



**2021 Annual Compliance Monitoring
&
Operational Performance Report**

**Reporting Period January 1 – December 31, 2021
Revision 1**

**Cameco Fuel Manufacturing Inc.
Operating Licence
FFOL-3641.0/2022
200 Dorset Street East
Port Hope, Ontario
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Submitted to:
The Canadian Nuclear Safety Commission
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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.

CFM operates a Class IB nuclear facility in Port Hope, Ontario under Canadian Nuclear Safety Commission (CNSC) fuel facility operating licence FFOL-3641.0/2022 employing approximately 130 workers. In addition, approximately 125 employees work at a metal manufacturing plant located in Cobourg, Ontario, which does not handle uranium products. CFM is licensed to produce nuclear fuel bundles using uranium dioxide (UO₂) primarily for CANDU reactors used by both domestic and international customers. On February 17, 2022, CFM was granted a 1 year licence FFL-3641.00/2023.

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, local residents, and the environment. Corporate policies and programs, including the Safety, Health, Environment and Quality (SHEQ) policy provide guidance and direction for the development of site-based programs and procedures that are defined in CFM's Management Systems Program Manual (CFM-MS).

In 2021, CFM continued to be included in Cameco's registration of the ISO14001:2015 Environmental Management System. CFM has a Safety Analysis Report (SAR) that documents the detailed safety analysis carried out for the facility. The SAR, which was updated in May of 2021, describes the hazards, preventative measures and mitigating controls associated with the licensed activities at CFM. The report summarizes major assessments for the facility and is updated to incorporate facility changes and improvements since the last version.

At CFM, changes to the physical design of equipment, processes, and the facility with the potential to impact safety are evaluated using the internal change and design control process from project planning through to completion of the project. This process is used to help identify potential impacts to the environment and health and safety. In 2021, CFM continued to use the electronic Management of Change (MOC) format to evaluate design and change control projects. There were no modifications undertaken that required written approval from the Commission or a person authorized by the Commission during the year.

CFM 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. As a result of these programs, plans and procedures, CFM's operations have maintained radiation exposures and environmental emissions well below regulatory limits.

For various radiological and environmental parameters, CFM has established internal 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 2021, there was one action level exceedance associated with an employee's internal dose. There were no other action level exceedances in the radiological or environmental monitoring program.

CFM maintains a comprehensive uranium inventory system to demonstrate compliance with safeguard requirements. In 2021, periodic audits of this inventory system were conducted jointly by the International Atomic Energy Agency (IAEA) and the CNSC. All audits were completed to the satisfaction of both regulatory bodies.

The scope of transportation activities at CFM includes the transport of Class 7 radioactive materials outlined in the *Transportation of Dangerous Goods Act SOR/2008-34*. There were no reportable transportation events involving CFM produced material in 2021.

Cameco works to build and sustain the trust of local residents by acting as a responsible 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 environmental practices and performance. Cameco continued its strategic approach to community outreach in 2021 with the continuation of newsletters. In 2021 Cameco continued to expand the use of social media into the overall communication strategy.

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1. INTRODUCTION

1.1 General Introduction

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

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

CFM operates a Class 1B nuclear facility in Port Hope, Ontario under Canadian Nuclear Safety Commission (CNSC) fuel facility operating licence FFOL-3641.0/2022 that is valid until February 28, 2022. In 2021 CFM submitted an application to the CNSC for a 20 year licence that will be considered by the Commission later in 2022. The Port Hope facility employs approximately 130 workers. In addition, approximately 125 employees work at a metal manufacturing facility located in Cobourg, Ontario, which does not handle uranium products.

CFM (Figure 1) is located at 200 Dorset Street East in the Municipality of Port Hope, Ontario and operates a fuel manufacturing facility. The facility is currently licensed to produce nuclear fuel bundles using uranium dioxide (UO₂) primarily for domestic CANDU reactors. The licence also provides continued authorization to process, and store depleted and enriched UO₂.

On February 17, 2022, CFM was granted a 1-year licence FFL-3641.00/2023 that is valid until February 28, 2023. Requesting a one year licence was a strategic decision based on the current situation where both the BRR and CFM licenses are renewed in the same calendar year. By deliberately staggering licensing activities for the future, no two Ontario Cameco facilities are applying for licensing in the same year. This is beneficial due to re-licensing resource requirements in both organizations. This approach is supported by CNSC staff with activities related to the one year licence occurring 2021. On October 4, 2021, Cameco Fuel Manufacturing formally applied to renew its CNSC operating licence for a 20 year period. This licence application requested an increase to the production limit from 125 Megagrams (Mg) of UO₂ as pellets during any calendar month to 1,650 tonnes of uranium (tU) as uranium dioxide (UO₂) pellets. This move from a monthly production limit in Mg to an annual limit in tonnes allows for variation in production from month to month. The Commission will consider Cameco's application later in 2022.

Figure 1 - Cameco Fuel Manufacturing (Port Hope)



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

CFM maintains the required programs, plans and procedures in the areas of health and safety, radiation protection, environmental protection, emergency response, fire protection, waste management, and training.

As a result of these actions, CFM maintained radiation exposures to the workforce well below dose limits. Environmental emissions and public radiation exposures are being controlled to levels that are below regulatory limits.

The submission of this report fulfills the requirement of Section 2.2 in the fuel facility operating licence FFOL-3641.00/2022. CFM's annual report is structured according to *REGDOC-3.1.2, Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills*. The purpose of this report is to summarize operating performance and provide a summary of the Safety and Control Areas for the calendar year of 2021 to demonstrate that CFM has met the regulatory requirements of the *Nuclear Safety and Control Act (NSCA)*.

Cameco is committed to reducing the frequency and significance of all events at site, including loss of primary containment (LOPC) events. Therefore, all events ranked level two or higher are investigated and resulting actions are tracked through the Cameco Incident Reporting System (CIRS).

Action levels are referenced in the LCH under the Radiation Protection section for worker dose and the Environmental Protection section for emissions. During 2021, CFM had one action level exceedance related to an employee’s internal dose. CFM is confident that through the investigation and the corrective actions that the incident will not recur. There were no other action level exceedances in the radiation protection or environmental protection program in 2021.

In addition to the CNSC, CFM is regulated by other federal and provincial agencies, such as the Ontario Ministry of the Environment, Conservation and Parks, Environment and Climate Change Canada, Employment and Social Development Canada, and Transport Canada. CFM is compliant with applicable federal, provincial, and municipal regulations.

The acronyms in the following table are used in this report.

Table 1

Acronyms Used in This Report	
Acronym	Description
AACQ	Provincial Ambient Air Quality Criteria
ACGIH	American Conference of Governmental Industrial Hygienists
ACL	Administrative Control Limit
ALARA	As Low As Reasonably Achievable
BRR	Blind River Refinery
Bq	Becquerel
CAM	Continuous Air Monitor
Cameco	Cameco Corporation
CFM	Cameco Fuel Manufacturing Inc.
CIRS	Cameco Incident Reporting System
CFM-MS	Cameco Fuel Manufacturing-Management System document
CCM	Contaminated Combustible Material
CCME	Canadian Council of Ministers of the Environment
CNSC	Canadian Nuclear Safety Commission

CSA	Canadian Safety Association
DRL	Derived Release Limit
EBRL	Exposure Based Release Limits
E/OH&S	Environmental Occupational Health & Safety
ERA	Environmental Risk Assessment
ERAP	Emergency Response Assistance Plan
FHA	Fire Hazard Analysis
FPP	Fire Protection Program
FSD	Fuel Services Division
g	Gram
HPP	Hazard Prevention Program
hr	Hour
IAEA	International Atomic Energy Agency
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
JHSC	Joint Health & Safety Committee
kg	Kilogram
KPI	Key Performance Indicator
L	Litre
LCH	Licence Conditions Handbook
Mg	megagram
m³	cubic metres
µg	micrograms
µSv	microsievert
mSv	millisievert
MECP	Ministry of the Environment Conservation and Parks
MOC	Management of Change
CFM-NC	Nuclear Criticality Safety Program Manual
NEW	Nuclear Energy Worker

NDR	National Dose Registry
NFPA	National Fire Protection Agency
OSLD	Optically Stimulated Luminescence Dosimeters
PDP	Preliminary Decommissioning Program
PHCF	Port Hope Conversion Facility
PHFES	Port Hope Fire and Emergency Services
PP2	Powder Preparation and Powder Receiving Area
PPE	Personal Protection Equipment
PSSR	Pre Start Safety Reviews
QA	Quality Assurance
RP	Radiation Protection
SAP	corporate wide enterprise application software for asset management, maintenance management, accounting and purchasing functions
SAR	Safety Analysis Report
SAT	Systematic Approach to Training
SCA	Safety and Control Area
SCI	Site Condition Inspection
SHEQ	Safety/Health/Environment & Quality
SSC	Systems Structures and Components
TLD	Thermo Luminescent Dosimeters
TED	Total Effective Dose
TRIR	Total Recordable Injury Rate
UO2	Uranium Dioxide
yr	Year

1.2 Facility Operation

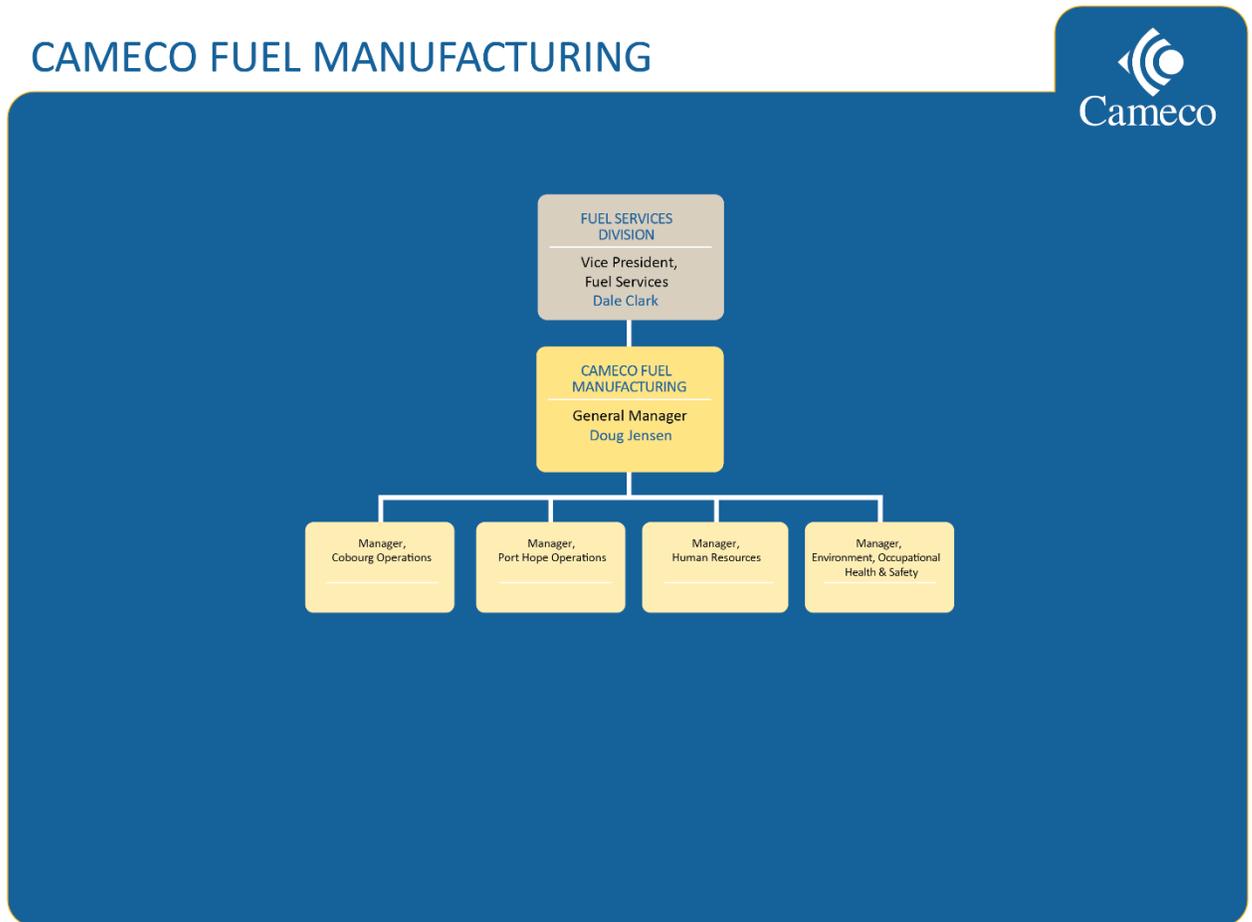
Cameco continues to strive for operational excellence at all of its facilities through consistent application of management systems to ensure that they operate in a safe, clean, and reliable manner. Corporate policies and programs, including Safety, Health, Environment and Quality (SHEQ) provide guidance and direction for all site-based programs and procedures that define the site management system.

The General Manager at CFM has overall accountability for safely operating and maintaining the facility. The responsibilities for supporting programs and procedures have been delegated among the management team at CFM and their respective personnel. All members of the site's management team are accountable for their roles and responsibilities.

In 2021 there were no changes in management positions at CFM's Port Hope facility. The organization chart for the management structure currently in place at CFM is provided in Figure 2.

The Manager, Environment/Occupational Health and Safety (E/OH&S) acts as the primary site radiation safety officer and reports directly to the General Manager. This position is responsible for the radiation and environmental protection programs in place at the Port Hope facility. As specified in CFM's Radiation Protection Program, there is an alternate Radiation Safety Manager position held by the Radiation Safety Coordinator which is the alternate site contact for the CNSC. This position reports to the Manager of E/OH&S.

Figure 2: CFM Organizational Chart



In 2021, CFM continued to be included in Cameco’s registration of the ISO14001:2015 Environmental Management System.

CFM is issued a Licence Conditions Handbook (LCH) by the CNSC. This handbook establishes, in a consolidated document, the compliance framework related to the CFM licence. The LCH outlines 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. The LCH was revised in July of 2021 as CFM has implemented an additional Regulatory Document as well as updated the version referenced for other standards and Regulatory Documents. In addition, CFM proposed revisions to environmental action levels which were accepted by the CNSC.

CFM also has a Facility Licensing Manual (FLM) that describes the commitment by CFM to operate a safe and efficient nuclear facility which meets the requirements of the CNSC.

CFM's FLM was revised in 2021 to incorporate some minor clarifications requested by the CNSC after the full rewrite of the document that took place in 2020.

CFM schedules and conducts internal audits to assess the organization's level of conformance to management systems. In addition, independent third-party experts conduct compliance audits in the areas of health, safety, environment, and radiation protection legislation to help ensure that CFM continues to meet all applicable legal requirements. Cameco's corporate office also performs periodic audits of the site management systems programs to ensure the site complies with corporate expectations.

Changes to the physical design of equipment, processes, and the facility with the potential to impact safety are evaluated using an internal change and design control process from project planning through to project completion. This process is used to help identify potential impacts to radiation protection, the environment, health and safety, security, and fire protection.

CFM underwent two planned shutdown events during the course of the year to conduct maintenance and project activities.

CFM maintains the required programs, plans, and procedures in the areas of health and safety, radiation protection, environment, emergency response, fire protection, waste management, and training. As a result of these actions, CFM'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 well below the established limits.

As the pandemic continued to persist throughout 2021, CFM continued to update HSI 419 – *Hazard Prevention for COVID-19 Response* throughout 2021 based upon changing local, provincial, and federal health guidelines. Starting in November of 2021, all employees, contractors and visitors were required to be fully vaccinated in order to access the site. Throughout the year, on-site voluntary rapid testing was offered twice per week, resulting in over 2500 tests being performed, with all test results negative. As government guidelines changed, CFM was able to keep up with changes to its entry questionnaire as well as changes in requirements for in-person meetings and types of face coverings. COVID continued to present operational challenges in 2021; however, the direct operating impact was less than it was in 2020 due to lower overall absenteeism and protocols becoming more commonplace. Improvement resources, primarily in the Safety and Health areas continued to be called upon to manage COVID requirements. These resources therefore were not available to make some planned improvements to processes and systems. In addition, COVID related supply chain disruptions required management attention which also detracts from time that would have been spent making systemic improvements. Information about government/public health measures, vaccination clinics

and evolving protocols was continuously communicated to employees through various channels.

The performance of the facility in 2021 demonstrates that CFM is qualified to carry out the activities permitted under the operating licence. CFM is committed to take all reasonable precautions to protect the environment and the health and safety of employees and the public, to maintain the security of the facility and the nuclear substances associated with the facility as well as the necessary measures to facilitate Canada's compliance with international safeguard obligations.

1.3 Production or Utilization

CFM's operating licence permits the production of up to 125 Mg of UO₂ as pellets, during any calendar month. There were no major changes to the production loading of the facilities in 2021.

Production rates for 2021 were within the monthly limit. Detailed plant production information is considered "confidential" and is submitted to CNSC staff on an annual basis under a separate cover.

