2017 Annual Compliance Monitoring
&
Operational Performance Report

Reporting Period January 1 – December 31, 2017

Blind River Refinery
Operating Licence
FFOL-3632.00/2022

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Submitted to:
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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 Canadian Nuclear Safety Commission (CNSC) operating Licence FFOL-3632.00/2022 and employs approximately 120 workers.

BRR processes natural uranium ore concentrates into natural uranium trioxide (UO_3). Cameco receives uranium ore concentrates from mines and mills worldwide. In 2017, BRR had licensed production capacity of 18,000 tonnes of uranium as UO_3. 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 small quantities of UO_3 to other customers around the world who are licensed by the CNSC or the equivalent authority in another country.

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 and efficient nuclear facility which meets the requirements of the CNSC.

BRR continues to maintain the safety analysis for its site operations. The approach used to assess risks to workers, the public and the environment is described in the Safety Report for the site.

At BRR changes to the physical design of equipment, processes and the facility with the potential to impact safety are evaluated using a design control process from project planning through to completion of the project. This review identifies impacts and potential impacts to the environment and health and safety. There were no significant modifications made at the refinery in 2017.

BRR has programs and procedures that ensure the facility is operated in a safe, clean and reliable manner. BRR has an established Planned Maintenance (PM) program. All PM tasks are initiated and documented through the work notification system in SAP. SAP is corporate-wide enterprise application software for asset management, accounting, and purchasing functions.

BRR maintains a number of programs, plans and procedures in the areas of health and safety, radiation protection, environment protection, emergency response, fire protection, waste

management, and training. The design and development of SAT based training programs for all necessary positions has been completed.

As a result of these programs, plans and procedures, BRR's operations have maintained radiation exposures well below the dose limits. 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. There was only one CNSC action level exceedance reported in 2017 for an individual whole body dose result above the monthly limit. An investigation indicated that the reported exposure was non-personal in nature and the individuals reported dose for that month subsequently adjusted as per the process described in S260: *Making Changes to Dose Related Information Filed with the National Dose Registry*.

BRR has an Emergency Response Plan in place to cover potential on-site and off-site emergency situations. BRR also has a comprehensive Fire Protection Program (FPP) in place to minimize both the probability of occurrence and the consequence of fire at the facility. Annual Third Party Reviews of compliance with the inspection requirements of the National Fire Code and the National Fire Protection Association, NFPA-801 are carried out. The site also maintains a Fire Hazard Analysis (FHA) that has been reviewed and accepted by CNSC staff. Lastly, BRR has a mutual aid agreement in effect with the Town of Blind River Fire Department.

BRR has a Waste Management Program which complies with applicable regulatory and licence requirements. The refinery also has an approved Preliminary Decommissioning Plan and financial guarantee.

The security plan in place for BRR provides the basis for security operations at the facility and identifies the systems and processes in place to meet security program objectives.

A comprehensive uranium inventory system to demonstrate compliance with Safeguards requirements is maintained by BRR. Receipts and shipments of natural uranium material are recorded and all uranium transfer reports are submitted to CNSC. In 2017 two short notice random inspections (SNRI) of this inventory system were conducted by the International Atomic Energy Agency (IAEA).

The scope of transportation activities at BRR includes the transport of Class 7 radioactive materials outlined in the Transportation of Dangerous Goods Act and associated regulation. Shipments included both incoming uranium ore concentrate from around the world and outgoing UO_3. There were three reportable transportation related events in 2017. Reports on each event were prepared and submitted to CNSC staff.

Cameco works to build and sustain the trust of local residents by acting as a good corporate citizen in the communities in which it operates. 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 performance. Cameco continued the enhanced strategic approach to community outreach in 2017, meeting regularly with both the Mayor of the Town of Blind River and the Chief of the Mississauga First Nation to discuss issues of mutual concern and interest. Numerous plant tours are given annually to interested parties.

Table of Contents

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 is the world's largest commercial uranium refinery and has been in operation since 1983.

BRR (Figure 1) is located approximately five kilometers to the west of the Town of Blind River in the District of Algoma. The property encompasses an area of approximately 258 hectares in total, which includes a secured area of approximately 11 hectares, representing the CNSC-licensed area. Cameco has a lease arrangement for an additional 195 hectares to the east of the existing property boundary. While located in Blind River, the refinery is also located adjacent to and south of the Mississauga First Nation, our closest neighbour.

Figure 1 – Blind River Refinery

BRR operates a Class 1B nuclear facility in Blind River, Ontario under operating licence FFOL-3632.0/2022. The current licence is valid until February 28, 2022. The current licensed production capacity is 18,000 tonnes of uranium as UO_3 but provision has been made to increase capacity to 24,000 tonnes of uranium as UO_3, once certain conditions have been met and the business climate warrants.

BRR processes natural uranium ore concentrates into natural uranium trioxide (UO_3). Cameco receives uranium ore concentrates from mines and mills worldwide. In 2017, BRR was licensed to produce up to 18,000 tonnes of uranium as UO_3. 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 the CNSC or the equivalent authority in another country. BRR employs approximately 120 workers.

The purpose of this document is to summarize the performance of BRR in 2017 and to demonstrate that BRR has met the regulatory requirements of the Nuclear Safety and Control Act. It is submitted in accordance with the CNSC license FFOL-3632.00/2022 section 2.2 and organized based on the CNSC document “Annual Compliance Monitoring and Operational Performance Reporting Requirements for Class 1 A & B Nuclear Facilities”. There were no operational challenges experienced at the facility in 2017. The workforce decreased by approximately 8 people in 2017 due to retirements and attrition.

There were no exceedences of CNSC regulatory limits in 2017. There were four reportable events; one a CNSC radiological action level exceedence and three transportation incidents. These incidents are discussed in more detail later in the report.

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 other federal and provincial regulators, such as the Ontario Ministry of the Environment and Climate Change (MOECC), Environment and Climate Change Canada (ECCC), Employment and Social Development Canada (ESDC) and Transport Canada (TC).

The acronyms in Table 1 are, or 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
MOECC	Ministry of the Environment and Climate Change
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 continues to strive for operational excellence at all of its facilities through consistent application of management systems across its operations 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 BRR Quality Management System.

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 impacts and potential impacts to the environment as well as to health and safety. There were no significant modifications carried out at the facility in 2017.

During 2017 BRR operated routinely with no major operating problems. The UO_3 plant shut down during the summer to allow for scheduled maintenance work, employee vacation time and to match Cameco PHCF production requirements. The UO_3 plant also shuts down for approximately two weeks at the end of the year for the Christmas and New Year's holiday period. BRR also has shorter shutdown periods throughout the year, ranging from a few hours to a few days. These shutdowns are both planned (inventory or production requirement related) and unplanned (extended power outages due to storm events and/or to effect critical maintenance repairs).

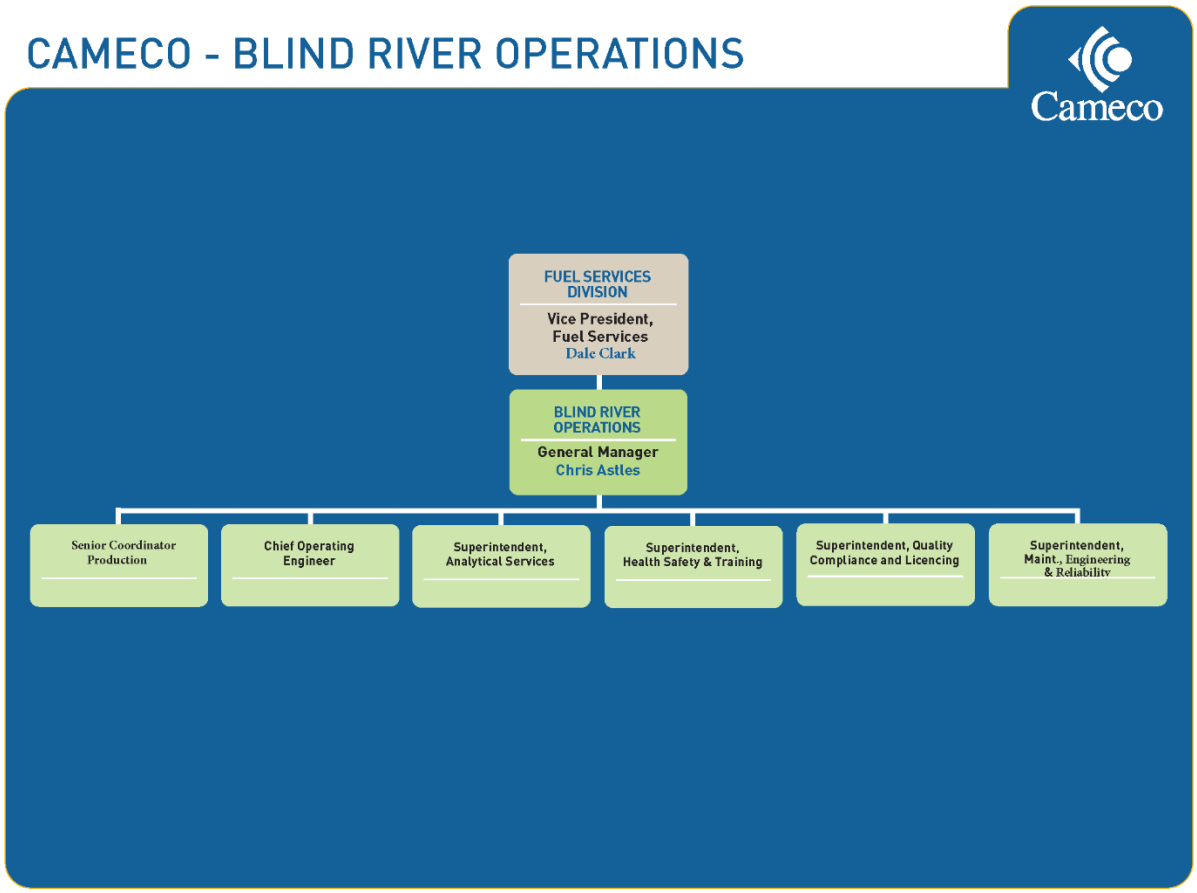
As specified in the Licence Condition Handbook (LCH) for BRR, an annual third party review of compliance with the inspection requirements of the National Fire Code and the National Fire Protection Association, NFPA-801 was carried out, with a copy of the report submitted to the CNSC.

The general manager of the Blind River refinery is accountable for the programs and procedures for operating and maintaining the facility. The responsibilities for these programs and procedures have been delegated amongst the management team at BRR and their respective personnel. All members of the BRR management team are held accountable for the roles and responsibilities that they hold.

There was a net reduction of approximately 8 employees in 2017, achieved primarily through retirement and attrition. However, despite the manpower reductions, the refinery continued to operate at a high level, with no lost time accidents and no environmental incidents. A 2017 organization chart for the management structure at BRR is provided below in Figure 2. There are no vacant positions at the refinery management level.

The superintendent, Quality, Compliance & Licensing is the site liaison with the CNSC and reports directly to the general manager. This position is responsible for the radiation, environment and quality management programs in place at BRR.

Figure 2 – BRR Organizational Chart



A Facility Health and Safety Committee (FHSC) has been in place for many years and includes representation from both management and workers. The general manager, the superintendent, quality, compliance & licensing, the superintendent, health safety & training and the health safety officer are permanent members of this committee. There is worker representation from all areas on this committee as well, including production, maintenance, powerhouse, analytical services, security and administration. In addition to conventional health and safety issues, this committee also discusses radiation and environment related issues. A separate ALARA committee is also in place.

BRR has a LCH issued by the CNSC. The purpose of this handbook is to establish and consolidate into one document the compliance framework related to the Cameco Blind River

refinery facility licence. The LCH specifies the CNSC expectations by defining the licensing basis, explaining the regulatory context related to each licence condition, and identifying the verification criteria for each licence condition.

BRR also has a Facility Licensing Manual (FLM) that describes the commitment by Cameco Corporation to operate a safe and efficient nuclear facility which meets the requirements of the CNSC. There is also an Operations Quality Assurance manual that describes the CNSC accepted quality assurance program in place to ensure that the licensed activities at the site are controlled and conducted in a safe manner. The licensed activities are controlled by the use of documented procedures and the provision of qualified personnel. Controls are established commensurate with the safety significance of the activity, system or equipment.

As part of the management system programs, internal audits are conducted each year to assess the level of conformance to these management systems. 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 audits include assessment of both conformance and legal compliance. The most recent corporate SHEQ audit was conducted in the second quarter of 2017. A summary of the 2017 audit program is being provided to the CNSC under separate confidential correspondence.

1.3 Production or Utilization

The annual licensed production limit of 18,000 tonnes of uranium as UO_3 was not exceeded in 2017.

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 2017 that required written approval of the Commission or a person authorized by the Commission.

The following BRR documents referenced in the LCH were updated and reissued in 2017:

- Public Information Program, AM 120
- Training Program Manual, AM 300
- BRR Preliminary Decommissioning Plan
- Emergency Response Plan, EP 100

2. SAFETY AND CONTROL AREAS

2.1 Management

2.1.1 Management Systems

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 QA requirements and other regulatory requirements. The application of QA requirements is scaled according to the complexity and hazard potential of a particular activity.

An annual site management review meeting is held to review the suitability, adequacy and effectiveness of the corporate SHEQ policy and the site programs and procedures to ensure conformance to both Cameco and CNSC requirements. The annual review meeting is typically held in the first quarter of the following year. The 2017 annual management review meeting was held in March 2018 and concluded that while there were opportunities for improvement, the site management systems were suitable, adequate and effective.

As noted previously, the corporate SHEQ group assumed responsibility for completion of required internal audits at Cameco licensed facilities, including the BRR, in 2017. Audits focused on the areas of health and safety, contractor management, emergency preparedness and response and selected elements from the site License Conditions Handbook. Findings were assessed and corrective actions developed, as appropriate; in order to continually improve all aspects of site performance.

There were also two external audits/inspections carried out by third parties as follows:

- A third-party audit of the Fuel Services Internal Dosimetry Program. This audit is a requirement under the quality assurance program developed for the Internal Dosimetry Services License issued to the Cameco FSD sites.
- An annual third party review of compliance with the inspection requirements of the *National Fire Code, 2005* and the *National Fire Protection Association, NFPA-801, 2003*, as required by Section 3.11 of our LCH.

It should be noted that the above list does not include inspections completed by CNSC staff as part of their oversight of licensed activities. There were no significant findings identified in any of the audits/inspections undertaken in 2017. Audits are documented in the Cameco Incident

Reporting System (CIRS) and corrective actions taken to address any issues identified. More detail on the 2017 audit program is being provided to the CNSC under separate confidential correspondence.

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 assurance documentation. A total of 97 site documents were either reviewed and updated, or created in 2017.

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 it 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.

All employees are encouraged to build and maintain a questioning attitude with respect to health, safety, radiation protection and environmental issues.

Cameco has implemented a standardized, systematic approach to training (SAT) across all of its operations. SAT applies a robust, risk-informed system to analyze and track training requirements and develop and deliver appropriate training programs. The SAT process covers the initial training of employees, routine re-qualification, as well as re-qualification of employees after an extended absence. The design and development of SAT-based training programs for positions considered "in-scope" was completed in 2011. Mandatory federal, provincial and/or Cameco-required training is tracked and trended, with 95.7% attendance achieved in 2017, a slight decrease from the 96.6% reported in 2016. Employees on short or long-term absences due to illness or disability may affect these statistics. Cameco has processes in place to ensure employees are fully qualified to carry out the activities they have been assigned and also to ensure that employees who miss required training sessions are identified and scheduled to attend a subsequent training session.

BRR is a 24 hour a day, seven day a week operation. Following the requirements of Part II of the *Canada Labour Code*, BRR has defined maximum hours of work in a shift cycle for all employees. In addition, to ensure qualified personnel are available on-site to conduct licensed activities in a safe manner, minimum crew complements for UO_3 operations and emergency response have been defined.

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, safe haven, 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.

A formal mentoring program pairs new employees with experienced workers for the first six months of their employment. The mentoring process helps to ensure that new employees are properly trained in how to carry out their duties safely and to minimize risks to people and the environment.

A safety culture self-assessment of the refinery operation is completed periodically, approximately every five years. The most recent assessment was completed in 2013 and re-affirmed that BRR has a strong commitment to safety, scoring 6.1 on the 7 point scale used to assess the strength of the safety culture at the refinery. The results from the 2013 self-assessment, carried out by a third-party with the assistance of employees from other Cameco locations, improved upon the results from the prior assessment completed in 2008 and reaffirmed that BRR has been successful in continually improving its safety culture. The next self-assessment is scheduled for 2018.

