for Key Lake in 2013 and 2020, with a review conducted in 2018 in alignment with the CSA N288.6 standard.

Historic measured loadings to the receiving environment, combined with predicted future loadings for continued mining and milling at Key Lake and McArthur River are input to the respective ERAs. The ERAs are important tools to assess potential future effects to

the environment and human health from the continued operations and decommissioning for the operations.

The most recent ERAs for Key Lake and McArthur River were completed in 2020 and were completed in accordance with CSA N288.6. These ERAs concluded that both Key Lake and McArthur River remain within the objective of the licensing basis and that human health and the environment in the vicinities of the operations remain protected. Cameco posts summaries of the current ERAs on our website [3, 4].

### **3.10.5 Environmental Monitoring Program**

#### **3.10.5.1 Aquatic Environment**

Key Lake and McArthur River also conduct comprehensive aquatic environment monitoring to meet the requirements of the Environmental Effects Monitoring (EEM) program in accordance with the *Metal and Diamond Mining Effluent Regulations* (MDMER), as well as the Environmental Management Program (EMP) requirements as outlined in each operations' *Environmental Protection Program* and SMOE Approval to Operate Pollutant Control Facilities.

Specific to Key Lake, during the licence term monitoring programs were completed in the David Creek drainage in 2016, 2019 and 2022 to satisfy EEM requirements. As the 2022 EEM program included a desktop component, additional monitoring to satisfy provincial and CNSC requirements was completed in 2022.

In addition to the above programs, in 2017, Cameco completed the final requirements of the Key Lake Molybdenum and Selenium Follow-up Program. The program included routine effluent and receiving water quality, sediment quality and fish chemistry monitoring throughout the David Creek drainage.

The program demonstrated that with few exceptions, molybdenum and selenium concentrations in the treated effluent and surface waters were stable or decreasing throughout the drainage, and several decreases in fish tissue concentrations were noted. As water quality was collected on a routine basis, and sediment and fish tissue are sampled within the EMP, it was concluded that current monitoring requirements were sufficient, and that the formal follow-up program could conclude.

The results of the 2022 David Creek drainage EMP indicated similar sediment quality to previous monitoring years in Unknown and Delta lakes, decreasing selenium concentrations in the tissues of small-bodied fish, and either no change or decreasing concentrations/specific activities of the licenced constituents in large-bodied fish tissues in Delta Lake.

Measured concentrations of selenium in spottail shiner whole body and ovaries, northern pike flesh and ovaries, and white sucker flesh from Delta Lake were the lowest measured

since monitoring began. This evidence supports that selenium concentrations continue to improve in Delta Lake.

Cameco conducts sampling of the McDonald Creek drainage every three years, with programs completed in 2016, 2019 and 2022. Fish chemistry monitoring is conducted every six years, with the most recent program taking place in 2022. Results from the recent program demonstrated sample results are similar to previous monitoring years. During the licence term, Cameco completed EEM monitoring programs at McArthur River in 2016, 2019 and 2022. As the 2019 program included a desktop component, additional fish chemistry monitoring was completed for the EMP.

The 2022 EMP demonstrated that temporal comparisons of the sediment quality data showed declines in molybdenum concentrations in both near- and far-field sampling areas as well as declines in selenium concentrations in the near-field exposure area from levels observed in 2007. Results from the fish chemistry component were lower than those observed during previous monitoring periods, with selenium concentrations remaining below the applicable criteria.

### **3.10.5.2 Terrestrial Environment**

In addition to comprehensive aquatic monitoring, Key Lake and McArthur also monitor the terrestrial environment in accordance with each operations' *Environmental Protection Program* and SMOE Approval to Operate Pollutant Control Facilities requirements.

Currently, Cameco conducts monitoring on a five-year frequency at Key Lake, with programs completed during the licence term taking place in 2016 and 2021. Soil and lichen are collected to monitor the potential influences of air emissions on the surrounding environment. Results from the 2021 program indicated the majority of licensed parameters are comparable to, or lower than, historical results and the presence of a healthy lichen community.

Prior to 2022, terrestrial monitoring programs were completed at McArthur River every three years with sampling taking place in 2015, 2018 and 2021 during the licence period. Sampling focused on blueberry plants, soil, and lichen. Results from the 2021 program were comparable to historical results, and given the results of previous programs, the frequency of the terrestrial monitoring was adjusted to a six-year frequency in 2022.

### **3.10.6 Environmental Performance Report**

The Environmental Performance Report (EPR) is a requirement of the SMOE for mining operations in the province of Saskatchewan. The EPR provides an update, assessment, and summary of the operationally relevant environmental data and other information relating to performance of Key Lake and McArthur River. The report also provides comparison of the current study period results to predictions made in the relevant ERA documents. The EPR includes an overall evaluation of environmental monitoring and the