1.4 Facility Modification

In 2021, there were no modifications undertaken that required written approval from the Commission or a person authorized by the Commission. Equipment and facility improvements in 2021 included:

- Creation of Continual Improvement Community of Practice group: as recommended in the 2020 Lean Assessment, a Lean Community of Practice group was formed to assist advancing and consolidating the various lean systems that are already in place at CFM. The team started a project in 2021 and will finalize this activity in 2022.
- Improvement to Waste Reduction Plan: a site level objective was identified and implemented to align recycle container signage with what is accepted by our recycling outlets in order to increase diversion. This is in response to findings from the 2020 waste audit.
- Improvements to Centrifuges: the grinder coolant processing centrifuges that came online in 2020 were further streamlined resulting in improved uptime in the process of removing solids from the grinder coolant.
- Dispensing Shed Upgrades: a review of the flammable's dispensing shed was completed, and improvement were initiated in 2021 with completion expected in early 2022.
- Installation of Stack Sampling Timers: a multiyear project was completed in 2021 to install stack timers interlocked to sampler system improving accuracy of results.
- Scrap Material Release Improvements: electronic waste and scrap metal monitoring practices were improved to reduce potential for material being released off site without being monitored and process implemented for complex objects.

The LCH references core CFM documents that form the licensing basis of the facility in each safety and control area. In 2021, there were 10 documents that were updated and required to be submitted to the CNSC:

- Facility Licensing Manual (FLM), version #11
- Management System Program Manual (CFM-MS), version #4
- Nuclear Criticality Safety Program Manual (CFM-NC), version #8
- Change and Design Control Procedure (MSP 13-02), version #21
- Preventive Maintenance Execution Management (AP 018), version #8
- Pressure Retaining Components (MSP 27-16), version #3
- Preliminary Decommissioning Plan (PDP), May 2021
- Safety Analysis Report (SAR), May 2021
- Environmental Protection Program (EPP), version #5

- Systematic Approach to Training – Training Plan Manual (CFM-HR-01), version #4

2. SAFETY AND CONTROL AREAS

2.1 Management

2.1.1 Management System

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

CFM's Management Systems Program Manual (CFM-MS) is designed to meet the requirements of *CSA N286-12 Management System Requirements for Nuclear Facilities*. The CFM-MS provides the controls necessary to ensure all processes are conducted in a safe manner and processes that apply to licensed activities are conducted in accordance with applicable CNSC and other regulatory requirements. The application of management system requirements is scaled according to the complexity and hazard potential of a particular activity. There were no significant changes to the Management Systems Program in 2021. The CFM-MS was revised in 2021 to align with Cameco's Safety, Health and Environment Policy, reference the years the safety culture assessments were completed, and add a reference for the Joint Health and Safety Committee procedure.

A site management review meeting is held annually to review the suitability, adequacy, and effectiveness of the management system at CFM. The site programs and procedures that support the policy and ensure conformance to both Cameco and CNSC requirements are reviewed in adequate detail to demonstrate effectiveness. The review is conducted in alignment with of the SCAs contained within the CNSC regulatory framework outlined in CFM's LCH. The 2021 annual site management review meeting was held March 8, 2022 to review the suitability, adequacy, and effectiveness of the management system at CFM. The site management systems, which cover all site programs, were reviewed and sufficient information was provided to demonstrate effectiveness.

Overall, the conclusion of the site is that the Management System program manuals: CFM-MS - Management Systems Program Manual N286, CFM-QA - Quality Assurance Management System, QA 002 - Nuclear Quality Assurance Manual, FSD-PGR-EMS-001 FSD Environmental Management System and the Licence Conditions Handbook (LCH) are adequate, suitable and effective for the following reasons:

- Adequate – The identified Management System Programs fully meet the requirements of all the standards required by our customers and regulatory organizations.

- Suitable – The CFM-QA (N299.1) and QA-002 (N285) quality programs capture the needs of our customers, including our regulatory customers. The Quality Manual QA 002 is a separate manual required by our customers who require ASME code work. They prefer to have all their requirements clearly defined in one manual. There are several common procedures and work instructions that apply to both programs and these are easily referenced in the manuals as required.
- Effective – The internal and external audits are identifying non-conformances and opportunities for improvement; the results are showing that the systems are effectively implemented.

Overall, it is recommended that the conclusion be that the CFM Management Systems, adhering to the N286, N299.1 and N285.0 standards, and the CFM License Conditions (LCH) are suitable, adequate, and effective.

Engagement of all teams at CFM in continual improvement for all 4 pillars of success continued in 2021. Sources of continual improvement activity included:

- Daily huddle meetings. The daily huddle meetings continued in a virtual Microsoft Teams format for most of 2021 utilizing the same structured format as previous. The huddle continued to involve all departments in a review of previous day performance and the identification and implementation of improvement activities.
- Monthly Performance Review. CFM continued with a standardized approach to monthly review of business performance to identify performance gaps and improvement opportunities in 2 venues:
 - Continual Improvement review. Supervisors and support staff update their performance in the areas of quality, OEE, production, maintenance and areas for improvement to the leadership group.
 - Operating Review. Department managers and their support groups review safety, financial and improvement project performance using both leading and lagging indicators.
- Kaizen (Green) Cards. CFM targeted participation of all employees in at least one continual improvement activity in their work area. Improvements could be suggested via the CFM Newspaper process, via the local supervisor led continual improvement meetings or data driven via the Daily Huddle or Monthly Continual Improvement review. 230 (95%) of employees were able to participate in completion of at least one green card in 2021. In total 843 green card participations (1 person participating in 1 green card is deemed a green card participation event) took place.

- Continual Improvement Community of Practice. As recommended in the 2020 Lean Assessment, a Lean Community of Practice group was formed to assist advancing and consolidating the various lean systems that are already in place at CFM. The team completed a project in 2021, using the removal of surplus material as an example to identify and illustrate the challenges in implementing standardization. The team will finalize this activity in 2022 and begin to create a framework for future standardization activities.
- Domestic Waste Reduction Plan: A site level objective was identified and implemented to align recycle container signage with what is accepted by our recycling outlets in order to increase diversion. This is in response to findings from a 2020 waste audit.

CFM follows a systematic evaluation method for its safety culture self-assessments which are generally completed every five years. Cameco uses these assessments to shape the safety program improvements at each site. A safety culture self-assessment was completed late in 2021 with the report including the analysis to be provided early in 2022.

There were no organizational changes in 2021 or changes in the roles and responsibilities at the facility that would affect the facility, prescribed information, or nuclear substances.

In 2021, CFM continued to be included in Cameco's registration to the ISO 14001:2015 Environmental Management System, which is an internationally recognized standards for quality and environmental management through the corporate certificate. Being a part of the corporate certificate provides consistency among the Cameco sites with specific cost benefits being realized, reduction in audit frequencies and better corporate program oversight.

All documents that support the licensed activities are subject to the site document control process. Documents that support the 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 listing of management program documents that were revised in 2021 and the reason for the revision is provided below:

- Facility Licensing Manual (FLM), version #11 – The FLM was updated to address the CNSC staff comments related to version 10.
- Management System Program Manual (CFM-MS), version #4 – The changes in this version were primarily administrative to align with Cameco's Safety, Health and Environment Policy, reference the years the safety culture

assessments were completed, and add a reference for the Joint Health and Safety Committee procedure.

- Nuclear Criticality Safety Program Manual (CFM-NC), version #8 - The changes in this version were primarily administrative to reflect changes in the acronym to align with CFM's updated document structure, updated reference to *REGDOC - 2.4.3 CNSC Regulatory Document Safety Analysis Nuclear Criticality Safety v1.1*, revised CCC meeting frequency and updated format.
- Change and Design Control Procedure (MSP 13-02), version #21 – The procedure was updated to reference the change in process for change control projects from paper copy to the SAP Management of Change (MOC) electronic process.
- Preventive Maintenance Execution Management (AP 018), version #8 – The procedure was updated to include Work Closeout processes and instructions.
- Pressure Retaining Components (MSP 27-16), version 3 – The procedure was updated to reflect the current responsibilities as well as added the inspection and servicing requirements for Pressure Relief Devices as required by *CSA B51-19, Boiler, Pressure Vessel, and Pressure Piping Code*.
- Preliminary Decommissioning Plan (PDP) – The PDP was reviewed and updated to meet the requirements in the CNSC guidance documents *G-219, Decommissioning Planning for Licensed Activities and G-206, Financial Guarantees for the Decommissioning of Licensed Activities* as well as *CSA N294-19 Decommissioning of facilities containing nuclear substances*.
- Safety Analysis Report (SAR) - The Safety Analysis Report was updated to include the recommendations from CNSC staff provided in 2015 and 2020 as well as requirements in the draft *REGDOC 2.4.4 Safety Analysis for Class 1B Nuclear facilities*.
- Environmental Protection Program (EPP) – The EPP was updated to reflect changes in the derived release limits, action levels and to align with the current practice for terrestrial and aquatic sampling.
- Systematic Approach to Training – Training Plan Manual (CFM-HR-01), version #4 - The training manual was updated to include a mapping table of CFM documents to the *REGDOC 2.2.2* section 1.2, addition of in scope definitions, addition of corporate aligned DIF analysis, clarification on Job Task Observations, update to the reference section, and removal of document retention reference as practice exceeds requirements.

A listing of other documents that were revised in 2021 and the reason for the revision is provided below:

- Derived Release Limit (DRL) – The report was completed in accordance with the guidance of *CSA Standard N288.1-14, Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities* and incorporated recommendation from CNSC staff from the version submitted in August 2020. The updated DRL recommended changing the critical receptor calculation from using the gamma dose rate at location #1 to location #2, including liquid emissions in the public dose calculation and separating out sources of air emissions to stack and building ventilation. These changes were accepted by the CNSC and were implemented in the first quarter of 2021.
- Review of Environmental Risk Assessment (ERA) – a review of the November 2016 ERA was conducted to meet the 5-year review requirement under Clause 11 of *N288.6-12 Environmental risk assessment at class I nuclear facilities and uranium mines and mills* with the review results required to be submitted to the CNSC. This review concluded that there are no identified risks that have emerged since the last ERA review and there were no changes identified in the review which required a full update of the ERA before the 5-year timeframe.
- Review of Environmental Action Levels – CFM completed a comprehensive review of its environmental action levels in accordance with the guidance in CSA standard *N288.8-17 Establishing and implementing action levels for releases to the environment from nuclear facilities*. This review was undertaken to support the licence renewal application. The proposed action levels were submitted to the CNSC for approval and were implemented in the third quarter of 2021.
- Exposure Based Release Limits (EBRLs) – Cameco submitted proposed EBRLs to support the licence renewal application which were accepted by CNSC and included in the 1 year licence granted in 2022.

In 2021, an internal SHEQ audit coupled with a Compliance audit was conducted by Cameco Corporation. The audit was conducted against the following site programs: Radiation Protection and Environmental Protection. CFM also conducted its own internal audit in 2021. Findings, opportunities for improvement and areas of concern from all audits are entered into CIRS to ensure that they are reviewed by site management and processed accordingly.

In 2021, there were four external audits or inspections completed. After being reviewed, all audits findings are entered into CIRS where corrective actions or activities can be assigned, and their progress tracked.

The following is a list of the external audits conducted in 2021:

- Compliance Inspection focusing on the Environmental Protection SCA conducted by CNSC staff.
- Compliance Inspection focusing on the Human Performance Management - Training SCA conducted by CNSC staff.
- Fire Protection Program audit conducted by PLC (Site Condition Inspection).
- Annual FSD Internal Dosimetry Program audit conducted by Arcadis Canada.

As part of the management system program, CFM scheduled and conducted internal audits in 2021 to assess the level of conformance to these management systems. All of the audits and inspections that were performed included various aspects of the site training program. As a result of an inspection finding in 2021, CFM will include the SAT program (CNSC Personnel Training Reg 2.2.2) as part of its internal audit process in 2022.

The Management System is in place to integrate the requirements for health, safety, environment, security, quality, and finance as described in *CSA Standard N286-12* and in the LCH. Operationally, and as presented to the CFM Board of Directors annually, CFM continues to achieve performance that is in overall compliance with requirements in these areas, including the SCAs and can therefore conclude that the management system is effective at achieving its intended purpose. Resultant improvement actions and opportunities are identified from this management review and are tracked for completion.

The audits described above pertain to other sections of this report; however, the information will not be repeated. Further information regarding CFM's auditing process will be submitted under separate confidential correspondence.

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 to ensure that there are sufficient numbers of employees in all relevant job areas and that they have the necessary knowledge, skills, and tools to safely carry out the licensed activities.

CFM 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 NSCA and its Regulations.

CFM has a number of programs, procedures and processes that establish the framework for a safe work environment and foster a sustainable safety culture at the site. All employees are encouraged to maintain a questioning attitude with respect to health, safety, radiation protection and environmental issues.

The Systematic Approach to Training (SAT) method of training applies a robust, risk-informed system to analyze and track training requirements and develop and deliver appropriate training. The SAT process covers the initial training of employees, routine re-qualification, as well as re-qualification of employees after an extended absence. Records are maintained for all training documentation. CFM documents this system in a site procedure titled “Systematic Approach to Training – Training Plan” (CFM-HR-01) to meet the CNSC Regulatory Document 2.2.2 *Personnel Training*”.

Training and employee qualification activities continued through 2021 at CFM amid pandemic related challenges. The shift from Instructor Led Training (ILT) to Virtual Instructor Led Training (VILT) that began in 2020 continued throughout 2021. This shift became the new normal. Despite the challenges with the pandemic, CFM training had a strong year for compliance. Beginning the year, CFM’s compliance score was at 94.2%. CFM was able to improve compliance and closed the year with a compliance of 97.9%. This was our highest year end compliance and was 2.9% above the 95% target. CFM employees completed 5,444 hours of training during the year and completed 151 scheduled courses. Part of this success came from focusing on No-Go courses (courses that are required prior to an employee completing work tasks). The training department began providing No-Go status updates during the weekly morning supervisor meetings. With this increased level of attention, No-Go courses closed-out 2021 with a completion of 99.7%.

The Radiation Protection training, which was developed using the Systematic Approach to Training framework, was live in 2021. During the year, 71 employees were assigned and completed the training. By the end of the year, 100% of active employees were compliant. In fact, CFM was 100% compliant during the entire fourth quarter. Toward the end of 2021, using the Systematic Approach to Training, the analysis document was

updated. After approval of analysis, the training design was updated and approved. The eLearning was subsequently updated and was pending final approval at the end of 2021.

At the end of 2021 CFM had a very strong year with safety course metrics. at 100% compliance in other training programs such as: CAM CoHE – Control of Hazardous Energy, CAM Job Hazard Analysis, CFM Confined Space Theory & Practical as well as CFM Emergency Evacuation.

Some improvements in the training program advanced in 2021 include:

- SAT Orientation - Completed the full orientation for new hires. This initiative initiated in 2020 and was completed in 2021.
- SAT PP2 – began work on updating an SAT compliant package for PP2 operators.
- Leadership 360 - Conducted leadership 360 surveys, focused on emotional intelligence and provided individual reports to all people leaders in the CFM organization.
- Self-Check training – developed and rolled out a self-check course based on content from Cameco SHEQ and risk tolerance videos.
- SAT Radiation Protection - Updated the eLearning based on changes to pregnant NEWs, dose for NEWs responding to emergencies, and changes to the extremity rings. This involved updating the analysis and design.

CFM complies with Part III of the *Canada Labour Code* as it defines the maximum hours of work for all employees on-site. In addition, CFM has committed to the CNSC that a minimum complement of employees will be available to respond to emergency situations.

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

There are no CNSC certified positions at CFM; however, CFM does employ trade staff such as electricians, millwrights, and process technicians (instrumentation technicians). In 2021, CFM hired two process technicians to replace vacancies. There were no other changes in certification of personnel (including recertification and decertification) or any change in status of certified personnel (e.g., termination, removal from duties, failure to pass a requalification exam, retirements, or transfers).

CFM continues to enhance communication between facility management and employees as this is critical to sustaining a positive safety culture. To support communication with employees and contractors, several methods are utilized to ensure critical/important information is delivered in a timely fashion. Critical/important information may include

topics of industrial safety, radiation safety, environmental protection, quality performance, production and project plans, management systems, etc.

The CFM training department continues to provide support to employees and long-term contractors on training, qualifications, and requalification at CFM. Through a continuous improvement mindset and attention to course completion, the compliance results for 2021 continued to strengthen throughout the year. Maintaining strong results coincided with SAT development and responding to corrective actions.

As demonstrated by the training compliance data along with the improvements in the program and the results of the audits and inspections related to the human performance aspects at CFM, management has determined that CFM's Human Performance program continues to effectively provide for the development and implementation of training programs for workers. The requirements regarding this program provides the necessary processes to support responsibilities, qualifications, and requalification training of persons at CFM.

Updated documents (procedures, work instructions etc.) flow through a Document Review Record (DRR) process. Any document that is identified as impacting an employees tasks is electronically routed through this process for the employees review and signature. The process documents the changes to the document and that the employee has reviewed the document. The process also allows for feedback from the reviewer to the document owner.