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 2017, BRR continued to operate in a manner that supports safe, clean and reliable production and in compliance with applicable acts and regulations.

There was a scheduled summer shutdown of the UO_3 plant to allow for planned maintenance activities, to allow for employees to utilize vacation time and to match Cameco PHCF production requirements. Refinery start-up after the extended summer shutdown period was routine. The refinery production schedule throughout the year closely aligned with that of Cameco's PHCF.

BRR operated in accordance with site programs and procedures and did not exceed any CNSC regulatory limits during the year. 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 routinely looks at various aspects of site operations related to the licensed activities. BRR also had some external audits completed in 2017, as identified in Section 2.1.1 of this report. There were no significant issues identified from either internal or external audits in 2017.

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. The safety report was last updated and reissued in 2016.

There were no modifications made in 2017 that affected the safety case for the refinery. The safety significant systems at the facility have been identified and a preventive maintenance program is in place to ensure that the equipment associated with these systems is properly maintained.

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 Cameco's budgeting process for capital expenditures, plant improvements related to physical design are identified and prioritized.

BRR contains numerous types of conventional industrial equipment including storage tanks, conveyors and associated piping, as well as specialized equipment for the UO_3 refining process.

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.

BRR has a contractual arrangement with the provincial TSSA to ensure that oversight of pressure retaining components and systems continues to be carried out by a third-party expert. As part of this process, BRR continues to utilize non-destructive examination techniques to assess the integrity of pressure vessels and related systems. These examinations are primarily done in-house by qualified staff, though qualified third-party experts are used when necessary.

Examples of physical improvements implemented in 2017 include:

- Improved lighting in a number of areas including the machinist bay, fork lift bay, stores, S&FP loading docks and at the tote bin trailer loading area;
- Developed and installed prototype splashguard on denitration scrubber pump seal;
- Installed piping to route denitration scrubber acid to the scrub recycle tank;
- Installed liquid feed bioreporter system in place of redundant pellet feed system in the powerhouse;
- Installed Teflon line inside Concentrator "B" to reduce corrosion;
- Changed hinges on security main gate;
- Replaced "B" boiler blowdown valves; and
- Installed new powerhouse "boiler" programmable logic controller (PLC).

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.

BRR has an established PM program as defined in the site PM plan. All PM tasks are initiated and documented through the work notification system in SAP, a corporate-wide enterprise application software package for asset management, maintenance management, accounting and purchasing functions. PM plans are issued, reviewed and updated periodically to ensure the PM routines developed continue to be effective and adequate. Key Performance Indicators (KPIs) are in place to monitor the effectiveness of the program.

All regulatory related preventive maintenance work orders driven by the preventive maintenance plans were completed.

BRR has an in-service inspection program which applies to both registered and non-registered piping and vessels in the refinery, including those related to safety significant systems. Technicians performing radiographic, ultrasonic, magnetic particle and liquid penetrant inspections are certified in accordance with the Canadian General Standards Board (CGSB). Test methods have been selected on the basis of the historical record of operating and inspecting the UO_3 plant. They are considered the most appropriate for detecting potential problems and for revealing the type of deterioration most likely to occur as a result of the service conditions to which the equipment is subjected.

The in-service inspection (ISI) program was maintained throughout the year with no significant issues identified. In 2017, 95% of all ISI’s were completed within 10% of the frequency rate, which met the established objective.

In addition to the ISI program, a process is in place to identify equipment and components reaching the end of their service life through means such as increased maintenance requirements, lack of availability of replacement parts or manufacturers recommendations. Items identified for replacement are assessed through the design change process and may require a capital expenditure, depending on the nature and cost of the replacement component.

Based on the maintenance related KPI's, the maintenance program, which includes the aging management component, is considered to be effective.

Fire protection systems are tested according to an established schedule as outlined in the Fire Protection Program (FPP). Third-party reviews are conducted to confirm required tests and inspections with respect to fire protection are completed and these review reports are submitted to the CNSC.

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. Additional measures to ensure that equipment is operating as designed include monitoring of environmental systems (i.e. conductivity probes in condensate return lines to detect leaks, in-plant uranium-in-air monitoring and real-time stack monitoring for oxides of nitrogen (NOx)) as well as operator and specialist (i.e. safety officer and radiation safety officer) inspections.

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.

For various radiological parameters, Cameco has established action levels, accepted 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 (IAL), which are set below the action levels and provide an even earlier warning of a potential concern. A result above an IAL is also investigated and remedial actions taken if necessary.

The current action levels for external dosimetry are 2.0 mSv whole body and 15 mSv skin exposure for people on a monthly dosimeter badge change frequency and 0.7 mSv whole body and 6 mSv skin exposure for people on a quarterly badge change frequency. BRR has also established actions levels with respect to urinalysis - 63 µg/L U for routine bi-weekly samples and 44 µg/L U for routine monthly samples. There is also a lung counting action level of 10 mSv between consecutive counts.

In 2017 there was one CNSC radiological action level exceedance reported, compared to none in the previous year. A process engineer exceeded the monthly action level for whole body dose. However, the investigation revealed that the reported exposure was non-personal in nature. CNSC staff were in agreement and a dose adjustment was made for this individual.

Radiation objectives and targets are established jointly by the site management team and site specialists, including the radiation safety officer, to ensure there is agreement, a commitment and awareness of these objectives and targets across all areas of the refinery's operation. These objectives and targets can address, among other things, worker dose reduction initiatives and other projects which examine ways to reduce in-plant uranium-in-air concentrations. The status of these objectives and targets is reviewed by the site management team and resources are allocated as required to achieve the targets. Status reports on the objectives and targets are posted on the ALARA bulletin board outside the employee change rooms so that employees are aware and can review the status of the objectives and targets as well.

At the start of 2017 five radiation safety objectives were created, four of which have now been completed. The closed objectives were to investigate the feasibility of removing the two nuclear gauges from site, to switch to a new style of full and half-face respirator for the refinery, to assess what equipment/software is required to upgrade the gamma spectroscopy system and to reinforce procedural adherence and remind employees of the danger of dust complacency. The one 2017 objective that remains open is to review the CNSC radiological action levels. Completion of this objective is now scheduled for the second quarter of 2018. Four new radiation safety objectives have been created in 2018 related to the following activities/topics: removal of nuclear gauges, update ALARA Assessment report, off-site ERT response training and the use of carpets in Zone 2 areas.

As part of the work of the joint workplace health and safety committee, updates on the status of the radiation protection program are discussed at the monthly meetings and employees are encouraged to bring forward any questions or concerns. In addition to this committee, a separate ALARA committee is in place. This committee meets regularly to review and discuss radiation safety related incidents and issues, and to make recommendations for improvements.

Any issues identified during either regulatory or internal audits are documented in the CIRS database so that corrective actions can be identified and implemented.

There were a total of thirty-four separate radiation training sessions held in 2017 covering a variety of radiation safety topics including respirator training, radiation meter training, dosimeter training, procedural review and radiation theory training. At the end of 2017, 99.2% of the required training was completed. There was one new hire and a departmental transfer that had not completed all of their required rad training by the end of 2017 as both individuals only started in their new roles in mid-November 2017. Their remaining training has since been completed.

There were 33 radiation-related documents updated in 2017. These included procedures and forms related to air sampling, urine sampling, lung counting, dosimetry, respiratory protection

and surveying. All radiation safety procedures and forms are reviewed and updated as required on a regular basis.

An inventory of sealed and unsealed sources that are used or possessed on site is listed in the radioisotope source control procedure. Regular inspection and leak tests of the sealed sources were carried out in 2017 following this procedure. Results showed that all sources are accounted for and pose no undue risk to workers. Control of sealed sources was maintained throughout the year.

All radiation monitoring devices and instrumentation are routinely checked and calibrated as required. Calibration frequencies are identified and a calibration schedule maintained. Equipment that is damaged or non-operational is removed from service until it can be repaired and recalibrated. In 2017 new radiation protection monitoring devices/instrumentation was purchased to either augment the existing equipment inventory or to replace non-operational equipment that was deemed no longer repairable.

Calibration of contamination monitoring instrumentation is done in-house or by a qualified third party vendor, while calibration of gamma survey meters is done by a qualified third party vendor. Other radiation protection instrumentation such as air flow calibrators and respirator fit testing equipment is also sent off-site for calibration by a qualified third party.

Dosimetry

Cameco uses a licensed dosimetry services provider accredited by the CNSC. The dosimetry service provides optically stimulated luminescence (OSL) dosimeters to monitor whole body and skin dose for employees, contractors and visitors as required. Ring dosimeters are also issued to certain employees, dependent on their job duties. Dosimeters are changed monthly for operations (production and maintenance) personnel and quarterly for administration and support staff. Results are provided by the dosimetry services provider to both Cameco and to the National Dose Registry.

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

Whole Body Dose

Table 2 shows the annual external dose results for three work groups, employees in operations, employees in administration and/or support roles and contractors who have been made nuclear energy workers (NEWs). All employees are also NEWs. The highest doses are from the operations work group, consisting of production and maintenance personnel.

Table 2

2017 Annual External Dose Results (mSv)							
Work Group	**Number of Individuals**	**Whole Body Dose**			**Skin Dose**		
		Min.	**Average**	**Max.**	**Min.**	**Average**	**Max.**
Operations	72	0	0.7	2.4	0.1	5.5	16.2
Administration/Support	57	<0.1	0.3	0.7	<0.1	0.8	3.9
NEW Contractors	15	0	<0.1	0.2	0	0.1	1.1

As illustrated in Table 3 and Figure 3, approximately 88% of external whole body doses in 2017 were 1 mSv or less, with no result greater than 3 mSv, similar to the previous year. Whole body dose is a component of effective dose.

Table 3

2017 Whole Body Dose Distribution	
Dose Range in mSv	**% of Individuals**
0 – 1	87.5
1 – 2	9.7
2 – 3	2.8
3 – 4	0
4 – 5	0
>5	0

Figure 3

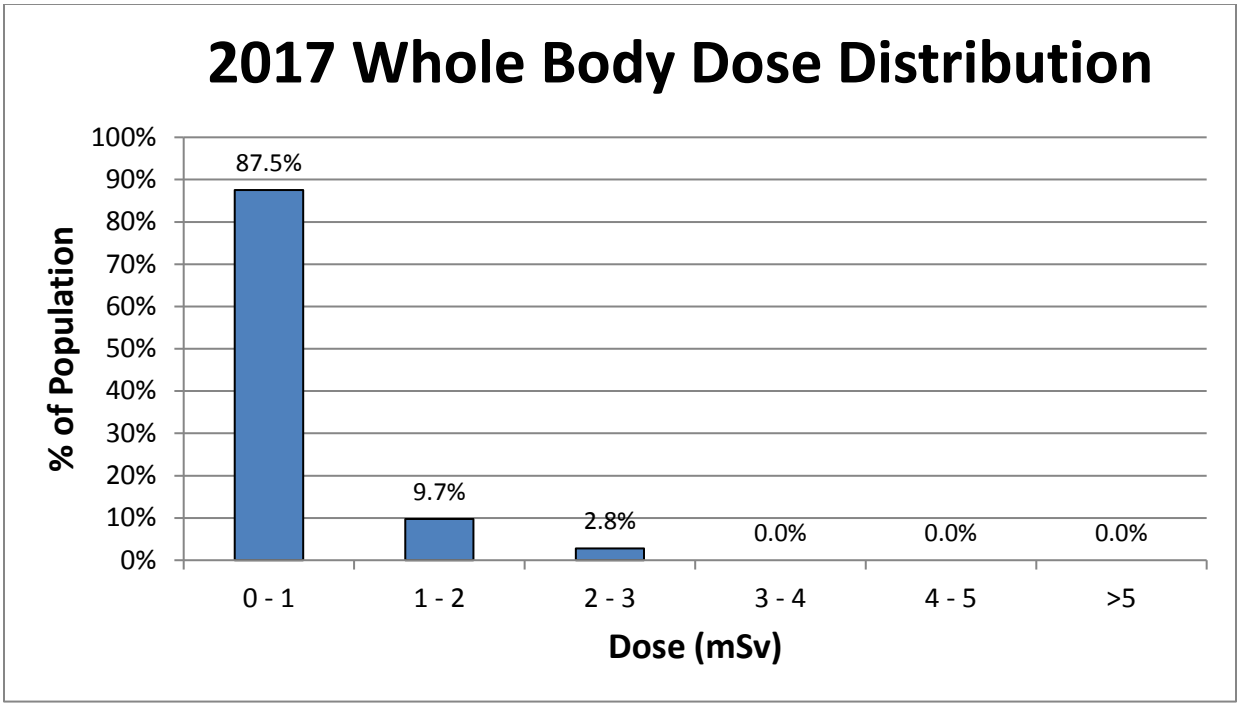


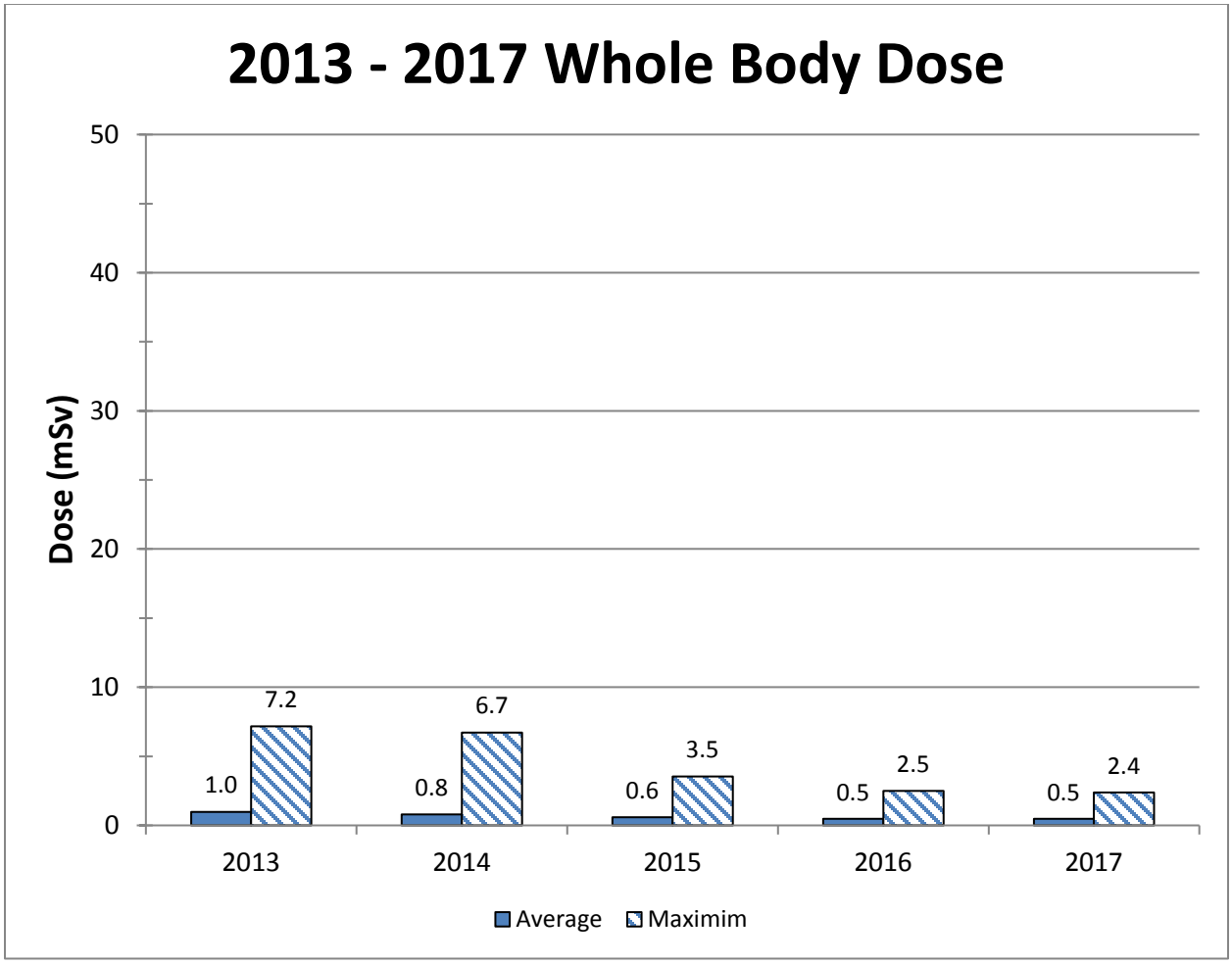
Table 4 and Figure 4 show the average, minimum and maximum individual external whole body dose for the five year period from 2013 – 2017. The average whole body dose has not exceeded 1.0 mSv in the five year period and has gradually decreased over that time. Reasons for the decrease include lower UO_3 production in recent years and improved procedural adherence.