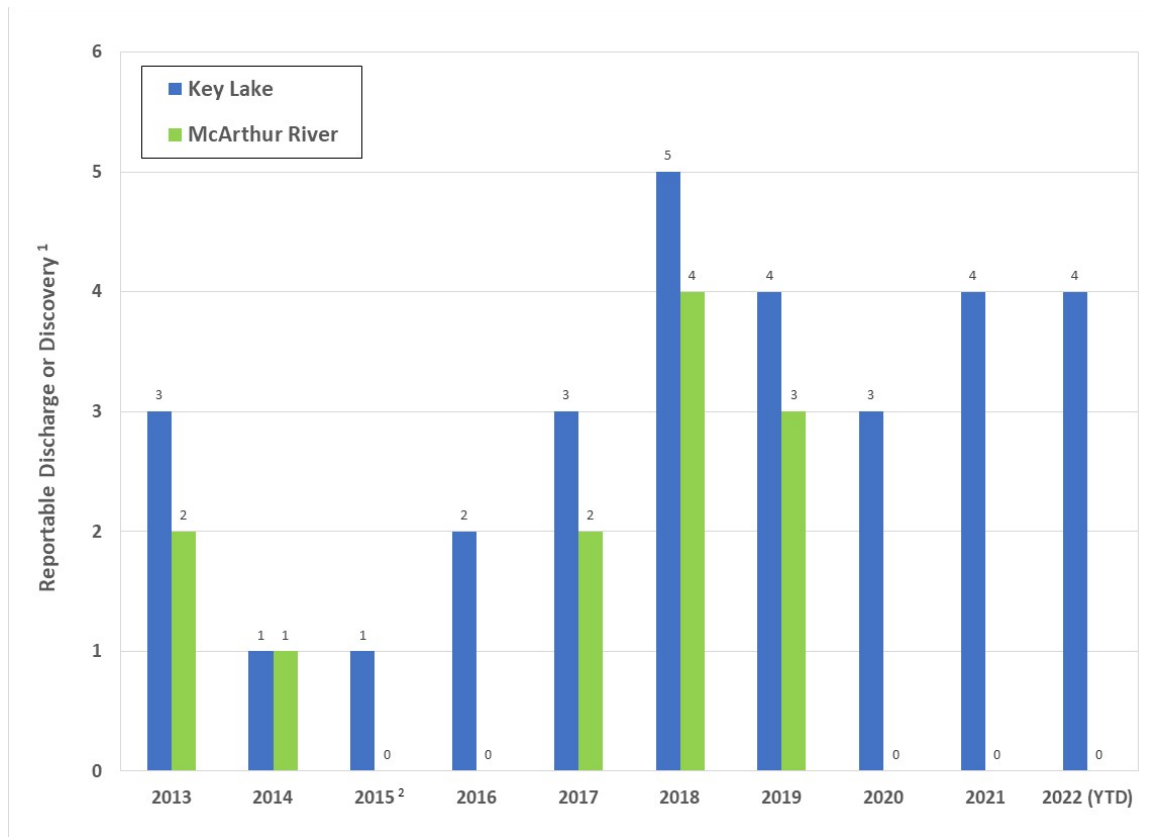


environmental condition around the sites of Key Lake and McArthur River. Further, the EPR provides recommended improvements to operational monitoring activities and programs.

In accordance with the provincial requirements, Cameco completes the EPR on a five-year cycle. During the current licence term, EPRs were submitted in 2015, which captured the years 2010 to 2014 inclusive and in December 2020, which captured the years 2015 to 2019 inclusive. Overall, both EPRs completed in the licence term demonstrated that Key Lake and McArthur River are performing within the scope of their respective environmental monitoring programs and predictions of previous ERAs. Further, the EPRs concluded that the environment and human health in the vicinity of the site remains protected.

### **3.10.7 Reportable Discharges and Discoveries**

During the licence term, 30 events at Key Lake and 12 events at McArthur River were reported to CNSC that were classified as reportable discharges or discoveries in accordance with the regulations of the Province of Saskatchewan. Cameco's timely response and implementation of corrective actions resulted in minimal impact to the environment for all events. All reportable discharges, including a summary of the event, are posted on the Cameco website. A summary of reportable discharges and discoveries during the licence term is provided in Figure 3.10-2.



(1) Includes discharges of treated effluent in accordance with provincial legislation.

(2) New legislation introduced by the Province of Saskatchewan in 2015, provided new criteria for classification of reportable discharges and discoveries.

**Figure 3.10-2: Key Lake and McArthur River reportable discharges and discoveries.**

### 3.10.7.1 Key Lake Discoveries in Groundwater

During a review of Key Lake groundwater monitoring data in 2018, Cameco noted that a groundwater monitoring well near the molybdenum extraction building showed an increase in uranium concentrations. Follow up groundwater sampling and analysis confirmed the increase in uranium concentrations in this area and the event was reported in December 2018. Cameco investigated the potential cause of the release, which indicated the likely source was from the sump area in the molybdenum extraction building. In accordance with the Saskatchewan Environmental Code, Cameco contracted a third-party expert to conduct a site assessment in the area to inform the development of a corrective action plan.

Field work, including installation and monitoring of additional groundwater monitoring wells, was completed in 2019 with the final site assessment report submitted in 2020. The subsequent corrective action plan, approved by the CNSC and SMOE in 2021, was also prepared by a third-party expert and included an ERA to assess the potential effect of the uranium in groundwater to downstream receptors. The results of the ERA indicated that there was no discernible influence on the predicted surface water and sediment quality as

a result of the elevated uranium concentrations identified in groundwater. However, Cameco is implementing additional remediation to recover and treat the groundwater in this area. Based on a capture zone analysis for the uranium plume, groundwater recovery wells were drilled in 2021 and Cameco is installing the associated infrastructure to collect the groundwater for treatment within the mill bulk neutralization circuit.

During additional groundwater sampling as part of the 2018 molybdenum extraction building event site assessment, elevated COPCs, specifically ammonia and sulfate, were observed in two of the newly installed deeper groundwater monitoring wells. Based on an examination of all 2020 and 2021 sampling results, the elevated COPCs observed in these wells was deemed not related to the 2018 molybdenum extraction building event. As such, Cameco reported these elevated COPCs as a new discovery in June 2021. Upon an assessment of the concentrations and distribution of COPCs in the groundwater samples, it was deemed likely that a release to the environment occurred prior to Key Lake going into a state of care and maintenance in 2018.

Cameco contracted a third-party expert to conduct a site assessment in the area and develop the associated corrective action plan for the elevated ammonia and sulfate identified in groundwater. The site assessment was completed in May 2022 and the associated corrective action plan is nearing completion. Further, as a result of these events, Key Lake is currently undertaking additional inspections and repairs, as required, of containment systems within the Key Lake mill.

