



**2018 Third Quarter Compliance Monitoring
&
Operational Performance Report**

**Blind River Refinery
Operating Licence
FFOL-3632.0/2022**

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Executive Summary

Cameco Corporation (Cameco) is a major supplier of uranium processing services required to produce nuclear fuel for the generation of safe, clean and reliable electricity around the world. Cameco's Fuel Services Division (FSD) is comprised of the Blind River Refinery (BRR), the Port Hope Conversion Facility (PHCF), Cameco Fuel Manufacturing Inc. (CFM) and a divisional head office located in Port Hope Ontario.

BRR operates a Class IB nuclear facility in Blind River, Ontario under a Canadian Nuclear Safety Commission (CNSC) operating licence and employs approximately 120 workers. In the third quarter of 2018, Cameco operated under CNSC licence FFOL-3632.0/2022.

Cameco is committed to the safe, clean and reliable operations of all of its facilities and continually strives to improve safety performance and processes to ensure the safety of both its employees and local residents. Corporate policies and programs, including the Safety, Health, Environment and Quality (SHEQ) policy provided guidance and direction for the development of site-based programs and procedures. BRR also has a Facility Licensing Manual (FLM) that describes the commitment by Cameco Corporation to operate a safe, efficient, nuclear facility which meets the requirements of the CNSC.

As a result of these programs, plans and procedures, BRR's operation maintained radiation exposures well below the regulatory dose limits in the third quarter of 2018. Environmental emissions are being controlled to levels that are a fraction of the regulatory limits, and public radiation exposures are also well below the regulatory limits.

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1. INTRODUCTION

1.1 General Introduction

Cameco Corporation (Cameco) is a major supplier of uranium processing services required to produce nuclear fuel for the generation of safe, clean and reliable electricity around the world.

Cameco's Fuel Services Division (FSD) is comprised of the Blind River Refinery (BRR), the Port Hope Conversion Facility (PHCF), Cameco Fuel Manufacturing Inc. (CFM), and a divisional head office located in Port Hope, Ontario.

BRR operates a Class IB nuclear facility in Blind River, Ontario under operating licence FFOL-3632.0/2022. The current licence is valid until February 28, 2022. The licence includes an increase in licensed production capacity from 18,000 tonnes of uranium as UO_3 to 24,000 tonnes of uranium as UO_3 , once certain conditions have been met. While located in Blind River, the refinery is also situated adjacent to and south of the Mississauga First Nation.

BRR is the world's largest commercial uranium refinery and has been in operation since 1983. The refinery processes natural uranium ore concentrates into natural uranium trioxide (UO_3). Cameco receives uranium ore concentrates from mines and mills worldwide. The majority of the UO_3 produced at BRR is shipped to the PHCF, where it is converted to either uranium dioxide (UO_2) or uranium hexafluoride (UF_6). BRR also prepares and ships UO_3 to other customers around the world who are licensed by an equivalent authority to the CNSC in another country. BRR employs approximately 120 workers.

The refinery employs qualified personnel and has established a strong management system to ensure compliance with other federal and provincial regulations. In addition to the CNSC, BRR is regulated by federal and provincial regulators, such as the Ontario Ministry of the Environment, Conservation and Parks (MOECP), Environment and Climate Change Canada (ECCC), Employment and Social Development Canada (ESDC) and Transport Canada (TC).

In the quarter the refinery did not exceed any CNSC regulatory limits with respect to radiation exposure or environmental discharge limits.

The acronyms in the following table may be used in this report.

Table 1

List of Acronyms	
Acronym	Description
ALARA	As Low As Reasonably Achievable
BRFD	Blind River Fire Department
BRR	Blind River Refinery
CCM	Contaminated Combustible Material
CCME	Canadian Council of Ministers of the Environment
CFM	Cameco Fuel Manufacturing
CGSB	Canadian General Standards Board
CNC	Contaminated Non-combustible Material
CNSC	Canadian Nuclear Safety Commission
DRaff	Dried Raffinate
DRL	Derived Release Limit
ECCC	Environment and Climate Change Canada
ECA	Environmental Compliance Approval
ERAP	Emergency Response Assistance Plan
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESDC	Employment and Social Development Canada
FAA	First Aid Attendant
FFOL	Fuel Facility Operating Licence
FHA	Fire Hazard Analysis
FHSC	Facility Health and Safety Committee
FLM	Facility Licensing Manual
FPP	Fire Protection Program
FSD	Fuel Services Division
IAEA	International Atomic Energy Agency
IAL	Internal Administrative Level
ISI	In-Service Inspection
KPI	Key performance indicator

LCH	Licence Condition Handbook
MFN	Mississauga First Nation
MNR	Ministry of Natural Resources
MOECP	Ministry of the Environment, Conservation and Parks
mSv	millisievert
NEW	Nuclear Energy Worker
NFPA	National Fire Protection Association
NOx	Nitrogen Oxides
NPRI	National Pollutant Release Inventory
OHSAS	Occupational Health and Safety Advisory Services
OSL	Optically Stimulated Luminescence
PHCF	Port Hope Conversion Facility
PIP	Public Information Program
PIV	Physical Inventory Verification
PM	Preventive Maintenance
PWQO	Provincial Water Quality Objectives
RL	Respirator Limit
S&FP	Sample & Feed Preparation
SAT	Systematic Approach to Training
SHEQ	Safety Health Environment and Quality
SNRI	Short Notice Random Inspection
SSC	Systems Structures and Components
TC	Transport Canada
TED	Total Effective Dose
TRA	Toxics Reduction Act
UF ₆	Uranium Hexafluoride
ug U/L	micrograms of uranium per litre
UOC	Uranium Ore Concentrate
UO ₂	Uranium Dioxide
UO ₃	Uranium Trioxide
uSv	microsievert

1.2 Facility Operation

Cameco is committed to the safe, clean and reliable operations of all of its facilities and continually strives to improve safety performance and processes to ensure the safety of both its employees, and local residents.

At BRR changes to the physical design of equipment, processes and the facility with the potential to impact safety are evaluated using an internal design control process from project planning through to completion of the project. This review identifies potential impacts to the environment as well as to health and safety of personnel. There were no significant modifications carried out at the facility in the third quarter of 2018.

1.3 Production or Utilization

Detailed plant production information is considered “protected proprietary” and is submitted to CNSC staff on an annual basis under a separate cover.

1.4 Facility Modification

There were no modifications affecting the safety analysis of BRR made in the third quarter of 2018 that required written approval of the Commission or a person authorized by the Commission.

2. SAFETY AND CONTROL AREAS

2.1 Management

2.1.1 Management System

This safety and control area covers the framework which establishes the processes and programs required to ensure that the organization achieves its safety objectives and continuously monitors its performance against these objectives, as well as fostering a healthy safety culture.

BRR's operations quality assurance program identifies the controls required to ensure all processes are conducted in a safe manner and that processes applying to licensed activities are conducted in accordance with applicable CNSC quality assurance (QA) requirements and other regulatory requirements. The application of QA requirements is scaled according to the complexity and hazard potential of a particular activity.

Starting in 2017 Cameco's corporate SHEQ group assumed responsibility for completion of required internal audits at Cameco licensed facilities, including the BRR. The internal audit program encompasses all key areas of refinery operations including environmental protection, radiation safety, occupational health and safety and quality management. The most recent internal audits by the corporate SHEQ group were carried out in the third quarter of 2018. There were no significant findings identified.

All procedures that support licensed activities are subject to the site document control process. Documents that support licensed activities are maintained in electronic format on a database available to all site personnel. This includes, but is not limited to, procedures for operating and maintaining the facility, as well as environmental, health and safety, radiation protection and quality management documentation.

2.1.2 Human Performance Management

This safety and control area covers activities that enable effective human performance, through the development and implementation of processes that ensure that licensed staff members are sufficient in numbers in all relevant job areas, and have the necessary knowledge, skills and tools in place, in order to safely carry out their duties.

BRR has a sufficient number of qualified workers as well as the minimum number of responsible people to carry on the licensed activities safely and in accordance with the Nuclear Safety and Control Act and Regulations.

BRR has a number of programs, procedures and processes that combine to form the framework for a safe environment and foster a sustainable safety culture. Management has focused on enhancing the site's safety culture by establishing comprehensive environmental, radiation and health and safety programs. These programs have contributed to the development of processes and practices such as the use of hazard recognition cards for maintenance activities and self-audit hazard recognition cards for other types of work.

A range of programs are in place to ensure that employees are fit for duty. They cover human resource matters such as a program for alcohol and substance abuse, violence in the workplace, respectful workplace as well as addressing more general health matters such as medical surveillance and radiation protection monitoring.

Cameco has an audit program that routinely looks at various aspects of the site training program. Corrective actions are taken to address any issues identified during these audits.

2.1.3 Operating Performance

This safety and control area includes an overall review of the conduct of the licensed activities and the activities that enable effective facility performance.

In the quarter, BRR continued to operate in a manner that supports safe, clean and reliable production and in compliance with applicable acts and regulations. Annual operating targets are set and key performance indicators established for refinery operations.

As noted previously in this report, Cameco has an internal audit program that looks at various aspects of site operations related to the licensed activities. All audits are documented in the Cameco Incident Reporting System (CIRS) and corrective actions are taken to address any issues identified.

2.2 Facility and Equipment

2.2.1 Safety Analysis

This safety and control area covers the maintenance of the safety analysis which supports the overall safety case for the facility. This safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventative measures and strategies in reducing the effects of such hazards.