The highest individual whole body exposure was 2.4 mSv, received by a process operator. This is the lowest annual maximum whole body dose reported in the last five years and the fifth year in a row the maximum individual whole body dose has decreased.

Table 4

2013 – 2017 Whole Body Dose					
Result (mSv)	**2013**	**2014**	**2015**	**2016**	**2017**
Minimum	0	0	0	0	0
Average	1.0	0.8	0.6	0.5	0.5
Maximum	7.2	6.7	3.5	2.5	2.4

Figure 4



Site visitors and non-NEW contractors may also be issued dosimeter badges. The average and maximum whole body results for these individuals were <0.1 mSv and 0.1 mSv, respectively.

Skin Dose

Table 5 and Figure 5 illustrate that over 92% of individual skin doses in 2017 were less than or equal to 10 mSv, with no skin dose result above 20 mSv. Last year there were no employees with a skin dose result greater than 30 mSv. All results remain less than 10% of the regulatory limit of 500 mSv.

Table 5

2017 Skin Dose Distribution	
Dose Range in mSv	**% of Individuals**
0 – 10	92.4
10 – 20	7.6
20 – 30	0
30 – 40	0
40 – 50	0
>50	0

Figure 5

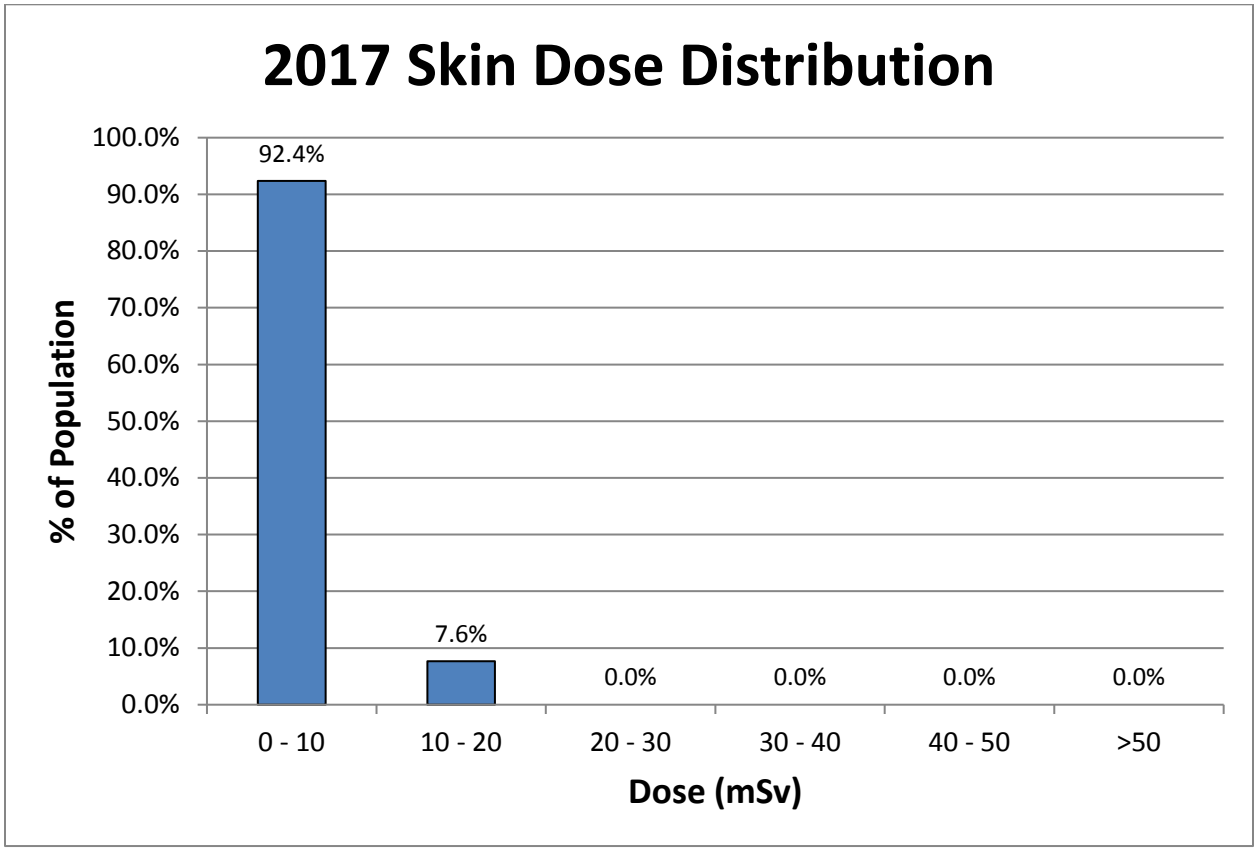


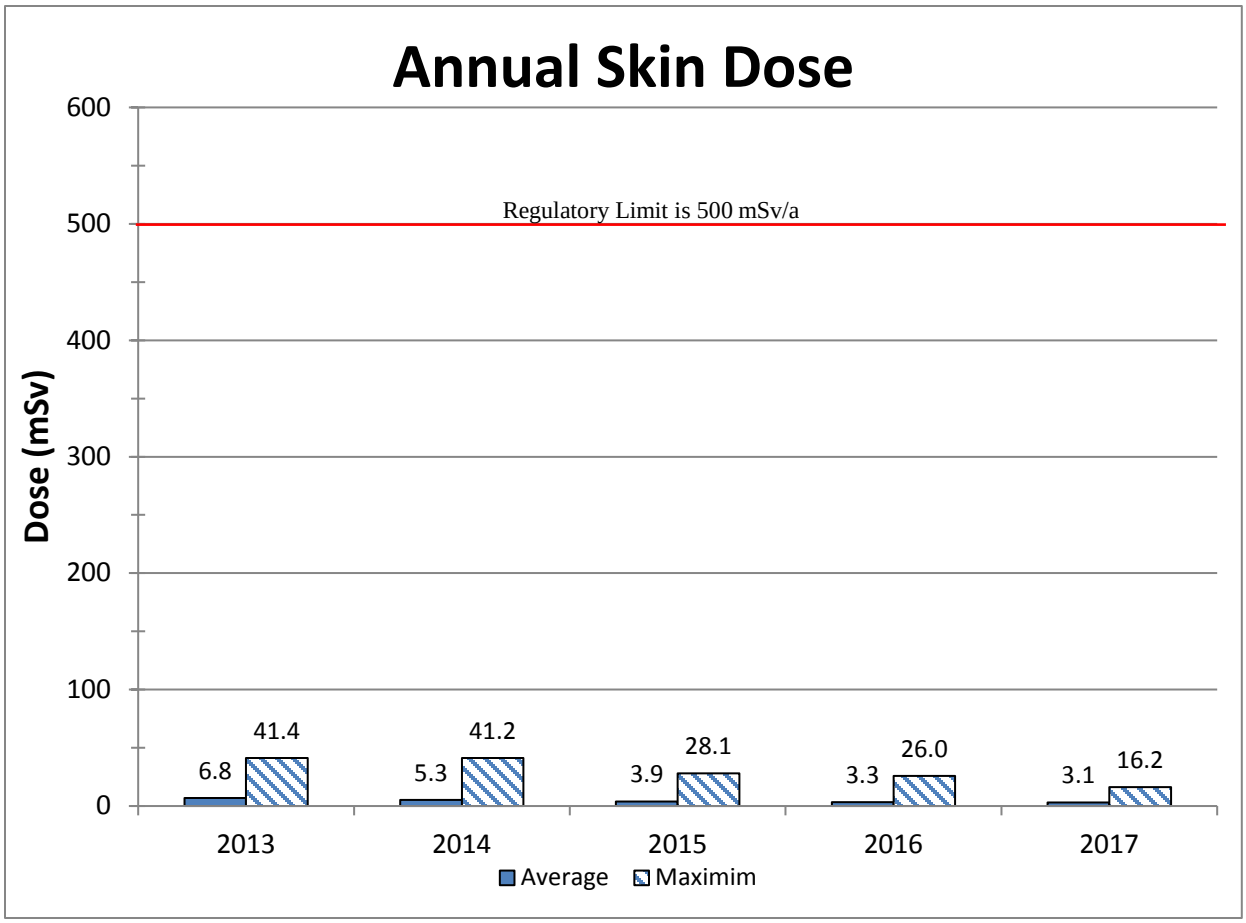
Table 6 and Figure 6 show the average, minimum and maximum individual skin doses for the five year period from 2013 – 2017. The average individual skin dose decreased in 2017 for the fourth consecutive year. Reasons for the decrease include lower UO_3 production in recent years and improved procedural adherence. The refinery average result of 3.1 mSv is less than 1% of the CNSC annual regulatory limit.

The maximum individual skin dose in 2017 was 16.2 mSv compared to 26.0 mSv in 2016. This result is approximately 3% of the CNSC annual limit. The individual with the highest skin dose is a process operator. The average and maximum non-NEW contractor/visitor skin dose results were <0.1 mSv and 0.1 mSv, respectively.

Table 6

2013 – 2017 Skin Dose					
Result (mSv)	**2013**	**2014**	**2015**	**2016**	**2017**
Minimum	0	0	0	0	0
Average	6.8	5.3	3.9	3.3	3.1
Maximum	41.4	41.2	28.1	26.0	16.2

Figure 6



Extremity Dose

Process operators working in the DRaff area and certain 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 but may be worn in other areas of the refinery as well. Table 7 shows the average, minimum and maximum ring dosimeter result for employees over the last five years. In a trend similar to what has been noted with respect to whole body and skin dose, the average annual extremity dose has steadily decreased over the last four years. The average result of 1.0 mSv in 2017 is less than 1% of the CNSC annual limit of 500 mSv, with the maximum dose at approximately 3% of the regulatory limit.

Table 7

2013 – 2017 Extremity Dose					
Result (mSv)	**2013**	**2014**	**2015**	**2016**	**2017**
Minimum	0	0	0	0	0
Average	13.5	5.4	1.5	1.2	1.0
Maximum	35.1	48.2	15.3	10.6	13.6

Urine Dose

Table 8 shows the distribution of urine results for 2017. The majority of results (99%) are less than or equal to 5 µg U/l, and <0.1% of the results are greater than 25 µg U/l. These percentages are the same as reported in 2016.

Table 8

2017 Urinalysis Results	
Distribution of Results	**Number of Results**
Number of Samples ≤ 5 µg U/l	3241
Number of Samples >5 to ≤ 25 µg U/l	20
Number of Samples >25 to ≤ 50 µg U/l	1
Number of Samples ≥ 50 µg U/l	1
Number of Samples Analyzed	3263

The 2017 urine dose distribution is shown in Table 9 and Figure 7. About 78% of individuals were assigned a urine dose of 0.2 mSv or less, similar to the 77% in 2016. Also in 2017 approximately 98% of the results were less than 1 mSv, compared to 96% in 2016. Cameco's Fuel Services Division has an Internal Dosimetry Licence (#11010-16-24.0) for both urinalysis and lung counting.

Table 9

2017 Urine Dose Distribution	
Dose Range in mSv	**% of Individuals**
0 – 0.2	77.6
0.2 – 0.4	7.5
0.4 – 0.6	6.0
0.6 – 0.8	3.7
0.8 – 1.0	3.0
>1.0	2.2