Throughout this process, Cameco provided updates to Indigenous communities located in the vicinity of Key Lake and McArthur River in accordance with Cameco's Collaboration Agreements and *Public Information Programs*. More specifically, regular updates on the status of the site assessments and corrective actions plans were provided at quarterly meetings with the Joint Engagement Subcommittee (JIES), the Joint Engagement and Environment Subcommittee (JIEES) and the Lac La Ronge Indian Band (LLRIB) Traditional Lands and Resource Advisory Committee (LLRIB Committee).

### **3.10.8 Future Plans**

Throughout the next licence term, Key Lake and McArthur River will continue to examine opportunities to more efficiently manage and treat water, with the goal to reduce loadings of COPCs to the environment. Further, Cameco is also undertaking further assessment and, where required, upgrades to engineered containment systems and their associated inspection and maintenance programs to prevent future releases to groundwater.

### **3.10.9 Conclusions**

The KEY-EMP and MCA-EMP are both effectively managed and have not only ensured the operations remain in compliance with all environmental regulations, but also that potential environmental impacts are controlled and monitored. During the current licence

term, both Key Lake and McArthur River demonstrated effective protection of the environment.

### **3.11 Emergency Management and Fire Protection**

The Key Lake and McArthur River *Emergency Preparedness and Response Programs* (KEY-EPRP and MCA-EPRP) and *Fire Protection Programs* (KEY-FPP and MCA-FPP) describe how these operations prepare for and addresses emergencies that may impact the health and safety of the workforce, the environment and the protection of property. Together, they ensure that appropriate emergency response and contingency plans and procedures are developed, maintained and readily available for use.

As with the other safety and control areas, risks are systematically identified and managed through the use of administrative and engineered controls. Administrative controls include, but are not limited to training, routine drills and exercises, communication protocols and the development of knowledgeable emergency response teams (ERT) and a mine rescue team (MRT) responsible for responding to emergencies. Engineered controls include alarms (fire and smoke sensors, underground stench and winter mint gas systems), emergency facilities (health centre, fire hall and underground refuge stations) and equipment (fire truck, ambulance, and spill response equipment). Cameco's periodic audits, reviews and self-assessments help identify improvements and provide assurance that the management systems are functioning effectively and efficiently.

#### **3.11.1 Discussion**

##### **3.11.1.1 Emergency Management**

Throughout the current licence term, Cameco's ERT and/or the MRT safely responded when required to do so. Debrief meetings were held after each event with the objective of identifying strengths and opportunities for improvement. Cameco reports instances of ERT and/or MRT mobilization to the CNSC Duty Officer as required by the CNSC and posts information specific to these events on our website.

Emergency response plan training is provided to all new workers, including identification of responsibilities during an emergency. Further, training in all aspects of emergency response, including mine rescue and firefighting continues at Key Lake and McArthur River. New members are certified for underground mine rescue by the provincial Mine Rescue Coordinator. Cameco maintained adequate ERT and MRT capacity at Key Lake and McArthur River during the care and maintenance period. As activities have increased following the announcement to resume production, the number of ERT and MRT workers have increased to provide additional capacity and flexibility. Currently, Key Lake and McArthur River are targeting approximately 40 trained ERT/MRT at each operation and will be looking to work with the province on certification of these workers once training is complete.

Cameco completes testing of the KEY-EPRP and MCA-EPRP, included that required by provincial and federal legislation, through tabletop exercises, drills, or simulations. The testing is intended to evaluate emergency preparedness, increase awareness, familiarity, and confidence, as well as validate its effectiveness. Cameco carries out all testing of the KEY-EPRP and MCA-EPRP in accordance with internal, provincial, and federal regulatory requirements. A summary of the testing conducted during the current licence term is provided in Table 3.11-1 and Table 3.11-2.

***Table 3.11-1: Key Lake emergency response testing.***

	<b>Tabletop Exercises</b>	<b>Drills</b>	<b>Simulations</b>
2013	2	15	4
2014	1	19	2
2015	1	18	2
2016	1	18	6
2017	3	16	5
2018	3	20	3
2019	3	12	2
2020	3	11	3
2021	5	11	5
2022	6	25	7

**Table 3.11-2: McArthur River emergency response testing.**

	<b>Tabletop Exercises</b>	<b>Drills</b>	<b>Simulations</b>
2013	1	15	2
2014	1	17	1
2015	1	25	1
2016	1	19	1
2017	1	26	1
2018	0	9	2
2019	2	7	2
2020	3	9	3
2021	1	6	2
2022	3	11	3

In addition to on-site training and testing, response team members have showcased their skills by participating in annual provincial mine rescue competitions sponsored by the Saskatchewan Mining Association.

### 3.11.1.2 Fire Protection

Fire protection at Key Lake and McArthur River is facilitated by the KEY-FPP and MCA-FPP. These programs are in compliance with provincial legislation, which incorporate by reference the *National Fire Code of Canada* and the *National Building Code of Canada*, including applicable province-wide prescribed exemptions and other modifications. These programs ensure effective management of fire prevention, detection and suppression systems and processes at the operations. Cameco also commissions third-party experts to conduct fire hazard assessments and fire protection audits at our operations. During the current licence term, these assessments did not identify any significant issues related to fire protection measures. Other (minor) recommendations from these assessments are tracked and completed within Cameco's corrective action process.

### 3.11.2 Future Plans

The KEY-EPRP, MCA-EPRP, KEY-FPP, and the MCA-FPP are meeting regulatory requirements, with training and testing as a key component of ongoing efforts for continuous improvements of the programs. Cameco is also working towards implementation of CSA N393-13, *Fire protection for facilities that process, handle, or store nuclear substances* by December 31, 2023. Overall, the operations have been diligent in dealing with corrective action items and working to ensure compliance. In this

regard, Key Lake and McArthur River continue to make adequate provision for the protection of the environment, as well as the health and safety of persons.