BRR has a safety report that documents the detailed safety analysis carried out for the facility. Design reviews are done prior to making any plant modifications that may affect the safety case for the refinery, with the site safety report updated periodically to include the findings from design reviews completed since the last revision to the report.

There were no modifications made in the third quarter of 2018 that affected the safety case for the refinery.

2.2.2 Physical Design

This safety and control area relates to activities that impact on the ability of systems, structures and components (SSCs) to meet and maintain their design basis, given new information arising over time and taking into account changes in the external environment.

As part of the Cameco budgeting process for capital expenditures, plant improvements related to physical design are identified and prioritized.

Changes to the physical design of equipment, processes and the facility with the potential to impact safety are evaluated from project planning through to the completion of the project. This review identifies impacts and potential impacts to the environment and health and safety. A design control procedure is in place which ensures that any equipment changes or modifications will not have an adverse effect on the environment or on the health and safety of employees or members of the public.

2.2.3 Fitness for Service

This safety and control area covers activities that impact on the physical conditions of systems, structures and components (SSCs), to ensure that they remain effective over time. This includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.

BRR has programs and procedures that ensure that the facility is operated in a safe, clean and reliable manner. These programs and procedures address the following areas that comprise this safety control area: a Preventative Maintenance program (PM), an in-service inspection program and other testing and review systems.

Process monitoring is conducted through product and intermediate quality control testing (such as chemical analysis) to ensure that the equipment is functioning within design specifications.

2.3 Core Control Processes

2.3.1 Radiation Protection

This safety and control area covers the implementation of a radiation protection program, in accordance with the *Radiation Protection Regulations*. This program must ensure that contamination and radiation doses are monitored and controlled.

The refinery has an extensive Radiation Safety Program in place to meet the requirements of the *Nuclear and Safety Control Act* and the *Radiation Protection Regulations* and ensure exposures are kept to levels as low as reasonably achievable (ALARA). The program includes the following aspects:

- external dosimetry – personal monitors for assessment of whole body and skin exposure;
- internal dosimetry – urinalysis and lung counting programs;
- workplace air sampling program;
- a respirator program; and
- radiation surveys and contamination surveys.

The CNSC regulatory limits for effective dose for nuclear energy workers (NEWs) are 50 milliSieverts (mSv) per year and 100 mSv over a five-year dosimetry period. The current five year dosimetry period began on January 1, 2016.

For various radiological parameters, Cameco has established action levels, approved by the CNSC that may be indicative of a potential loss of control for that specific parameter. These action levels serve as an early warning of a condition that warrants further investigation. In addition, as a continual improvement tool, Cameco has established lower-tier internal administrative levels, which are set below the action levels and provide an even earlier warning of a potential concern. A result above an internal administrative level is also investigated and remedial actions taken if necessary. In the quarter there were no CNSC regulatory limits or action levels exceeded with respect to radiation exposure.

The following tables and graphs summarize radiation exposure results. Note that in figures with ranges on the horizontal axis, a range of 1 – 2, for example, means all results greater than (>) 1 and less than or equal to (\leq) 2.

Whole Body Dose

Table 2 shows the quarterly whole body dose results for three work groups: employees in operations; employees in administration and/or support roles and contractors who have been designated nuclear energy workers (NEWs). All employees are also NEWs. The highest doses

are typically from the operations work group, consisting of production and maintenance personnel. The CNSC action level for whole body dose is 2.0 mSv in a month for individuals on a monthly dosimetry service badge change frequency and 0.7 mSv in a quarter for individuals on a quarterly dosimetry service badge change frequency.

Table 2

2018 Third Quarter Whole Body Dose				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Operations	68	0.09	0	0.58
Administration/Support	59	0.07	0	0.22
NEW Contractors	9	0.07	0	0.25

From Figure 1, 100% of all NEW whole body dose results in the quarter were ≤ 1 mSv.

Figure 1

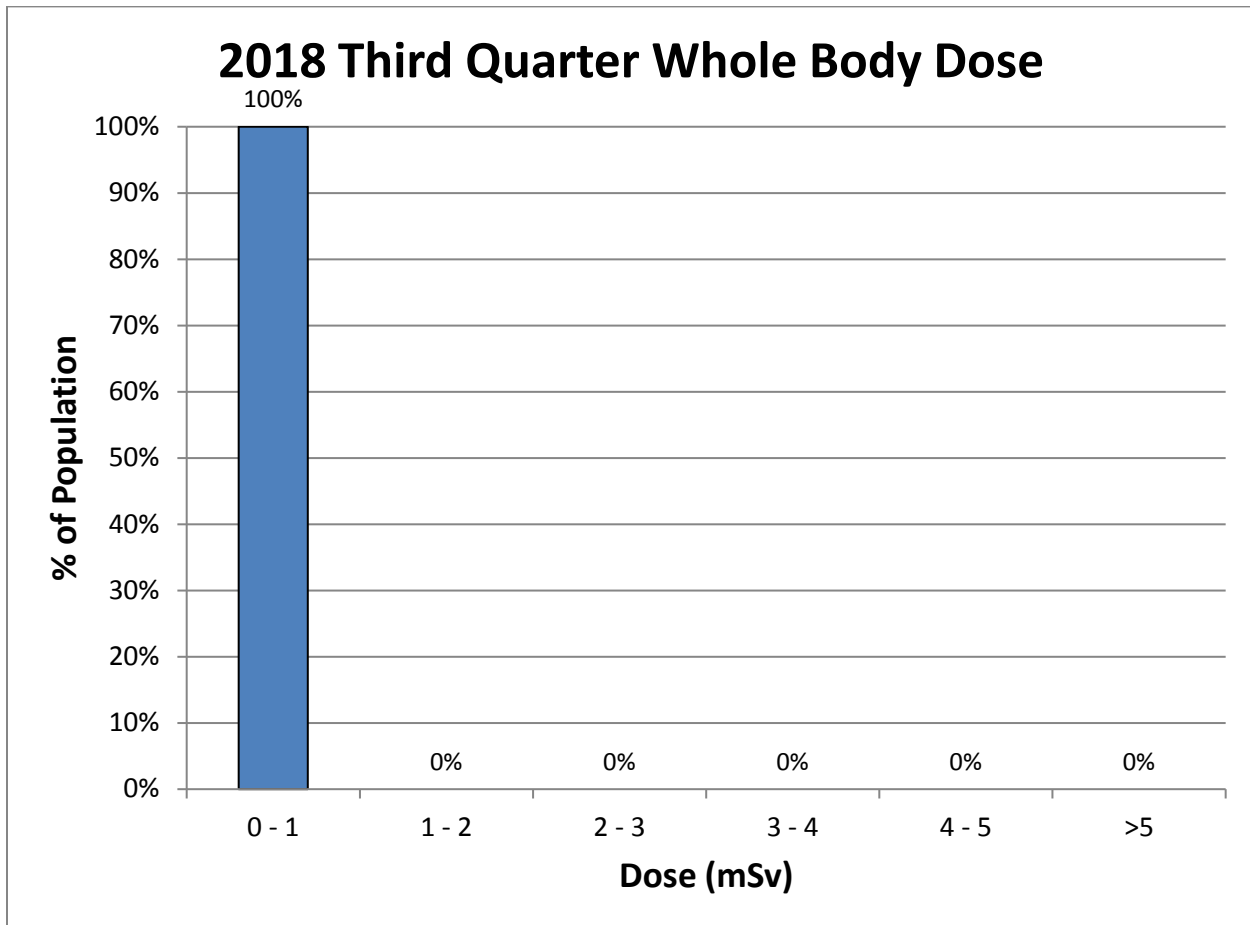


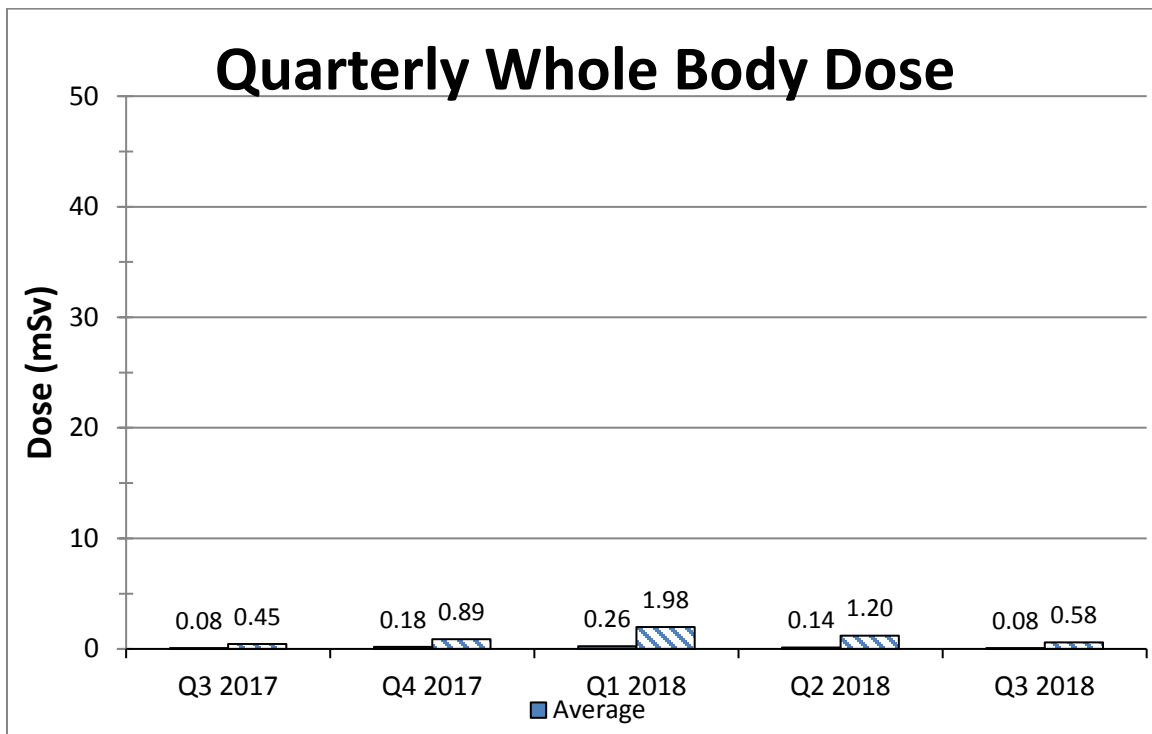
Table 3 and Figure 2 show the average and maximum individual whole body results for the last five quarters. The average and maximum individual whole body doses were lower than in the previous quarter due to lower production levels and fewer operating days in the quarter. Third quarter results are typically lower than results in other quarters due to the summer shutdown and vacation period.