Figure 7

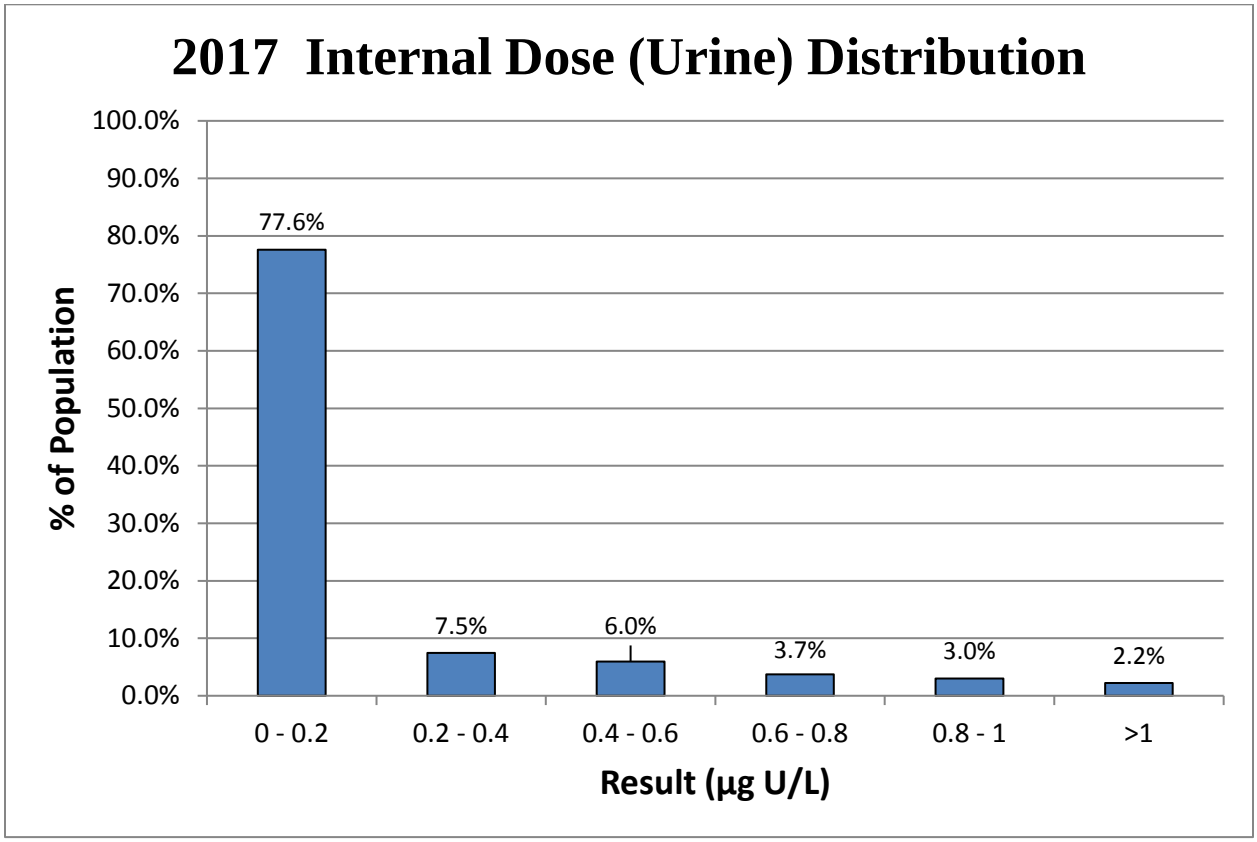


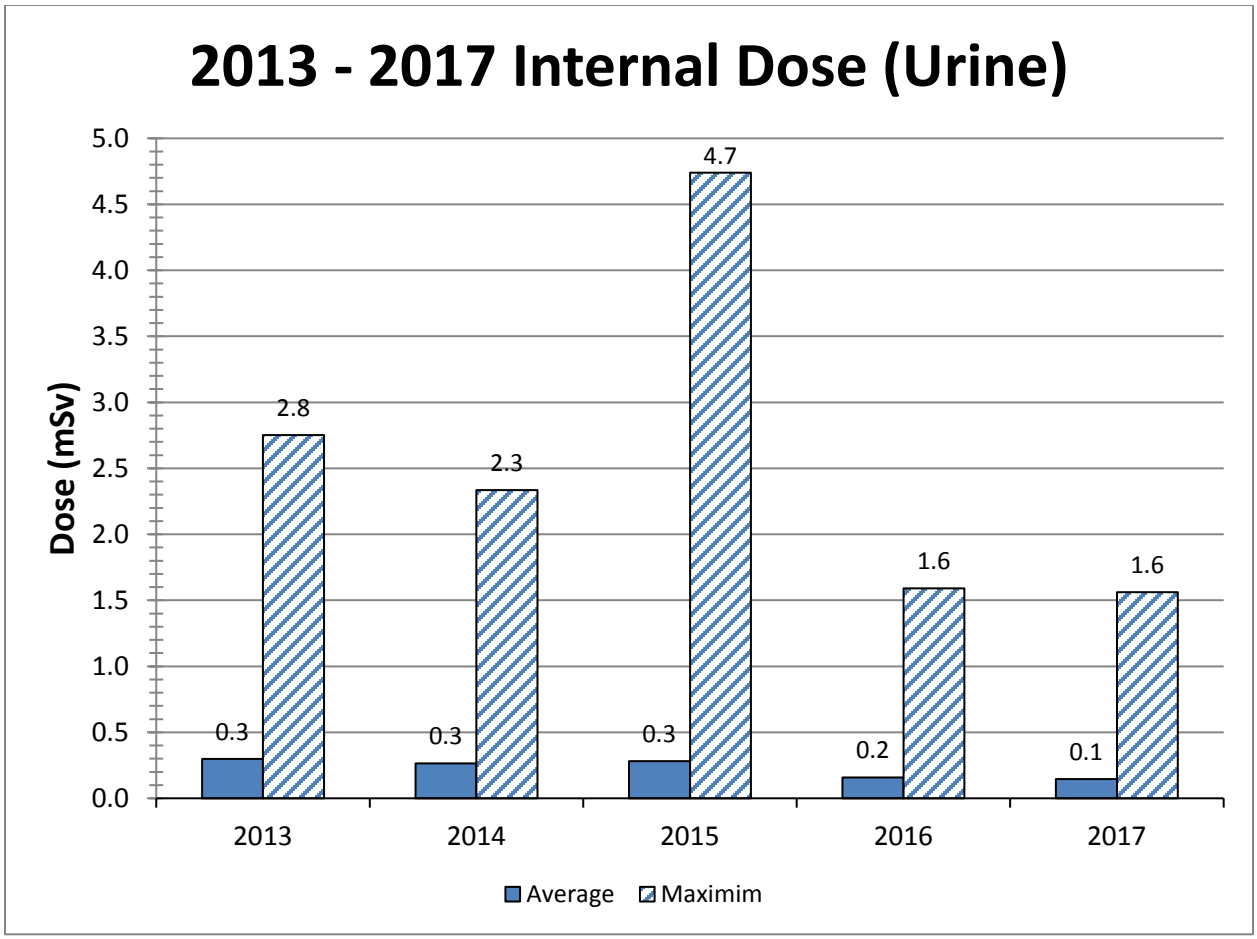
Table 10 and Figure 8 show the minimum, average and maximum individual assigned urine dose for the 2013 – 2017 periods. Overall refinery results have been stable over the last five years. The individual with the highest maximum individual urine dose in 2017 was an S&FP operator. The maximum dose in 2017 is the same as it was in 2016 and the lowest in the five year period.

Urine dose is a component of effective dose.

Table 10

2013 – 2017 Internal Dose (Urine)				
Year	**Number of Individuals**	**Minimum Dose (mSv)**	**Average Dose (mSv)**	**Maximum Dose (mSv)**
2013	161	0	0.3	2.8
2014	150	0	0.3	2.3
2015	147	0	0.3	4.7
2016	141	0	0.2	1.6
2017	134	0	0.1	1.6

Figure 8



Lung Dose

Table 11 and Figure 9 show the breakdown of the internal lung dose for individuals in 2017. This data includes both employees and contractor NEWS. Over 83% of individuals had an assigned lung dose less than or equal to 1 mSv and no one had an assigned lung dose greater than 2 mSv. Due to the nature of the lung dose assessment methodology, there can be some year-to-year variation in dose group assignments, which impacts directly on the percentage of individuals in each dose range.

Table 11

2017 Lung Dose Distribution	
Dose Range in mSv	**% of Individuals**
0 – 1	83.4
1 – 2	16.6
2 – 3	0
3 – 4	0
4 – 5	0
>5	0

Figure 9

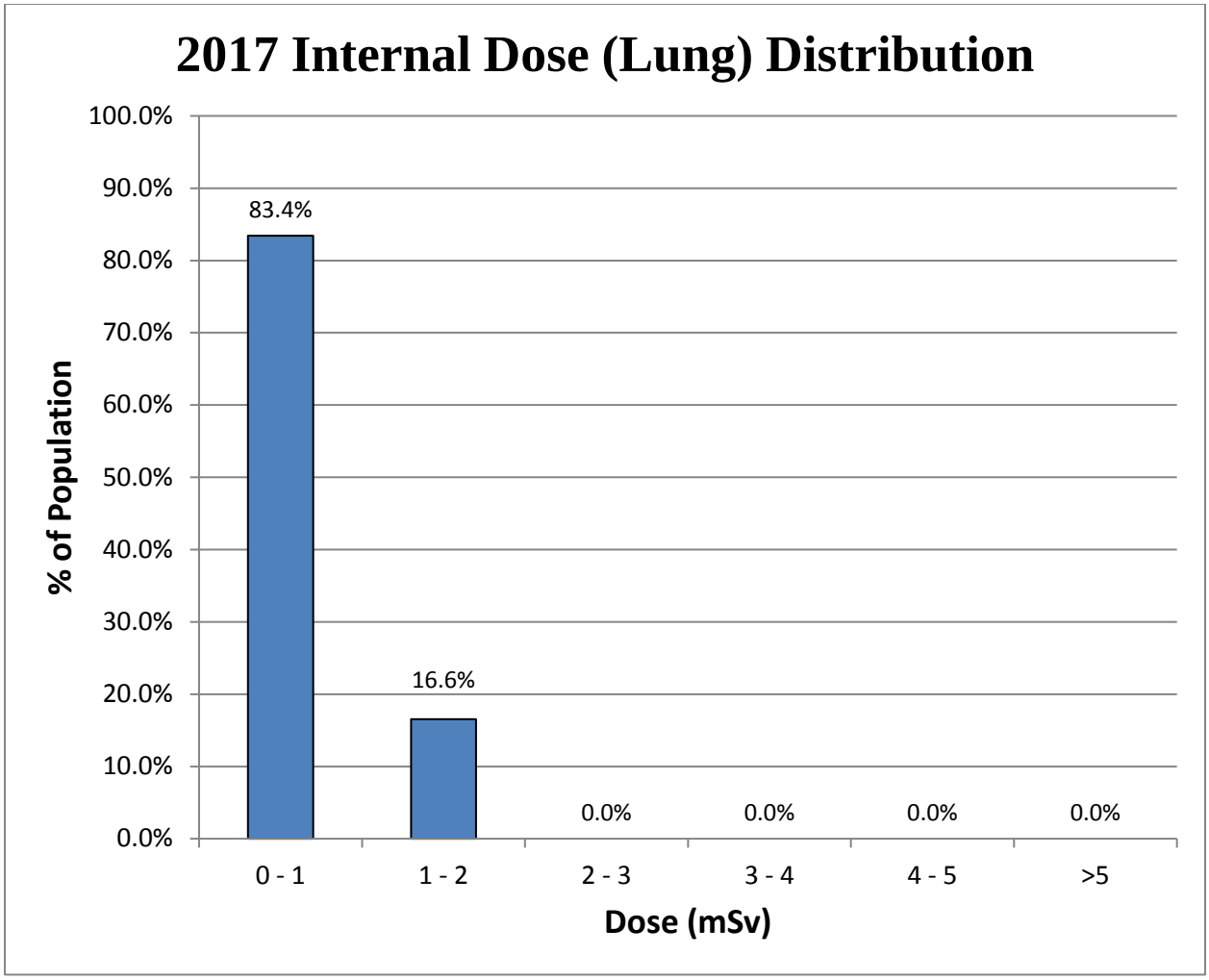


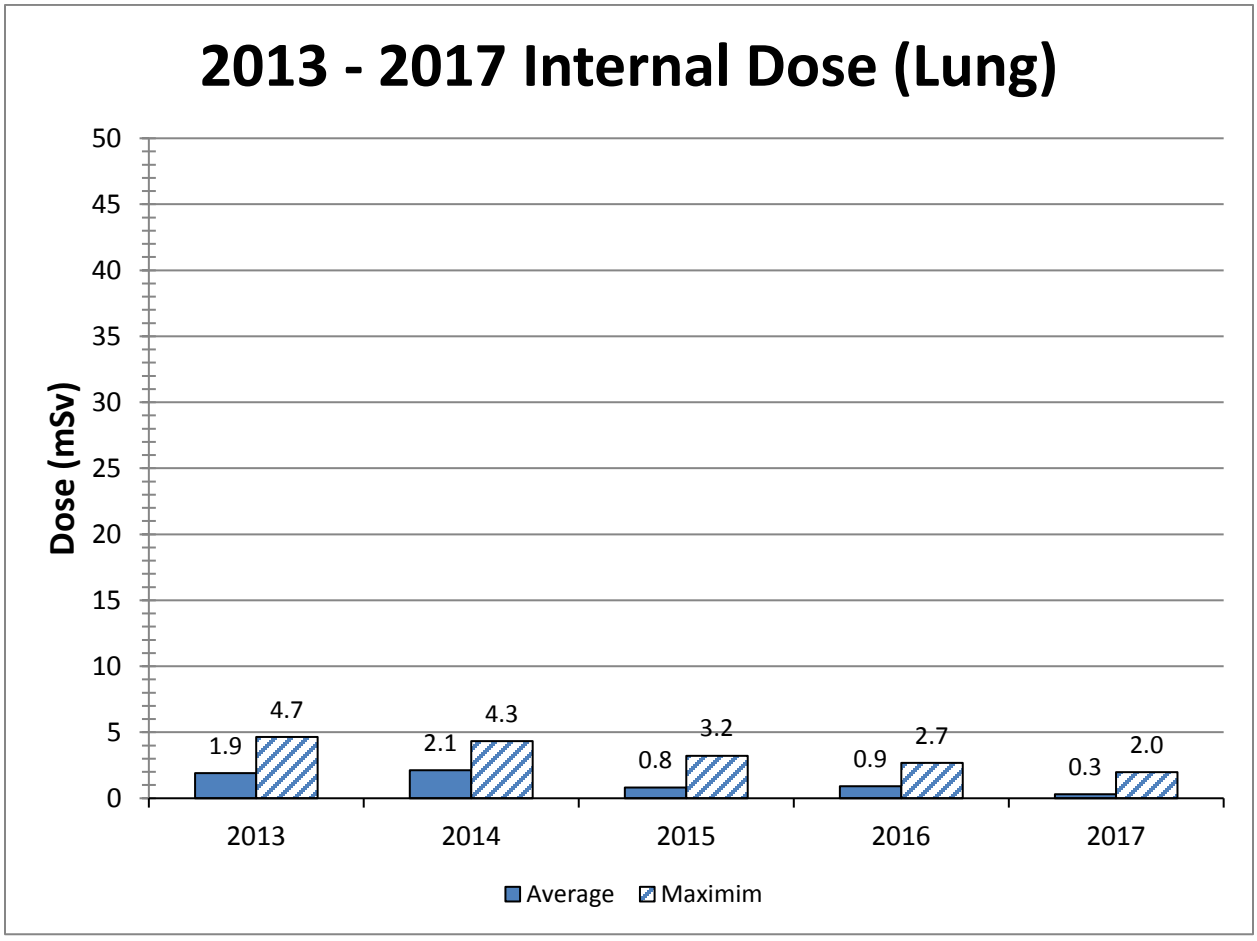
Table 12 and Figure 10 show the minimum, average and maximum individual assigned lung dose for the 2013 – 2017 period. The average individual lung dose in 2017 is lower than in 2016 and is the lowest average in the five year period. The highest individual lung dose in 2017 was 2.0 mSv; lower than the 2.7 mSv maximum dose reported in the previous year. Overall, individual lung dose has shown a decreasing trend over the last five years.

Lung dose is a component of effective dose.

Table 12

2013 – 2017 Internal Dose (Lung)				
Year	**Number of Individuals**	**Minimum Dose (mSv)**	**Average Dose (mSv)**	**Maximum Dose (mSv)**
2013	171	0	1.9	4.7
2014	162	0	2.1	4.3
2015	154	0	0.8	3.2
2016	154	0	0.9	2.7
2017	145	0	0.3	2.0

Figure 10



Total Effective Dose

Table 13 and Figure 11 show the breakdown of the total effective dose for individuals in 2017. This data includes both employees and contractor NEWs. All individuals had an effective dose of 4 mSv or less. Last year over 11% of individuals had an effective dose greater than 4 mSv.

Table 13

2017 Total Effective Dose Distribution	
Dose Range in mSv	**% of Individuals**
0 – 2	83.4
2 – 4	16.6
4 – 6	0
6 – 8	0
8 – 10	0
>10	0