### **3.11.3 Conclusions**

Key Lake and McArthur River are meeting regulatory requirements with respect to emergency management and fire protection. Ongoing training opportunities are being provided to response team members, with scheduled training courses being offered weekly. Third-party expert assessments have indicated that the fire protection and fire hazards are well managed through on-site fire response systems. The operations continue to make adequate provision for the protection of the environment, as well as the health and safety of persons, through the well-established programs.

## **3.12 Waste Management**

Waste management activities at Key Lake and McArthur River are described within the Key Lake *Waste Management Program* (KEY-WMP) and the McArthur River *Waste Management Program* (MCA-WMP). In accordance with these programs, Cameco manages and disposes of wastes in compliance with applicable laws and regulations and in accordance with generally accepted industry practices in a manner that mitigates potential adverse impacts to human health and the environment. Key Lake and McArthur River dispose of waste on site only when it cannot be practically reduced, reused, recycled, and/or recovered (4Rs). Quantities of wastes produced, recycled, stored, and disposed of and the locations used for waste storage and disposal are tracked as part of the KEY-WMP and MCA-WMP.

### **3.12.1 Key Lake**

The KEY-WMP applies to the management of tailings, waste rock, solid waste and liquid waste. A detailed breakdown of the waste types generated at Key Lake and their storage or disposal location is provided in Table 3.12-1.

**Table 3.12-1: Key Lake waste types and storage locations.**

Waste Type		Storage/Disposal Location
Tailings	Tailings from milling of the Gaertner and Deilmann orebodies	AGTMF
	Tailings from milling of the final ore from the Gaertner and Deilmann orebodies Tailings from milling of McArthur River orebody and associated blend materials.	DTMF
Waste Rock	Non-mineralized overburden from open pit mining of the Deilmann and Gaertner orebodies	Gaertner Waste Rock Pile Deilmann North Waste Rock Pile Deilmann South Waste Rock Pile
	Special waste rock	Deilmann Special Waste Pad Gaertner Special Waste Pad
	McArthur River low-grade mineralized material	Ore and mineralized material lined storage pad area
	Nickel rich waste rock from historical Key Lake mining activities	Gaertner Pit
Solid Waste	Non-contaminated waste	Landfill
	Potentially contaminated waste (from Key Lake and McArthur River)	AGTMF
	Hazardous substances and waste dangerous goods (HSWDG)	HSWDG areas, including storage units
	Recyclable or reusable materials	Temporary laydown areas
Liquid Waste	Water from the Deilmann/Gaertner dewatering system	Treated in the reverse osmosis water treatment plant
	Potentially contaminated water	Treated in the mill bulk neutralization circuit
	Sewage	

Low-grade mineralized material from McArthur River is temporarily stored on the Phase 1/2 ore pads or the Phase 3/4 mineralized material pads at Key Lake. Material on these pads is selected to provide the appropriate blend with the McArthur River high-grade ore slurry for processing in the Key Lake mill.

The Key Lake waste ticketing system requires the waste generator to initiate a waste ticket for the disposal of contaminated waste in the AGTMF or non-contaminated waste in the landfill. Key Lake personnel are required to document the type and quantity of waste material on the waste ticket. To ensure the waste handling process is being carried



out properly, routine checks are completed at the landfill and the AGTMF. Contaminated waste transported to Key Lake from McArthur River is also subject to the waste ticketing process.

### **3.12.1.1 Progressive Reclamation**

Cameco's reclamation efforts during the licence term at Key Lake included ongoing monitoring of the cover and vegetation trials in place on the Deilmann North Waste Rock Pile. The proposed strategy for reclaiming the Deilmann North Waste Rock Pile is to recontour the pile and compact the surface of the waste rock prior to placement of a store and release engineered cover system over the entire exposed waste rock surface. This strategy is similar to that utilized by Cameco for reclamation of the Rabbit Lake B-Zone Waste Rock Pile in 2013.

In 2010, Cameco established a field scale cover trial area to assess the proposed cover design (Figure 3.12-1) and in parallel established vegetation trials to assess the use of soil amendments to accelerate re-vegetation. Based on the information and knowledge acquired from the field scale tests (both cover trial and vegetation trials), Cameco submitted a detailed design package in 2015. Cameco received comments from the CNSC outlining concerns with the proposed design and subsequently deferred construction of the project and responded to the comments. Since deferral, soil amendments were added to the cover trial plot and seedlings planted to establish vegetation on the cover trial area. Evaluation of the cover system performance is currently ongoing. Additionally, in 2021, Cameco installed monitoring wells through the DNWRP and collected core samples of the waste rock. The monitoring wells, in combination with additional testing on the core samples will be utilized to review and validate the characterization of the DNWRP.



***Figure 3.12-1: Deilmann North Waste Rock Pile cover trial area.***

In 2015, Key Lake also successfully reclaimed the former Heap Leach facility area. The Heap Leach facility was a test area constructed in 1987 with field testing conducted in 1988 and 1989. Subsequently, the facility was neutralized and modified to be used as an engineered cover test site in 1992. The material from the area, including the cover material, liner infrastructure and underlying soils were excavated and disposed of at the Key Lake AGTMF. The final area was graded and revegetated as detailed in the as-built report submitted in 2015, which was accepted by CNSC staff in November 2015. Currently, vegetation throughout the facility continues to take hold and Key Lake continues to visually inspect the area on an annual basis.

### **3.12.2 McArthur River**

The MCA-WMP applies to the management of waste rock, solid waste, and liquid waste. A detailed breakdown of the waste types generated at McArthur River and their storage or disposal locations is provided in Table 3.12-2.