The maximum whole body dose was 0.58 mSv to an S&FP operator. Some contractors and visitors may be issued dosimeter badges even though they are not NEWs. The highest non-NEW whole body result in the quarter was 0.06 mSv.

Table 3

Quarterly Whole Body Dose				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Q3 2017	129	0.08	0	0.45
Q4 2017	128	0.18	0	0.89
Q1 2018	130	0.26	0	1.98
Q2 2018	140	0.14	0	1.20
Q3 2018	136	0.08	0	0.58

Figure 2



Skin Dose

Table 4 shows the third quarter skin dose for three work groups: employees in operations; employees in administration and/or support roles and contractors who have been made NEWs. The highest doses are from the operations work group, consisting of production and maintenance personnel. The CNSC action level for skin dose is 15.0 mSv in a month for individuals on a monthly dosimetry service badge change frequency and 6.0 mSv in a quarter for individuals on a quarterly badge change frequency.

Table 4

2018 Third Quarter Skin Dose				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Operations	68	0.61	0	2.09
Administration/Support	59	0.14	0	1.30
NEW Contractors	9	0.12	0.02	0.46

As shown in Figure 3, all individual skin dose results were ≤ 10 mSv.

Figure 3

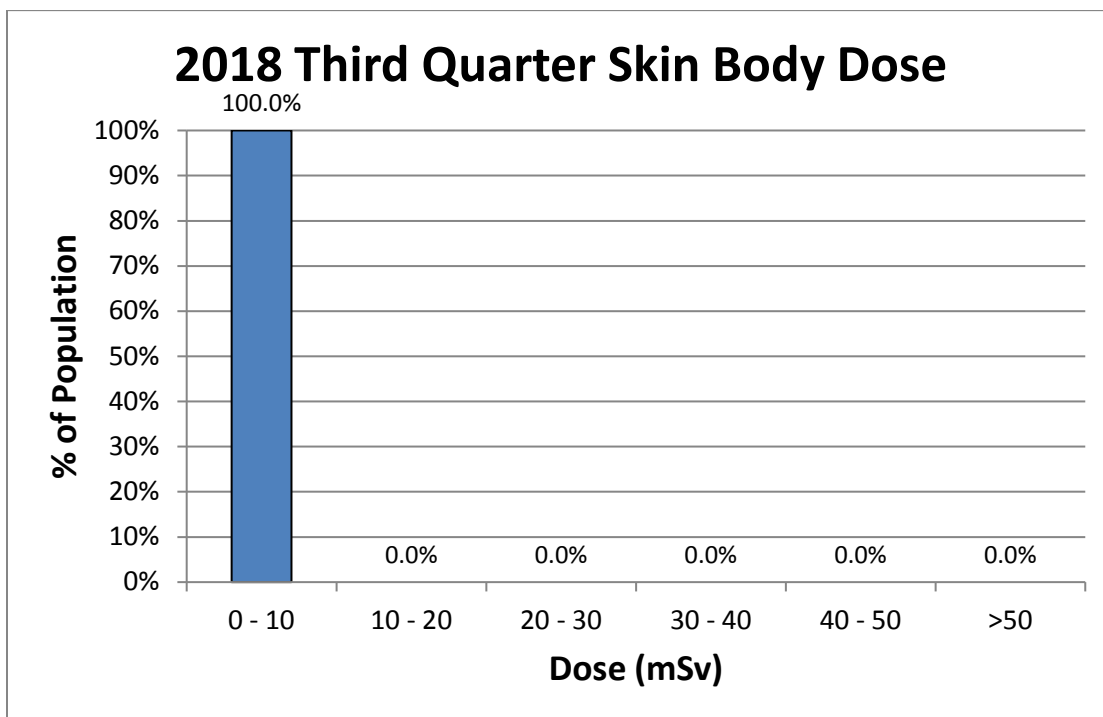


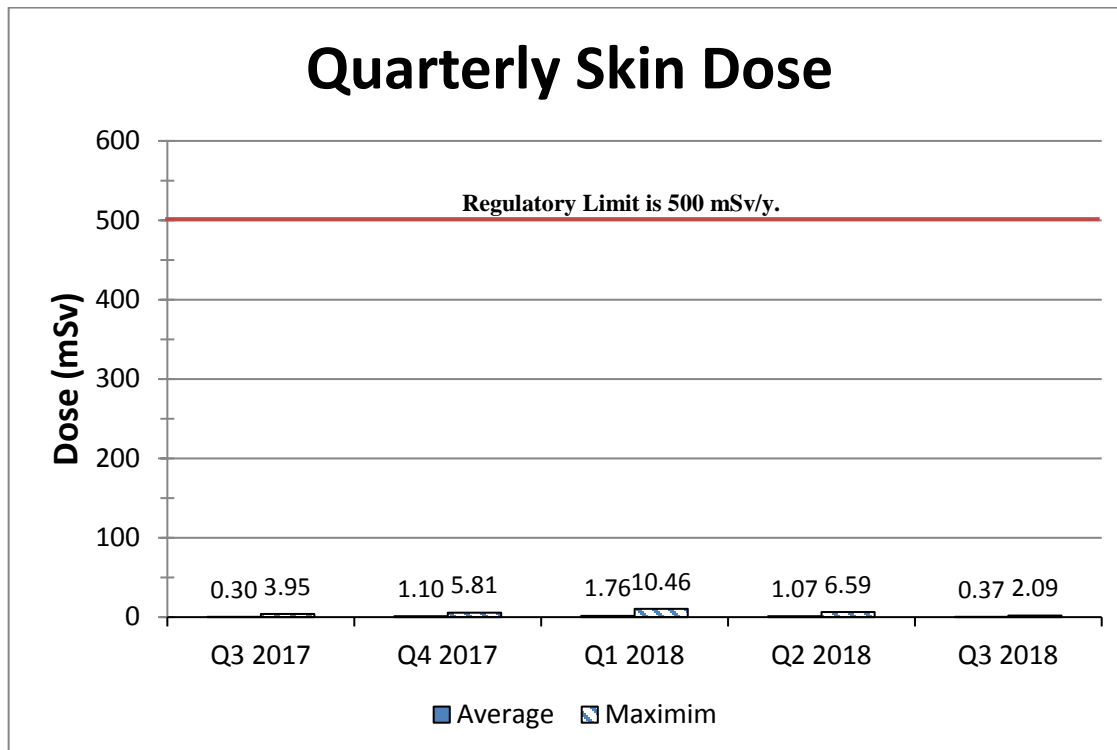
Table 5 and Figure 4 show the average and maximum individual skin dose results for the last five quarters. The average and maximum individual skin dose were lower than in the previous quarter but comparable to prior quarters. As noted previously, results are typically lower in the third quarter.

The maximum skin dose was 2.09 mSv to a maintenance employee. Some contractors and visitors may be issued dosimeter badges even though they are not NEWs. The highest non-NEW skin dose result in the quarter was 0.11 mSv.

Table 5

Quarterly Skin Dose				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Q3 2017	129	0.30	0	3.95
Q4 2017	128	1.10	0	5.81
Q1 2018	130	1.76	<0.1	10.46
Q2 2018	140	1.07	0	6.59
Q3 2018	136	0.37	0	2.09

Figure 4



Extremity Dose

Process operators working in the DRaff area and designated maintenance workers have historically been issued ring dosimeters. These dosimeters are only required to be worn when working in the DRaff area of the refinery. Table 6 shows the average and maximum ring dosimeter result for employees over the last five quarters. As noted before, results are typically lower in the third quarter than in other quarters. The annual equivalent dose limit for hands and feet is 500 mSv. The highest extremity dose in the quarter was to a maintenance employee.

