



**2021 Third Quarter Compliance Monitoring
&
Operational Performance Report**

Reporting Period July 1 –September 30, 2021

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

**328 Eldorado Road
Blind River, Ontario
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Submitted to:
The Canadian Nuclear Safety Commission
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Submitted on November 23, 2021

I 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 140 workers. 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. BRR maintains the required programs, plans and procedures in the areas of health and safety, radiation protection, environment, emergency response, fire protection, waste management, and training.

As a result of these programs, plans and procedures, BRR's operations maintain radiation exposures to workers and the public well below the regulatory dose limits. Environmental emissions are also being controlled to levels that are a fraction of the regulatory limits.

There were no radiation protection or environmental protection action level exceedances in the third quarter of 2021.



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1.0 Third Quarter Overview

1.1 Facility Operation

Cameco continues to strive for operational excellence at all its facilities through consistent application of management systems to ensure that they operate in a safe, clean and reliable manner. Corporate policies and programs, including that for Safety, Health, Environment and Quality (SHEQ) provide guidance and direction for all site-based programs and procedures that define the Blind River Refinery's Quality Management System. Cameco continually strives to improve safety performance and processes to ensure the safety of both its employees, and residents.

There were no significant changes to Structure, Systems and Components (SSC) or processes in the quarter.

There were no radiation protection or environmental protection action level exceedances in the third quarter of 2021.

The Blind River refinery carried out the annual summer shutdown from July 12, 2021, to August 20, 2021. During the six-week shutdown, employee vacations were staggered to accommodate uranium ore concentrate deliveries, contractor work and routine maintenance activities.

The refinery was scheduled to start-up on August 23, 2021, however during the shutdown period, BRR experienced a power surge which damaged the uninterruptible power supply (UPS). The UPS system ensures that power to critical systems (i.e., computers) is maintained in the event of a power failure. The damaged UPS parts were sent out for re-build. A new UPS was sourced and identified as a suitable replacement through the design change control program. The new replacement UPS was installed, commissioned, and the facility started up on September 2, 2021.

On September 3, 2021, the refinery experienced a short power outage as a result of a power line issue from a service provider. The refinery started up a few hours later and continued to operate routinely until September 17, 2021. Although BRR did not schedule a planned shutdown, the decision to shut down the facility was made to accommodate reduced production rates at the conversion facility. The facility remained shut down for the rest of the third quarter.



1.2 Physical Design/Facility Modification

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 modifications affecting the safety analysis of BRR made in the third quarter that required written approval of the Commission or a person authorized by the Commission.

2.0 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.

Whole Body Dose

Table 1 shows the whole-body dose summary results from the third quarter 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.

Employees are on either a monthly or quarterly dosimeter badge change frequency. The highest doses are 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 employees on a monthly dosimetry service badge change frequency, and 0.7 mSv in a quarter for employees on a quarterly dosimetry service badge change frequency. There were no results above either whole body dose action levels in the quarter.

Table 1

2021 Third Quarter Whole Body Dose				
Work Group	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
NEW Contractors	22	0.05	0.00	0.26
Administration/Support	60	0.09	0.00	0.42
Operations	82	0.25	0.00	1.26
Total (Max)	164	0.17	0.00	1.26

Table 2 shows the employee average, minimum, and maximum quarterly individual external whole-body exposures for the last five quarters. The average whole-body dose decreased from 0.33 mSv in Q2 to 0.17 mSv in Q3 2021. The decrease in the maximum and average whole-body dose may be attributed in part to a decrease in operating days.



Table 2

Whole Body Dose by Quarter				
Work Group	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
Q3 2020	145	0.25	0.00	2.09
Q4 2020	157	0.26	0.00	2.25
Q1 2021	149	0.30	0.00	1.56
Q2 2021	157	0.33	0.00	3.47
Q3 2021	164	0.17	0.00	1.26

Skin Dose

Table 3 shows the quarterly skin dose summary results 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.

Employees are on either a monthly or quarterly dosimeter badge change frequency. The CNSC action level for skin dose is 15.0 mSv in a month for employees on a monthly dosimetry service badge change frequency, and 6.0 mSv in a quarter for employees on a quarterly badge change frequency.

There were no radiation protection action level exceedances in the third quarter of 2021.

Table 3

2021 Third Quarter Skin Dose				
Work Group	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
NEW Contractors	22	0.06	0.00	0.27
Administration/Support	60	0.28	0.00	1.13
Operations	82	1.53	0.00	4.40

Table 4 show the employee average and maximum quarterly individual skin exposure results for the last five quarters. The average skin dose decreased from Q2 2021, likely due in part to a decrease in refinery operating days.