**Table 3.12-2: McArthur River waste types and storage locations.**

Waste Type		Storage/Disposal Location
Waste Rock	Clean waste rock	Clean waste rock pile
	Low-grade mineralized material	Lined storage pad area
	Potentially acid generating waste rock	Lined storage pad area
Solid Waste	Non-contaminated waste	Landfill
	Potentially contaminated waste	Contaminated materials management area prior to transport to Key Lake AGTMF
	Water treatment plant solids residue or filter press material	Lined storage pad area
	Hazardous substances and waste dangerous goods (HSWDG)	HSWDG areas
	Recyclable or reusable materials	Temporary laydown areas
Liquid Waste	Potentially contaminated water	Collected in lined ponds prior to treatment in the water treatment plant
	Sewage	Facultative treatment lagoon system

During the licensing term, McArthur River has made efforts to reduce the amount of non-contaminated waste disposed of at the landfill. Recycling efforts have reduced annual non-contaminated waste disposed of at the landfill from approximately 3,400 m<sup>3</sup> in 2013 to 3,100 m<sup>3</sup> in 2017, prior to suspension of production at McArthur River. The annual non-contaminated waste disposed of at the landfill was further reduced when production was suspended at McArthur River. This was achieved through increased emphasis on the 4Rs program across the operation.

Cameco also undertook measures to reduce the volume of contaminated solid waste from McArthur River that is transported to Key Lake for disposal in the AGTMF through increased emphasis on waste segregation and classification. During the licence term, the annual volume of contaminated waste sent off site was reduced from approximately 6,000 m<sup>3</sup> in 2013 to 3,400 m<sup>3</sup> in 2017, prior to suspension of production at McArthur River.

### 3.12.2.1 Progressive Reclamation

Cameco's reclamation efforts during the licence term at McArthur River included regrading of the borrow area known as Kirsch Pit, as well as ongoing revegetating areas of the operation that are no longer required to support mining activities or need to be stabilized against erosion. During the current licence term, approximately 13 hectares have been revegetated at McArthur River.

### 3.12.3 Future Plans

Despite many more years of planned production ahead, Key Lake and McArthur River endeavour to undertake progressive reclamation in areas of the operations that are no longer required for future mining or milling activities. Further, Key Lake and McArthur River will continue to look for opportunities to reduce wastes generated and wastes requiring disposal on site during the next licence term. During the current licence term, McArthur River received approval for expansion of the site domestic landfill. Construction of this landfill expansion will take place during the next licence term.

Cameco will continue to work towards fully addressing the regulatory comments with respect to the performance of the DNWRP cover through ongoing monitoring of the cover trial. Cameco anticipates providing an update on the performance of the vegetated cover in conjunction with a finalized detailed design and construction schedule. Pending regulatory approval, Cameco anticipates proceeding with construction during the proposed 20-year licence period.

### 3.12.4 Conclusions

The KEY-WMP and MCA-WMP are effective in ensuring volumes of waste material are being reduced wherever possible and that all waste generated is being tracked and handled in a way that is protective of the environment. The mature waste management programs at Key Lake and McArthur River continue to adequately protect the environment, as well as the health and safety of persons.

## 3.13 Security

The Key Lake *Security Program* (KEY-SP) and McArthur River *Security Program* (MCA-SP) are designed to prevent the loss or theft of nuclear materials and substances and to prevent the interference of safe activities at Key Lake and McArthur River.

### 3.13.1 Discussion

Specific to the KEY-SP and MCA-SP, Cameco conducts Threat, Risk and Vulnerability Assessments (TRVAs) to ensure appropriate security measures are taken for potential threats. The TRVAs are completed in accordance with the International Atomic Energy Agency document *Nuclear Security in the Uranium Extraction Industry*. The objectives of the TRVA are to:

- Identify important material and sensitive information that needs protection.
- Identify and assess potential threats to the materials and information.
- Assess the risks associated with each threat to determine the estimate probability of occurring and potential consequences.

- Identify existing vulnerabilities and opportunities for mitigation to reduce residual risk.

The scope of the TRVA includes all key processes at Key Lake and McArthur River. The TRVA also includes a general assessment of the security measures. The assessment methodology consists of a review of security procedures, observations of security measures and discussions with select Key Lake and McArthur River employees. A hazard/risk list is compiled and maintained by the operations. The most recent TRVAs for Key Lake and McArthur River were completed in 2021 and noted that, due to the remote nature of the operations, the security risk is considered low and that current security measures are sufficient to address the current threat level.

### **3.13.2 Future Plans**

Key Lake and McArthur River do not foresee any significant changes to the management of security at the operations in the next licence term.

### **3.13.3 Conclusions**

During the current licence term, there were no significant incidents or security-related issues at Key Lake or McArthur River. The KEY-SP, MCA-SP and security measures in place at the operations remain adequate and are expected to remain adequate for the upcoming licence period.

## **3.14 Safeguards and Non-proliferation**

Key Lake and McArthur River meet obligations arising from the *Canada-International Atomic Energy Agency Safeguards Agreement* through the respective *Mining Facility Licensing Manuals* and the *Access Procedures Under the Additional Protocol*.

### **3.14.1 Discussion**

In carrying out the licensed activities, Key Lake and McArthur River made adequate provision for the maintenance of national security and measures required to implement international obligations to which Canada has agreed. Conditions for the application of International Atomic Energy Agency (IAEA) safeguards are contained in the operating licence and criteria in order to meet the conditions contained in the LCH and in CNSC REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*. Cameco reports production results in detail on an annual basis to the CNSC in accordance with international requirements. The IAEA was granted complementary access to Key Lake from July 7-8, 2014, as well as to McArthur River/Key Lake for a joint site-visit from August 26-29, 2019. No issues were identified by the IAEA as part of these activities.