Table 6

Quarterly Extremity Dose				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Q3 2017	37	0	0	0
Q4 2017	39	0.2	0	4.3
Q1 2018	38	1.2	0.3	7.4
Q2 2018	41	1.0	0.1	4.5
Q3 2018	37	0.2	0	0.6

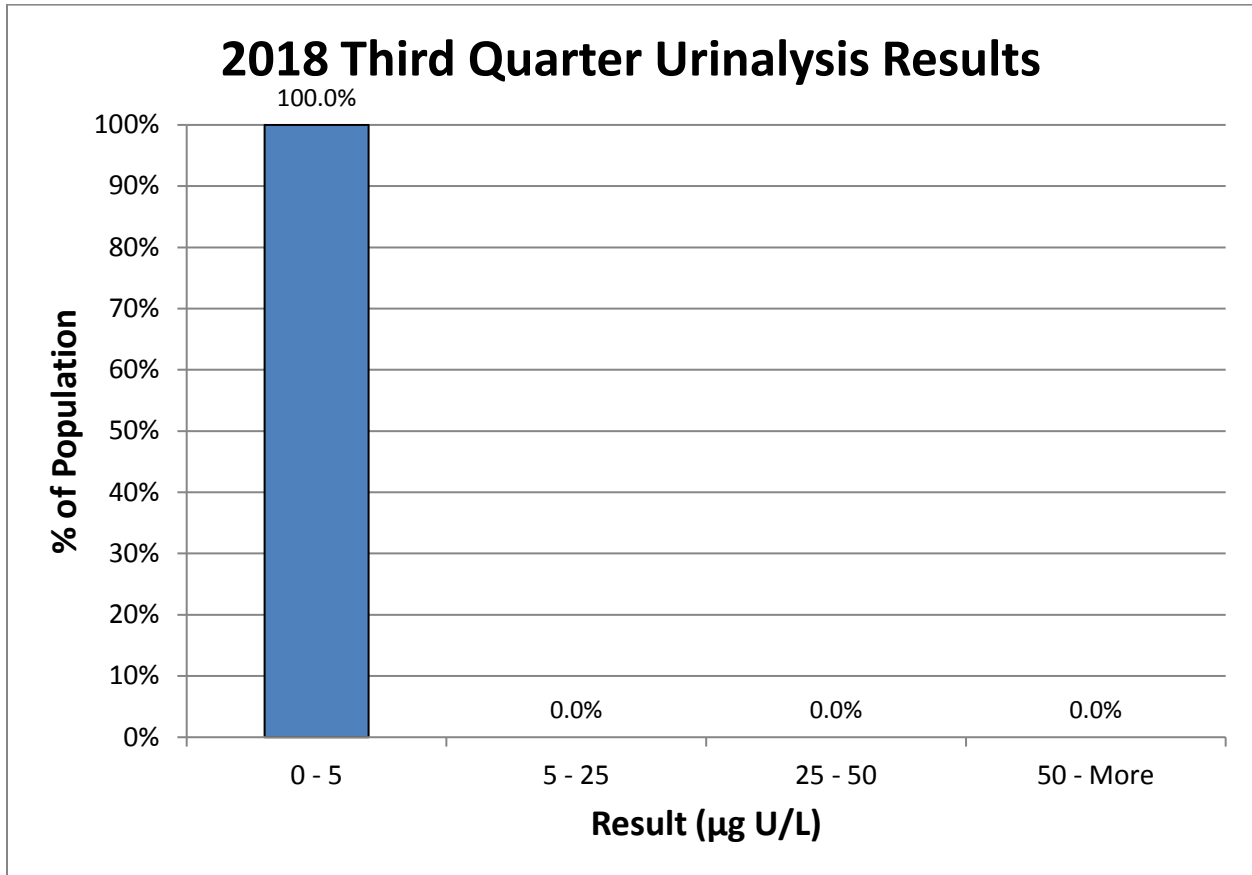
Urinalysis

Table 7 and Figure 5 show the distribution of urine results for the third quarter of 2018. All of the results are less than or equal to 5 µg U/L. The highest result, 4.5 µg/L, was from a non-routine sample submitted by a process operator.

Table 7

2018 Third Quarter Urinalysis Results	
Distribution of Results	Number of Results
Number of Samples ≤ 5 µg U/L	663
Number of Samples >5 to ≤ 25 µg U/L	0
Number of Samples >25 to ≤ 50 µg U/L	0
Number of Samples ≥ 50 µg U/L	0
Number of Samples Analyzed	663

Figure 5



Internal Dose (Urine)

The breakdown of internal urine dose for individuals in the third quarter of 2018 is shown in Figure 6. The majority of the results (approximately 96%) were less than 0.2 mSv. The highest individual urine dose in the quarter was 0.42 mSv to an S&FP operator.

Cameco has an Internal Dosimetry Licence (#11010-16-14.3) specific to the Fuel Services Division, for both urinalysis and lung counting.

Figure 6

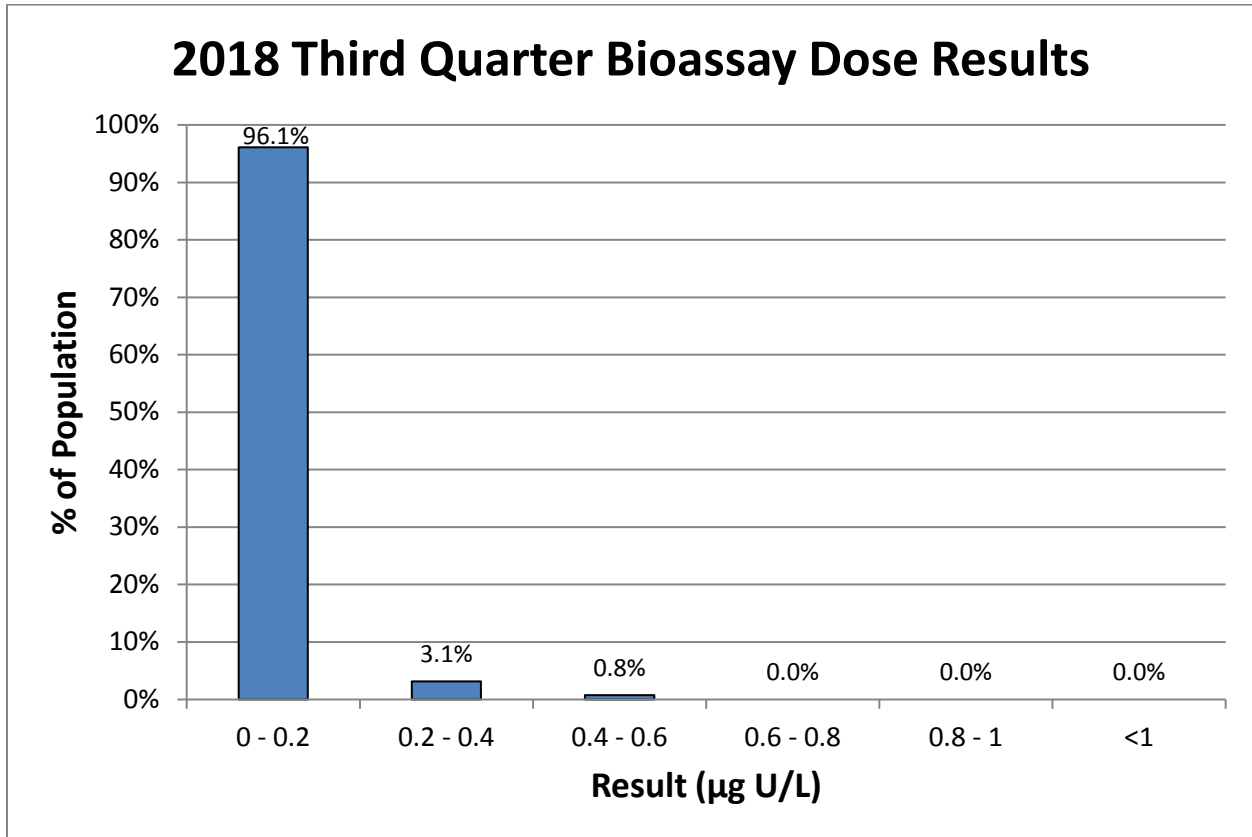
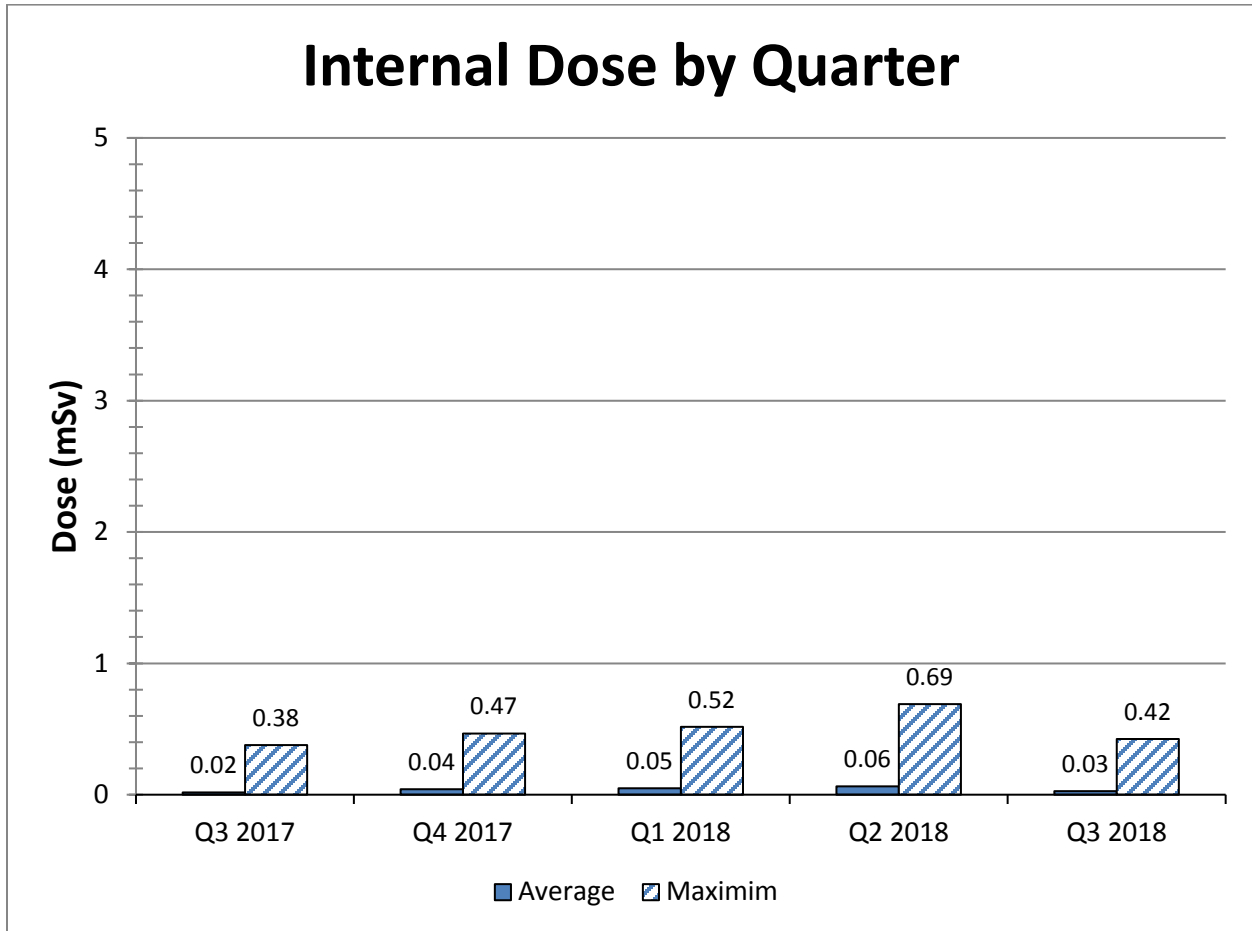