Figure 11

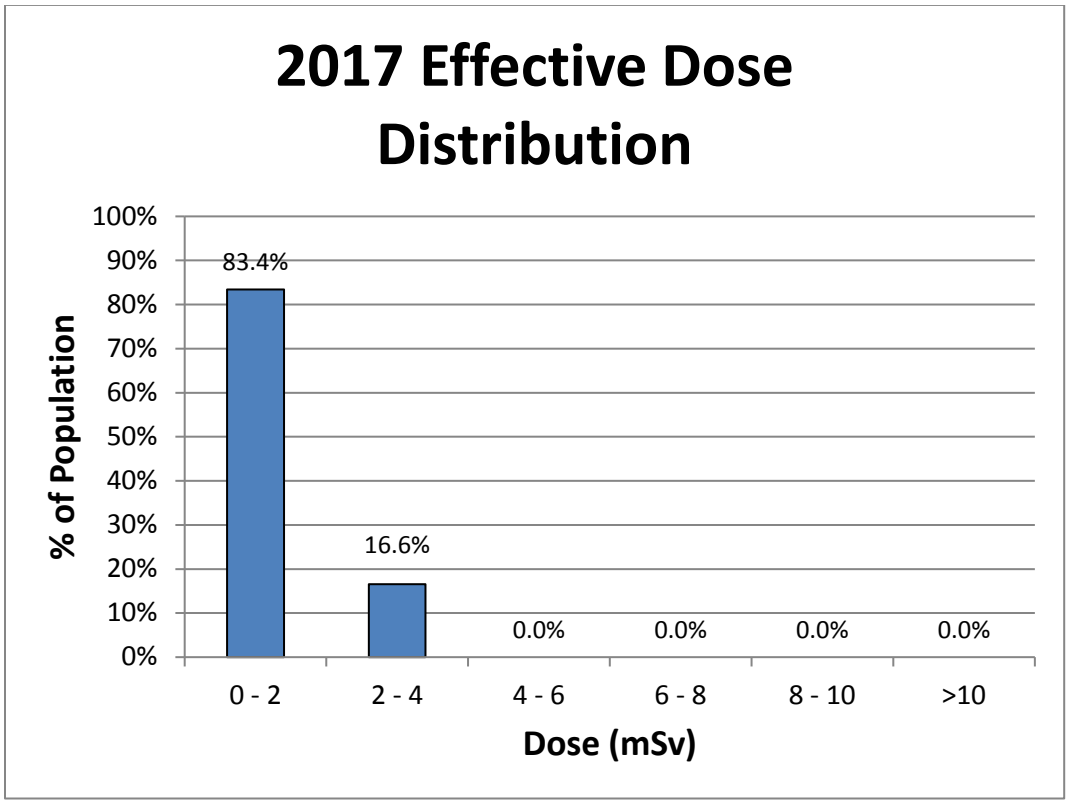


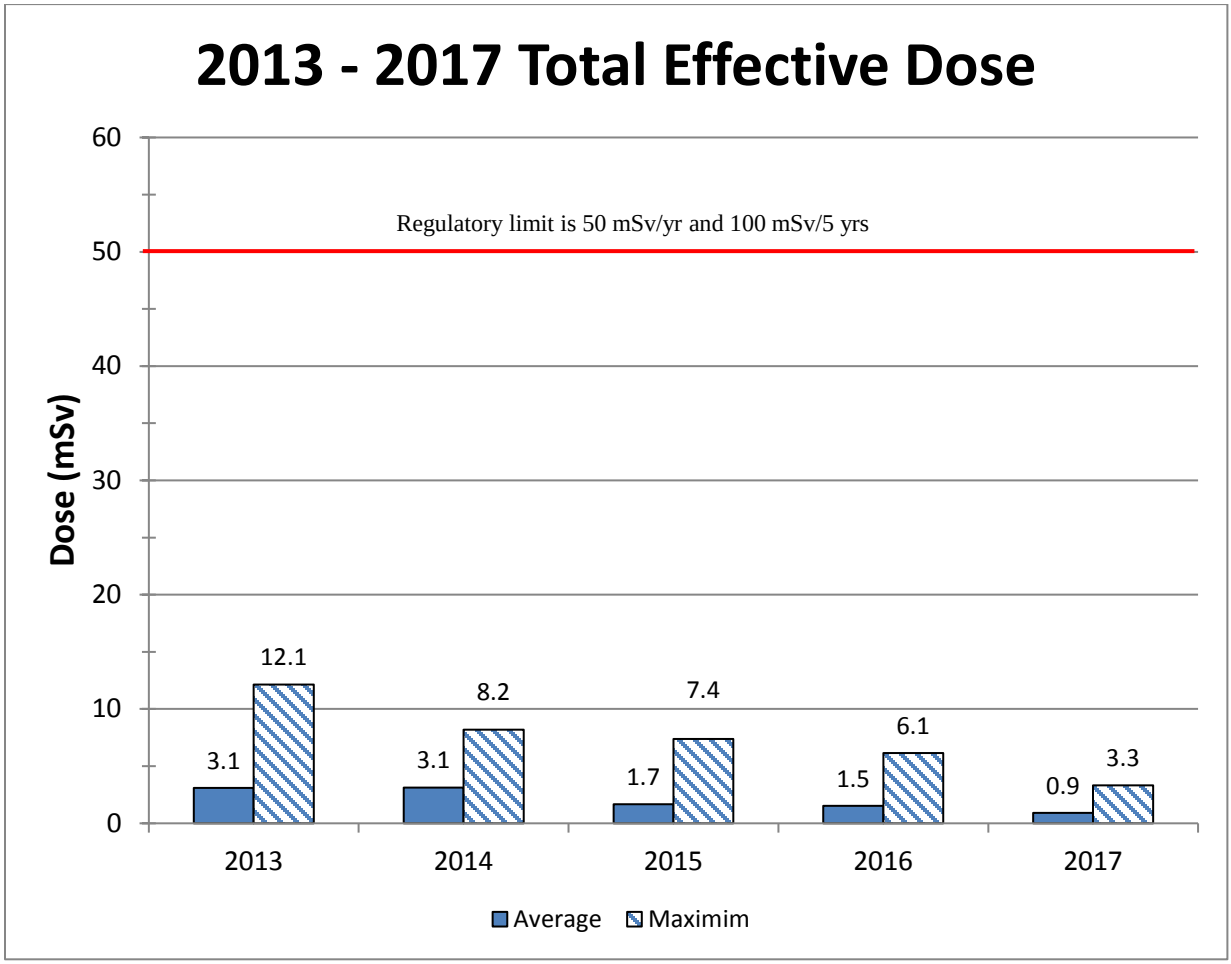
Table 14 and Figure 12 show the total effective dose results for the 2013 – 2017 period. The average total effective dose in 2017 was lower than the average effective dose in the previous year and the lowest in the five year period. The maximum individual total effective dose in 2017 was significantly lower than the previous year and the lowest in the 5 year period as well. The annual regulatory limit for total effective dose is 50 mSv; therefore the highest individual result in 2017 was approximately 7% of the annual regulatory limit.

With respect to the regulatory limit of 100 mSv total effective dose over five years, the highest individual result for the current five-year dosimetry period (January 1, 2016 to December 31, 2020) is 9.4 mSv to an S&FP operator.

Table 14

2013 – 2017 Total Effective Dose				
Year	**Number of Individuals**	**Minimum Dose (mSv)**	**Average Dose (mSv)**	**Maximum Dose (mSv)**
2013	171	0	3.1	12.1
2014	162	0	3.1	8.2
2015	154	0	1.7	7.4
2016	154	0	1.5	6.1
2017	145	0	0.9	3.3

Figure 12



As indicated in Table 15, the individual with the highest effective dose in 2017 is an S&FP operator. Historically, S&FP operators have been one of the work groups that receive the highest effective dose at the refinery. Three of the five highest individual doses in 2017 were to S&FP operators.

Table 15

2017 Five Highest Total Effective Dose Individuals				
Occupation	Urine Dose (mSv)	Lung Dose (mSv)	External Whole Body Dose (mSv)	Effective Dose[1] (mSv)
S&FP Operator	1.6	<0.1	1.8	3.3
S&FP Operator	0.9	<0.1	2.3	3.1
Process Operator	0.4	<0.1	2.4	2.8
S&FP Operator	0.7	0.2	1.8	2.8
Process Operator	0.5	<0.1	2.3	2.8

[1] Note that the effective dose value may not match the combined urine + lung + whole body dose value due to rounding.

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 amount 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 16 summarizes 2017 alpha monitoring results from both areas and includes both swipe samples and direct contact surface measurements. There were six results above the internal administration level (IAL) in 2017, compared to no results above the IAL in 2016. For any results over the IAL, the affected area is cleaned and re-monitored to verify the contamination has been removed. Contamination readings above the IAL pose no significant risk to people or to the environment. There were no adverse trends noted during routine contamination monitoring activities.

Table 16

	2017 Alpha Contamination Monitoring Results			
Area	**Number of Readings Above IAL**	**Total Number of Measurements**	**Action Level – Swipes (Bq/cm^2)**	**Action Level – Contact Readings (Bq/cm^2)**
Zone 1	0	1,290	0.15	0.37
Zone 2	6	14,232		

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. There were no contamination issues identified related to vehicles leaving the refinery.

Three whole body monitors are in routine service at the front entrance to the facility. All employees and visitors are required to pass through a whole body monitor prior to exiting the refinery. Any contamination issues identified are addressed promptly prior to individuals leaving site.

In-plant Air

A summary of in-plant air sampling results for 2017 is provided in Tables 17 and 18. Approximately 0.1% of the samples were above the uranium-in-air respirator level (RL). There were 11 samples above the RL in 2017 compared to 23 samples above in 2016. Average results for each of the four plant areas identified in the table were very similar to 2016 area average results. Overall, the 2017 in-plant air sampling results were slightly lower than in 2016, with the average result being 1 µg U/m^3, or approximately 1% of the RL. The highest result for the year was from the denitration area. The UO_3 processing areas consist of the plant areas necessary for the production of UO_3, from calcination through to denitration. The UO_3 ancillary areas include raffinate/DRaff, sump treatment, equipment decontamination and the maintenance shop.

Table 17

2017 Uranium In-plant Air Sampling Results				
Plant Area	**# of Samples**	**Average (µg U/m^3)**	**Maximum (µg U/m^3)**	**# of Samples above RL[1]**
Warehouse	2,428	2	76	0
UOC and UO_3 Labs	206	<1	2	0
UO_3 Processing Areas	4,365	2	292	8
UO_3 Ancillary Areas	3,830	<1	169	3
TOTAL	**10,829**	**1**	**292**	**11**

[1] Respirator Level (RL) is 90 µg U/m^3

As shown in Table 18, there were a total of 1,100 samples from the raffinate/DRaff area analyzed for thorium-in-air in 2017. This number represents approximately 42% of the total number of samples collected from the area. About 2% of the samples analyzed for thorium-in-air were actually above the thorium-in-air RL, the same percentage as in 2016. The number of RL samples in 2017 decreased slightly compared to the previous year, from 23 to 20. The highest result for the year occurred during clean-up activities. All personnel wear the proper PPE during clean-up activities.

Table 18

2017 Thorium-in-air Air Sampling Results from Raffinate/DRaff Area			
# of Samples[1]	**Average Th-230 (Bq/m^3)**	**Maximum Th-230 (Bq/m^3)**	**# of Samples above RL[2]**
1,100	0.01	2.40	20

[1]Represents the number of samples actually analyzed for thorium-in-air.

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

Gamma Surveys

Plant gamma surveys using hand-held meters are done on a routine basis throughout the refinery. The frequency of the readings and the number of readings taken in each area varies based on the area of the refinery and the historical results from that area. Measurement frequencies can vary from weekly to semi-annually. Table 19 summarizes the results from general area readings taken in 2017. The results indicate that the raffinate/DRaff area has the highest gamma fields of all refinery areas. This is consistent with results from prior years, with the average and maximum results from this area in 2017 very similar to the previous year. There were no other adverse trends noted. Appropriate signage is posted at areas or locations where there is a reasonable probability that a person may be exposed to a dose rate greater than 25 µSv/h.

Table 19

2017 Summary of Plant Gamma Readings by Area (µSv/h)			
Location	**Average Result**	**Maximum Result**	**Range**
UOC Warehouse	5	12	<1 – 12
UOC Sub-sampling Lab	8	9	8 – 9
Calcination Area	4	10	1 – 10
Digestion	2	4	1 – 4
Solvent Extraction	1	2	<1 – 2
UO_3 Sub-sampling Lab	7	9	5 – 9
Scrap Recovery	1	1	<1 – 1
Raffinate/DRaff	26	174	<1 – 174
Boildown	1	3	<1 – 3
Equipment Decontamination	4	10	1 – 10
Sump Treatment	1	1	1
Denitration	2	3	1 – 3
Nitric Acid Recovery	<1	<1	<1

2.3.2 Conventional Health and Safety

This safety and control area covers the implementation of a 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 has been in place for many years 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.

Non-radiological safety hazards are managed through a comprehensive Occupational Health and Safety program as prescribed by the Cameco Health and Safety Management Program. This program set out the requirements for management of health and safety aspects of the operation consistent with Cameco's corporate SHEQ policy, which is modeled on the OHSAS 18001 standard. 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.

The BRR site program undergoes several review processes, including scheduled procedure reviews, program audits, and annual management review. Conformance to the program is also tested through various inspection programs, incident investigations, and ongoing analysis by the joint workplace committees.

The health and safety management program fosters and promotes a strong sustainable safety culture. Cameco has five key principles in the area of safety that form the framework for how safety is managed. These are:

- safety is our first priority;
- we are all accountable for safety;
- safety is part of everything that we do;
- safety leadership is critical to Cameco Corporation; and
- we are a learning organization.

The effectiveness of the conventional OHS system can be evaluated by the responsiveness of the site to leading safety activities such as audits, inspections, evaluations, reviews, benchmarking, training and employee participation and engagement. There is a site joint workplace health and safety committee, known as the Facility Health and Safety Committee (FHSC), which meets monthly to discuss safety-related issues. Committee members also participate in site FHSC inspections which are carried out on a weekly basis during operations. A schedule is followed to ensure the entire facility is inspected annually. Inspection results are distributed and published and are also entered into the CIRS database for recording and tracking purposes. Departmental inspections are also conducted on a monthly basis. A total of 36 FHSC inspections were conducted in 2017, along with 93 department inspections.

BRR has tracked leading and lagging safety indicators for many years. These consist of, but are not limited to, tracking safety meeting attendance, tracking the percentage of safety inspections completed and safety statistics. This data is reviewed by site and divisional management and has helped improve the overall safety performance at the refinery. Table 20 presents the safety statistics for the refinery over the last five years.

Table 20 – Safety Statistics

Year / Parameter	2013	2014	2015	2016	2017
First Aid Injuries	15	12	12	12	5
Medical Diagnostic Procedures	3	2	6	0	1
Medical Treatment Injuries	2	1	0	1	0
Lost Time Injuries	0	0	0	0	0
Lost Time Injury Frequency	0	0	0	0	0
Lost Time Injury Severity	0	0	0	0	0

All reported Occupational Health and Safety incidents are documented in CIRS for tracking and management. The CIRS system defines five categories of incidents based on actual and potential outcome, with Category 1 incidents being minor in scope and Category 5 incidents having the highest actual and potential consequences.

There were 73 health safety related incidents recorded in the CIRS database in 2017. Of these, six were related to injury or illness, two were related to equipment or property damage and 65 incidents were identified as near misses. A significance rating system is built into the CIRS database and used to assess all events and near misses. The significance ratings range from I (lowest significance or minor) to V (highest significance or major). There were no health safety

incidents assigned significance levels of III - V, all of the incidents were classified as Level I or II. In addition, 28 use of experience events were created in CIRS as learning opportunities based on incidents that happened at other sites, both within Cameco and external to the company.

There were no injuries reportable to ESDC in 2017, compared to one reportable injury in 2016.

In June 2017 BRR achieved eleven years without a lost-time injury and continues to be a leader in conventional safety within Cameco. BRR's total recordable injury rate (TRIR) in 2017 was 0, which met Cameco's corporate TRIR target for the year.

The refinery has an effective orientation program for contractors, utilizing health and safety orientation handbooks and classroom training.

BRR has a safety charter (the Charter) in place detailing our employee's commitment to safety. Each employee is asked to sign the Charter to demonstrate their personal commitment to safety. As new employees are hired, Cameco explains the Charter to them and requests they sign the Charter. A copy of the Charter, with all employee signatures, is posted at the front entrance to the refinery.

Several activities to improve occupational health and safety were undertaken in 2017, including the following:

- Replaced an electrical breaker with a different type so that the worker is outside of the danger zone when tripping and racking out the breaker for annual testing;
- Lowered baghouse cage storage rack beside "A" incinerator baghouse to address ergonomic issues;
- Installed rack for shower cleaning hose, eliminating safety concern with hose coiled on floor;
- Installed CSA approved machine guarding on maintenance shop drill presses;
- Purchased new cordless hammer drills, reducing tripping hazards; and
- Fabricated a stand for a 5 gallon water carboy, allowing for safer handling and dispensing.
- completion of welding fume sampling;
- completion of annual and area personal noise sampling; and
- holding a "safety stand down" upon return to work after the summer and Christmas shutdown periods.

At the start of 2017 five health and safety objectives were created, four of which have been completed. The closed objectives were to review legal requirements with respect to ladders and ladder usage at the refinery, to support the roll out of the Corporate Job Task Observation standard, to conduct a lock-down drill and to review plant clothing usage with respect to high visibility and zone control requirements. The one 2017 objective that remains open is to support the roll out of the Corporate Electrical Safety Standard. Completion of this objective is now scheduled for the second quarter of 2018. Five new health and safety objectives have been created in 2018 related to the following activities/topics: STOP Observation refresher, Control of Hazardous Energy – Isolation Lists, refinery noise survey, contractor management program review and the development of a pre-incident plan for excavation rescue.

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.

The key characteristics of the operation and activities that can have a significant environmental impact are monitored and measured and are described in the Environmental Monitoring Plan and associated procedures. These documents identify the emissions to the air, water and land, the programs that are in place to monitor them, what is measured, the legal requirements and the reporting requirements. Five environmental related documents and two forms were updated in 2017.

Environmental objectives and targets are established jointly by the site management team and site specialists, including the environmental specialist, to ensure there is agreement, commitment and awareness of these objectives and targets across all areas of the refinery's operation. These objectives and targets can address, among other things, planned environmental improvements or enhancements in the field, purchase of new monitoring equipment and procedural and data management improvements. The status of these objectives and targets is reviewed by the site management team and resources are allocated as required to achieve the targets. Update reports

on the objectives and targets are posted on the EMS bulletin board outside the employee change rooms so that employees are aware of and can review the status of the objectives and targets.

Four of the five environmental objectives set at the start of 2017 have been completed. These objectives were related to review of CNSC action levels, reduction of legacy waste on site, review of storm water lagoon pumping system and assessing internal recycle of liquid effluent streams. An objective to assess an alternate location for the incinerator CEMS sampling point was cancelled, as it was no longer a priority at this time.

Four new environmental objectives were established at the start of 2018. The objectives are related to the purchase and installation of a new NOx analyzer, updating the site Derived Release Limit (DRL) report, the implementation of the CSA standards for radioactive waste and the identification of the main contributors for uranium loadings in refinery liquid effluent.

As part of the joint workplace health and safety committee, updates on the status of the environmental protection program at the refinery are discussed at the monthly meetings and employees are encouraged to bring any questions or concerns forward.

Any issues identified during either regulatory or internal audits are documented in the CIRS database so that corrective actions can be identified and implemented.

Dose to the Public

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.