### 3.14.2 Future Plans

Key Lake and McArthur River will continue to ensure Canada's international obligations to safeguard nuclear materials are being met during the next licence term.

### 3.14.3 Conclusions

Key Lake and McArthur River continue to ensure Canada's international obligations to safeguard nuclear materials are being met.

## 3.15 Packaging and Transport

The Key Lake *Transportation Program* (KEY-TP) and McArthur River *Transportation Program* (MCA-TP) apply to the activities required to manage transportation activities at the operations. The KEY-TP and MCA-TP detail the methods and practices that are utilized for transportation of bulk commodities, freight, low-grade mineralized material, ore slurry and waste materials to and from Key Lake and McArthur River.

### 3.15.1 Discussion

The shipment of uranium ore slurry and waste rock from McArthur River to Key Lake has been safely handled since late 1999. In the most recent year of production (2017), McArthur River shipped over 4,000 slurry trucks in total to Key Lake, with an additional 1,700 truckloads of low-grade mineralized material. In 2018, Cameco submitted an application to the CNSC to re-define low-grade mineralized material at McArthur River to include material with a uranium content not exceeding 3% by mass. This application was made following the revision of the *Packaging and Transport of Nuclear Substances Regulations, 2015* changing the definition of LSA-I material to include up to 3% uranium by mass.

When in production, shipments of drummed yellowcake from Key Lake occur on a daily basis. For North American shipments, drums are loaded and secured in dry van semi-trailer loads for shipments to Cameco's Blind River refinery or a similar uranium fuel processing facility in the United States.

The transportation of bulk commodities and freight are also included within the KEY-TP and MCA-TP. Similarly, Key Lake and McArthur River have managed these materials safely during the licence term. There were four incidents at Key Lake and three incidents at McArthur River involving transport during the current licence term. None of the incidents resulted in health or radiological effects, or releases to the environment. In accordance with Cameco's corrective action process, these incidents were investigated, and Cameco put in place corrective actions.

### **3.15.2 Future Plans**

Key Lake and McArthur River believe that the KEY-TP and MCA-TP support the safe packaging and transportation of bulk commodities, freight, ore slurry and waste materials, and remain protective of the environment and the health and safety of persons.

### **3.15.3 Conclusions**

The KEY-TP and MCA-TP ensure the shipment of uranium ore slurry and low-grade mineralized material from Key Lake and McArthur River remain protective of the environment and the health and safety of persons.

## 4.0 Other Matters of Regulatory Interest

### 4.1 Indigenous Engagement

Cameco recognizes the right of Indigenous Peoples to be consulted and, where applicable, to have their interests accommodated by the Crown with respect to any activities associated with CNSC-licensed operations and projects that could potentially impact the exercise of Indigenous or treaty rights. Cameco assists the CNSC in the discharge of Indigenous consultation and accommodation obligations where they arise. The Crown's duty to consult and accommodate aligns with Cameco's corporate values, commitments, and measures of success, and as such constitutes sound business practice.

As the majority of northern Saskatchewan residents are of Indigenous origin, including First Nations and Métis, Cameco's public engagement activities relating to Key Lake and McArthur River also provide opportunities for the Province of Saskatchewan and the CNSC to effectively consult with Indigenous Peoples in northern Saskatchewan. The engagement process is described, in detail, within the Key Lake *Public Information Program* (KEY-PIP) and the McArthur *Public Information Program* (MCA-PIP).

### 4.2 Public Information Program

Consistent with Cameco's vision, mission and values and measures of success, the objective of the KEY-PIP and MCA-PIP is to ensure local target audiences with an interest in both Key Lake and McArthur River are informed on a timely basis about operations, activities, and anticipated effects on the environment and the health and safety of persons, to elicit feedback and provide meaningful response, and thereby build the trust and support of stakeholders.

The primary audience for the KEY-PIP and MCA-PIP are the rights-bearing First Nation and Métis communities, which are located in the vicinity of the site. Specifically, these communities are:

- Northern village of Pinehouse and the Kineepik Métis Local Inc. #9 (Pinehouse).
- English River First Nation (ERFN).
- Lac La Ronge Indian Band (LLRIB).
- Northern settlement of Patuanak and the Patuanak Métis Local #82.

Cameco has a longstanding history of collaboration, building relationships and maintaining commercial arrangements with these First Nation and Métis communities and municipalities. In 2012, Cameco and Orano signed a Collaboration Agreement (CA) with Pinehouse. Further, Cameco and Orano signed a CA with ERFN in 2013 and with the LLRIB in 2017. These agreements reinforce prior benefits and are structured on pillars of workforce development, business development, community investment and community engagement and environmental stewardship that include:



- Preference for hiring residents of these communities for Cameco operations and the establishment of employment targets in consultation with the communities.
- Providing career awareness programs and scholarship funding.
- Preference for community-owned businesses in meeting the service requirements for Cameco operations.
- Investing in community projects and priorities.
- Ongoing community engagement and environmental stewardship.

Since these CAs were signed, Cameco and Orano have provided significant funding for workforce development, community investment and business development initiatives. As of the end of 2021, more than \$102 million has been invested in workforce development, including salaries for members of our primary audience communities. At the end of 2022, there were 93 people from these communities employed with Cameco. With the restart announcement in 2022, Cameco has continued to build a strong workforce in northern Saskatchewan as a priority and, at the end of 2022, 51% of our workforce at the operations are Residents of Saskatchewan's North. In addition, approximately \$22 million has been invested in the communities and \$378 million spent with eligible businesses since signing.

Engagement between Cameco and the communities under the Pinehouse and ERFN agreements occurs primarily through the Joint Engagement Subcommittee (JIES) and the Joint Engagement and Environment Subcommittee (JIEES), respectively. The LLRIB has an established Traditional Lands and Resource Advisory Committee (LLRIB Committee), and Cameco continues to engage this group. These committees have the long-term objective of ensuring the operation's effects on the environment are minimized and building capacity and knowledge regarding environmental management, protection, and monitoring.