Table 8 and Figure 7 show the average and maximum individual assigned urine dose for the last five quarters. Both the average and maximum individual urine dose results were just slightly lower than results from previous quarters. Third quarter results are typically lower than results in other quarters due to the summer shutdown and vacation period.

Table 8

Internal Urine Dose by Quarter				
Year	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
Q3 2017	126	0.02	0	0.38
Q4 2017	125	0.04	0	0.47
Q1 2018	127	0.05	0	0.52
Q2 2018	131	0.06	0	0.69
Q3 2018	128	0.03	0	0.42

Figure 7



Internal Dose (Lung)

Employee lung counting was not carried out in the third quarter. Internal lung dose is only reported to NDR annually due to the nature of the dose assessment. Employee internal lung dose and total effective dose information is only reported in the BRR annual report.

Contamination Control

An extensive contamination control program is in place at the refinery. The refinery is divided into three zones for contamination control purposes. Zone 1 areas are designated as clean areas, with no dispersible radioactive material allowed, while Zone 3 areas are production areas. Zone 2 areas are considered buffer zones where small amounts of radioactive material may be present. Routine contamination monitoring is done in Zone 1 and 2 areas, with a focus on employee lunchrooms, change rooms and hallways. Table 9 summarizes quarterly alpha monitoring results from Zone 1 and Zone 2 areas. Monitoring results include both swipe samples and direct contact

surface measurements. There was only one contamination result above the administration level in the quarter, compared to one results above the administration level in the previous quarter. Contamination readings above the administration level if found, would generally not be considered a significant risk to people or to the environment.

Table 9

2018 Third Quarter Alpha Contamination Monitoring Results		
Area	Total Number of Measurements	Number of Readings Above Internal Administrative Level¹
Zone 1	232	0
Zone 2	2,990	1

¹ Administrative level for swipes is 0.15 Bq/cm² and for direct contact readings is 0.37 Bq/cm².

All plant clothing is laundered on site and clothing and work boots are routinely monitored for contamination, with items contaminated above administrative levels disposed of via the on-site incinerator.

Vehicles leaving the refinery are also checked for contamination. During the quarter no contamination issues were identified related to vehicles leaving the site. Three whole body monitors are located at the entrance to the facility to check individuals for contamination. All employees and visitors are required to pass through one of these monitors prior to exiting the refinery.

In-plant Air

A summary of in-plant air sampling results in the third quarter of 2018 is provided in Tables 10 and 11. There were no uranium-in-air respirator level (RL) samples in the quarter, compared to two in the previous quarter. There were also no thorium-in-air RL samples in the quarter, compared to sixteen in the previous quarter.

Table 10

2018 Third Quarter Uranium In-plant Air Sampling Results				
Plant Area	# of Samples	Average ($\mu\text{g U/m}^3$)	Maximum ($\mu\text{g U/m}^3$)	# of Samples above RL¹
Warehouse	257	1	19	0
UOC Lab	1	0	0	0
Calcination	179	3	25	0
Main Aisle	1	3	3	0
Maintenance Shop	1	0	0	0
Gravimetric Feeders	40	2	18	0
Digestion	17	0	0	0
Solvent Extraction	1	0	0	0
Sump Treatment	1	0	0	0
Equipment Decontamination	35	0	0	0
Aisle to Powerhouse	1	0	0	0
Boildown	4	0	0	0
Denitration	84	3	61	0
UO ₃ Lab	1	0	0	0
Raffinate/DRaff	327	<1	3	0
Control Room	1	0	0	0
TOTAL	2768	1	172	0

¹ Respirator Level (RL) is 90 $\mu\text{g U/m}^3$

Table 11

2018 Quarterly Thorium-in-Air Sampling Results				
Plant Area	# of Samples¹	Average Th-230 (Bq/m^3)	Maximum Th-230 (Bq/m^3)	# of Samples above RL²
First Quarter	478	0.03	1.55	33
Second Quarter	376	0.02	0.36	16
Third Quarter	122	0	0	0
Fourth Quarter				
TOTAL	976	0.02	1.55	49

¹Total number of samples collected and analyzed in the raffinate area is shown in Table 9. Only samples above a pre-established uranium-in-air concentration are normally analyzed for Th-230.

² Respirator Level (RL) is 0.15 Bq/m^3 Th-230.

2.3.2 Conventional Health and Safety

This safety and control area covers BRR’s program to manage non-radiological workplace safety hazards and to protect personnel and equipment.

A key element of a safe, clean and reliable operation is a comprehensive and well-established worker protection program which is in place at the BRR. The foundation of the program is based on the Nuclear Safety and Control Act and its regulations as well as Part II of the Canada Labour Code. The regulations made pursuant to the Nuclear Safety and Control Act and the Canada Labour Code prescribe specific health and safety requirements that are met by the BRR.

The site program sets out the requirements for management of health and safety aspects of the operation consistent with Cameco’s corporate SHEQ policy. Key components of the program include:

- compliance with all safety and health-related legal and regulatory requirements;
- the setting of site safety and health objectives;
- the implementation of corporate safety standards;
- the development and maintenance of a formal hazard recognition, risk assessment and change control processes; and
- the documentation of health and safety significant incidents from the start through to the verification of completion of corrective actions via the CIRS database.

Table 12 below lists the safety statistics for the refinery for the quarter and year-to-date.

Table 12 – Safety Statistics

2018 Safety Statistics		
Year / Parameter	Third Quarter	Year To Date
First Aid Injuries	1	7
Medical Diagnostic Injuries	0	1
Medical Treatment Injuries	0	0
Lost Time Injuries (LTI)	0	0
Lost Time Injury Frequency	0	0
Lost Time Injury Severity	0	0

There were no lost time injuries in the quarter. BRR achieved a company record 12 years without a lost time accident on June 19, 2018.

2.3.3 Environmental Protection

This safety and control area covers the programs that monitor and control all releases of nuclear and hazardous substances into the environment, as well as their effects on the environment, as the result of licensed activities.

There are both federal and provincial regulatory authorities that have legislative jurisdiction over environmental protection at the facility. Cameco monitors air and liquid effluents discharges to ensure that they meet applicable provincial and federal requirements.

The refinery's Environmental Monitoring Program (EMP) is comprised of the following components:

- sampling of water and air emissions;
- high-volume sampling of ambient air, both near the refinery and in the Town of Blind River; and
- additional ambient sampling, including soil, surface water and groundwater monitoring

For key emission parameters, Cameco has established action levels accepted by the CNSC that may be indicative of a potential loss of control for that specific parameter. As noted previously, these action levels serve as an early warning of a condition that warrants further investigation. In addition, as a continual improvement tool, Cameco has established some lower-tier internal administrative levels, which are set below the action levels and provide very early warning of a potential concern. A result above an internal administrative level is also investigated and remedial actions taken if necessary.

Cameco Corporation is registered to the ISO 14001:2004 standard for environmental management systems.

There were no exceedances of CNSC regulatory limits or action levels with respect to air or liquid emissions in the third quarter of 2018.

Public Dose

The derived release limit (DRL) for a given radionuclide is defined as the release rate that would cause an individual of the most highly exposed group to receive and be committed to a dose equal to the regulatory annual dose limit due to release of the radionuclide to air or surface water during normal operation of a nuclear facility over the period of a calendar year.

The DRL for the facility is based on three components: dose to the public from air emissions, dose from water discharges and dose from gamma radiation. For the refinery, dose to the public from air and water emissions is a very small fraction of the public dose limit (<0.001 mSv).