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 2021, CFM continued to operate in a manner that supports safe, clean, and reliable production and in compliance with applicable acts and regulations.

Production rates for 2021 were within the monthly limit. Detailed plant production information is considered “proprietary” and is submitted to CNSC staff on an annual basis under a separate cover.

For a three-week period in July of 2021 and one week period in December, the facility underwent planned shutdowns to complete maintenance and project work and to conduct uranium physical inventory activities (in support of CNSC/IAEA requirements).

The main challenge for CFM in 2021 continued to be sustaining ongoing reliable operations and meeting customer commitments while operating throughout the uncertainty caused by the COVID pandemic. Although 2021 represented our second year of the pandemic, there continued to be changing requirements and employee absences to manage. Once again in 2021 CFM employees were able to meet the challenge and continued to perform safely.

Overall, CFM’s Operational Performance remains effective. CFM continued to meet customer requirements safely and at expected quality levels. Continual improvement activities continue to focus on reducing internal defect levels and improving equipment performance. CFM continues to maintain the implemented management system and programs for the safe and effective operation of the facility.

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. The 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.

To operate in a safe, clean, and reliable manner, CFM utilize various programs and procedures including the Safety Analysis Report (SAR), Fire Hazard Assessment (FHA), environmental aspects registry, chemical hazard and other assessments.

The design, construction, operation and maintenance of CFM is intended to eliminate or minimize to the extent possible the potential of radiological, chemical or other physical hazard to facility personnel, the environment and the general public. This is accomplished not by a single approach but rather by a defense-in-depth approach and has been systematically reviewed and documented from several perspectives.

CFM has a Safety Analysis Report (SAR), which was updated in May of 2021 documents the hazards, preventative measures and mitigating controls associated with the licensed activities at the facility. This report summarizes major assessments for the facility and is updated to incorporate facility changes and improvements since the last version.

This safety report is periodically reviewed, on a frequency not to exceed every five years, which includes:

- assessing incidents that have occurred at the facility against the report to confirm the response of safety systems
- assessing all design changes, including those initiated as a result of an incident or accident
- assessing the results of supporting studies and reports
- reviewing the credible accident scenarios and predictive modelling

The facility has a nuclear criticality program, accepted by the CNSC, to address the handling and processing of enriched uranium. The Nuclear Criticality Safety Program Manual (NCSPM) meets the requirements outlined in the CNSC regulatory document *RD-327 Nuclear Criticality Safety*.

The physical improvements implemented in 2021 did not alter or affect the overall design basis for the facility and therefore, the design basis remains valid.

As required by its operating licence, CFM is subject to third party reviews for verification of the requirements under the current edition of the *National Building Code*, the *National*

Fire Code, and *NFPA 801* for all modifications. In 2021, there were no third party review reports submitted to the CNSC as there were no modifications that required reviews.

Other Safety Analysis initiatives include the following:

- COVID-19: CFM continued to update *HSI 419 – “Hazard Prevention for COVID-19 Response”* throughout 2021 based upon local, provincial, and federal guidelines. Beginning in November of 2021, all employees, contractors and visitors were required to be fully vaccinated in order to access the sites. Over the year, on-site voluntary rapid testing was offered twice per week; over 2500 tests were performed, with all test results being negative.
- ACGIH annual assessment: in conjunction with Cameco corporate personnel, CFM conducted a review of the proposed changes from ACGIH. No new limits were identified to be imposed for substances in use at CFM and no actions were determined to be necessary.
- Ergonomic Improvements: In 2021, the JHSCs investigated a broader scope to the Industrial Athlete program beyond the focus of stretching. This included promoting a healthy diet through supplied breakfasts, being physically fit, and being mentally healthy through promotion of mental health week. In 2021 a new Cameco ergonomic standard was introduced which will be fully implemented by the end of 2022. CFM has completed a gap analysis of its current ergonomic practices and the new Cameco corporate standard and will begin to close those gaps in the first half of 2022.
- Noise surveys: In the fourth quarter of 2021, a sound level survey of both CFM sites was conducted to identify potential areas of concern. From this survey, new Similar Exposure Groups (SEGs) were identified based on current sound levels.
- Control of Hazardous Energy (CoHE): A new CoHE team was created in 2021 to look for ways to improve the current CoHE program and to provide clarity for those who have questions. Issues being addressed range from contractors and CoHE, to lockout verifications.
- Light Survey: Illumination surveys were conducted at both CFM locations to ensure that lighting levels aligned with part VI of the Canada Occupational Health and Safety Regulations. Deficiencies were noted and entered into CIRS for correction in 2022.
- Industrial Hygiene – Mould inspections were conducted at both CFM locations as part of Cameco’s industrial hygiene program. Ceiling tiles that have sustained water damage were noted as areas of concern. Deficiencies

were noted and entered into CIRS for corrective actions to be implemented in 2022.

- Risk Registry – Hazard Assessments: A review and update of CFM’s health and safety risk registry began in 2021. This 3-year initiative will update risk rankings and align listed processes with current state. This project is set to conclude at the end of 2023.
- A Facility Condition Inspection was conducted by Professional Loss Control (PLC) to ensure that CFM meets *CSA N393* requirements.

As in 2020, CFM continued to perform safety audits/inspections and implement recommendations through its corrective action process. Job Task Observations (JTOs) were completed at a rate of 94% overall throughout the year while 93% of all required layered inspections were completed.

CFM has a *Nuclear Criticality Safety Program Manual (CFM-NC)* to address the handling and processing of enriched uranium. The CFM-NC has been developed to guide generation and implementation of CFM’s criticality prevention practices as they pertain to licensing and criticality prevention issues. The manual was updated in 2021 to meet the CNSC regulatory document *REGDOC - 2.4.3 CNSC Regulatory Document Safety Analysis Nuclear Criticality Safety v1.1*. There were no processing activities of enriched material conducted on site in 2021.

CFM is maintaining an effective safety analysis program that identifies and assesses hazards and risks, including new and unforeseen risks not initially considered, on an ongoing basis. CFM maintains a Safety Analysis Report that considers the hazards associated with the facility. This risk assessment supports the development and setting of site objectives and targets, as well as the development of preventive and protective measures for personnel and operations.

2.2.2 Physical Design

This safety and control area relates to activities that impact on the ability of systems, structures, and components to meet and maintain their design basis, given new information arising over time and taking 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.

Design requirements impact all life cycle phases of CFM facilities, from site selection, construction, operation and through to decommissioning. To ensure ongoing effectiveness of all systems, structures, and components essential to the safe operations at CFM, changes to the physical design of equipment, processes and the facility are managed through the Change and Design Control program (MSP 13-02 - Change and Design Control).

These identified systems, structural, and component changes are subjected to a graded approach to the application of CFM's management systems; taking into account design inputs / requirements such as, but not limited to, regulatory, functional, performance, operational, safety, environmental and quality considerations, and stakeholder impact.

In 2021, CFM began tracking compliance and implemented KPIs for the new SAP-based electronic Management of Change tool. The questionnaires and reference documents were updated throughout the year to incorporate any new or changes to the existing regulatory requirements, standards, internal Cameco and CFM procedural changes, etc., as well as to account for any organizational changes.

The Community of Practice, consisting of representatives across the different Cameco sites and departments has been initiated to provide an ongoing forum for identifying and discussing program related concerns, potential opportunities for improvement, new developments etc.

Once designs are established and approved, equipment and services that are required to permit construction of the design are procured through supply chain management. Activities include but are not limited to, procurement documentation, specification development, vendor selection, receipt and inspection and storage of items.

Improvements to the facility completed in 2021 include the following:

- Flammable Dispensing building modifications - external experts worked with CFM to develop a scope of work which was completed to upgrade the building to current standards.

- Furnace Cooling Jacket Replacement - This was the first in a series of planned replacements. The cooling jackets have reached end of life and were in need of replacement.
- Grinder coolant phase 2- This project addressed opportunities that were noted after the installation of the grinder coolant processing centrifuges.

The physical improvements did not alter or affect the overall design basis for the facility and therefore, the design basis was valid and maintained in 2021. The requirement in *REG DOC 3.1.2* requesting a description of validation activities and the results of the validation for any major changes is not applicable at CFM, as there were no major changes.

CFM has a contractual arrangement with the provincial Technical Standards and Safety Authority to ensure that oversight of pressure retaining components and systems continue to be carried out by a third-party expert.

CFM has implemented and is maintaining a design control process that effectively ensures design outputs are reviewed, verified, and validated against the design inputs and performance requirements. CFM ensures that the design inputs selected for safety, performance and dependability of the design item are achieved.

2.2.3 Fitness for Service

This safety and control area cover activities that impact the physical conditions of systems, structures, and components 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.

CFM has programs and procedures that ensure that the facility is operated in a safe, clean, and reliable manner.

CFM has an established Planned Maintenance (PM) program as defined in site documentation. All tasks are initiated and documented through the site work notification system. In 2021, CFM continued to utilize SAP for all planned maintenance. Maintenance plans are issued, reviewed, and updated periodically to ensure the routines developed continue to be effective and adequate. KPIs are in place to monitor the effectiveness of the program. Testing and verification activities are integrated into the preventive maintenance strategy for systems, structures, and components.

The asset management program accounts for ageing through a number of processes designed to detect early warning signs and to prescribe rehabilitation programs or proactive replacement strategies. The effectiveness of the program is measured by the same means as the overall maintenance program.

Fire protection systems are tested according to an established schedule as outlined in the Fire Protection Program. Third-party reviews are conducted to confirm that required tests and inspections are completed and these review reports are submitted to the CNSC. In 2021 there were no projects that required third party reviews.

Continual improvement within the Fitness for Service Safety Control area is contained within the Operational Reliability Improvement plan. This plan was established early in 2020 based on the results of an Operational Reliability Self-Assessment that was completed at CFM by the Cameco Asset Management and Reliability team together with Fuel Services Division site representatives in October of 2019.

Regular progress reviews continued at the site as well as at the divisional level. Three out of 14 open actions were completed in 2021. Progress has been made on the remaining activities and they are expected to be completed in 2022.

The KPI's related to Fitness for Service in 2021 included:

1. Continually Improve Overall Equipment Effectiveness (OEE) – Overall OEE was stable in 2021 as compared with 2020 levels. There were some challenges related to staffing as a result of COVID; however, the

production demands were the same and operationally the plant was run in a similar fashion as 2020.

2. **Improve Efficiency and Effectiveness of Maintenance Activities –**
Overall, there has been a steady improvement in PM compliance over the last 5 years. Multiple staffing changes in Maintenance Planning as well as unexpected absenteeism related to COVID had some negative effect on this KPI.

Overall, the CFM Fitness for Service program remains effective. CFM continued enhancing and optimizing Operational Reliability with the goal of improving Overall Equipment Effectiveness while reducing operating costs and achieving performance comparable to industry best practices in all aspects of its operation.

In instances where Fitness for Services program KPI's such as OEE or other maintenance program effectiveness measures are not meeting the improvement targets set for them, it is generally due to some objective challenges and changes in data handling as the systems mature, and not an indicator of lack of improvement in this SCA.

The maintenance, surveillance and in-service inspection and testing programs continue to be managed effectively at CFM. All safety significant systems continue to operate without serious incident and improvement to overall fitness for service programs continues. All maintenance programs incorporate strategies for assessing the ongoing effectiveness of equipment, including detecting and deleterious effects of aging.

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*. The program must ensure that contamination and radiation doses are monitored and controlled.

CFM 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 to ensure exposures are kept to levels ALARA. The program includes the following components:

- external radiation dosimetry – personal monitoring.
- internal dosimetry – urine analysis and lung counting program.
- workplace air sampling program.
- respirator program.
- contamination surveys; and
- gamma surveys.

The CNSC regulatory limits for total effective dose for Nuclear Energy Workers (NEWs) are 50 millisievert (mSv) per year and no more than 100 mSv over specified five-year periods.

For various radiological parameters, CFM has established action levels, accepted by the CNSC that may be indicative of a potential loss of control for that specific parameter. Action levels pertaining to radiation protection are listed in the Radiation Protection section of CFM's LCH. These action levels serve as an early warning of a condition that warrants further investigation. A result above an action level is investigated and remedial actions taken if necessary.

Radiation protection objectives and targets are established jointly by members of the site management team and site specialists to ensure there is agreement, commitment and awareness of these objectives and targets across all areas of the operation. These objectives and targets can address, among other things, worker dose reduction initiatives and other projects which examine ways to reduce airborne uranium concentrations. The status of these objectives and targets is reviewed by the site management team through KPIs and resources are allocated as required to achieve the targets.

Some of the radiological activities in 2021 included:

- Deployment of new or modified processes to meet revised radiation protection regulations. Included communication strategies to inform NEW at the Port Hope facility. Initiatives included:
 - Participated in eye dose assessment to meet new limits.

- Modified RP training to include new requirement for pregnant/breastfeeding, changes in eye dose, extremity dose and emergency dose limits.
- Created common NEW declaration form within FSD that includes new and modified requirements such as dose limits and pregnant/breast feeding information.
- Created a communication for employees to notify them of the changes to the RP regs
- Completed extremity dose assessment to determine requirement for using a licensed dosimetry service provider.
- Improved notification process for surface contamination after lung counts. Also clarified steps to be taken when surface contamination present. Communication provided to employees on the changes and updated the lung count appointment sheet with information.
- Implemented alarms for continuous air samplers in the Furnace Hall including working with the JHSC to establish procedures for area evacuation during alarms.
- Improved process for surveying E-waste to ensure all items are monitored and eliminate the possibility of material added after the survey. This improved process also assisted the shipper/receiver for shipping of material off site.
- Improved process for surveying scrap metal in zone 2 maintenance shop which allows for proper monitoring and sorting of complex objects as well as provides control of material after scanning to ensure nothing is added to the bin without being monitored.
- Improved tracking of urine samples to ensure employees are submitting samples on time. This included a review at the morning meetings for routine Monday morning submissions.
- Collected and reviewed dose rate data through OSLDs posted throughout the facility.
- Collected and reviewed airborne concentrations, and direct surveys readings and follow up.
- Continued oversight for compliance to hand and foot monitoring requirement as well as urine submissions.

Procedural reviews related to radiation protection that were made in 2021 include the following:

- HSI-102 Responding to CAM Alarm Activation & UO₂ Powder Loss of Primary Containment – Updated to include evacuation instructions if CAM alarm in the Furnace Hall.
- HRI-013 Training & Qualification of Radiation Protection Personnel – general update.

CFM is committed to the ALARA concept and is continually identifying and implementing radiation protection improvements. The success of the above initiatives and programs are measured against set ALARA targets.

CFM's performance in 2021 regarding the ALARA targets is summarized below:

- Maintain employee radiation exposures to ALARA levels or below:
 - The average whole body dose for all NEWs was below the public dose limit of 1 mSv which is considered in the region of ALARA.
 - The individual total effective dose ALARA target for 2021 was maintained at 9.5 mSv/year as a maximum dose to an individual. This goal was not achieved in 2021 as the maximum total effective dose for the year was 9.9 mSv. This is due to the internal dose to one employee. The second highest dose was 7.4 mSv.
 - The average and the maximum Whole Body and Skin Dose is comparable to or lower than previous years.
 - The extremity dose assessment in 2021 demonstrated that the method of wearing rings for one week and extrapolating that dose for the quarter was overestimating actual dose. This was demonstrated by the dose reported much lower in 2021 when employees wore rings continuously from April to October.
 - The average internal dose for 2021 is lower or comparable to the previous 4 years. The maximum dose is higher than previous years and is directly related to the lung dose exceedance event.
 - The average Effective Dose is comparable to and lower than previous 4 years.
 - The urine results for employees in the program, continued to be low in 2021 with no exceedances of the screening level.
- Achieve 98% compliance to Urine Analysis schedule
 - Urine sample submissions in 2021 were above the target with 99% of samples submitted and 98% of employees submitting urine samples on time.
- Complete one ALARA initiative

- Target was achieved in 2021 (i.e., radiological initiatives such as improved urine analysis compliance, improved waste monitoring processes).

As part of CFM's audit program, several audits and inspections were conducted which included legal and regulatory compliance audits as well as procedural use and adherence inspections. Any issues identified during these audits are documented in the CIRS system and appropriate corrective actions were taken.

Radiation Protection training, which was developed using the Systematic Approach to Training framework, was live in 2021. During the year, 71 employees were assigned and completed the training. By the end of the year, 100% of active employees were compliant. In fact, CFM was 100% compliant during the entire fourth quarter. Toward the end of 2021, updates to some content areas required an updated of the eLearning. Using the Systematic Approach to Training, the analysis document was updated. With the analysis approved, the training design was updated and approved. The eLearning was subsequently updated and pending final approval.

In 2021, radiation monitoring instrumentation was maintained as per regular calibration and maintenance schedules. The hardware in the hand and foot monitors was upgraded in 2021 to extend the lifespan of this equipment.

Inventory of sealed and unsealed sources that are used or possessed on-site are referenced in the radioisotope source work instructions and associated forms and are verified annually. The inventory completed in 2021 determined the sources are in a state of safe operation and pose no undue risk to workers.