Table 4

Skin Dose Results by Quarter				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Q3 2020	143	1.06	0.00	9.87
Q4 2020	157	1.59	0.00	13.82
Q1 2021	149	1.63	0.00	9.24
Q2 2021	157	1.73	0.00	21.33
Q3 2021	164	0.88	0.00	4.40

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 5 shows the average and maximum ring dosimeter result for employees over the last five quarters. The average extremity dose decreased from Q2 2021, likely due to a decrease in refinery operating days.

Table 5

Quarterly Extremity Dose				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Q3 2020	42	0.9	0.0	2.4
Q4 2020	42	0.8	0.0	9.4
Q1 2021	58	1.5	0.0	6.2
Q2 2021	57	2.4	0.0	13.8
Q3 2021	57	0.6	0.00	3.2
Quarterly Action Level 15.0 mSv (NEWS)				

Urinalysis

Table 6 show the distribution of urine results for the third quarter of 2021. A total of 985 urine samples were analyzed for uranium during the quarter. As shown in Table 6, approximately 98% of routine urine analysis results were less than 5 µg U/L in the quarter.

All results above 6.3 µg U/L (weekly submission) and 4.4 µg U/L (monthly submission) were screened by radiation protection staff. There were no official investigations related to uranium in urine during the third quarter of 2021. No urine analysis action levels were exceeded in the third quarter of 2021.



Table 6

2021 Third Quarter Urinalysis Results	
Distribution of Results	Number of Results
Number of Samples $\leq 5 \mu\text{g U/L}$	970
Number of Samples >5 to $\leq 25 \mu\text{g U/L}$	14
Number of Samples >25 to $\leq 50 \mu\text{g U/L}$	0
Number of Samples $\geq 50 \mu\text{g U/L}$	1
Number of Samples Analyzed	985
Action Level $63 \mu\text{g U/L}$ (Routine Bi-Weekly Sample)	
Action Level $44 \mu\text{g U/L}$ (Routine Monthly Sample)	

Internal Dose (Urine)

Table 7 shows the internal urine analysis doses for the last five quarters. The average and maximum internal urine analysis doses in the quarter were 0.04 mSv and 0.36 mSv.

Table 7

Internal Urine Dose by Quarter				
Year	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
Q3 2020	134	0.06	0	0.58
Q4 2020	141	0.07	0	0.69
Q1 2021	141	0.07	0	0.61
Q2 2021	147	0.05	0	0.61
Q3 2021	147	0.04	0	0.36

Lung Dose

The lung count trailer arrived at the BRR on September 28, 2021, to begin the fall lung counting campaign.

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 locations 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 8 summarizes quarterly alpha monitoring results from Zone 1 and Zone 2 areas. Monitoring results include both swipe samples and direct contact surface measurements.



Table 8

2021 Third Quarter Alpha Contamination Monitoring Results		
Area	Total Number of Measurements	Number of Readings Above IAL
Zone 1	276	0
Zone 2	4498	6
Internal Administrative Level (IAL) for swipes is 0.15 Bq/cm ² and for direct contact readings is 0.37 Bq/cm ² .		

In-plant Air

Routine air sampling is performed by collecting airborne particulate on air sampling filters and quantifying the airborne concentration of uranium. A summary of in-plant air sampling results in the third quarter of 2021 is provided in Tables 9 and 10.

Table 9

2021 Third Quarter Uranium In-plant Air Sampling Results				
Plant Area	# of Samples	Average (µg U/m³)	Maximum (µg U/m³)	# of Samples above RL
Aisle to Powerhouse	3	<1	<1	0
Boildown	50	<1	26	0
Calcination	448	4	148	1
Digestion	87	<1	11	0
DRaff/Raffinate	919	<1	94	1
Equipment Decontamination	190	<1	31	0
Gravimetric Feeder	85	5	95	1
Main Aisle	3	2	4	0
MAINT. SHOP	3	<1	1	0
Solvent Extraction	3	<1	<1	0
Sump Treatment	3	2	3	0
U CONC Lab	2	<1	<1	0
UO ₃ Lab	3	<1	<1	0
Warehouse	419	1	94	1
Denitration	543	8	178	9
Grand Total	2761	3	178	13
Respirator Level (RL) is 90 µg U/m ³				

The maximum in-plant air sample of 178 µg U/m³ recorded on September 13, 2021, was the result of planned clean-up activities associated with plugged denitration lines and a hole in a venturi. The area was posted as a dust mask area, until it was cleared by the radiation protection group. The hole in the venturi was repaired.