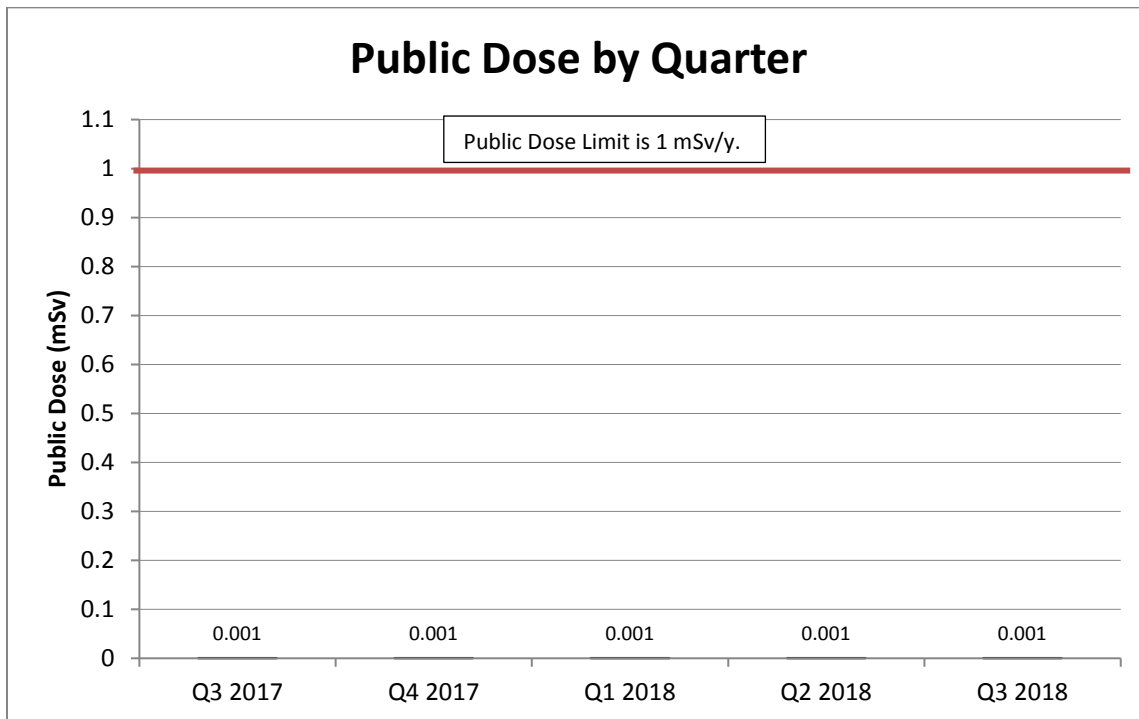
Therefore, the gamma component represents virtually all the estimated public dose.

The critical receptor is the hi-vol station at the golf course. An environmental dosimeter is placed at the hi-vol station and changed out on a quarterly basis. Public dose information for the last five quarters at the critical receptor is shown in Table 13 and Figure 8 below. Dose to the public continues to be quite low on a quarter to quarter basis.

Table 13

Public Dose by Quarter (mSv)					
DRL Component	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018
Air	<0.001	<0.001	<0.001	<0.001	<0.001
Water	<0.001	<0.001	<0.001	<0.001	<0.001
Gamma	0.001	0.001	0.001	0.001	0.001
Total Quarterly Dose	0.001	0.001	0.001	0.001	0.001

Figure 8



Gamma Monitoring

Environmental dosimeters are placed along each of the four perimeter fence lines; north, south, east and west. The dosimeters are collected and replaced in the field monthly. Fence line results for each month in the quarter are shown in Table 14.

Table 14

2018 Third Quarter Measured Fence Line Gamma Levels (µSv/h)			
Fence Line	July	August	September
East	0.42	0.42	0.41
North	0.26	0.24	0.23
South	0.41	0.38	0.33
West	0.80	0.85	0.79

The dose rate along the west fence line is typically higher than the dose rates along the other three sides due to the proximity of the uranium concentrate storage pad along the west fence. Radiation levels will vary from month to month depending on the amount of inventory in storage. It should be noted that outside of the west fence line is a heavily forested area between 100 and 200 m wide. This forested area west of the refinery, which is owned and controlled by Cameco, continues until it reaches the eastern bank of the Mississagi River.

There was minimal variation in the results from month-to-month this quarter. Results from the west fence were slightly lower than in previous quarters due to a reduction in the amount of uranium concentrate stored on the west pad. Results from the other three locations were similar to the previous quarter.

A CNSC action level of 1 µSv/h is in effect at the north fence only. Results at the north fence remained below the action level in the quarter.

Despite the fact that environmental dosimeters are being used along the fence line, the critical receptor for the gamma component of dose to the public remains the hi-vol station at the golf course; as the land immediately outside the perimeter fence on all four sides is owned and controlled by Cameco. The golf course north of the refinery is the closest location where members of the public can reasonably be expected to be in proximity to the refinery for any significant period of time.

Air Emissions

The refinery has two process stacks and an incinerator stack that are routinely monitored for uranium and particulate emissions. The absorber stack also has an on-line NO_x analyzer. Each process area also has its own separate ventilation system. Uranium emissions from each of the individual process area ventilation systems are determined through calculation. Third-party sampling of some of the ventilation systems has been done in the past to verify uranium emission estimates. A variety of pollution control equipment including bag houses, scrubbers and activated carbon beds are used at the facility to control and reduce emissions to air.

Stack uranium emissions by quarter are shown in Table 15 and in Figure 9.

Stack sampling for uranium and particulate is done using TSI samplers, while NO_x emissions are measured by a continuous emission monitor. Uranium emissions from each of the three stacks continue to be a fraction of their respective CNSC regulatory limits. Results from stack parameters this quarter were generally lower than in the previous quarter due to fewer operating days in the quarter as a result of the summer shutdown and vacation period. The incinerator did not operate in the third quarter 2018.

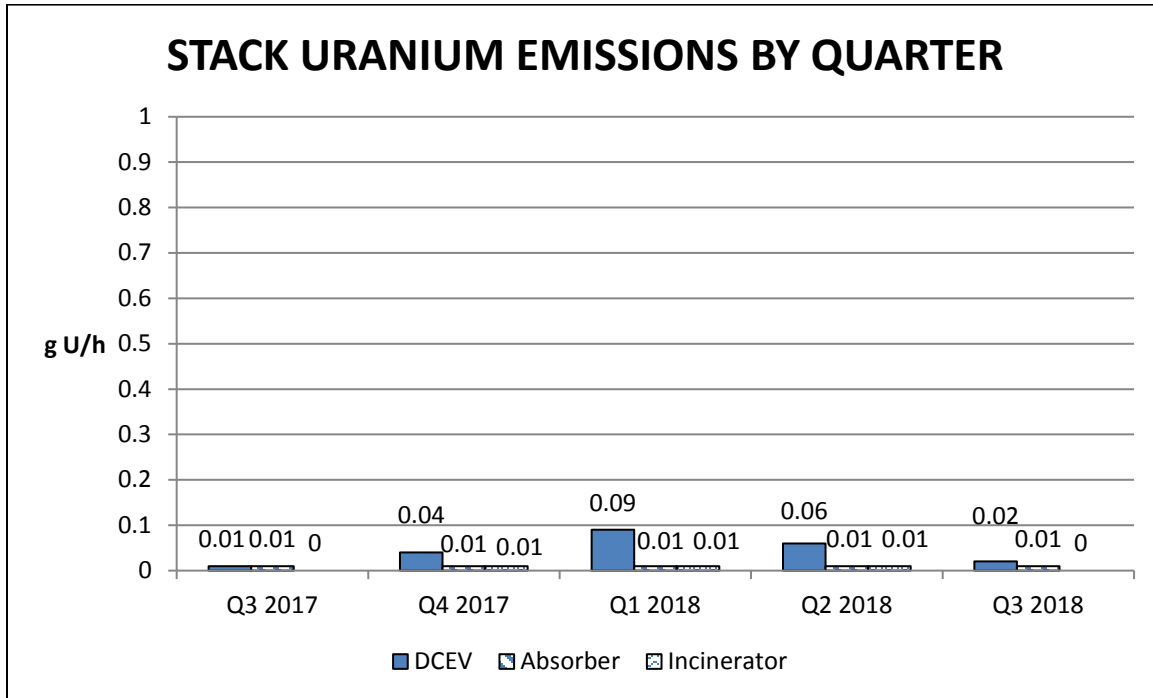
Overall results remain consistently below the regulatory limit from quarter to quarter with no adverse trends noted.

Table 15

Daily Stack Emissions by Quarter									
Source	Parameter	CNSC Licensed Limit	CNSC Action Level	Value	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018
DCEV	Uranium (g U/h)	100	10	Avg.	<0.01	0.04	0.09	0.06	0.02
				Max.	0.06	0.18	0.24	0.18	0.17
Absorber	Uranium (g U/h)	100	1	Avg.	<0.01	0.01	0.01	0.01	0.01
				Max.	0.06	0.10	0.13	0.18	0.06
	Nitrogen Oxides (kg NO ₂ /h)	56	12	Avg.	<0.1	2.9	4.0	1.9	0.4
				Max.	0.3	5.0	5.4	4.7	4.0
Incinerator	Uranium (g U/h)	10	1.5	Avg.	0	<0.01	<0.01	<0.01	0
				Max.	0	<0.01	<0.01	<0.01	0
All stacks	Particulate (g/h)	11,000	NA	Avg.	1.4	10	12	8.7	6.1
				Max.	11	23	29	19	137

< denotes less than detection limit

Figure 9



Liquid Discharges

The refinery has one liquid effluent discharge location into Lake Huron. All liquid effluent is sampled and analyzed prior to discharge to ensure all federal and provincial regulatory discharge parameter limits are met. An effluent treatment circuit and supplementary pollution control equipment are installed in the UO_3 plant to control and reduce emissions to water.