Radiological initiatives planned for 2022 include:

- Upgrade control units for the alpha Cam heads (part of CFM's plan to maintain current and upgrade from planned obsolete equipment).
- Upgrade alpha counter for air sampling system (part of CFM's plan to maintain current and upgrade from planned obsolete equipment).
- Review and identify possible process improvements for monitoring and releasing zone 2 wastes.
- Implement minimum PPE for entering cells in zone 2.
- Review hand and foot monitoring process and implement improvements.

In 2021, the internal dose for an individual was higher than previous years due to an internal exposure event. Investigation into the incident resulted in improvements in the communication when dealing with surface contamination as well as corrective actions

relating to grinding operations. The Radiation Protection Program remains effective as evidenced by the lack of serious radiation protection related non-conformances identified during inspections. In addition, CFM was successful in eliminating the need to wear extremity ring dosimeters in 2021 by demonstrating that employee dose was below the 50 mSv/yr requirement to use a licensed dosimetry service provider.

Dosimetry

At CFM, all employees and contractors working more than 80 hours per year are considered NEWs and are provided dedicated dosimeters to measure external radiation exposure. CFM uses Landauer's Optically Stimulated Luminescence (OSL) dosimeters to monitor whole body, skin, and eye dose and Thermo Luminescent Dosimeters (TLDs) in the form of rings worn on the fingers for extremity dose determination. Dosimeters are changed monthly for production related employees and quarterly for all other employees. Landauer, a licensed dosimetry service provider, sends the dosimeter results to the National Dose Registry (NDR) and provides a copy to CFM.

CFM assesses internal dose using lung counting from Cameco's licensed internal dosimetry service. The internal dose program applies to CFM employees who are in direct contact with open uranium dioxide for more than 500 hours per year working in the Pelleting Area. These employees undergo a direct in-vivo (lung counting) measurement twice per year, with campaigns run six months apart. Internal dose for other employees is prorated based on the number of hours that individual worked in the Pelleting Area throughout the reporting year and the average dose from the measured group. For employees and contractors that worked less than 80 hours per year in the Pelleting Area an internal dose is considered insignificant and is not assigned.

In 2021 there was one exceedance of CFM's radiation protection action levels. An individual was assigned an internal dose based on an elevated routine lung count and a series of investigative follow up counts. Based on the investigation, an internal dose of 6.5 mSv was assigned to the employee. The exposure is believed to have occurred over a few months and was not identified in the employee's routine urine submissions. This prevented early identification and intervention until the routine lung count was performed and resulted in a higher dose. The investigation identified the probable cause of the intake and actions were taken to prevent recurrence. The exceedance was reported to the CNSC, and the dose has been captured in the employee's annual internal dose and has been reported to the National Dose Registry.

The following tables and graphs summarize the 2021 annual dose results for employees:

- whole body dose.
- skin dose.

- extremity dose.
- urine analysis results.
- internal dose; and
- total effective dose.

Whole Body Dose

The action levels for whole body dose for NEWs are 1.6 mSv per month for production staff and 1.0 mSv per quarter for support staff and contractors. The monthly action level applies to NEWs who are monitored on a monthly basis (primarily production employees). The quarterly action level pertains to NEWs who are monitored on a quarterly basis (i.e., office staff, contractors, etc.). These individuals receive lower radiation exposure and therefore a lower action level has been established. Additionally, all individuals that were assigned personal dosimeters and classified as non-NEW received no measurable whole body dose in 2021.

Table 2 and Figure 3 display the distribution, in 1 mSv increments, of whole body dose for all NEWs in 2021. Note that figures with ranges on the horizontal axis identify results that are greater than or equal to the first number and less than the second value. For example, 1 – 2 on the horizontal axis in figure 3 means all results in that range are greater than or equal to 1 mSv (≥ 1 mSv) and less than 2 mSv (< 2 mSv).

As can be seen from the table and figure, approximately 82% of employee external whole body doses in 2021 were 1 mSv or less, with the majority of employees whole body doses less than 5 mSv (99.5%). Distribution results for 2021 were different when compared to those in 2020 with less individuals in the 4-5 mSv range however, there was 0.5 % of individuals greater than 5 mSv in 2021 with none in 2020.

Table 2

2021 Whole Body Dose Distribution	
Dose Range (mSv)	Percentage of Individuals (%)
0 – 1	82.0
1 – 2	8.8
2 – 3	4.6
3 – 4	3.7
4 – 5	0.5
> 5	0.5

Figure 3

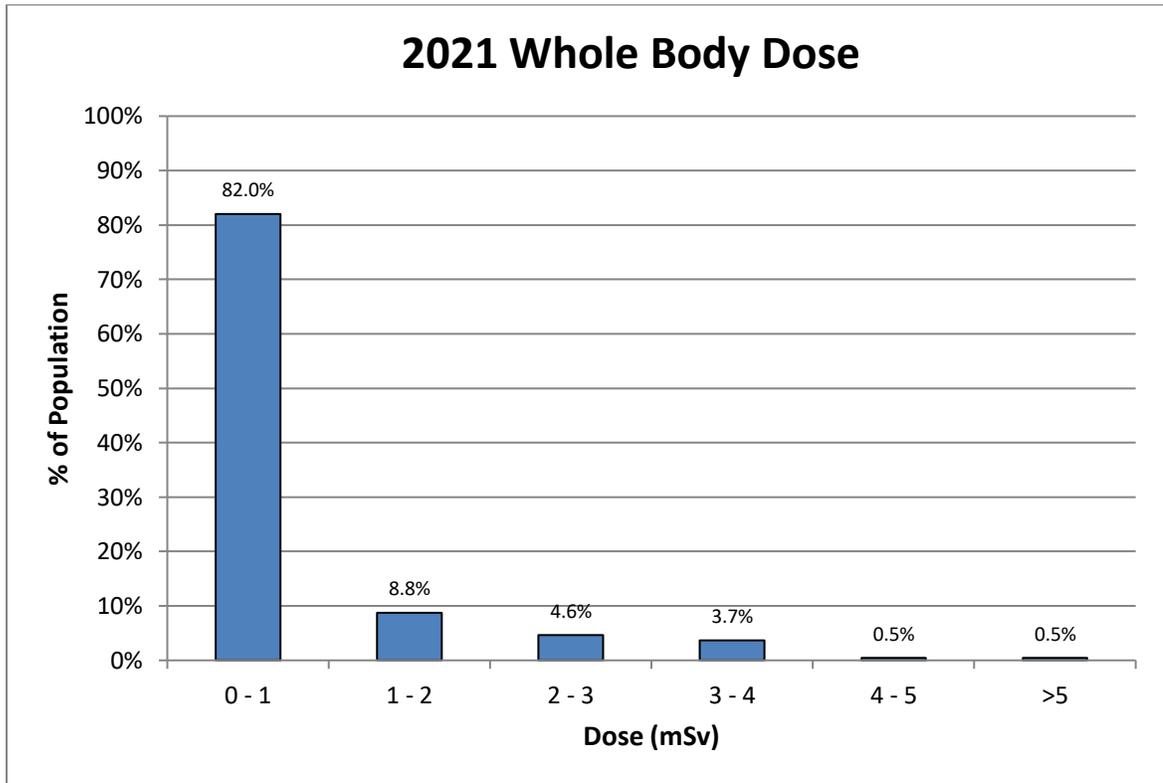


Table 3 shows the annual NEW whole body dose results for three work groups: employees in operations; employees in administration and/or support roles; and outside contractors/visitors. The highest exposures are from the operations work group, consisting of production, maintenance, and quality personnel. The average dose for all NEWs was 0.5 mSv in 2021 and the maximum individual external whole body dose was 5.4 mSv to a Pelleting Area employee.

Table 3

2021 Annual Whole Body Dose				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Operations	110	1.0	0.0	5.4
Administration / Support	88	0.1	0.0	1.2
Contractors/Visitors	19	0.0	0.0	0.2

Table 4 and Figure 4 show the annual average, minimum, and maximum individual external whole body exposure for all NEWs from 2017 – 2021. The average and maximum dose in 2021 was similar to previous years other than 2020 which was lower.

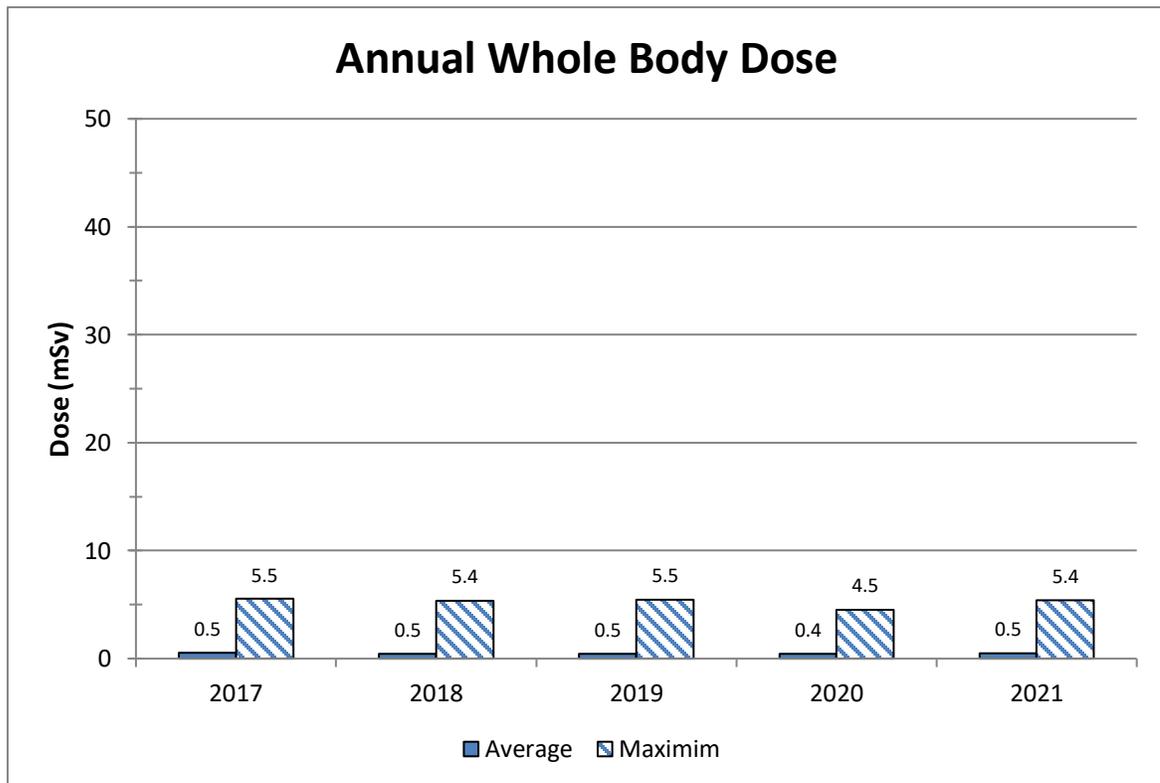
Average and maximum dose can be impacted by numerous conditions such as the number of people, overtime, work tasks, etc. In 2020 and 2021 there were less NEWs onsite with the least in 2021. Many of these NEWs were support staff and contractors which would have lowered the average if they were on site during those years.

The individual with the maximum whole body dose is an operator in the Pelleting Area; however, it was not the same individual with the maximum dose in 2020.

Table 4

2017 – 2021 Whole Body Dose				
Year	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
2017	270	0.5	0.0	5.5
2018	267	0.5	0.0	5.4
2019	256	0.5	0.0	5.5
2020	247	0.4	0.0	4.5
2021	217	0.5	0.0	5.4

Figure 4



Skin Dose

The CNSC regulatory limit for skin dose to NEWs is 500 mSv per year. CFM’s action levels are 20 mSv per month and 5 mSv per quarter. The action level for skin dose was not exceeded in 2021.

Table 5 shows the annual NEW skin dose results for three work groups: employees in operations; employees in administration and/or support roles; and outside contractors/visitors. The highest exposures are from the operations work group, consisting of production, maintenance, and quality personnel. The maximum skin dose in 2021 for a production employee was 40.9 mSv (8% of annual limit). The average dose for all NEWs in 2021 was 3.5 mSv. In 2021, all individuals that were assigned dosimeters and classified as non-NEW received no measurable skin dose.

Table 5

2021 Annual Skin Dose				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Operations	110	6.8	0.0	40.9
Administration / Support	88	0.1	0.0	3.8
Contractors/Visitors	19	0.1	0.0	0.7

Table 6 and Figure 5 display the distribution of skin dose received by NEWs in 10 mSv increments at CFM in 2021. The majority of NEWs received a skin dose below 10 mSv (88%) with no employee exposures above 50 mSv. The distribution in 2021 is improved when compared to the 2020 distribution with no NEWs above 50 mSv; however, there were more NEWs in the 40-50 mSv range.

Table 6

2021 Skin Dose Distribution	
Dose Range (mSv)	Percentage of Individuals (%)
0 – 10	88.0
10 – 20	6.9
20 – 30	1.4
30 – 40	2.3
40 – 50	1.4
> 50	0.0

Figure 5

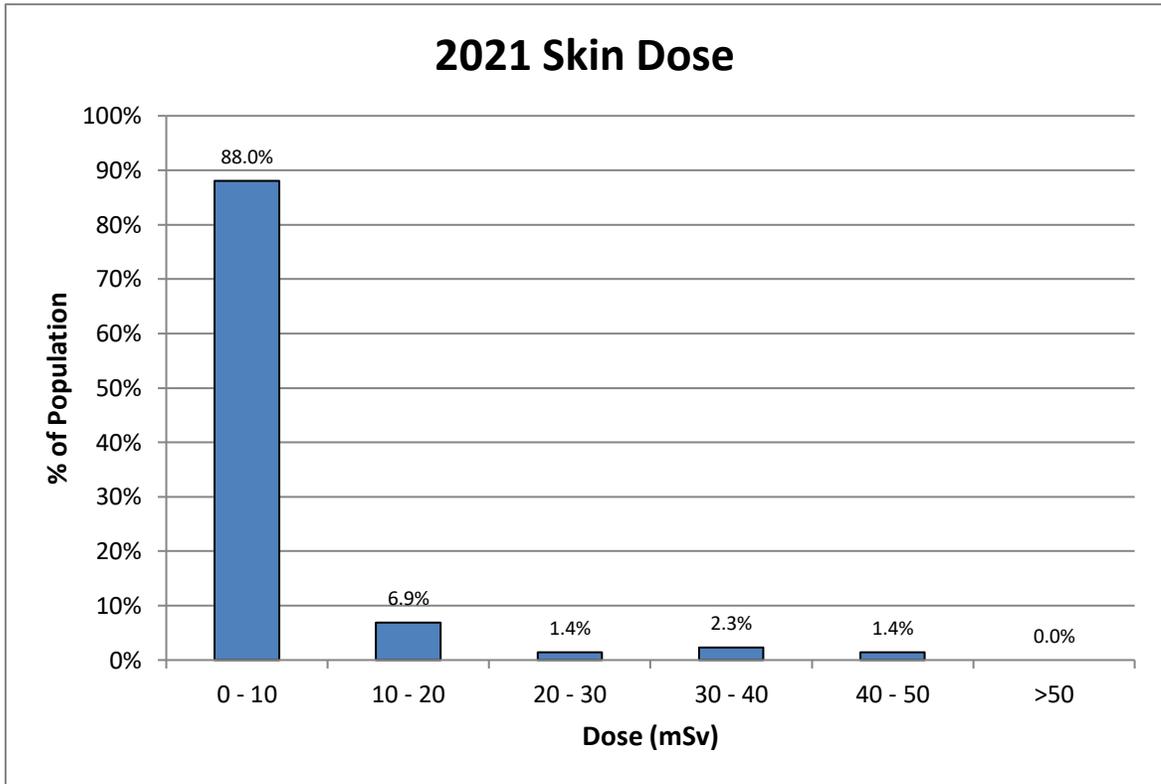
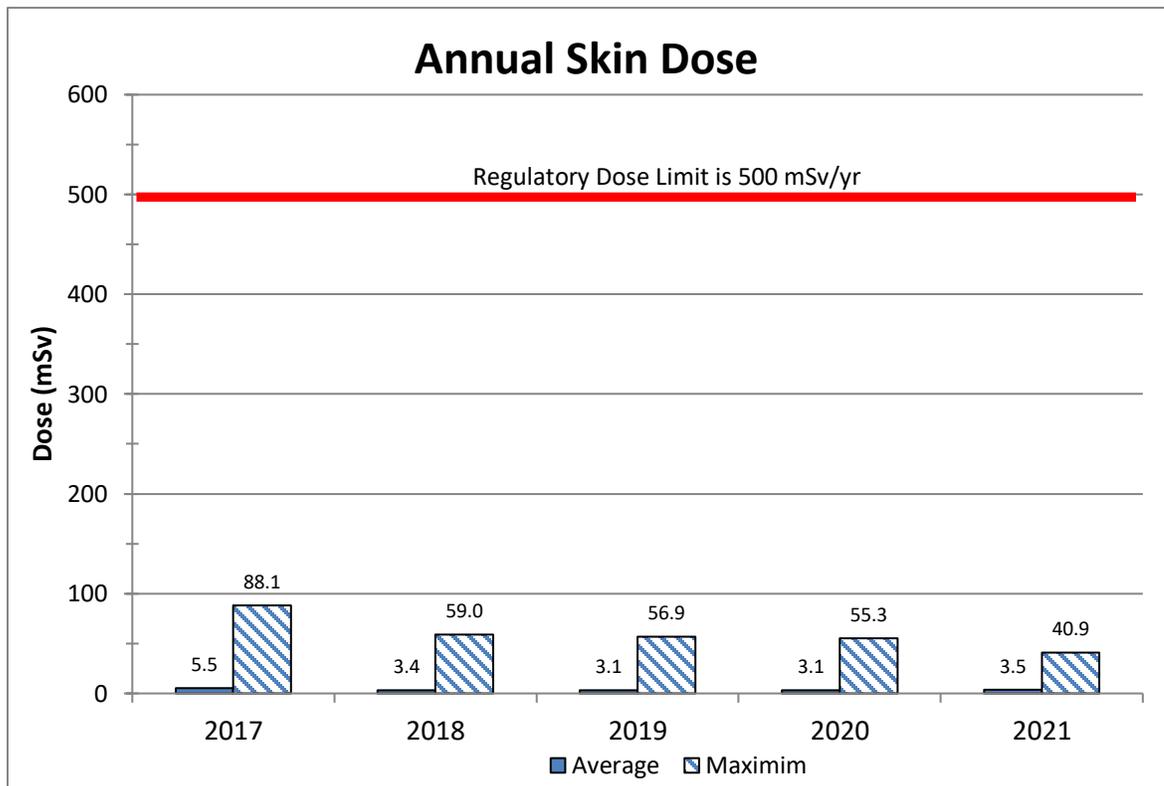