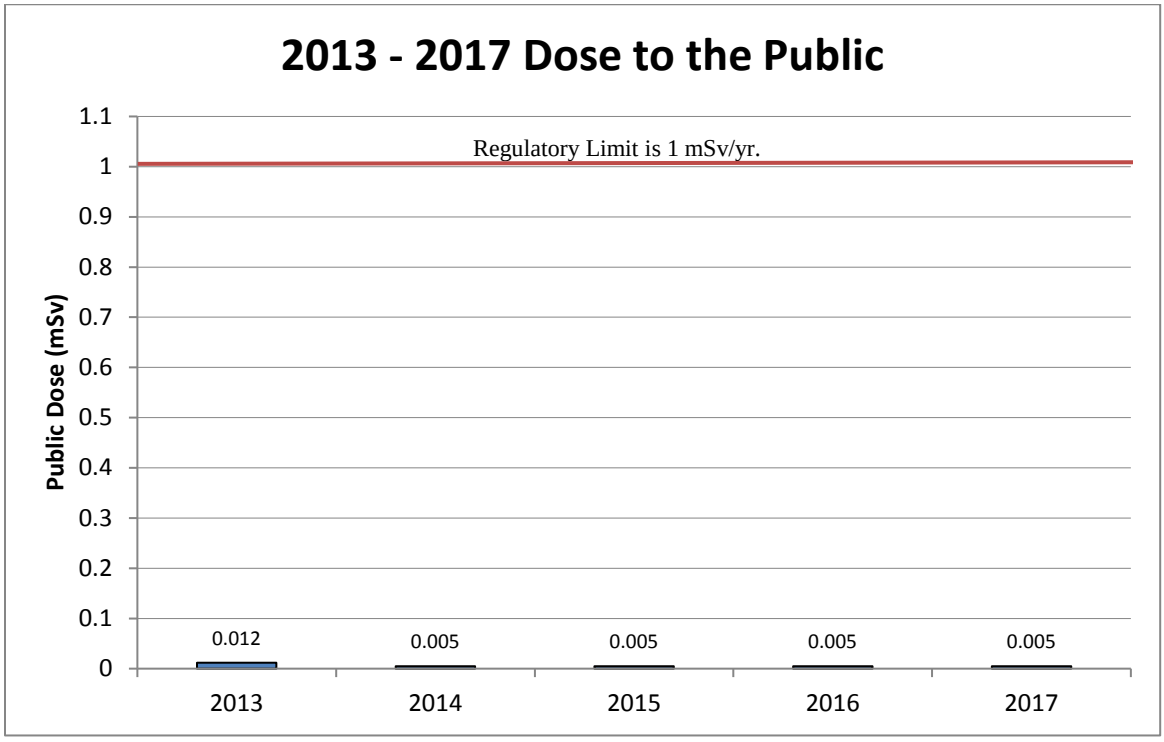
The critical receptor is the hi-vol station at the golf course. An environmental dosimeter is placed at the hi-vol station and changed out on a quarterly basis. In 2017, the estimated dose to the public based on results from the dosimeters located at the golf course hi-vol station is 0.5% of the public dose limit, or 0.005 mSv.

The annual estimated dose to the public for the 2013 – 2017 periods is shown in Table 21 and Figure 13.

Table 21

Dose to the Public						
Dose in mSv	**Regulatory Limit**	**2013**	**2014**	**2015**	**2016**	**2017**
Critical receptor	1 mSv/year	0.012	0.005	0.005	0.005	0.005

Figure 13



Environmental dosimeters are also being placed along each of the four perimeter fence lines; north, south, east and west. The perimeter fence line surrounds the refinery and defines the boundary of the CNSC licensed facility. The dosimeters are collected and replaced in the field monthly. Results from the fence line dosimeters are being reported in the CNSC quarterly reports.

Gamma levels along the fence line can vary as the inventory of uranium materials in the yard area does change through the course of a year based on concentrate receipts, production requirements and shipping schedules. Table 22 below summarizes the 2017 results from each fence line.

Table 22

2017 Measured Fence Line Gamma Levels (µSv/h)			
Fence Line	**Monthly Average Result**	**Monthly Maximum Result**	**Range**
East	0.38	0.58	0.23 – 0.58
North	0.24	0.29	0.18 – 0.29
South	0.43	0.56	0.30 – 0.56
West	1.10	1.25	0.94 – 1.25

A CNSC action level of 1.0 µSv/h is currently in effect at the north fence only. All north fence results in 2017 were below this action level value. On average results along the fence lines were slightly lower when compared to 2016 results, likely due to changes in inventory levels in the various yard areas.

Despite the fact that environmental dosimeters are now 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 neighbouring golf course; as the land immediately outside the perimeter fence continues to be owned and controlled by Cameco. The golf course 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 NOx 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 and verified periodically by third-party sampling of some of the ventilation systems. 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. Total uranium releases to the environment are shown in Table 23 and Figure 14 below.

Total uranium loadings to the environment have shown a decreasing trend in recent years, with the 2017 total being the second lowest in the history of refinery operations. Note that 2016 had the lowest total uranium loadings in the history of refinery operations. This is attributable in part to decreasing UO_3 production in recent years but also to improved operational performance.

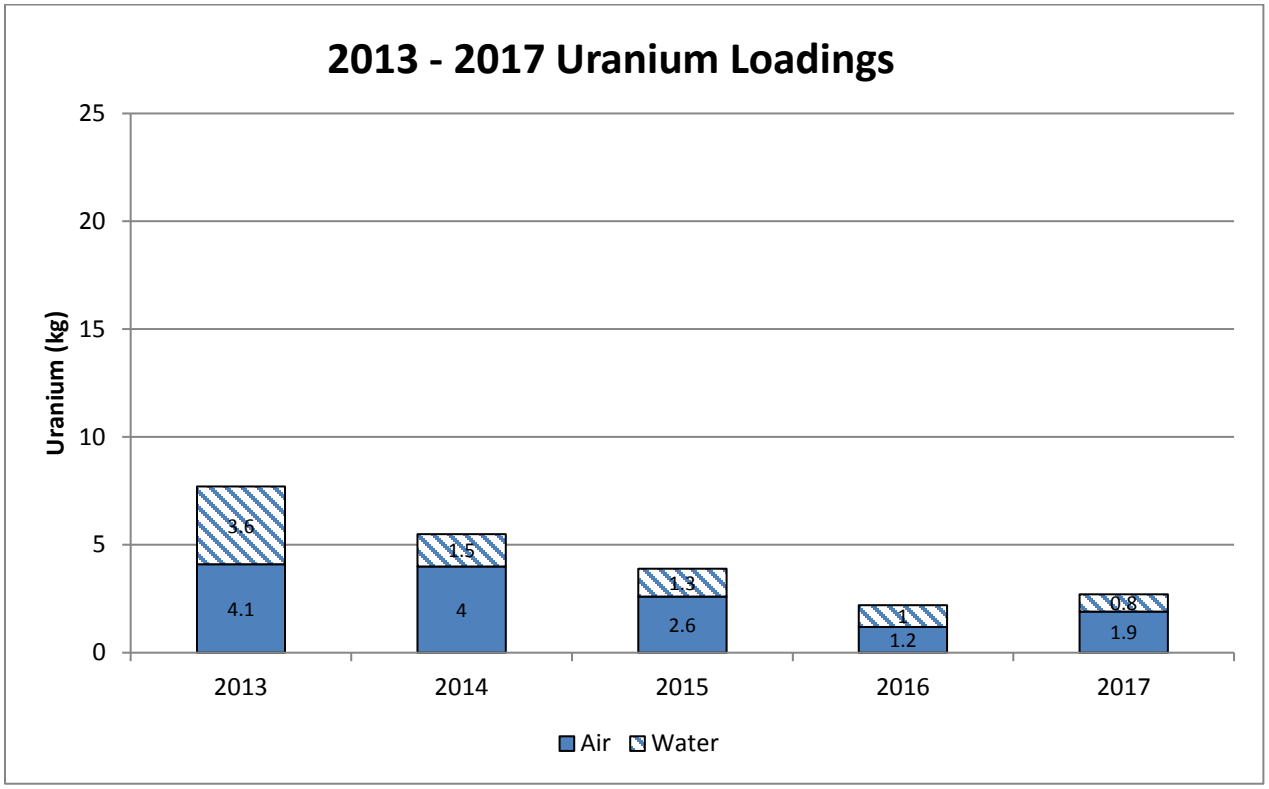
Emissions to air represent a combination of uranium loadings from the two process stacks and the incinerator stack, as determined from the routine stack sampling program, and uranium loadings from the various process area ventilation exhaust systems, as determined by in-plant air

sampling data and exhaust discharge rates. Approximately 50% of emissions to air in 2017 were from process ventilation exhaust systems, with the other 50% attributable to stack emissions. Approximately 80% of the stack emissions were from the DCEV, with emissions from the absorber stack and the incinerator stack combining for the remaining 20%. The variation in uranium loadings to water from year-to-year is attributable to changes in annual production levels and also to the volume of wastewater discharged in a given year. This volume will vary with annual precipitation received, as storm water run-off on site is collected, combined with and discharged with other refinery liquid effluent streams.

Table 23

Total Uranium Emissions to the Environment (kg U)					
Emission	**2013**	**2014**	**2015**	**2016**	**2017**
Air	4.1	1.5	1.3	1.0	0.8
Water	3.6	4.0	2.6	1.2	1.9
Total	7.7	5.5	3.9	2.2	2.7

Figure 14



There were no exceedances of CNSC regulatory limits or action levels with respect to air emissions in 2017. As indicated in Table 24 stack emissions for the key regulatory parameters remain low and well below CNSC licensed limits and action levels.

Table 24

2013 - 2017 Daily Main Stack Emissions									
Source	**Parameter**	**CNSC Limit**	**CNSC Action Level**	**Value**	**2013**	**2014**	**2015**	**2016**	**2017**
DCEV	Uranium (g U/h)	100	10	Average	0.04	0.05	0.05	0.05	0.04
				Max.	0.25	0.60	0.38	1.09	0.31
Absorber	Uranium (g U/h)	100	1	Average	<0.01	<0.01	0.01	0.01	0.01
				Max.	0.10	0.05	0.03	0.04	0.10
	Nitrogen Oxides (kg NO_2/h)	56	12	Average	3.4	2.0	2.5	1.6	1.7
				Max.	5.8	4.8	5.6	4.8	5.0
Incinerator	Uranium (g U/h)	10	1.5	Average	<0.01	<0.01	<0.01	<0.01	<0.01
				Max.	<0.01	0.01	0.01	0.02	0.01
All stacks	Particulate (g/h)	11,000	-	Average	14	9	6	6	8
				Max.	42	41	59	45	31

Results less than the detection limit are denoted as "<".

Stack sampling for uranium and particulate is done using TSI samplers, while NOx emissions are measured by a continuous emission monitor. Stack sampling for uranium and other parameters of interest from the two process stacks was completed in 2017 by an independent third-party.

Stack sampling of the incinerator was also carried out by an independent third-party to demonstrate that emissions from the incinerator meet provincial MOECC limits as specified in the Environmental Compliance Approval (ECA) for the incinerator. Results from annual testing are shown in Table 25. Results from most parameters are generally comparable to the 2016 levels, though there was a notable decrease in emissions rates in 2017 for lead, cadmium and mercury. There is no identifiable reason for the decrease in emission rates for these three parameters in 2017. While results for total suspended particulate (TSP) were lower in 2017 than in 2016, results are still elevated somewhat compared to results from the 2013-2015 period. However, with respect to the criteria in Ontario Regulation 419: Air Pollution – Local Air Quality, the TSP result is at <1% of the regulatory limit. Year-to-year results for the other parameters are not indicating any adverse trends, with all results well below their respective limits. Copies of the stack testing reports have been submitted to CNSC staff.

Table 25

Incinerator Stack Sampling Results for Air Pollution Control Circuit (APC)						
Parameter	**2013**	**2014**	**2015**	**2106**	**2017**	**% of Limit (for 2017)**
Total Suspended Particulate (mg/s)	2.33	0.61	1.3	7.18	6.50	52[1]
Uranium (mg/s)	0.004	<0.001	0.001	0.003	0.001	<1[2]
NOx as NO_2 (mg/s)	112	104	69	60	68	11[1]
Mercury (µg/s)	0.22	0.12	0.17	0.42	0.11	<1[1]
Cadmium (µg/s)	0.54	0.22	0.09	6.2	0.90	9[1]
Lead (µg/s)	10	0.48	0.63	11.6	3.6	3[1]
Dioxins & Furans (pg I-TEQ/Rm^3)	12	11	12	7.5	6.4	8[1]
HCl (mg/s)	<3.9	<2.8	<3.1	<1.35	<0.88	<5[1]
HF (mg/s)	<0.66	<1.9	<0.63	<0.74	<0.50	<3[3]
SO_2 (mg/s)	<9	<8.6	<3.8	<7.5	<7.7	<20[1]

[1] Limit as indicated in MOECC Amended Environmental Compliance Approval 7751-6PUNQV.
[2] Limit as per Appendix A of CNSC license FFOL-3632.00/2022
[3] % of POI allowable limit as per O. Reg 419

Water 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 parameters 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 26, concentrations of key parameters in liquid effluent emissions remain well below regulatory limits. Data for uranium, nitrate and radium-226 is reported as the monthly average of weekly composite results, while limits for pH are based on individual daily discharges. Results are comparable to previous years.

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

Table 26

2013 – 2017 Liquid Effluent Discharges									
Parameter	**Units of Measure**	**CNSC Licensed Limit**	**CNSC Action Level**	**Value**	**2013**	**2014**	**2015**	**2016**	**2017**
Uranium	mg/l	2	0.2	Average	0.01	0.02	0.02	0.01	0.01
				Max.	0.03	0.05	0.05	0.01	0.02
Nitrate	mg/l as N	1000	80	Average	26	17	13	11	14
				Max.	39	32	23	19	25
Radium – 226	Bq/l	1	0.05	Average	0.01	0.01	<0.01	0.01	0.01
				Max.	0.02	0.02	0.01	0.01	0.01
pH		Min 6.0	Min. 6.5	Min.	7.1	7.1	7.2	7.3	7.3
		Max 9.5	Max. 9.0	Max.	8.4	8.4	8.4	8.6	8.2

Ambient Air Monitoring

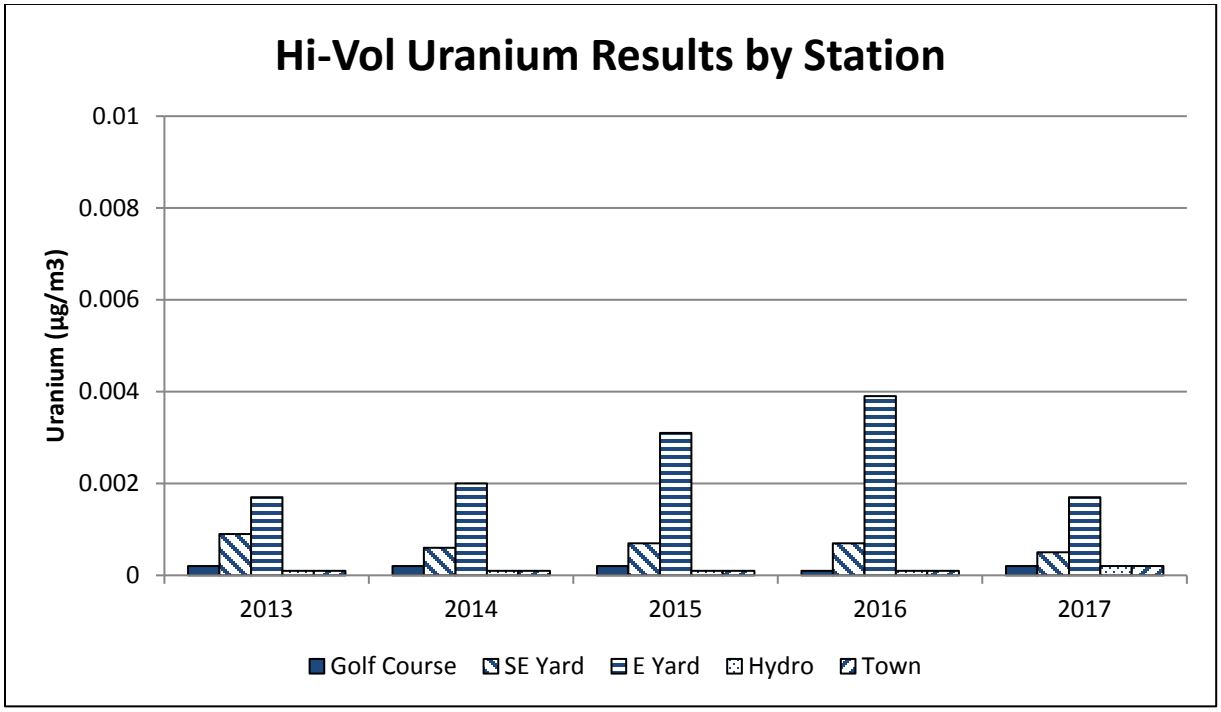
In addition to onsite monitoring of emissions, the refinery also has a comprehensive ambient air monitoring program.