As indicated in Table 16 and Figure 10, concentrations of key parameters in liquid effluent emissions remain well below regulatory limits. To allow for direct comparison to regulatory reporting criteria, data for uranium, nitrate and radium-226 is reported based on the monthly average of the weekly composite results, while limits for pH are based on individual daily discharges. The average results for all four parameters typically remain within a fairly narrow range from quarter to quarter. Note that third quarter results for nitrate are typically lower than results in other quarters due to the summer shutdown and vacation period. There were no discharges in July, only one in August and five in September.

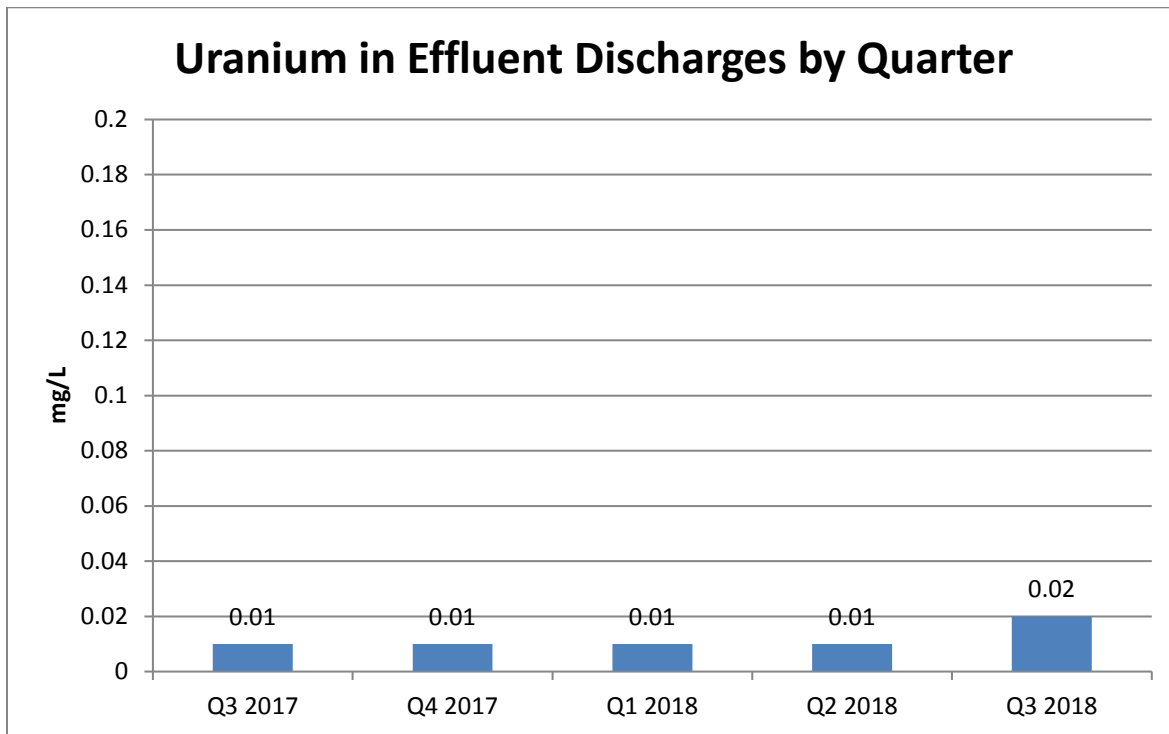
There are no notable trends in the data as shown in Table 16.

Effluent parameters are analyzed either in-house, using conventional and appropriate analytical instrumentation or completed by a third-party contract laboratory.

Table 16

Liquid Effluent Discharges by Quarter									
Parameter	Units of Measure	CNSC Licensed Limit	CNSC Action Level	Value	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018
Uranium	mg/l	2.0	0.2	Avg.	0.01	0.01	0.01	0.01	0.02
				Max.	0.01	0.02	0.02	0.01	0.03
Nitrate	mg/l as N	1000	80	Avg.	1.4	22.7	29.8	17.3	2.6
				Max.	1.9	25.4	32.1	30.4	6.9
Radium – 226	Bq/l	1.0	0.05	Avg.	0.01	0.01	0.01	0.01	<0.01
				Max.	0.01	0.01	0.01	0.01	0.01
pH		Min 6.0	Min. 6.5	Min.	7.6	7.3	7.3	7.5	7.6
		Max 9.5	Max. 9.0	Max.	8.1	8.1	7.7	8.5	8.0

Figure 10



Ambient Air Monitoring

In addition to onsite monitoring of emissions, the refinery also has a comprehensive ambient air monitoring program.

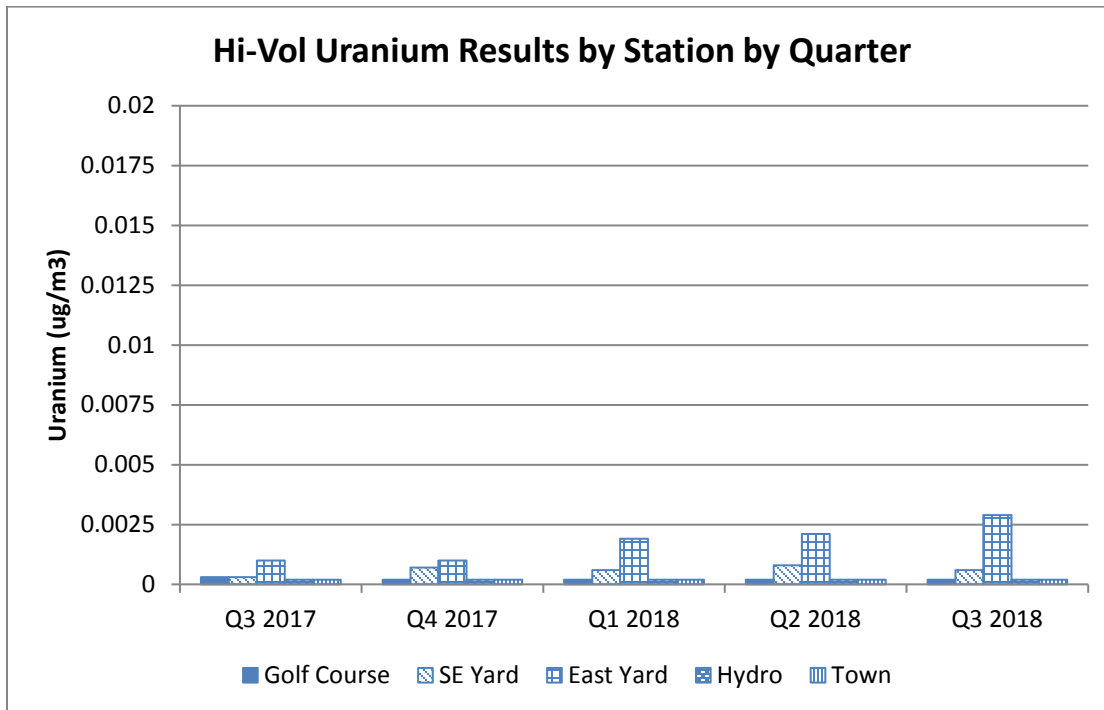
Table 17 and Figure 11 show the quarterly average uranium-in-air concentrations at each of the five hi-vol locations and the maximum individual result for each location. The hi-vol stations operate continuously with filter papers changed out and collected approximately every two weeks. Two of the stations, the SE Yard and the East Yard, are located within the Cameco fence line, while the golf course location is also on Cameco property but located outside the fence line, which defines the CNSC licensed area. The remaining stations, the Hydro yard and the Town location, are located approximately 1 km and 5 km from the refinery respectively. Historically, the stations with the highest uranium concentrations have been the two stations located inside the fence line. These are the closest stations to the main refinery building containing the UO₃ plant.

In general, results in the third quarter of 2018 are comparable to results from the previous quarters. All results remain well below the provincial annual average criteria of 0.03 µg U/m³.

Table 17

Uranium-in-Air Concentration (µg U/m³) at Hi-Vol Stations by Quarter						
Quarter	Result	Golf Course	SE Yard	East Yard	Hydro Yard	Town of Blind River
Q3 2017	Average	0.0003	0.0003	0.0010	0.0002	0.0002
	Maximum	0.0004	0.0004	0.0012	0.0002	0.0002
Q4 2017	Average	0.0002	0.0007	0.0010	0.0002	0.0002
	Maximum	0.0005	0.0016	0.0019	0.0005	0.0005
Q1 2018	Average	0.0002	0.0006	0.0019	0.0002	0.0002
	Maximum	0.0003	0.0011	0.0046	0.0003	0.0003
Q2 2018	Average	0.0002	0.0008	0.0021	0.0002	0.0002
	Maximum	0.0004	0.0020	0.0037	0.0004	0.0004
Q3 2018	Average	0.0002	0.0006	0.0029	0.0002	0.0002
	Maximum	0.0003	0.0013	0.0064	0.0002	0.0002

Figure 11



Soil Monitoring

Soil sampling is conducted at designated sampling locations in the vicinity of the refinery at least annually. Soil sampling was conducted in the third quarter. Soil sampling results for 2018 will be summarized and reported in the 2018 Annual Compliance Monitoring and Operational Performance report.