Table 7 and Figure 6 present the employee annual average, minimum, and maximum individual skin exposure for the five-year period from 2017 – 2021. The chart illustrates that the maximum annual dose received by an individual is below the regulatory limit. The average skin dose in 2021 was higher than the previous 4 years. This is due to number of employees in the 40-50 mSv range which has increased over last year. The maximum skin dose was lower in 2021 than previous years. Average dose can be impacted by numerous conditions such as the number of NEWs onsite, overtime, etc. In 2020 and 2021 there were less NEWs onsite with the least number in 2021. Many of these NEWs were support staff and contractors which would have lowered the average if they were on site during those years. The employee with the maximum skin dose is a Pelleting Area employee and is the same employee with the maximum whole body dose in 2021.

Table 7

2017 – 2021 Skin Dose				
Year	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
2017	270	5.5	0.0	88.1
2018	267	3.4	0.0	59.0
2019	256	3.1	0.0	56.9
2020	247	3.1	0.0	55.3
2021	217	3.5	0.0	40.9

Figure 6



Eye Dose

The CNSC regulatory dose limit to the lens of the eye for NEW’s is 50 mSv per year. There is currently no action level for eye dose; however, Cameco is looking into setting an action level based on data collected. In 2021, all individuals that were assigned visitor dosimeters and classified as non-NEWs received no measurable eye dose.

Table 8 and Figure 7 display the distribution, in 5 mSv increments, of the calculated dose to the eye for all NEWs in 2021. The calculated eye dose for the majority of NEWs was below 5 mSv (88%) with very few employees above 20 mSv (less than 1%).

Table 8

2021 Eye Dose Distribution	
Dose Range (mSv)	Percentage of Individuals (%)
0 – 5	87.6
5 – 10	6.9
10 – 15	2.3
15 – 20	2.8
> 20	0.5

Figure 7

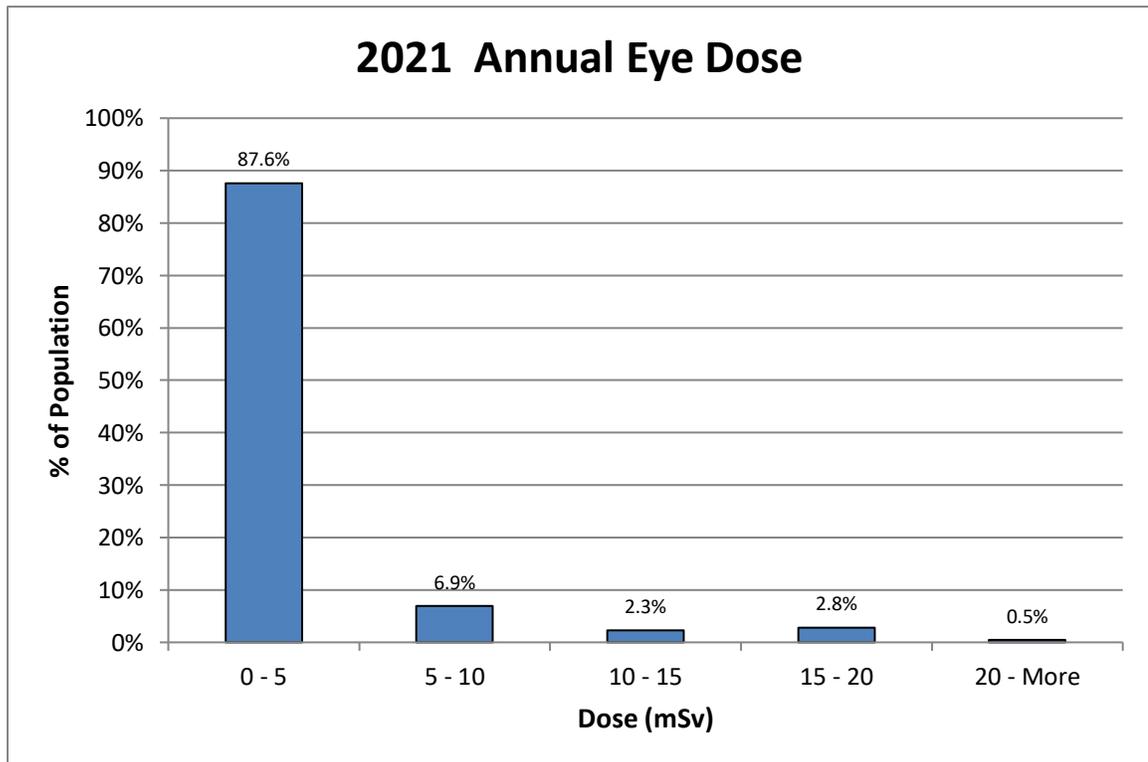


Table 9 shows the annual NEW eye dose results for three work groups: employees in operations; employees in administration, and/or support roles; and outside contractors/visitors. The highest doses are from the operations work group, consisting of production and maintenance personnel. In 2021, the average eye dose for all NEWs was 1.8 mSv and the maximum annual eye dose for production employees was 20.5 mSv.

Table 9

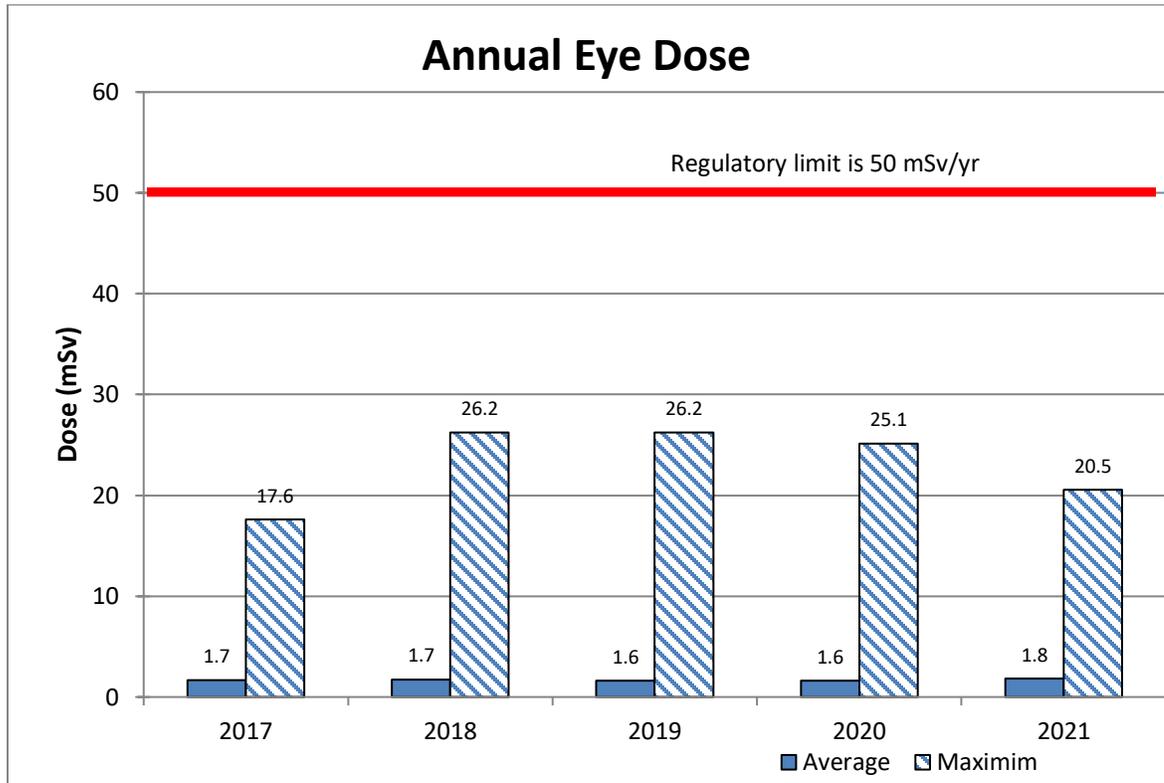
2021 Annual Eye Dose				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Operations	110	3.5	0.0	20.5
Administration / Support	88	0.1	0.0	2.5
Contractors/Visitors	19	0.1	0.0	0.4

Table 10 and Figure 8 presents the employee average, minimum and maximum eye dose for the five year period from 2017 – 2021. The chart illustrates that the maximum annual dose received by an individual is below the regulatory limit. Over the five year period the average eye dose is higher than previous years. This is likely due to the lower number of support staff and contractors on site during the year due to COVID. The maximum eye dose was lower in 2021 than previous years. In 2021, the individual with the highest dose was a Pelleting Area employee and was the same individual with the maximum whole body and skin dose.

Table 10

2017 – 2021 Eye Dose				
Year	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
2017	270	1.7	0.0	17.6
2018	267	1.7	0.0	26.2
2019	256	1.6	0.0	26.2
2020	247	1.6	0.0	25.1
2021	217	1.8	0.0	20.5

Figure 8



Extremity Dose

The CNSC regulatory limit for extremity dose to NEWs is 500 mSv per year. The action level for CFM is 55 mSv per quarter. The quarterly action level applies to production NEWs who regularly handle product as part of their daily tasks.

It should be noted that starting in the second quarter, CFM began an assessment for the extremity dose to align with the Radiation Protection Regulations (RPR) issued in 2020. Specifically, section 8 of the RPR adds the requirement to use a licensed dosimetry service for equivalent doses to the skin, hands, and feet if the annual dose would be over 50 mSv. In order to determine if doses were above this level employees were asked to wear extremity rings continuously. A review of the doses was completed in November which identified the majority of employees did not require dose to be assigned from a licensed dosimetry service provider as employee dose was less than 50 mSv. Therefore, this group of employees stopped having dose assigned from extremity ring dosimeters at the beginning of November. There was one group of employees that required further data and continued to wear extremity rings until the end of the year. The review of dose to

that group was completed early in 2022 and it was determined that this group was also not required to be assigned dose from a licensed dosimetry service provider.

Extremity dose in 2021 was calculated using the previous method (i.e., wearing dosimeters for one week per quarter) for January to March and summed with the monthly dose results for April to October which was the last full month the ring dosimeters would be worn by all employees. Dose for November and December was estimated using the average of the monthly dose from April to October (excluding July due to shutdown). Since the pelleting area quality inspectors, who have worn dosimeters from April to December, have a full year of extremity dose, these individuals will be assigned dose using the previous method for the first quarter and the monthly dose the remainder of the year.

Table 11 and Figure 9 display the distribution of the 2021 extremity dose for NEWs in 20 mSv increments. The majority of NEWs received an extremity dose below 20 mSv (94-92% for both the left and right hand respectively) with no employee dose above 60 mSv. Future estimates for extremity dose will be determined using results from 2021.

Table 11

2021 Extremity Dose Distribution		
Dose Range (mSv)	Percentage of Individuals (%)	
	Left Hand	Right Hand
0 – 20	94.0	91.6
20 – 40	4.8	8.4
40 – 60	1.2	0.2
60 – 80	0.0	0.0
80 – 100	0.0	0.0
> 100	0.0	0.0

Figure 9

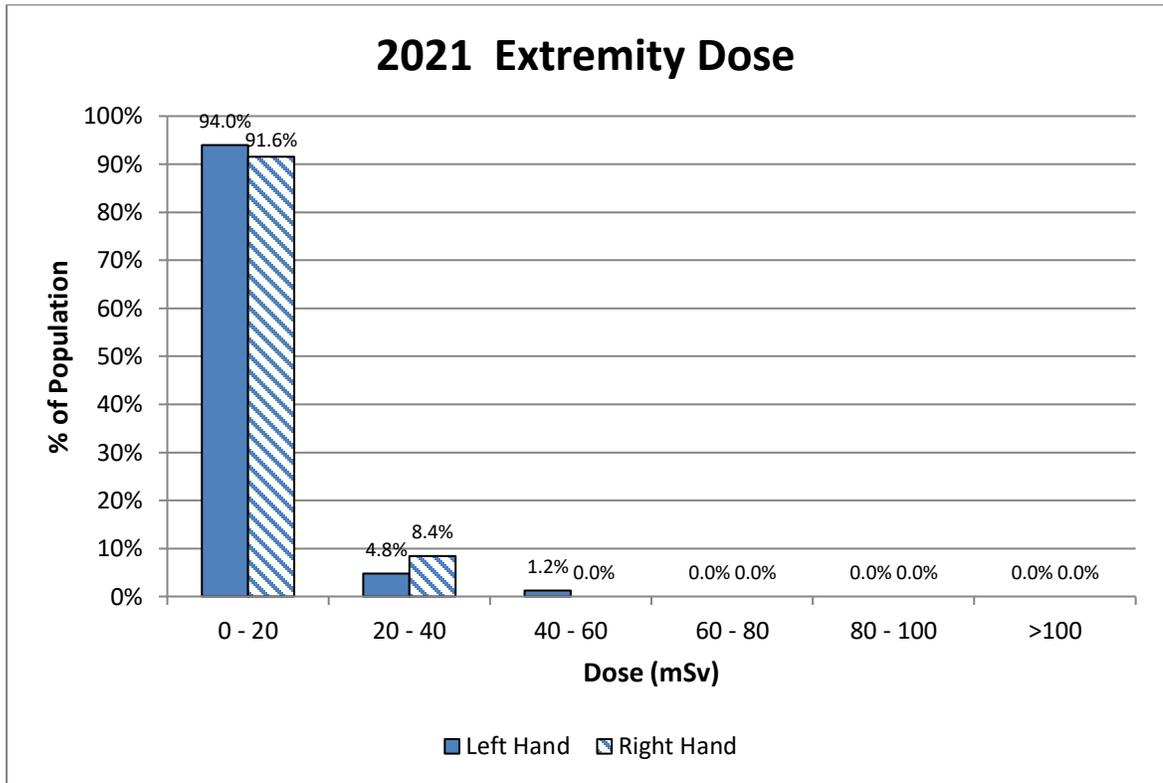


Table 12 and Figure 10 show the annual average, minimum, and maximum extremity dose for all NEWs enrolled in the extremity program from 2017 – 2021. The average extremity dose was 7.9 mSv for the left extremity and was 8.4 mSv for the right extremity. The maximum extremity dose in 2021 for an individual for the left hand extremity was 41.9 mSv and for the right hand the maximum dose was 35.3 mSv.