Table 27 and Figure 15 show the annual average uranium-in-air concentrations at each of the five hi-vol locations and the maximum individual result for each location. Two of the stations, the SE Yard and the East Yard, are located within the Cameco fence line, which defines the CNSC licensed area. The Golf Course location is also on Cameco property but located outside the fence line. The remaining stations, the Hydro yard and the Town location, are located approximately 1 and 5 km from the refinery respectively. Results in 2017 are comparable to previous years. For the three stations furthest away from the refinery, the year-to-year results are largely unchanged over the five year period. Annual results from all stations remain well below the MOECC annual average criteria of 0.03 ug/m3, with the highest annual average location result in 2017 only at approximately 6% of this annual average criteria.

Table 27

2013 – 2017 Annual Uranium-in-Air Concentration at Hi-Vol Stations ($\mu g/m^3$)						
Year	**Result**	**Golf Course**	**SE Yard**	**East Yard**	**Hydro Yard**	**Town of Blind River**
2013	Average	0.0002	0.0009	0.0017	0.0001	0.0001
	Maximum	0.0006	0.0019	0.0044	0.0006	0.0007
2014	Average	0.0002	0.0006	0.0020	0.0001	0.0001
	Maximum	0.0005	0.0014	0.0037	0.0003	0.0006
2015	Average	0.0002	0.0007	0.0031	0.0001	0.0001
	Maximum	0.0003	0.0015	0.0111	0.0003	0.0003
2016	Average	0.0001	0.0007	0.0039	0.0001	0.0001
	Maximum	0.0003	0.0016	0.0192	0.0002	0.0002
2017	Average	0.0002	0.0005	0.0017	0.0002	0.0002
	Maximum	0.0005	0.0016	0.0070	0.0005	0.0005

Figure 15



Soil Monitoring

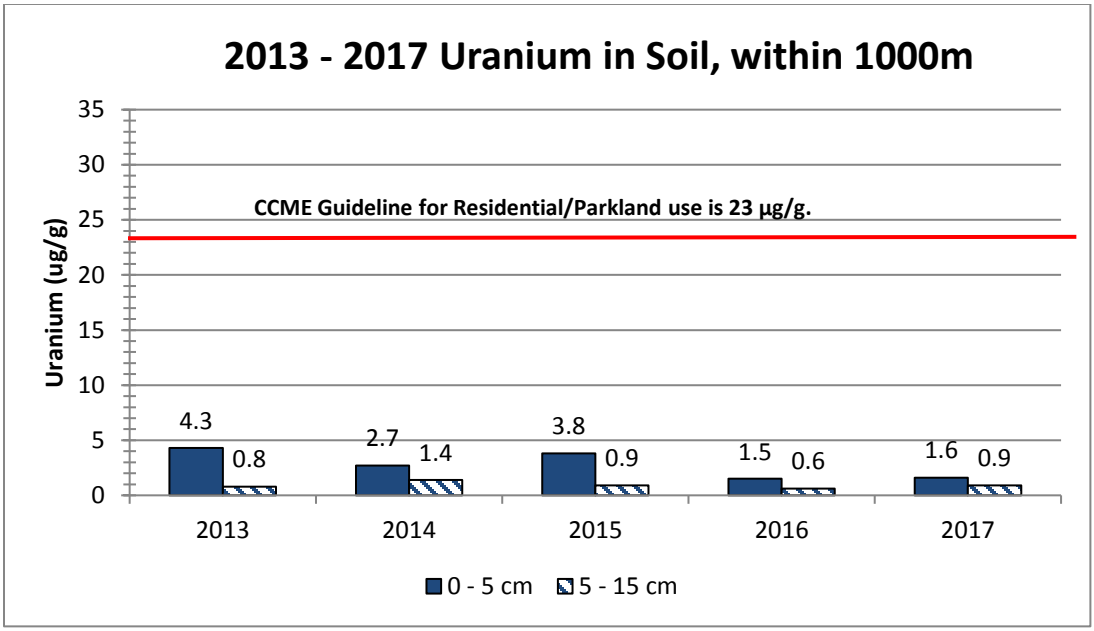
Table 28 and Figure 16 show the results from the soil sampling locations in the vicinity of BRR. The average uranium in soil result at the 0 – 5 cm depth for sample locations within 1000m of the refinery increased slightly compared to 2016 but was lower than in previous years. The maximum individual result of 2.8 µg/g U in 2017 was from a sample location south-east of the perimeter fence and is slightly lower than the maximum individual result from 2017, which was also from the same sample location.

All results are well below the Canadian Council of Ministers of the Environment (CCME) guideline of 23 µg/g U for residential or parkland use.

Table 28

2013 – 2017 Soil Uranium Results				
Location	Depth (cm)	Number of Samples	Average (µg/g U)	Range (µg/g U)
2017				
Sampling sites within 1000m	0 – 5	7	1.6	0.7 – 2.8
	5 – 15	7	0.9	0.5 – 1.9
Sampling sites outside 1000m	0 – 5	2	0.6	0.3 – 0.9
	5 – 15	2	0.7	0.4 – 1.0
2016				
Sampling sites within 1000m	0 – 5	8	1.5	0.4 – 2.9
	5 – 15	8	0.6	0.2 – 1.0
Sampling sites outside 1000m	0 – 5	2	0.5	0.2 – 0.8
	5 – 15	2	0.6	0.2 – 1.0
2015				
Sampling sites within 1000m	0 – 5	17	3.8	0.5 – 9.7
	5 – 15	17	0.9	0.3 – 1.9
Sampling sites outside 1000m	0 – 5	2	1.4	0.2 – 2.6
	5 – 15	2	0.4	0.1 – 0.8
2014				
Sampling sites within 1000m	0 – 5	7	2.7	0.5 – 7.2
	5 – 15	7	1.4	0.3 – 2.8
Sampling sites outside 1000m	0 – 5	2	0.6	0.1 – 1.0
	5 – 15	2	0.3	0.1 – 0.5
2013				
Sampling sites within 1000m	0 – 5	7	4.3	0.3 – 16.4
	5 – 15	7	0.8	0.3 – 2.1
Sampling sites outside 1000m	0 – 5	2	0.4	0.1 – 0.8
	5 – 15	2	0.2	0.1 – 0.3

Figure 16



Surface Water Monitoring

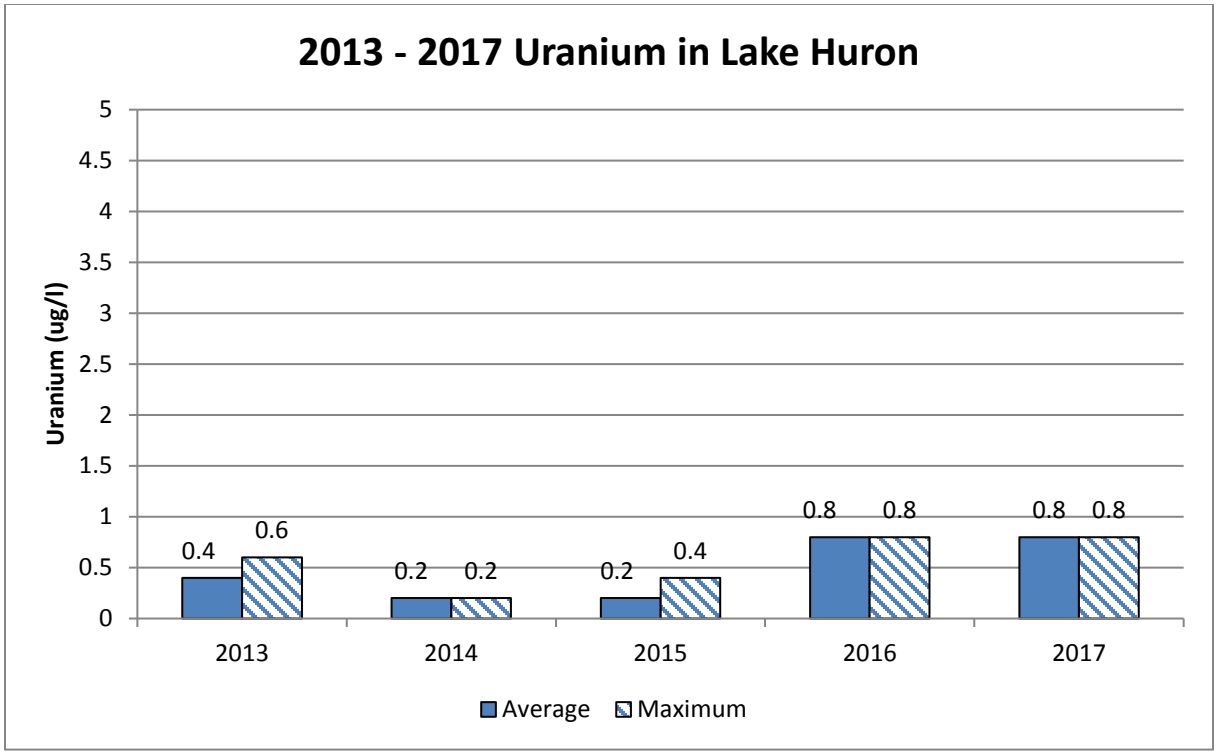
Table 29 and Figure 17 show surface water results for uranium at the location of the refinery outfall diffuser in Lake Huron. The concentration of uranium in the Lake remains well below published federal and provincial guidelines. Nitrate and radium-226 results are similar to previous years, while pH results are slightly lower than in 2016.

Table 29

2013 – 2017 Lake Average and Maximum Results at Diffuser							
Parameter	**Units**	**Value**	**2013**	**2014**	**2015**	**2016**	**2017**
Uranium	µg/l	Average	0.4	<0.2	0.2	<0.8 [1]	<0.8
		Maximum	0.6	<0.2	0.4	<0.8	<0.8
Nitrate	mg/l as N	Average	0.3	0.2	0.2	0.2	0.2
		Maximum	0.4	0.3	0.2	0.2	0.2
Radium–226	Bq/l	Average	<0.005	<0.005	<0.005	<0.005	<0.005
		Maximum	<0.005	<0.005	<0.005	<0.005	<0.005
pH		Average	7.2	7.6	7.3	8.0	7.3
		Maximum	8.1	7.9	7.9	8.2	7.7

[1] The ambient water method detection limit for uranium was reassessed in 2016.

Figure 17



Groundwater Monitoring

Cameco has an extensive groundwater monitoring program in place around the refinery with a total of 43 monitoring wells: 17 inside the perimeter fence and 26 outside the fence line. A map showing the location of all of the monitoring wells around the refinery is shown in Figure 19. The groundwater moves in a southwesterly direction towards the Mississagi River.

A summary of groundwater uranium results is shown in Table 30 and Figure 18. The average uranium result decreased slightly in 2017 compared to 2016. Uranium concentrations at BH #22 continued to gradually decrease in 2017 as well, with the maximum result down to 11.0 µg/L. Excluding BH #22, the maximum result from the other monitoring wells was 3.2 µg/L, from BH #6B. This monitoring well is actually located upstream of the refinery relative to the local groundwater flow. All results remain below the Provincial Full Depth Generic Site Condition Standard in a Potable Groundwater Condition (Table 2) value of 20 µg/L uranium.

Table 30

2013 – 2017 Uranium in Groundwater Results							
Parameter	**Units of Measure**	**Value**	**2013**	**2014**	**2015**	**2016**	**2017**
Uranium	µg/l	Average	0.5	0.6	1.7	1.3	1.2
		Maximum	3.7	8.9	18.5	14.0	11.0

Figure 18

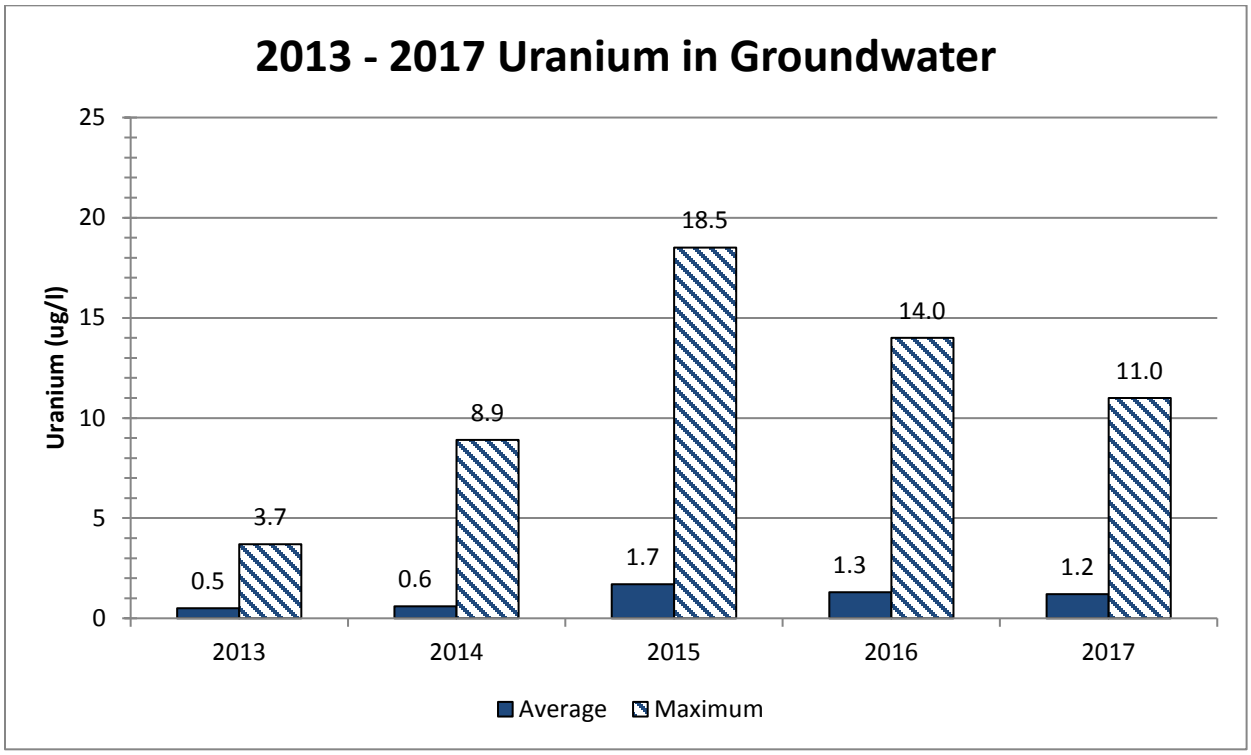
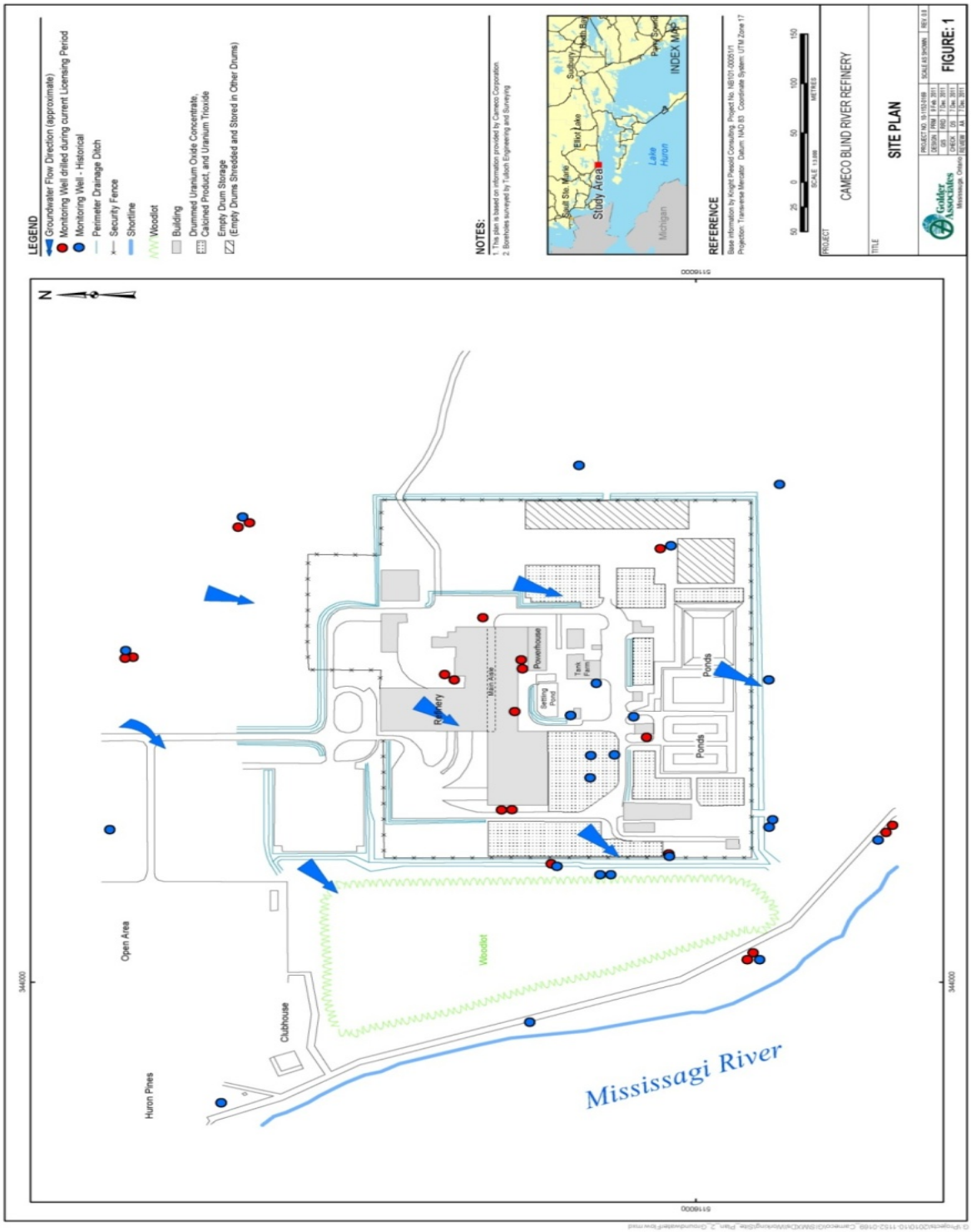