Table 10 is a summary of thorium-230 (Th) in-air sampling results collected from the Draff area quarterly.

Table 10

2021 Third Quarter Thorium-in-Air Sampling Results				
Plant Area	# of Samples¹	Average Th-230 (Bq/m³)	Maximum Th-230 (Bq/m³)	# of Samples above RL
First Quarter	461	0.04	1.02	38
Second Quarter	457	0.02	0.31	18
Third Quarter	382	0.00	0.47	3
Fourth Quarter	-----	-----	-----	-----

Respirator Level (RL) is 0.15 Bq/m³ Th-230



3.0 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. Table 11 below lists the safety statistics for the refinery for the quarter and year-to-date.

Table 11

2021 Safety Statistics					
Quarter / Parameter	Q1 2021	Q2 2021	Q3 2021	Q4 2021	YTD
First Aid Injuries	2	1	0	-----	3
Medical Diagnostic Procedures	0	0	0	-----	0
Medical Treatment Injuries	0	0	0	-----	0
Lost Time Injuries	0	0	0	-----	0
Lost Time Injury Frequency	0.00	0.00	0.00	-----	0.00
Lost Time Injury Severity	0.00	0.00	0.00	-----	0.00

There were no lost time injuries in the quarter. The Total Recordable Injury Rate (TRIR) YTD is 0.00.

BRR achieved a company record 15 years without a lost time accident on June 19, 2021.

Health and Safety Activities

Prior to the resumption of plant operations in September, a pre-startup safety campaign was carried out with the employees.

Weekly site COVID testing continued during the third quarter, with no active COVID cases reported. The facility increased employee and contractor vaccination requirements, with a mandated COVID vaccination requirement which will be implemented in the fourth quarter.

Facility Health and Safety Committee meetings were conducted as scheduled.

Safety meetings and internal scheduled training proceeded, with COVID parameters in place.

In addition, the site conducted a full scale ERT drill in the third quarter. Both external evaluators and CNSC staff were on-site to observe the drill.

4.0 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.

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. An updated, more conservative DRL report for the refinery was accepted by CNSC staff in 2019 and implemented at the start of 2020.

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 12. The increase in the gamma component of the DRL in 2020 is a result of utilizing the new DRL calculation and is not attributable to any operational changes or increase in refinery emissions.

Table 12

Public Dose by Quarter (mSv)					
DRL Component	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021
Air	<0.001	<0.001	<0.001	<0.001	<0.001
Water	<0.001	<0.001	<0.001	<0.001	<0.001
Gamma	0.002	0.002	0.002	0.002	0.002
Total Quarterly Dose	0.002	0.002	0.002	0.002	0.002

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 13.



Table 13

2021 Third Quarter Measured Fence Line Gamma Levels (µSv/h)			
Fence Line	July	August	September
East	0.47	0.40	0.44
*North	0.12	0.08	0.08
South	0.43	0.28	0.25
West	1.51	1.62	1.46

*North fence CNSC Action Level 1.0 µSv/h (Monthly)

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.

Stack uranium emissions by quarter are shown in Table 14.

Table 14

Daily Stack Emissions by Quarter								
Source	Parameter	CNSC Limit	Value	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021
DCEV	Uranium (g U/h)	100 ^a	Weekly Average	0.04	0.07	0.09	0.09	0.05
			Weekly Maximum	0.08	0.11	0.12	0.14	0.10
Absorber	Uranium (g U/h)	100 ^a	Weekly Average	<0.01	<.0.01	<0.01	<0.01	0.01
			Weekly Maximum	0.02	0.02	0.01	0.01	0.02
	Nitrogen Oxides (kg NO ₂ /h)	56 ^a	Weekly Average	2.3	3.5	4.2	3.7	1.3
			Weekly Maximum	4.8	5.2	4.8	4.8	4.0
Incinerator	Uranium (g U/h)	10 ^b	Daily Average	<0.01	0.00	0.00	0.00	0.00
			Daily Maximum	<0.01	0.00	0.00	0.01	0.01
All stacks	Particulate (g/h)	11,000 ^a	Weekly Average	9	11	10	12	9
			Weekly Maximum	17	16	12	16	17

Results less than the detection limit is denoted as “<”.

^a Limit based on weekly averaging period.

^b Limit based on daily result.