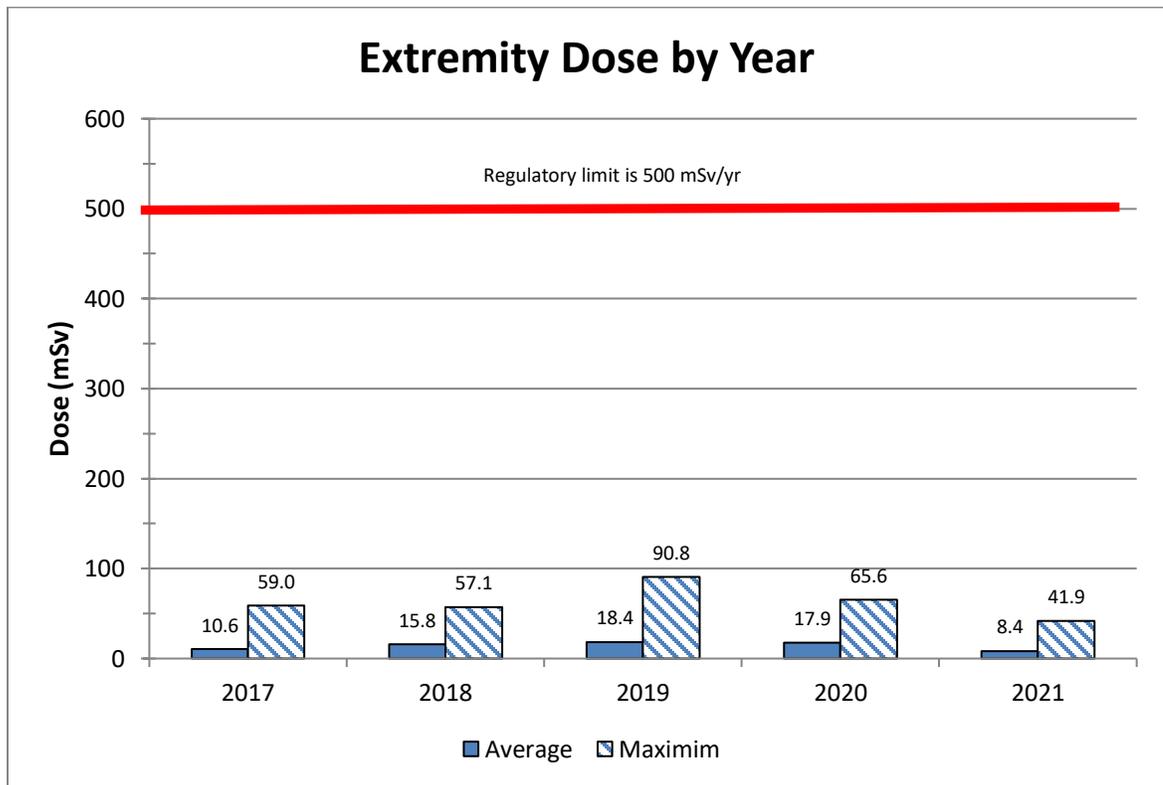
The average and maximum dose in 2021 was lower than the dose in previous years. The extremity dose assessment in 2021 demonstrated that the method of wearing rings for one week and extrapolating dose for the quarter was overestimating actual dose. This is demonstrated by the much lower dose measured on the monthly dosimeters in 2021. The chart illustrates that the maximum annual dose received by an individual is well below the regulatory limit.

The individual with the highest exposure was a Pelleting Area inspector and was not the same individual who received the highest whole body, skin and eye dose.

Table 12

2017 – 2021 Extremity Dose				
Year	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
2017	89	10.6	0.0	59.0
2018	93	15.8	2.5	57.1
2019	85	18.4	2.8	90.8
2020	85	17.9	3.4	65.6
2021	83	8.4	0.0	41.9

Figure 10



Urine Analysis

CFM collects routine bi-weekly urine samples from NEW's who work in the Pelleting Area and send them to Cameco's PHCF, which is part of a licensed dosimetry service that analyzes urine samples for uranium content. The action level for NEWs that participate in the internal dosimetry program is 10 µg/L uranium concentration for a routine sample. In 2021, there were no exceedances of the urine analysis action level.

Table 13 provides the distribution, in 2 µg/L increments, for the urine analysis results in 2021. Of the 1565 routine urine samples analyzed during the year, all routine sample results were below 2.0 µg/L. The maximum routine sample result collected in 2021 was 1.5 µg/L and the annual average was 0.3 µg/L. The maximum and average results were lower than previous years. In 2021, there were no routine urine results above the screening level.

Table 13

2021 Urine Analysis Uranium Concentration Distribution	
Single Sample Range (µg/L)	Percentage of Individuals (%)
0 – 2	100
2 – 4	0.0
4 – 6	0.0
6 – 8	0.0
8 – 10	0.0
>10	0.0

Internal Dose

CFM employees are incorporated into the approved and licensed internal dosimetry program for Cameco's FSD.

In 2021, there were no routine urine sample results above the internal administrative level of 4.0 µgU/L for routine samples and no internal dose was assigned to any employees from urine data.

Lung Counting

As part of the licensed FSD internal dosimetry program, Cameco employs the use of a lung counter to measure uranium in the lungs and calculate the associated committed effective dose. Employees who work in the Pelleting Area for more than 500 hours in a

year undergo direct in-vivo (lung counting) measurements. The action level for CFM is 5 mSv per year for an annual lung dose.

In 2021, there was one exceedance of the annual lung count action level. This was discovered during a routine lung count in the second quarter in which an operator's results indicated the presence of surface contamination. This prompted follow up activities including several additional lung counts. The lung counts continued to show results above the Decision Level (DL) and the presence of surface contamination. An internal dose was assigned to the employee for the period between December 18, 2020 (last lung count) and June 17 (midpoint of the combined lung counts) of 5.5 mSv, which is in excess of the annual lung count action level of 5.0 mSv. The 2021 dose for the employee was individually assigned for the first count and was group based for the second period, totaling an estimate of 5.9 mSv for 2021. A correction was applied to this estimate due the difference between his 2020 estimate and the actual, which was increased above the group by 0.5 mSv. This includes the individual dose assignment for 27 days in 2020. Therefore, the final internal dose for the employee in 2021 was calculated to be 6.5 mSv. The exceedance was entered into CIRS and was reported to the CNSC with a follow up investigation completed to identify the cause and corrective actions were implemented.

A total of 53 employees in the production work group met the criteria and required lung counting. These lung counts were performed in the second and fourth quarter of 2021. The remaining NEWs that were onsite in 2021 were prorated to obtain an internal dose according to the number of hours the person was physically in the Pelleting Area during the year and the average dose received by the measured group. Only NEWs who worked for more than 80 hours in the Pelleting Area in 2021 were included in the internal dose program and were assigned a prorated lung dose. There was a total number of 80 NEWs who were either measured for internal dose by lung counting or were assigned an internal dose by prorating the hours worked in the Pelleting area. The maximum internal dose assigned from lung counting was received by the Pelleting area employee with the elevated routine lung count. This individual was not the same person with the maximum whole body dose but is the same individual with the maximum total effective dose.

Table 14 and Figure 11 show the distribution of lung counting doses in 1.0 mSv increments. All NEWs were assigned an internal dose below 3.0 mSv (with the exception of the employee assigned an individual dose. The majority (45%) were assigned a dose between 1-2 mSv.

Table 14

2021 Internal Dose Distribution (Lung)	
Dose Range (mSv)	Percentage of Individuals (%)
0 – 1	32.5
1 – 2	45.0
2 – 3	21.3
3 – 4	0.0
4 – 5	0.0
>5	1.3

Figure 11

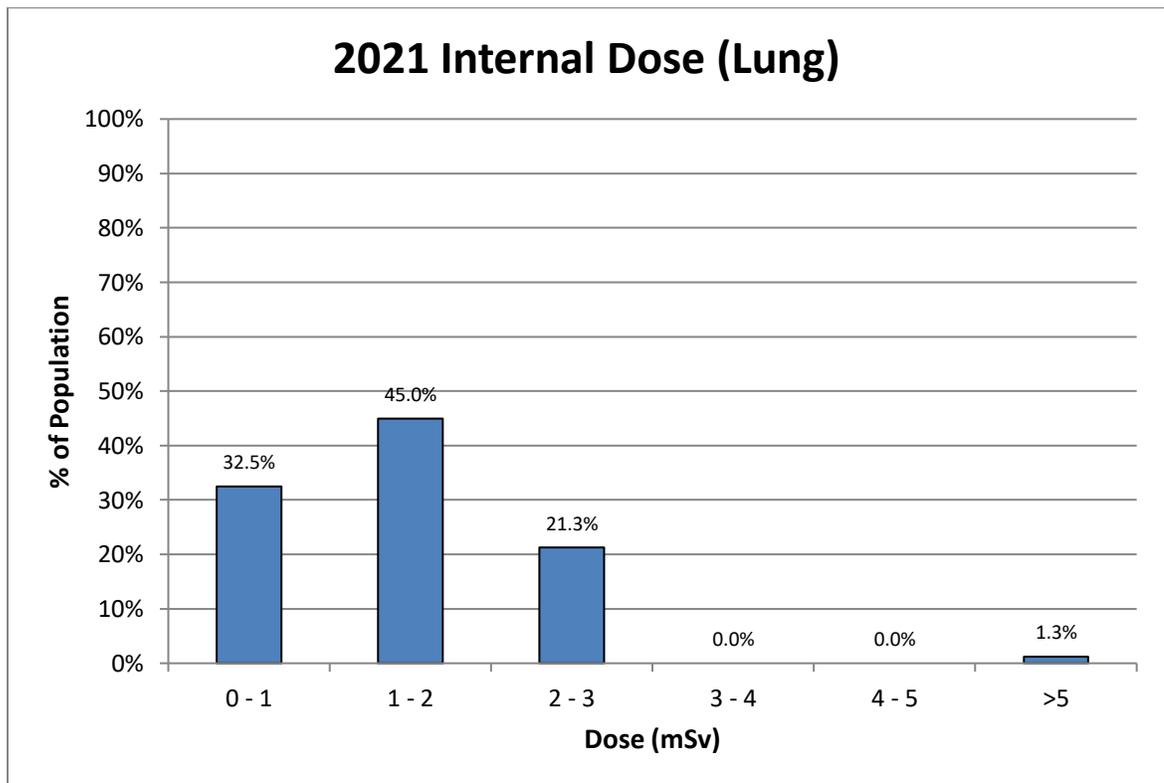


Table 15 shows the annual NEW lung dose results for three work groups: employees in operations; employees in administration, and/or support roles; and outside contractors/visitors. The number of individuals in the contractor group and the support group reflect employees and contractors that were onsite during the year, worked for more than 80 hours in the Pelleting Area, and are prorated based on the measured group. The majority of the employees in the operations work group have a measured lung dose (55) because they meet the criteria of greater than 500 hours working in the Pelleting Area. The remainder of the operations group include employees who worked in the Pelleting area more than 80 hours and less than 500 hours; therefore, their lung doses were prorated. The highest doses are from the operations work group, consisting of production and maintenance personnel.

Table 15

Internal Lung Count Doses 2021				
Dosimetry Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Operations	73	1.5	0.0	6.5
Administration/Support	7	0.2	0.1	0.3

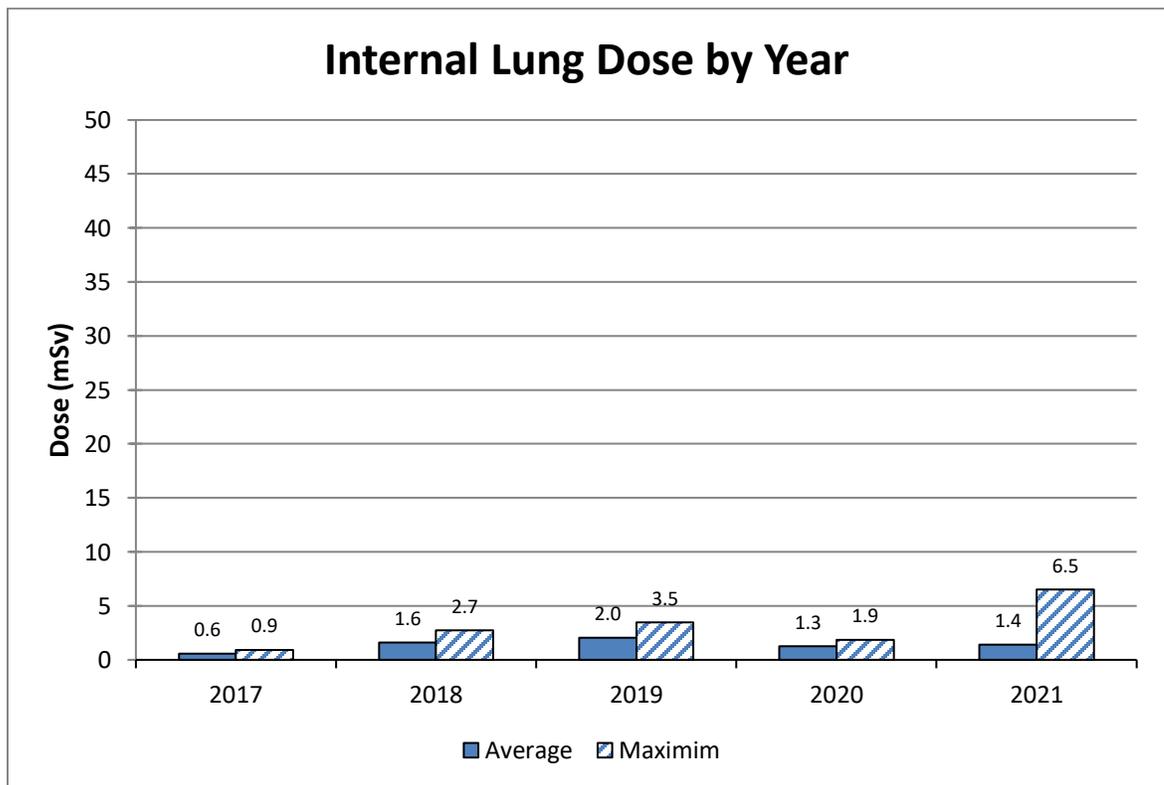
Table 16 and Figure 12 show the annual average, minimum, and maximum lung dose for the NEWs assigned a lung dose from 2017 – 2021. The chart illustrates that the maximum annual internal dose received by an individual is well below the regulatory limit. In 2021, the average lung dose for all NEWs in the internal dosimetry program was 1.4 mSv and the maximum lung dose was 6.5 mSv.

The average internal dose for 2021 (derived from lung count) is lower than 2018 and 2019, higher than 2017 and higher than 2020 but comparable. The maximum dose is higher than previous years and is directly related to the lung dose exceedance event. Using the next highest internal dose of 2.0 mSv (lung dose) puts 2021 maximum dose higher than 2017 but lower than 2018 and 2019 and comparable to 2020.

Table 16

2017 – 2021 Lung Dose				
Year	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
2017	95	0.6	0.0	0.9
2018	96	1.6	0.0	2.7
2019	81	2.0	0.0	3.5
2020	79	1.3	0.0	1.9
2021	80	1.4	0.0	6.5

Figure 12



As per the dosimetry program, lung count measurements above the DL result in individual dose assessments, rather than assessment based on the group average. In 2021, there was one employee with a routine lung count that exceeded the DL of the lung counter. All other lung counts were below the DL with doses based and assigned on the group average.

Total Effective Dose

Total effective dose is calculated by adding the whole body external dose measured from OSLDs and the internal dose derived from the lung count program. The CNSC annual regulatory limits for total effective dose are 50 mSv per year and no more than 100 mSv for specific 5 year periods.

Table 17 and Figure 13 display the distribution of total effective dose for NEWs in 2021 in 2 mSv increments. The majority of NEWs (79%) had a total effective dose of 2 mSv or less, with almost all NEWs less than 6 mSv (98.6%).

Table 17

2021 Total Effective Dose Distribution	
Dose Range (mSv)	Percentage of Individuals (%)
0 – 2	79.3
2 – 4	12.4
4 – 6	6.9
6 – 8	0.9
8 – 10	0.5
> 10	0.0

Figure 13

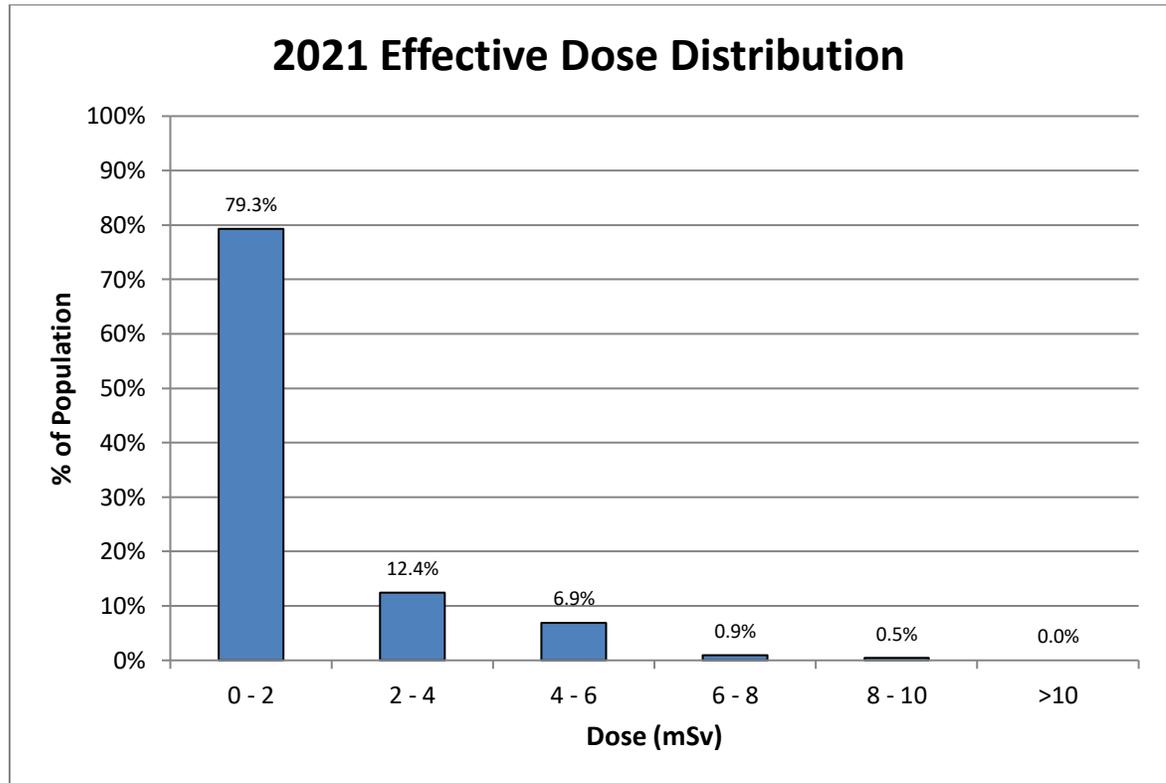


Table 18 shows the annual NEW total effective dose results for three work groups: employees in operations; employees in administration and/or support roles; and outside contractors/visitors. The highest exposures are from the operations work group, consisting of production, maintenance, and quality personnel. The maximum total effective dose for a NEW in 2021 was 9.9 mSv (20% of the annual dose limit), while the average total effective dose was 1.0 mSv.