Figure 19


LEGEND
Groundwater Flow Direction (approximate)
Monitoring Well drilled during current Licensing Period
Monitoring Well - Historical
Perimeter Drainage Ditch
Security Fence
Shortline
Woodlot
Building
Drummed Uranium Oxide Concentrate, Calcined Product, and Uranium Trioxide
Empty Drum Storage (Empty Drums Shredded and Stored in Other Drums)
NOTES:
1. This plan is based on information provided by Cameco Corporation
2. Boreholes surveyed by Tulloch Engineering and Surveying
INDEX MAP
Study Area
Lake Huron
Michigan
REFERENCE
Base information by Knight Piesold Consulting, Project No. NB101-00201/1
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17
SCALE 1:1000
METRES
PROJECT
CAMECO BLIND RIVER REFINERY
TITLE
SITE PLAN
FIGURE: 1
Golder Associates
Mississauga, Ontario
N
Powerhouse
Tank Farm
Main Area
Settling Pond
Refinery
Ponds
Ponds
Open Area
Woodlot
Clubhouse
Huron Pines
Mississagi River
344000
5116000

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 (FPP) 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 event of an emergency. The ERP was last updated and reissued in 2017. An emergency response needs analysis assessment was also completed in 2017 and submitted to the CNSC in early 2018.

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. In 2017 there were no incidents that required ERT activation and response.

ERT personnel are trained to NFPA 472 operations level for hazardous material response, and NFPA 600 for advanced internal/external firefighting. As part of the site Emergency Response Team (ERT), the refinery maintains first aid responders that are trained to respond to a variety of emergency medical situations, including chemical exposures and other site specific emergencies.

A mutual aid agreement has been signed by the Blind River Fire Department (BRFD) and Cameco. The commitment for assistance by the BRFD provides an additional layer of support to the refinery's emergency response capability. In addition, Cameco provides the BRFD with support, either financial or through the donation of equipment, and now conduct joint training exercises periodically with the BRFD so that in the event of an emergency at the refinery requiring off-site assistance, there will be a coordinated and effective response. It should also be noted that a number of the refinery's firefighters also belong to the town fire department.

To continually provide a high level of response capability, the refinery's ERT regularly engages in a number of training drills, exercises and courses. In 2017 these included:

- evacuation drills (held quarterly);
- regular crew ERT training (held monthly);
- first aid attendant training (held quarterly);
- industrial rescue training (held semi-annually);
- live fire training (held annually); and
- joint training exercise with Town of Blind River Fire Department (held annually).

An off-shift drill was also carried out in 2017. Lastly, on an annual basis Cameco meets with the local contractor that delivers UO_3 tote bins to the PHCF to review practices and procedures related to the shipment of UO_3, including reporting protocols and how to respond to a transportation event involving a uranium spill.

All internal drills and exercises were assessed against pre-defined expectations and opportunities for improvement were recorded and tracked to completion. The emergency response program is also subject to Cameco internal audits. A full scale simulation emergency response exercise involving the local EMS and hospital, typically held once every three years, was last carried out in the fall of 2015 and all corrective actions arising from that exercise have been addressed. The next full scale exercise will be held in 2018.

Emergency response is a key component of an effective FPP. The FPP at the facility meets internal Cameco requirements and it also meets the requirements of the National Fire Code of Canada, the National Building Code of Canada, and NFPA 801 Standard for Fire Protection for Facilities Handling Radioactive Materials.

In developing the FPP, a defense-in-depth approach was used to ensure that the fire protection measures are adequate for the fire protection of the facility. The FPP is made up of the Fire Hazard Analysis (FHA) and fire protection supporting documents and was last updated in 2016.

An FHA identifies fire hazards and their potential impact related to life safety, radiation safety, environmental protection and asset protection. The site FHA was last updated in 2016.

The fire protection supporting documents involve a number of areas which include fire prevention, fire protection and emergency response. The supporting documents define those elements which positively contribute to prevent fires, maintain fire safe conditions at the facility, maintain reliability of the fire protection systems and provide an effective emergency response to limit the effects of fire.

As required by our CNSC operating License BRR is subject to annual third-party reviews for verification of the inspection requirements under the National Fire Code and NFPA 801. There were no significant items identified during the 2017 inspection review.

In addition to this third-party inspection, Cameco conducts routine monthly fire inspections of the facility to identify deficiencies in fire protection elements and fire protection systems. All identified issues are documented and tracked until they have been addressed. In addition to these specific fire protection inspections, routine inspections of the facility are done daily by site security staff, who have been instructed to report any potential fire hazards noted during their rounds.

Cameco continues to utilize a divisional oversight role for the fire and emergency response organizations. This allows for alignment, consistency and sharing of best practices within the division.

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 the 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 until appropriate disposal options are available.

Wastes at BRR are segregated at the point of generation into contaminated and non-contaminated. Non-contaminated waste is either recycled or disposed of at an appropriate facility. Contaminated waste is stored in appropriate containers pending assessment of recycling or disposal options.

In 2017, a total of 3,510 kg of non-contaminated wastes were sent to a local landfill, similar to 2016. A total of 26,190 kg of non-contaminated materials were sent to appropriate recycling facilities, again very similar to 2016 levels.

BRR produces two secondary products at the facility; calcined and regeneration product, both of which are sent off-site to licensed facilities for uranium recovery. A uranium mill in the USA is licensed to receive both products, while Cameco's Key Lake operation is licensed to receive calcined product. A total of 2,276 drums of calcined product were generated at BRR in 2017, a slight decrease compared to 2016. Also, 5,000 drums of calcined product were shipped off-site, compared to 3,000 drums shipped in 2016.

A total of 93 drums of regeneration product were generated in 2017, a one-third increase from the previous year. There were 114 drums of regeneration product shipped, compared to no shipments in 2016. The number of drums of calcined and regeneration product shipped in a given year will vary with annual production, site inventory levels, transportation schedules and end-user requirements.

In 2017, the BRR incinerated 95,635 kg of contaminated combustible materials (CCM), more than double the amount incinerated in 2016 and reflective of an almost doubling of the incinerator operating days in 2017 compared to the previous year. BRR receives CCM material from both Cameco operations in Port Hope, the PHCF and CFM. Approximately 40% of the CCM material generated in 2017 was from the two Port Hope sites, similar to 2016 levels.

A total of 1,021 drums of contaminated non-combustible materials (CNC) were generated in 2017, almost double the amount generated in 2016. Also, only 16 drums of shredded metal were processed, compared to 220 drums in the previous year.

BRR sent 2,592 drums back to various uranium mines for reuse, a decrease of approximately 20% compared to 2016. In addition, a total of 14,428 drums were processed, decontaminated to unrestricted release criteria and sent to a local scrap metal dealer; a 15% reduction compared to the previous year and reflective of lower production levels in 2017. There were also just under 22,000 kg of scrap drum rings sent to the scrap metal dealer as well, a decrease of about 3,000 kg compared to 2016.

Lastly, a total of 3,400 drums containing shredded drum pieces and carbon steel were shipped to a permitted waste disposal facility in the United States.

2.3.6 Nuclear Security

This safety and control area covers the programs required 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 objectives. 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.

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.

There were two Short Notice Random Inspections (SNRI) conducted at the request of the IAEA in 2017; in May and December. Also, at the end of June the IAEA conducted a physical inventory verification (PIV) and a design inventory verification (DIV).

The refinery is in compliance with the requirements in CNSC regulatory document, Accounting and Reporting of Nuclear Material, 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.

UO_3 is produced and transported, in steel tote bins, by road from the refinery to Cameco's PHCF. As well, UO_3 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 three reportable transportation events in 2017. In each case a report was prepared and submitted to CNSC staff.

The first event occurred in June and was related to a shipment of uranium concentrate received from a foreign producer. Upon receipt it was noted that there were four damaged drums in the shipment, however there was no loss of material from any of the damaged drums. The second event occurred in September and was also related to a shipment of uranium concentrate received by BRR from a foreign producer. In this instance there were two damaged drums and one of the drums had released a small quantity of uranium concentrate onto the floor of the sea container. The spill was cleaned up without incident. The last event occurred in November and was related to a shipment of calcined product from BRR to Cameco's Key Lake mine in November. There was one damaged drum in this shipment that had released a small quantity of calcined product onto the floor of the trailer. The spill was again cleaned up without incident. In all three instances, there was no effect on the environment, the health and safety of persons, or national or international security.

In addition to the FSD Transportation Emergency Response Organization (TERO) organization, Cameco can also mobilize a hazardous materials response team with trained emergency response team members and dedicated HAZMAT equipment. An Emergency Response Assistance Plan (ERAP 2-0453) is on file with and has been approved by Transport Canada, pursuant to federal transportation of dangerous goods requirements, and applies to transportation emergencies. Transportation activities related to the shipping and receiving of goods at or from the refinery are included in the plan. Cameco reviews and updates the Emergency Response Assistance Plan as required.

3. OTHER MATTERS OF REGULATORY INTEREST

3.1.1 Public Information Program

In 2017, BRR continued to meet the requirements of CNSC RD/GD-99.3, Public Information and Disclosure programs.

The communications team for Cameco's fuel services division is comprised of a director of public and government affairs, two communication specialists and a community relations liaison. The divisional communications team remains a part of Cameco's recently renamed corporate Sustainability and Stakeholder relations department.

Local media coverage of Cameco was light but generally positive in tone during 2017. Most media attention continues to focus on Cameco`s sponsorship of and employee participation in local community events.

Since establishing Cameco FSD's social media presence in 2013, use of both Facebook and Twitter have helped to augment Cameco's public information program and support efforts to engage youth, community members and employees. These channels are used to share information about community investments, upcoming events and activities, employee volunteer activities and other matters of potential public interest.

As social media outreach continues to mature. The number of "followers" who have "liked" the Cameco Ontario Facebook page increased 21% this year to 411 and our Twitter feed has grown by 26% in 2017 with 171 followers. With shares and retweets, several posts garnered larger audiences and resulted in over double the views and retweets of our posts.

Since 2006, Cameco's FSD has had its own dedicated website to supplement information found on the corporate website (www.cameco.com). On March 22, Cameco Fuel Services Division launched their new community website, camecofuel.com. The new community site aligns visually with Cameco Corporation's various other community websites and is more user-friendly with the ability to view on various devices such as smart phones, tablets and desktop computers. Information from camecoporthope.com was transferred over to the new website.

The camecofuel.com website continued to serve as a valuable tool to make information about the company easily accessible to members of the public. Quarterly environmental status reports, basic information about reportable incidents, articles on matters of public interest, external newsletter, news releases and announcements as well as presentations from community forums were posted to the new site as applicable.

Total page views on our camecofuel.com website garnered 22,511 unique page views in 2017. The landing page for PHCF was the most frequently visited of the three FSD licensed facilities with more than 2,800 unique views; almost double compared to CFM and BRR.

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 and disclosure program.

In addition to posting the quarterly and annual reports on the FSD website, Cameco provides hard copies of these CNSC reports to the Town of the Blind River, to the MFN, to the Serpent River First Nation and to the Township of the North Shore.

Cameco continued its strategic approach to community outreach in 2017, meeting regularly with both the Mayor of the Town of Blind River and the Chief of the Mississauga First Nation to discuss issues of mutual concern and interest. Presentations to both the Town of Blind River and MFN councils are typically made on an annual basis. There were no requests for presentations in neighbouring communities last year.

Media and public interest in BRR continues to be very low, with a half-dozen articles appearing in local newspapers in 2017. The local articles were positive in tone as they focused on BRR's support for local projects and events. There were also a couple of articles focused on corporate Cameco issues.

Most contacts initiated by members of the public are related to employment opportunities. The only informal concerns expressed in the community have been related to the reduction in manpower due to retirements and attritions that have occurred in recent years. There were no complaints from the public with respect to the refinery operation in 2017.

In addition to formal public information activities, Cameco also has ongoing communication with local stakeholders. Phone calls, e-mails and meetings with private citizens, as well as representatives from organizations occur on a regular basis. Cameco makes every effort to accommodate requests for tours, as production schedules permit, and typically welcome a few hundred visitors per year. In 2017 Cameco provided plant tours to a number of groups and organizations, including representatives from the Metis Nation of Ontario, Sagamok First Nation, the Town of Blind River and MFN Fire Departments, Elliot Lake secondary school, Jeunesse-Nord secondary school, College Boreal, Lambton College and from the Ministry of Northern Development and Mines. A number of tours were also provided to individuals and groups from various Cameco supplier and customer organizations.

Cameco continued to develop partnerships and to provide financial and volunteer support to a number of events and organizations in Blind River and the surrounding area. Among those who received support in 2017 were:

- Town of Blind River Senior's Christmas Luncheon;
- Town of Blind River, Mississauga First Nation, and Iron Bridge residents during Cameco Cares Day;
- Town of Bind River Festivals Committee;
- Regional theatre and art events;
- Mississauga First Nation "Little NHL" Tournament;
- Mississauga First Nation and Serpent River First Nation powwow cultural events; and
- Town of Blind River Community Day Events.

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

The following is a summary of improvement plans and future outlook for 2017.

BRR has no major improvement plans scheduled in 2018, but remains committed to continual improvement and will continue to look for opportunities to make the site operate more efficiently, while minimizing risk to employees, the public and the environment.

In the area of emergency response Cameco intends to complete the projects started in 2017 to add additional sprinklers at the facility and also to replace the fire water pumps. With respect to environment and waste management Cameco is looking to continue reducing the historical inventory of waste management materials at the site. BRR also has additional capital projects planned related to maintenance of aging infrastructure.

There are no major changes planned in 2018 that could require Commission approval.

3.1.4 Safety Performance Objectives for Following Year

The following is a summary of project facility operations and proposed or foreseen changes to equipment, procedures, production capacity, organization and licensing documents for 2017 that apply to the BRR site.

Cameco will continue to look at ways to continually improve the operation to ensure safe and reliable performance. Minor changes, including the ones identified in the previous section of this report, will continue to be made in 2018 to help improve the operation.

Cameco is not planning any other changes in 2018 that will impact the equipment, procedures, production capacity, organization and licensing documents of the facility.

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.

In 2017 BRR did not exceed any CNSC regulatory limits. As a result of the effective programs, plans and procedures in place, the refinery was able to maintain individual radiation exposures well below all regulatory dose limits. 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.