In addition to engaging with the Métis people in the vicinity of our operations, Cameco engages with the Kineepik Métis Local #9 through our CA and works with the Patuanak Métis Local #82 President.

While the rights-bearing First Nation and Métis communities under the CA, local Métis people, and Cameco employees and long-term contractors are the primary audience for the KEY-PIP and MCA-PIP, Cameco considers the general public of the Northern Administrative District (NAD) and the province of Saskatchewan generally to be a secondary audience. Cameco provides information and responds to inquiries from the NAD communities and other organizations or groups such as the Northern Saskatchewan Environmental Quality Committee that may express interest in Key Lake and McArthur River through our websites and social media channels and direct engagement when appropriate.

In addition to the primary audiences for Key Lake and McArthur River, Cameco and Orano Canada Inc. (Orano) signed a CA with the Athabasca Basin communities known

as the Ya'thi Néné CA in June 2016. Engagement between Cameco and the communities under this CA occurs primarily through the Athabasca Joint Engagement and Environment Subcommittee (AJES), previously the Athabasca Working Group (AWG). In addition, the Ya'thi Néné Lands and Resource office was established to provide support to the subcommittee and the executive director is an AJES member.

Cameco engagement activities are guided by a set of principles that were developed through roundtable consultation with northern opinion leaders. These principles are:

- Open Channels for Communication
- Make it Simple
- Build Capacity for Understanding
- Hear the Elders
- Include Youth
- Speak and Hear Our Languages

These principles guide Cameco's communication and engagement efforts in northern Saskatchewan. Face to face engagement is Cameco's preferred process for engagement as it provides the best measure of the perceptions and opinions of the target audience. However, in response to COVID, Cameco has conducted recent engagement through virtual means. These engagement activities include meetings and events in stakeholder communities and at our operations, including tours and technical workshops. Other methods of engagement utilized by Key Lake and McArthur River include conventional media, social media, and polling.

Additionally, Cameco maintains a Public Disclosure Protocol that was developed in accordance with guidance provided by the CNSC. The Public Disclosure Protocol describes the types of routine and non-routine information that Cameco is committed to providing to target audiences. The public disclosure protocol is posted on Cameco's northern community website [5].

During the licence term, both Key Lake and McArthur have continued to show the commitment to conducting engagement activities in accordance with the KEY-PIP and MCA-PIP. Engagement activities have focused on providing members of the public with ongoing updates on the operations through presentations, including discussion on the surface and underground activities.

In all, approximately 160 specific engagement events were held in the current licence term with northern Saskatchewan communities in relation to Key Lake and McArthur River activities and projected life of mine activities, among other matters. A summary of these events is provided each year in the operations' annual reports.

Specific to this licence application, Key Lake and McArthur River undertook engagement activities beginning in 2021 to make target audiences aware of the upcoming licence

renewal and provide opportunities to communicate any concerns. Updates were conducted primarily through regular quarterly JIES, JIEES and LLRIB subcommittee meetings in accordance with the operations' *Public Information Programs*. However, Cameco also took the opportunity, when available, to discuss relicensing at scheduled NSEQC meetings. Cameco also created a dedicated webpage, specific to relicensing, for posting of key information [6].

From August to October 2022, CNSC staff and subcommittee members attended site visits at McArthur River (one) and Key Lake (two), where they were provided the opportunity to tour the operations and raise any questions or concerns. Cameco and CNSC staff also attended meetings in Pinehouse, La Ronge and Patuanak on November 21 and 22, 2022 as part of relicensing-specific engagement. These community meetings enabled leadership and the general public to engage in open discussions with Cameco and CNSC staff in regard to Cameco's requested licence renewal.

### **4.3 Eastern Athabasca Regional Monitoring Program**

The Eastern Athabasca Regional Monitoring Program (EARMP) was established in 2011 under the Province of Saskatchewan's Boreal Watershed Initiative. The program is supported by contributions from several stakeholders, including the SMOE, CNSC, Cameco and Orano. The EARMP was designed to identify potential cumulative effects downstream of uranium mining and milling operations in the Eastern Athabasca region of northern Saskatchewan. The community-based component of the program partners with communities to monitor the safety of traditionally harvested country foods by collecting and testing representative water, fish, berry, and mammal tissue samples from the seven communities located in the region.

Harvesting and consuming traditional foods are an important part of the culture in northern Saskatchewan, which contributes to an overall healthy lifestyle through physical activity and healthy eating. Community members play a key role in the program, as local knowledge is used to determine locations for the water, fish, berries and mammal samples. Locations focus on areas where community members routinely fish, hunt, and gather. Samples are then collected by, or with the aid of, community members.

As part of the 2018 EARMP program, an updated Human Health Risk Assessment was completed using all water chemistry and country foods chemistry data collected from the previous 7 years in the region. The results of the assessment indicated that the consumption of local water and country foods did not present health risks to Athabasca Basin residents and was safe for consumption.

The 2021/2022 program results continue to show that country foods are safe for consumption with chemical profiles for water, fish, berry and mammal tissue samples similar to previous monitoring years and natural background.

The EARMP collected and tested over 850 water and traditional food samples from the Athabasca Region from 2011 to 2021. Results indicate that the measured concentrations in the samples are similar to baseline levels and the regional reference range, and those used in the 2018 Human Health Risk Assessment.

Results from ten years of sampling have consistently demonstrated that water and traditional foods remain safe for consumption, and that they continue to be a safe and healthy dietary choice for residents of the Athabasca Basin. The 10-year summary report, annual reports and data from the programs conducted to date are publicly available at [www.earmp.ca](http://www.earmp.ca).