Table 18

2021 Annual Total Effective Dose (all doses)				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Operations	110	1.9	0.0	9.9
Administration / Support	88	0.1	0.0	1.4
Contractors/Visitors	19	0.0	0.0	0.2

Cameco measures and assigns dose to all workers with a potential to receive dose and designates workers as NEWs on this potential. Average results are reported using an assignment of a zero dose when the dose was too small to be measured. A measured dose

of zero is a legitimate dose and reflects the radiation exposure controls in place at the facility. Table 19 shows the annual NEW total effective dose results for measurable doses with zero doses removed for the three work groups: employees in operations; employees in administration and/or support roles; and outside contractors/visitors. The average effective dose for measurable doses with zero doses removed, for all NEW in 2021 was 1.4 mSv.

Table 19

2021 Annual Total Effective Dose (all measurable doses, zero doses removed)				
Work Group	Number of Individuals	Average (mSv)	Minimum (mSv)	Maximum (mSv)
Operations	100	2.1	0.0*	9.9
Administration / Support	52	0.1	0.0*	1.4
Contractors/Visitors	12	0.1	0.0*	0.2

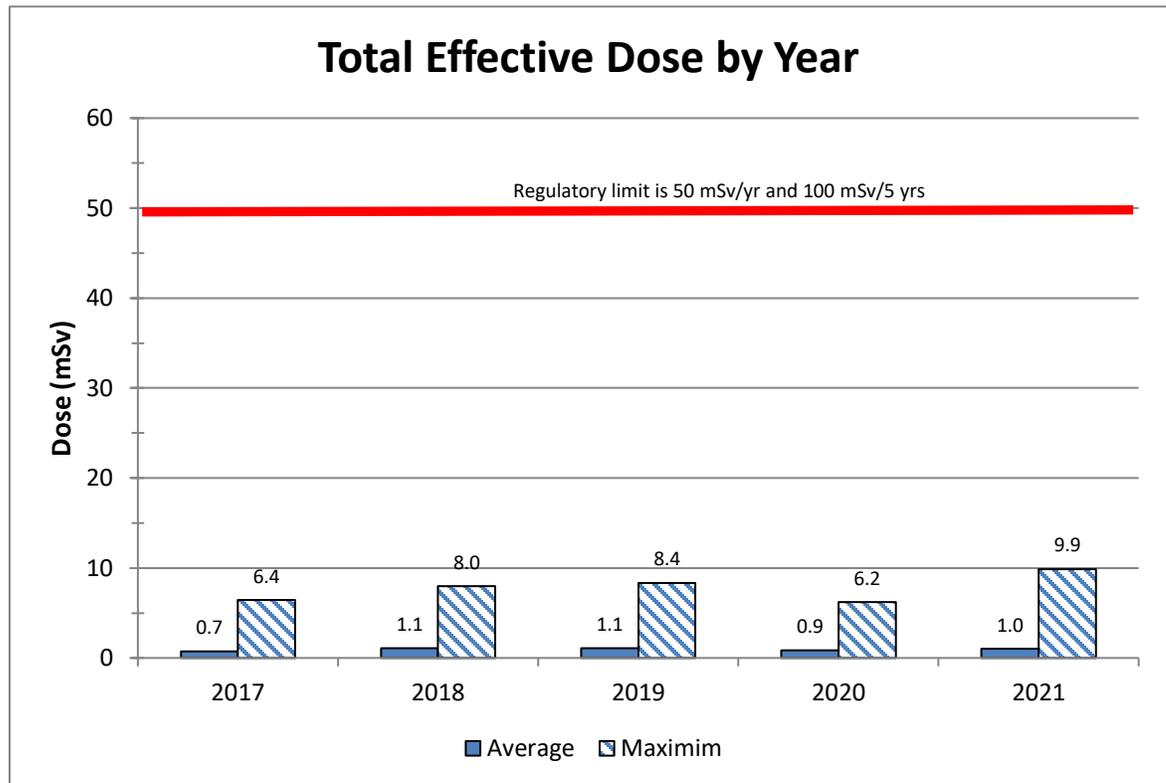
*minimum doses are rounded down to zero (i.e., all were less than 0.05 mSv)

Table 20 and Figure 14 show the employee annual total effective dose results for the period of 2017 – 2021. The average Effective Dose is comparable to and lower than previous years, except 2017 which is lower. The maximum total effective dose in 2021 was higher than the effective dose in previous years. This is due to the internal dose assigned to the employee with the lung dose. The external whole body dose contributed 34% of the maximum total effective dose with the remaining 66% coming from the internal lung dose. The person with the highest total effective dose is not same individual with the maximum whole body dose; however it is the same individual with the highest internal dose.

Table 20

2017 – 2021 Total Effective Dose				
Year	Number of Individuals	Average Dose (mSv)	Minimum Dose (mSv)	Maximum Dose (mSv)
2017	270	0.7	0.0	6.4
2018	267	1.1	0.0	8.0
2019	256	1.1	0.0	8.4
2020	247	0.9	0.0	6.2
2021	217	1.0	0.0	9.9

Figure 14



With respect to the regulatory limit of 100 mSv total effective dose over five years, the highest individual dose for the current five year dosimetry period (January 1, 2021 to December 31, 2026) is 9.9 mSv to a Pelleting Area operator.

The five NEWs with the highest total effective dose in 2021 are provided in Table 21. As indicated in table, these individuals all work in the Pelleting Area. Four of the five individuals with the highest total effective doses are furnace operators. Individuals working as furnace operators have historically received the highest external whole body dose. The individual with the highest effective dose is the employee with the lung dose that exceeded the action level. This employee is a general operator in the Pelleting Area. This information is provided to the JHSC committee for review and to discuss opportunities to lower dose.

Table 21

2021 Five Highest Total Effective Dose Individuals			
Occupation	Whole Body Dose (mSv)	Internal Dose (mSv)	Total Effective Dose (mSv)
General Pelleting Area Operator	3.3	6.5	9.9
Furnace Operator	5.4	2.0	7.4
Furnace Operator	4.6	2.0	6.6
Furnace Operator	3.9	2.0	5.9
Furnace Operator	3.6	2.1	5.7

Collective Dose

The collective dose in mSv for each dose component with all assigned doses from 2020 – 2021 is provided in Table 22. The number of employees included in each component is included in brackets next to the dose.

Table 22

2020 – 2021 Collective Doses (mSv)*							
	Whole Body	Skin	Eye	Extremity Left	Extremity Right	Internal Dose	Effective Dose
2020	108.0 (247)	761.9 (247)	394.2 (247)	1488.8 (83)	1520.2 (83)	102.1 (80)	210.1 (247)
2021	109.9 (217)	752.3 (217)	392.1 (217)	656.4 (83)	697.9 (83)	111.0 (80)	220.9 (217)

() includes the number of employees

*CFM began reporting collective doses in 2020

Contamination Control

CFM has an extensive contamination control program. The facility is divided into four zones for contamination control purposes. Zone 1 areas are designated as clean areas with no contamination permitted. Food and drink can be consumed in these areas and include the Lunch Room and office areas. Zone 2 areas contain no open sources of radioactivity but have the potential for contamination. These areas include the assembly area, change rooms and the machine shop. Zone 3 areas are the access points to Zone 4. Zone 4 areas contain open sources of radioactivity and include the pelleting area. Consumption of food and drink are restricted in Zones 2, 3, and 4.

Routine contamination monitoring is done in all areas with results provided in Table 23. Of the 2870 readings taken, none exceeded the Administrative Control Limits (ACL) for each zone.

Table 23

2021 Contamination Monitoring Results			
Area	Total Number of Measurements	Administrative Limits (Bq/cm ²)	Number of Readings Above Internal Limits
Zone 1	495	0.4	0
Zone 2	799	4.0	0
Zone 3	175	4.0	0
Zone 4	1401	40	0

In-Plant Air

Routine air sampling is conducted at workstations throughout the plant continuously during operations to monitor airborne UO₂ in the work environment. To ensure exposures to airborne uranium are well below the regulatory dose limits, CFM uses an internal Administrative Control Limit (ACL) for any daily air sampling result of 595 µg/m³ (15 Bq/m³) which is less than half the recommended concentration for an 80 hour monitoring period (urine bioassay schedule). The 2000 hour ACL represents an annual monitoring period and has been set at 52 µg/m³ (1.3 Bq/m³).

At CFM, air contamination monitoring is performed via a continuous air sampling system and/or a fixed air sampling system at calibrated sampling locations throughout the facility where uranium dust levels may be present.

A summary of in-plant air sampling results including the area monitors for 2021 is provided in Table 24. Of the 12,306 monitoring results 5 (less than 0.1%) exceeded the 2000 hour ACL with no results exceeding the 80 hour ACL. The average in-plant air result for the facility in 2021 was 2 µg U/m³.

Table 24

2021 Uranium In-plant Air Sampling Results					
Plant Area	# of Samples	Average ($\mu\text{g U/m}^3$)	Maximum ($\mu\text{g U/m}^3$)	# Samples > ACL ^{2000 hr}	# Samples > ACL ^{80 hr}
Ceramics Room	1343	1	8	0	0
Compaction Room	454	2	7	0	0
Load Room	910	1	7	0	0
Pangborn Room	454	5	123	3	0
Pelleting Area	1364	2	8	0	0
UO ₂ Grinders	908	4	100	2	0
Waste Treatment	228	3	24	0	0
PP2 Area	2864	1	16	0	0
Dry Waste Treatment	1635	1	9	0	0
Furnace Hall	2146	2	29	0	0
TOTAL	12306	2	123	5	0

During normal operation, some processes in the Pangborn Room require the use of respiratory protection. Therefore, procedures are in place requiring workers to wear respirators when performing specific job tasks to minimize internal exposure (in addition to local extraction). Local extraction is sufficient in other areas where UO₂ powder is used. The exceedances in the grinding area were mainly caused when the water pressure was adjusted. An improvement project for the grinders was identified in 2021 and will be implemented in 2022. The elevated results in the Pangborn room occurred during processes in which employees wear respiratory protection.

In all instances the elevated results are entered into CIRS, an investigation is completed, and corrective actions implemented.

Gamma Surveys

An ongoing ALARA initiative involves posting OSLDs around the pelleting area, the waste treatment area, the PP2 area, as well as the assembly area to determine areas of elevated gamma radiation. The annual average, quarterly minimum, and quarterly maximum result in each location is summarized in Table 25. The results illustrate that the Fuel Storage Area had the highest gamma fields (average of 6.1 $\mu\text{Sv/hr}$). The area is typically not occupied and has signage to notify employees and visitors to limit time spent in the area. The next highest reading (average 4.9 $\mu\text{Sv/hr}$) was in the powder receiving area. This is expected due to the amount of raw material stored in this area. Employees limit their time in this area as well. All areas of the facility are consistent with the levels seen in previous years.

Table 25

2021 Summary of Quarterly Plant Gamma Readings by Area (µSv/hr)				
Location #	Area	Average Result	Minimum Result	Maximum Result
13	Kitting	0.2	0.2	0.3
14	S Stacking	1.0	0.7	1.2
15	Stacking	0.1	0.1	0.1
16	Pelleting Entry	0.6	0.5	0.7
17	Pelleting Lab	0.2	0.1	0.3
18	S Grinding	1.2	1.1	1.2
19	Grinding	1.1	1.0	1.0
20	N Grinding	0.9	0.7	1.0
21	S Wall Pelleting	0.0	0.0	0.1
22	S Furnace	0.7	0.7	0.8
23	Furnace	1.0	0.8	1.2
24	N Furnace	0.1	0.0	0.1
25	SE Wall Furnace	0.3	0.2	0.5
26	E Wall Furnace	0.9	0.8	0.9
27	NE Wall Furnace	0.5	0.5	0.6
28	N Corridor	0.4	0.3	0.4
29	Ceramics Lab	0.2	0.1	0.2
30	R7#1 East Wall	1.5	1.4	1.7
31	PP2 West Wall	0.2	0.2	0.4
32	S Pressing	0.4	0.3	0.5
33	N Pressing	0.8	0.5	1.2
34	Pangborn Room	0.8	0.7	0.9
35	S Waste Treat.	2.3	1.8	2.8
36	N. Waste Treat	0.6	0.5	0.7
37	PP2 Powder Rec. N	1.2	1.1	1.3
38	Powder Receipt	0.2	0.0	0.4
39	U3O8 Add-back	1.5	1.1	1.7
40	S End Cap	0.2	0.1	0.2
41	End Cap	0.3	0.3	0.4
42	N End Cap	0.1	0.0	0.1
43	E Offices	0.0	0.0	0.0
44	S End Plate	0.0	0.0	0.0
45	End Plate	0.0	0.0	0.1
46	N End Plate	0.0	0.0	0.1
47	W Offices	0.0	0.0	0.0
48	S Inspection	0.1	0.1	0.1
49	Inspection	0.1	0.1	0.2
50	N Inspection	0.9	0.4	1.4
51	W Inspection	0.0	0.0	0.1
52	Strapping Bay	0.3	0.3	0.4
53	Packing	0.3	0.2	0.3
54	Fuel Storage Area	6.1	5.8	6.7
55	Graphite East	0.2	0.1	0.2
56	BMS Loading	0.9	0.7	1.2
57	PP2 Receiving	4.9	4.6	5.2
58	PP2 Press R53-1	1.3	1.1	1.4
59	PP2 E. Wall	0.5	0.4	0.6

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. The foundation of the program is based on the *NSCA* and its regulations as well as Part II of the *Canada Labour Code*.

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.

CFM manages non-radiological health and safety through a comprehensive E/OH&S program as prescribed by the Cameco Health and Safety Management Program. CFM maintains a series of detailed health and safety procedures and instructions, and the safety program is further supported by monthly safety meetings on a wide variety of safety topics, regular safety audits and monthly inspections conducted by employees from all levels of the organization as well as regular safety training. Management is involved throughout the year to ensure the conventional health and safety program remains valid and effective. Regular meetings with the senior management team review progress on safety related objectives and KPI's. When targets are overdue or off track, the senior management team will take actions to address the concern. In addition, during the annual Management Review, the Conventional Health and Safety program is reviewed by management with various aspects to determine the effectiveness of the program.

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

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

All regulations are audited at least once every three years. As part of the site internal audit program, audits of the various elements of the health and safety program are done on a routine basis. Any issues identified during these audits are documented in the CIRS database in order for corrective actions to be tracked and implementation verified. Further information on Health and Safety audit findings is provided in the Management Systems section of this report.

In 2021, CFM maintained its course of inspections and audits to not only identify potential safety risks, but to take corrective actions to mitigate those risks to prevent employee injuries. JHSC workplace inspections continued throughout the year and relied heavily on those members who remained on site during the work from home orders to meet CLC requirements. JTO's were reviewed at JHSC meetings to ensure completeness and to verify the adequateness of corrective actions based on any findings of concern.

CFM's 3-year SHEQ audit in 2020 resulted in several corrective actions to be implemented in 2021. These corrections further bolster CFM's health and safety processes. Key areas identified were contractor management, NRW/JHA/Confined Space permit consistency, and machine guarding.