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 UO₃ plant to control and reduce emissions to water. The concentrations of key parameters in liquid effluent emissions are shown in Table 15.

Table 15

Liquid Effluent Discharges								
Parameter	Units of Measure	CNSC Licensed Limit	Value	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021
Uranium	mg/l	2 ¹	Average	0.01	0.01	0.01	0.01	0.02
			Max.	0.02	0.02	0.02	0.01	0.02
Nitrate	mg/l as N	1000 ¹	Average	9.5	26.3	31.0	25.1	8.7
			Max.	29.0	32.0	38.9	37.3	10.3
Radium – 226	Bq/l	1 ¹	Average	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 ²	Daily Min.	7.6	7.3	7.6	7.4	6.8
		Max 9.5 ²	Daily Max.	8.1	8.3	8.0	8.4	8.4

¹ Limit based on monthly average of weekly composite samples

² Limit based on daily discharge sample

Ambient Air Monitoring

In addition to onsite monitoring of emissions, the refinery also has a comprehensive ambient air monitoring program. Table 16 shows the quarterly average uranium-in-air concentrations at each of the five hi-vol locations and the maximum individual result for each location by quarter.



Table 16

Uranium-in-Air Concentration ($\mu\text{g U/m}^3$) at Hi-Vol Stations by Quarter						
Quarter	Result	Golf Course	SE Yard	East Yard	Hydro Yard	Town of Blind River
Q3 2020	Average	0.0002	0.0011	0.0017	0.0001	0.0002
	Maximum	0.0004	0.0017	0.0025	0.0002	0.0002
Q4 2020	Average	0.0002	0.0007	0.0028	0.0002	0.0002
	Maximum	0.0003	0.0012	0.0047	0.0003	0.0002
Q1 2021	Average	0.0003	0.0008	0.0016	0.0002	0.0002
	Maximum	0.0004	0.0016	0.0032	0.0002	0.0002
Q2 2021	Average	0.0005	0.0013	0.0047	0.0002	0.0001
	Maximum	0.0012	0.0025	0.0081	0.0006	0.0002
Q3 2021	Average	0.0003	0.0008	0.0030	0.0008	0.0002
	Maximum	0.0005	0.0025	0.0099	0.0035	0.0006

5.0 Public Information Program

During the third quarter of 2021, BRR continued to meet the requirements of CNSC RD/GD 3.2.1, Public Information and Disclosure programs.

Public Engagement

During the third quarter of 2021 Cameco provided support for the Rotary Club of Blind River's charity golf tournament and other community golf tournaments. Cameco also supported the Blind River Fire Department's fire safety week program and sponsored Jr. A hockey.

On July 5, 2021, Cameco sent letters to vendors to inform them of the licence renewal intervention process. Letters were sent to 10 vendors.

Public Disclosure

No public disclosures were made during the third quarter.

Social Media

Cameco Ontario's Facebook community grew by 10 new followers (998 total) and had a total of 966 page likes at the end of the quarter. Cameco Ontario's 31 posts covered information such as:

- Emergency response drills at the Port Hope Conversion Facility and the Blind River Refinery
- Recognition of the inaugural National Day for Truth and Reconciliation with a video on September 30
- Shared the August/September issue of KBI Inspire Magazine which featured an article with Alice Wong of Cameco sharing her insight on approaching gender bias.

By the end of the quarter the Instagram account had grown by 30 new followers for a total of 642 followers. Photos and information featured was similar to the Cameco Facebook page.

Indigenous Engagement

The Q2 Compliance Report was provided to the Mississauga First Nation and Serpent River First Nation via email on August 24, 2021.

In July, the general manager had informal communication with the Chief of Mississauga First Nation, providing a general update and discussion of possible sampling program and possible support for the annual Pow Wow.

Website

The Blind River Refinery Derived Release Limits Public Summary was posted to the website: [Documents - Media Library - Media - Cameco Fuel Services](#)

The Q2 2021 Compliance Report was posted to the website: [Media Library - Media - Cameco Fuel Services](#)

Media Analysis

The Blind River Refinery was mentioned in an article regarding relicensing:

- NorthernOntarioBusiness.com - [Hearings this fall on Blind River uranium refinery licence renewal](#) – September 30, 2021

Communication Products

The Blind River Refinery Derived Release Limits Public Summary was posted to the website: [Documents - Media Library - Media - Cameco Fuel Services](#)



6.0 Other Matters of Regulatory Interest

There were no other matters of regulatory interest in the quarter.

7.0 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.