Surface Water Monitoring

Surface water sampling in Lake Huron is carried out twice a year. Surface water sampling was conducted in the third quarter. As with soil sampling, results from surface water monitoring activities are summarized and reported in the Annual report each year.

Groundwater Monitoring

Cameco has an extensive groundwater monitoring program in place around the refinery. There are 43 monitoring wells located around the refinery, 17 inside the perimeter fence and 26 outside the fence line. The monitoring well testing frequency varies from one to three times per year, depending on the location of the well. Groundwater sampling was carried out in the quarter. Monitoring results for uranium are summarized and reported in the Annual report each year.

Quality Assurance/Quality Control

The BRR environmental protection program sets out the effluent and environmental monitoring requirements for the facility to ensure adequate environmental protection measures are in place. The performance criteria of these programs is that 90% of planned samples are collected and analyzed to meet the data acceptance criteria.

In the quarter, 100% of all planned stack, water and other environmental samples were collected and analyzed. All analysis under the environmental program was completed with the quality control set out in the analytical methods. There were no instances where results were reported with failed QA/QC samples. There were no corrective actions needed for any samples. In total, all sample analyses were included in the quarterly reporting.

Overall, the performance criteria was met in the quarter.

2.3.4 Emergency Management and Response

This safety and control area covers emergency plans and emergency preparedness programs. These procedures must exist for emergencies and for non-routine conditions. This also includes the fire protection program and any results of emergency exercise participation.

Effective emergency response is carried out through the refinery Emergency Response Plan (ERP). The plan assigns specific accountabilities and sets out processes and procedures to protect the health and safety of employees, contractors, the public and the environment in the case of an emergency.

As the primary response provider for the facility, the refinery's Emergency Response Team (ERT) consists of approximately forty-five designated members that are in place to respond to emergencies at the facility. There were no incidents in the quarter that required formal activation of the ERT.

To continually provide a high level of response capability, the refinery's ERT regularly engages in a number of training drills, exercises and courses. These include:

- evacuation drills
- emergency response team recall drills
- fire and medical response emergencies
- outside of core hours drills
- live fire training
- search and rescue
- hazardous materials response
- pump operations

Routine emergency response training continued in the third quarter of 2018. In addition, a full scale emergency drill exercise was held in September involving paramedics and the local health center. CNSC staff were present to observe the exercise.

2.3.5 Waste and By-product Management

This safety and control area covers internal waste and by-product-related programs which form part of the facility's operations, up to the point where the waste is removed from the facility to a separate waste and by-product management facility. This also covers any ongoing decontamination and planning for decommissioning activities.

Solid wastes contaminated by uranium are reprocessed, recycled and re-used to the extent possible. Waste materials that cannot be reprocessed, recycled or re-used are safely stored on site pending final disposition.

Wastes generated at BRR are segregated at the point of generation into contaminated and non-contaminated as appropriate. Non-contaminated waste can be recycled or disposed of at an appropriate facility. A portion of the non-contaminated waste generated is incinerated on site. While this increases the volume of contaminated ash generated marginally, it dramatically decreases the amount of material sent to the local landfill. Contaminated combustible materials are incinerated on site and the contaminated ash is recycled to recover uranium. Contaminated non-combustible waste is stored in appropriate containers pending assessment of recycling or other disposal options.

In the third quarter of 2018, there was 585 kg of non-contaminated waste sent to the local landfill. A total of 7,020 kg of non-contaminated materials were sent to appropriate recycling facilities for recovery.

BRR produces two secondary products at the facility. These are calcined product and regeneration product, both of which are sent for uranium recovery to designated, licensed uranium mills in North America. A total of 77 drums of calcined product were generated in the quarter and 400 drums of calcined product shipped. With respect to regeneration product, a total of 4 drums were generated but no drums were shipped.

The BRR incinerator processed 0 kg of contaminated combustible material in the quarter. There were 121 drums of contaminated non-combustible materials (CNC) generated and no drums of shredded metal processed.

There were also 2,292 drums of contaminated non-combustible materials shipped to a permitted waste disposal facility in the United States.

Lastly, the BRR sent 184 empty drums back to various uranium facilities for reuse. A total of 2,974 drums were decontaminated to unrestricted release criteria and shipped to an area metal recycle operation.

2.3.6 Nuclear Security

This safety and control area covers the programs necessary to implement and support the security requirements stipulated in the regulations, in *Nuclear Safety and Control Regulations*, the *Nuclear Security Regulations* and other CNSC requirements.

BRR's security plan provides the basis for security operations at the facility and identifies the systems and processes in place to meet security program requirements. Accordingly, the security plan and related procedures are considered prescribed information, subject to the requirements of the *Nuclear Safety and Control Regulations*.

Though the refinery's security program is well managed and developed, the facility continues to look for opportunities to enhance the existing program. There were no security related issues in the quarter.

2.3.7 Safeguards and Non-proliferation

This safety and control area covers the programs required for the successful implementation of the obligations arising from the Canada/IAEA Safeguards and Non-proliferation Agreement.

The IAEA conducted a physical inventory verification (PIV) and a design inventory verification (DIV) in early July. CNSC staff also participated in the verification activities.

The refinery is in compliance with the requirements in CNSC REGDOC-2.13.1: *Safeguards and Nuclear Material Accountancy*. REGDOC-2.13.1 supersedes RD 336: *Accounting and Reporting of Nuclear Material* and will be incorporated into the next revision of the refinery License Conditions Handbook, replacing RD 336.

2.3.8 Packaging and Transport of Nuclear Substances

This safety and control area covers the packaging and transport of nuclear substances and other nuclear materials to and from the licensed facility.

UO₃ is produced and transported, in steel tote bins, by road from the refinery to Cameco's PHCF. As well, UO₃ is transported in drums via road, rail and/or marine transport to customers in the USA and, on occasion, other countries around the world. The tote bins and drums meet the Type IP-1 package requirements as specified in the CNSC *Packaging and Transport of Nuclear Substances Regulations*.

There were no reportable transportation events in the third quarter.

A representative of Transport Canada was on site in September to conduct a Transportation of Dangerous Goods inspection. There were no issues identified during the inspection.

3. OTHER MATTERS OF REGULATORY INTEREST

3.1.1 Public Information Program

BRR continues to meet the requirements of its public information program as per the CNSC regulatory document RD/GD-99.3: Public Information and Disclosure.

The communications team for Cameco's fuel services division includes a director of public and government affairs and communications specialists. The divisional communications team is part of the corporate responsibilities and communications group, which is in turn part of the corporate services department.

Cameco works to build and sustain the trust of local communities by acting as a good corporate citizen in the communities where we operate. A key element of building and sustaining that trust is a commitment to provide those in the community with accurate and transparent reporting of our environmental practices and performance. These are central values for Cameco and it is these values that drive the refinery's Public Information Programs (PIP). Information about Cameco's operations, practices and performance, as well as the nuclear industry can also be found at www.cameco.com.

In addition to the main corporate website, the website www.camecoblindriver.com provides information about all three operations that comprise the FSD. This site can be accessed through a number of URLs, including from the main Cameco website. The refinery prepares compliance reports which outline the performance and operation of the facility. Cameco provides copies of these CNSC reports to the Town of the Blind River, to the MFN, to the Serpent River First Nation (SRFN) and to the Township of the North Shore. The reports are also posted on the Cameco web site: www.camecoblindriver.com. Additional information such as public survey results and information on reportable environmental incidents are also available on the website.

Cameco provides annual updates on our performance to our neighbouring communities; the Town of Blind River and the Mississauga First Nation, via presentations made at local council meetings in each community. The general manager Blind River operations maintained routine contact with both the Mayor of the Town and the Chief of the MFN during the quarter, discussing issues of mutual interest.

There were no public tours in the quarter.

Cameco provides financial and other forms of support to local organizations and charities as part of its public outreach program. For example, in the third quarter Cameco provided sponsorship for the Town of Blind River community days, to regional theatre & art events and for a new Recreation Park in Thessalon. Cameco also celebrated 35 years of operation in Blind River with a centerfold story in the local newspaper.

3.1.2 Site-Specific

The CNSC *Nuclear Criticality Program* is not applicable to the Blind River refinery operation.

Cameco has an approved PDP and financial guarantee for the refinery.

The refinery met all other site-specific reporting requirements.

3.1.3 Improvement Plans and Future Outlook

Cameco remains committed to continual improvement and continues to look for opportunities to make the site operate more efficiently, while minimizing risk to employees, the public and the environment.

There were capital projects worked on this quarter related to maintenance of aging infrastructure including replacing a section of the buried fire water line on site, installation of a new motor control center and installation of a new NO_x analyzer for the nitric acid absorbers off-gas line.

A more detailed discussion on improvement plans and future outlook is provided in the Annual Compliance Monitoring and Operational Performance Report.

3.1.4 Safety Performance Objectives for Following Year

A discussion of safety performance objectives for the following year will be provided in the Annual Compliance Monitoring and Operational Performance Report for 2018.

4. CONCLUDING REMARKS

Cameco is committed to the safe, clean and reliable operations of all of its facilities and continually strives to improve safety performance and processes to ensure the safety of both its employees and the people in neighbouring communities.

Individual radiation exposures were maintained well below all applicable regulatory dose limits, as a result of the effective programs, plans and procedures in place. In addition, environmental emissions continued to be controlled to levels that are a fraction of the regulatory limits, and public radiation exposures are also well below the regulatory limits.

Cameco's relationship with our neighbouring communities remains strong and we are committed to maintaining these strong relationships.