#### **4.4 English River First Nation Country Foods Study**

In 2016, the English River First Nation (ERFN) secured federal funding to conduct a country foods study. The study was completed in 2017 and involved three components, including a dietary survey, sampling program, and human health risk evaluation. The involvement of community members was one of the fundamental goals of the study, which relied heavily on traditional knowledge to identify sample media and locations.

The sampling program involved collecting and analyzing country foods samples (fish, berries, birds, and mammals) from ERFN traditional hunting and gathering areas. Concentrations of parameters in the majority of country foods samples were low and often below laboratory detection levels, similar between areas, and similar to concentrations measured in northern Saskatchewan. Mercury levels in the fish collected from the ERFN study area were below guidelines for fish available in supermarkets.

The human health risk evaluation indicated that potential exposures to constituents of potential concern (COPCs) from the ingestion of country foods are below levels associated with adverse health effects, and generally within typical exposures from supermarket foods or background. Results from the program demonstrated that harvesting and eating traditional foods were integral components of good health among the ERFN, and that regularly eating locally collected fish, meat, berries and plants was safe.

The study was updated in 2021 to include additional interviews and sampling and involved a dietary survey, a sampling program, and an updated human health risk evaluation. The updated 2021 study concluded that harvesting and eating country foods are integral components of good health among the ERFN, and similar to the result of the 2017 study, locally collected fish, meat, berries and plants are safe to eat.

#### **4.5 Cost Recovery**

Cameco is in good standing with the CNSC regarding licensing fees for Key Lake and McArthur River.

## 4.6 Decommissioning and Financial Guarantees

### 4.6.1 Preliminary Decommissioning Plans and Cost Estimates

Key Lake and McArthur River maintain *Preliminary Decommissioning Plans* (KEY-PDP and MCA-PDP), which describe, at a high level, the methodology that would be undertaken to decommission the operations under a hypothetical “decommission tomorrow” scenario in the unlikely event that Cameco becomes insolvent and cannot fulfill its decommissioning obligations. The methodologies described within the KEY-PDP and MCA-PDP align with those approved through previous environmental assessments and form the basis for the accompanying *Preliminary Decommissioning Cost Estimates* (KEY-PDCE and MCA-PDCE). The KEY-PDCE and MCA-PDCE provide an estimate of the present value of the decommissioning cost, in accordance with the methodologies described within the respective *Preliminary Decommissioning Plans*. The KEY-PDCE and MCA-PDCE form the basis for each operation’s financial guarantee. Summaries of the current *Preliminary Decommissioning Plans* and *Preliminary Decommissioning Cost Estimates* are posted on the Cameco website [7, 8].

In accordance with CNSC and SMOE requirements, the documents are updated at five-year intervals or when a significant change to the operations may necessitate an update.

The current approved KEY-PDP and KEY-PDCE were submitted in August 2018 and are inclusive of anticipated activities at Key Lake to the end of 2023. Cameco submitted an updated KEY-PDP and KEY-PDCE in October 2019 to address regulatory comments, resulting in the current financial guarantee of \$222.5 million. The revised financial guarantee was approved by the CNSC through a Public Hearing in Writing in July 2020. Key Lake currently has financial instruments in place for the full amount of the approved financial guarantee.

McArthur River also has all necessary financial instruments in place for the financial guarantee amount of \$42.1 million approved by the CNSC through a Public Hearing in Writing in June 2019. The \$42.1 million financial guarantee amount is taken from the current MCA-PDP and MCA-PDCE finalized in June 2019.

Cameco submitted updated PDP and PDCE documents for both operations in 2022 as part of the regular five-year review cycle. The documents were prepared in accordance with updated compliance verification criteria documentation:

- CSA N294-19, *Decommissioning of Facilities Containing Nuclear Substances*
- CNSC REGDOC-2.11.2, *Decommissioning*
- CNSC REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities*.

The updated preliminary decommissioning plan and costs estimate documents are inclusive of anticipated activities at Key Lake and McArthur River to the end of 2028. No significant changes were proposed to decommissioning methodologies at Key Lake or

McArthur River. However, the associated cost estimates were updated to reflect current estimates of decommissioning costs. Currently, Key Lake and McArthur River are working with the CNSC and SMOE to address any comments prior to issuing final versions of the documents for acceptance. It is anticipated that the revised financial guarantees will be the subject of a CNSC Public Hearing in Writing.

## **4.7 Other Regulatory Approvals**

SMOE provides approvals for Key Lake and McArthur River in accordance with *The Environmental Management and Protection Act, 2010* of Saskatchewan and all associated regulations to assure mineral industrial operations are operated and managed in accordance with provincial legislation.

On November 29, 2021, Key Lake received an updated Approval to Operate Pollutant Control Facilities (PO21-197), from SMOE that expires November 30, 2029. This document provides approval to operate facilities, such as the tailings management facilities, waste rock storage area, water treatment facilities as well as the site landfills and hazardous substance and waste dangerous goods storage facilities at Key Lake.

On September 2, 2022, McArthur River received an updated Approval to Operate Pollutant Control Facilities (PO22-062), from SMOE that expires June 30, 2028. This document provides approval from to operate facilities, such as the waste rock storage areas, water treatment plant, the landfill and the hazardous substance and waste dangerous goods storage facilities at McArthur River.

## 5.0 Conclusions

Key Lake and McArthur River have demonstrated strong performance in all SCAs throughout the current licence term. In addition to achieving continual improvement in programs and operating performance, many improvements and upgrades to facilities are already in place or underway to support Key Lake and McArthur River's continued role as one of the largest uranium mine/mill producers in the world.

Based on our performance during the current licence period, we have demonstrated that we are qualified to carry on the licensed activities planned for the proposed 20-year licence term and will, in doing so, make the necessary provisions for the protection of the environment, as well as the health and safety of persons.

## References

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