Safety initiatives in 2021 included the following:

- Monthly safety meetings covering topics such as: return to work safety updates (completed after each shutdown), Radiation Protection Regulations updates/ALARA information, hearing protection, heat stress awareness, workplace violence prevention, summer safety, the importance of stretching after the holidays, mental health, school bus safety, emergency preparedness at home, social media safety and knowing your limits, fire safety, WHIMIS and ergonomics.
- Address remaining gaps to meet adherence to the Corporate Industrial Hygiene Standard such as the completion of mould surveys, illumination surveys, sound level surveys, creation of Hearing Conservation procedure, updated the asbestos survey.
- Introduction of the new Corporate Ergonomic Standard and with it a mandatory basic ergonomic awareness training for all employees. This training was completed in December of 2021. The Ergonomic Standard will incorporate ideals from the Industrial Athlete program that was introduced at CFM to help not only reduce, but to prevent ergonomic related injuries. Communication to employees regarding ergonomics takes place after each extended plant shutdown event (typically summer and Christmas) in the form of safety presentations and toolbox meetings.

- Continued safety awareness promotions and events (mental health awareness initiatives, importance of physical health, 2-month long STAR (Stop Think Act Review) activity to practice STAR on daily activities to ensure hazards are identified and then mitigate the hazards by implementing simple controls to prevent injuries, promote eating healthy and a healthy lifestyle.
- Improved Job Task Observation value and effectiveness.
- Continued to support mental health improvement initiatives.

Initiatives that are planned for 2022 include the following:

- Fully implement the Corporate Ergonomic Standard to help address ergonomic injuries and increase ergonomic awareness.
- Continue to track and trend incidents, including near miss incidents, to direct the focus for safety improvements.
- Complete welding fume sampling.
- Continual adaptation and deployment of COVID protocols as required; and
- Launch the new Continuous Improvement teams.

JHSC meetings and inspections continued at CFM in 2021. Due to the pandemic and the limiting of close contact, all meetings continued to be held virtually. The meetings saw a reduction in time spent meeting, but improvement continued in the areas of:

- Injury Trending – The JHSC regularly reviewed injury trends to guide focus for preventative measures. This information covered injury type, injured body part, contact type, and location. This information was posted for all employees to see as an awareness tool.
- Corrective action and activity follow up to ensure completeness and effectiveness of deficiency correcting for injuries.
- Increased communication with other departments. Representatives from engineering, training, and radiation protection would either pass on information to the committee or would attend committee meetings to include the JHSC in upcoming initiatives.

The committee met 22 times, reviewed 12 documents/program and completed 19 inspections, thereby meeting Canada Labour Code requirements.

The Job Task Observation completion rate improved from 92% in 2020 to 94% in 2021. Monthly safety meetings could not be done in person in 2021 due to COVID restrictions.

Therefore, the monthly safety presentations were delivered on-line in 2021 with a 99.5% viewing completion.

The tracking and trending of incidents, including near miss incidents, continues to direct the focus for safety improvements and helps to set the JHSC objectives for 2022. In previous years, sprains and strains were the most prevalent employee injury at CFM. In 2021, strains and sprains returned as our number one injury type. While several ergonomic injuries were due to reaching and stretching, another key contributor was over-exertion. These issues are to be addressed in 2022 with the incorporation of the new ergonomic standard and more ergonomic awareness.

All health or safety-related events are entered into the CIRS database system to ensure proper tracking and management. The CIRS classification system defines five categories of incidents based on actual and potential outcome, with Category I incidents being minor in scope and Category V incidents having the highest actual and potential consequences.

CFM's COVID hazard prevention response procedure continued to be revised throughout 2021. As provincial guidelines changed, CFM was able to keep up with changes to our entry questionnaire as well as changes in requirements for in-person meetings and types of face coverings.

CFM's Hazard Prevention Program (HPP) was developed and incorporated into the new Safety and Health Manual (CFM-SH). The Safety and Health Manual matches the requirements needed to qualify as the HPP – the identification of hazards, including health, safety, radiation, and fire safety hazards as they associate with both routine and non-routine activities and consists of 6 elements:

- an implementation plan
- a hazard identification and assessment methodology
- hazard identification and assessment
- prevention measures
- employee education
- program evaluation

A key component to the HPP is the review of risk assessments and in 2021 the JHSC began the process of reviewing risk assessments.

Following the Canada Labour Code requirement of a HPP, CFM evaluates the effectiveness of its health and safety program based upon a review of the following:

- a) Conditions related to the workplace and the activities of the employees:
 - Workplace violence survey/assessment
 - Management of Change process

- b) Workplace inspection reports:
 - JHSC monthly inspection reports
 - Industrial hygiene reports – noise, lighting, mould, asbestos
- c) Hazardous occurrence investigation reports:
 - All incidents are investigated back to root cause
- d) Safety inspections:
 - JTO's
 - Layered inspections
 - Sweep inspections
 - Process inspections
- e) First aid records and injury statistics, including records and statistics related to ergonomic related first aid injuries:
 - JHSC CIRS review
 - CFM Injury Classification reviews
 - Injury trending
- f) Any observations of the policy and workplace committees or the health and safety representative, on the effectiveness of the prevention program; and
- g) Any other relevant information.

Utilizing the program reviews above, statistics indicate that CFM continues to show improvement in injury frequency and severity. Through education, pro-active initiatives, and recognition of performance, the number of injuries and the severity of those injuries are continuing to trend down. Based upon this review, CFM has an effective safety program in place.

The final TRIR for 2021 was 0.44, with one recordable event for a medical treatment with restrictions. This is a decrease over 2020 (1.72) and is the lowest ever achieved TRIR for CFM. Table 26 shows the average and top quartile TRIR rates over the last five years in similar industries from the US Bureau of Labor Statistics for Fabricated Metal Product Manufacturing (NAICS 332000). While results for 2021 are not yet available from the Bureau using the data from previous years CFM is expected to be in the top quartile for the year.

Table 26

2017 – 2021 TRIR Rates					
Year / Parameter	2017	2018	2019	2020	2021
Average TRIR*	4.1	4.5	3.4	3.6	Not Available
Top Quartile*	1.6	1.5	1.5	1.1	Not Available
CFM TRIR	2.7	3.1	1.3	1.7	0.44

*Data obtained from US Bureau of Labor Statistics for Fabricated Metal Product Manufacturing (NAICS 332000).

Table 27 shows the safety statistics for the last five years, from 2017 to 2021. The past 5 years has seen a decreasing trend in recordable injuries. Restricted work decreased in 2021 while medical treatments and first aid injuries decreased from 2020. A critical component of injury prevention at CFM is the reporting of Near Misses. 41 near miss incidents were reported in 2021, up from 30 in 2020. While 29 near misses were classified as level I, 10 were classified as level II, and 2 were classified as level III. One of the level III near misses has resulted in a comprehensive review of the hoisting and rigging program at CFM, while the other directed attention to the completion of work by contractors.

Table 27

2017 – 2021 Safety Statistics					
Year / Parameter	2017	2018	2019	2020	2021
First Aid Injuries	14	14	11	17	15
Medical Diagnostic Injuries	2	1	3	1	2
Medical Treatment Injuries	2	2	0	2	0
Lost Time Injuries	0	0	0	0	0
Lost Time Injury Frequency	0.0	0.0	0.0	0.0	0.0
Lost Time Injury Severity	0.0	0.0	0.0	0.0	0.0

2.3.3 Environmental Protection

This safety and control area covers 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. CFM monitors facility discharges to ensure that they meet applicable provincial and federal requirements. CFM's environmental monitoring program is comprised of monitoring the following components:

- water and air emissions.
- gamma levels.
- ambient air; and
- soil and groundwater.

For key emission parameters, CFM has established internal action levels accepted by the CNSC, which 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. An exceedance of an action level does not indicate any adverse environmental effects; however, it is an indication there may be an issue that needs to be corrected within the environmental protection program. A result above an action level is investigated and remedial actions taken if necessary. Action levels are detailed in the Environmental Protection section of CFM's LCH.

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 Protection Program manual (CFM-EP) and associated procedures. This document identifies all of 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.

Environmental protection objectives and targets are established jointly by the site management team and site specialists as well as corporate and divisional leaders to ensure there is agreement, commitment and awareness of these objectives and targets across all areas of the operation. These objectives and targets can address, among other things, waste reduction initiatives and other projects which examine ways to reduce environmental emissions. Resources are allocated as required to achieve the targets and the status of these objectives are reviewed by the site management team.

Some of the objectives and targets from 2021 included:

- strive for zero reportable environmental events.
- maintain environmental performance without increasing environmental impact.
- completed review of environmental protection action levels with adjustment to building ventilation action level in PP2 area
- completed review of Environmental Risk Assessment
- determined and submitted for approval new Exposure Based Release Limits (EBRL) in preparation of 1 year licence for 2022
- completed GAP analysis against Cameco’s Containment Standard and develop compliance plan.
- Initiated upgrades to the groundwater treatment facility
- Implemented Waste Audit recommendations from 2020 waste audit.
- executed plan to remove legacy uranium contaminated waste from the site
- completed annual assessment to meet *CSA N288.4 Environmental Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* and *CSA N288.5 Effluent Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills*.
- reviewed Environmental Risk Assessment (ERA) – review concluded there were no changes identified which required a full update of the ERA before the 5-year timeframe”.

The environmental initiatives planned for 2022 include the following:

- maintain environmental performance without increasing environmental impact.
- implement plan associated with Cameco’s Containment Standard.
- Implement new environmental release limits.
- continue with upgrades to the groundwater treatment facility.
- participate in a Cameco initiative to move environmental data to a new software system with full implementation expected early in 2023.
- continue to implement recommendations from 2020 waste audit.
- continue with plan to remove legacy uranium contaminated waste from the site.

As part of the audit program, audits of the various elements of the environmental program are done on a routine basis. Any issues identified during these audits are documented in the CIRS database so that corrective actions can be tracked, and implementation verified. Further information regarding audits is provided in the Management Systems section of this report.

In 2021, all environmental releases were below the limits detailed in CFM's licence (FFOL-3641.0/2022). There were no spills to the environment in 2021.

To meet the annual assessment requirements of *CSA N288.4 Environmental Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills* and *CSA N288.5 Effluent Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills*, an assessment against performance criteria, objectives and targets, as well as the effectiveness of the effluent monitoring programs in accomplishing their respective objectives was performed. The following summarizes this assessment:

1. All required planned sampling with both internal and external analysis was completed as required to meet the Environmental Protection Program Table 12 "Planned Samples with Internal Analysis" and Table 13 "Planned Samples with External Analysis". Only planned periods (e.g., maintenance shutdown) or severe weather conditions interrupted planned sampling.
2. Sampling for some environmental parameters such as sewer and Hi-Volume air samples continue during planned maintenance outages while stack sampling (directly tied to production) are suspended until production resumed.
3. All sampling equipment was maintained in working order including applicable calibration cycles. A complement of back-up sampling equipment is maintained ready for immediate change over to limit sampling down time. Very few equipment failure events occurred in 2021.
4. All data is summarized and reported to the CNSC during quarterly and annual compliance reporting.

In 2021, there were no significant programmatic changes or challenges in the environmental protection program. In February of 2021, the CNSC completed a Compliance Inspection which focused on the Environmental Protection SCA. The inspection identified 4 non conformances and 1 recommendation related to Environmental Protection. All findings were addressed by CFM and completed by the end of 2021.

CFM's environmental protection program was determined to have been effective as evidenced by low airborne and liquid emissions from the facility. Additionally, there were no regulatory limit or action level exceedances in the environmental program in 2021 and the CNSC Environmental Protection focused inspection in February of 2021 identified minor findings with the program.

Dose to the Public

The NSCA requires that no member of the public shall receive from a neighboring nuclear facility an annual radiation dose in excess of 1 mSv. To ensure compliance with this

regulation, explicit limits are placed on the quantities of radioactive materials that may be released from licensed facilities in gaseous and liquid effluents, and on the gamma radiation levels emitted from the facility. These “Derived Release Limits” (DRLs) take into account all significant physical pathways and are calculated based on the average member of the site specific critical group receiving an annual dose of 1 mSv from each of the pathways. Since the pathways are site specific, different release limits apply to different facilities.

In 2021, CFM updated the Derived Release Limit Report to incorporate assessments of:

- a worker at the Port Hope Sewage Treatment Plant (STP),
- a palliative care facility constructed in 2014 to the northwest of CFM,
- changes to fuel storage practices,
- a shield berm installed on the north side of the fuel storage building,
- the current version of N288.1 *Establishing and implementing action levels for releases to the environment from nuclear facilities.*

This update resulted in significant changes to how the dose to the public is calculated. Most significantly, the critical receptor changed from the residents to the west of the facility to the residents of the palliative care facility to the northwest of the facility. The gamma dose as measured on the north fence line was determined to be most appropriate for calculation of dose at this receptor location. Additionally, the assessment of the STP worker indicated that although small, dose from water discharges needed to be included in the calculation of the dose to the public.

Similar to the changes to the calculations for dose to the public at PHCF in 2016 following the update to the DRL, the updated dose calculations for CFM related to the releases to water and the fence line gamma location are more conservative than those previously used. The reported dose for 2021 appears higher than previous years, but there has not been an actual increase in the emission/dose from the facility. The results represent a much more conservative estimate of dose to the public because the gamma monitoring location at the facility fence line is now closer to the operating facility than the previous location, resulting in the increase shown in the table. For this reason, the results beginning in 2021 should not be compared with previous years’ results.

From the 2021 DRL, the dose to the public from CFM operations is calculated based on three components: dose to the public from air emissions, dose from water discharges and dose from gamma radiation.

The updated DRLs used in 2021 are:

- air effluent (process stacks) – 299 kg/year.
- air effluent (building ventilation) – 41.5 kg/year
- liquid effluent – 331 kg/year; and
- gamma radiation levels (location #12) – 1.35 microsievert (μSv)/hr

The dose to the public from air and water emissions is a small fraction of the public dose limit. Therefore, the gamma component represents virtually all the estimated public dose.

Under its ALARA activities, CFM has focused considerable effort on ensuring adequate shielding to the west side of fuel storage areas due to the historical identification of the critical receptor as west of the facility. Prior to changing the critical receptor to location 12, CFM had implemented dose saving measures by installing a soil berm north of the Fuel Storage Building. Following the updated DRL and the first year of calculating dose based on a different critical receptor, CFM has identified an ALARA opportunity to further improve the gamma shielding on the north side of the Fuel Storage Building and will be implementing capital projects to reduce the dose measured at the fence line beginning in 2023.

Air effluent calculations include the assessment of releases of particulate UO_2 to air from process stacks and building ventilation from the facility. Process stacks are continuously sampled and analyzed daily for uranium emissions. The total amount of UO_2 released to the environment during the year in gaseous effluent from stacks in 2021 was 0.01 kg (8 grams).

In addition, each process area also has its own separate ventilation system. Emissions in the building ventilation from the Pelleting area is determined using the average in-plant air sampling result from the Pelleting Area along with exhaust discharge rates. The amount of uranium emitted from the PP2 area is calculated using the daily average of the continuous alpha monitors (alpha CAMs) set up in the area. As the building ventilation in this area uses HEPA filtration, a 90% efficiency factor is used in the calculation. The estimated release of UO_2 from all sources of building ventilation during 2021 was 0.89 kg in 2021. Therefore, the total amount of UO_2 released to air from stack emissions as well as building ventilation is estimated to be 0.9 kg in 2021.

At CFM, the gamma component represents the majority of the public dose. The closest residence to the CFM facility is located outside the fence line on the west side of the site. The location at the fence line that represents the critical receptor is location #12. To determine the total effective dose in this location, the natural background dose rate of $0.08 \mu\text{Sv/hr}$ for the Port Hope area is subtracted from the result.

The public dose calculation is demonstrated in the following formula:

Public Dose = Dose Air (stacks) + Dose Air (building ventilation) + Dose Water + Dose Gamma (location #12)

For the public dose from air emissions, the previous 2021 ACMOPR incorrectly reported the dose by summing the quarterly results. This was not correct as the quarterly results should have been averaged. Alternatively, the annual emissions could also have been calculated as detailed below. The fraction of the dose to the public from air is calculated using the following equation:

$$Dose_{Air\ 2021} = \left(\frac{Stacks_{2021}}{Stacks_{DRL}} + \frac{Building\ Ventilation_{2021}}{Building\ Ventilation_{DRL}} \right) \times Dose_{Allowable}$$

$$Dose_{Air\ 2021} = \left(\frac{0.01\ kg/y}{299\ kg/y} + \frac{0.89\ kg/y}{41.5\ kg/y} \right) \times 1\ mSv/y$$

$$Dose_{Air\ 2021} = (0.00003 + 0.021445) \times 1\ mSv/y$$

$$Dose_{Air\ 2021} = 0.021\ mSv/y$$

Table 28 and Figure 15 have been updated to reflect the correct dose to the critical receptor including the correction from air emissions of 0.021 mSv/yr.

Therefore, the corrected total dose to the member of the public from air emissions (process and building ventilation), liquid emissions and gamma levels is calculated to be 0.306.

The 2021 annual estimated dose, along with each component to the public, using revised DRLs, the revised formula (including liquid and breaking apart air sources), and the new location for the critical receptor is provided in Table 28 and Figure 15. Also provided for 2017 – 2020 is the estimated public dose using the previous method of calculation. The previous year’s annual calculation was performed by averaging the gamma component whereas the dose for 2021 was obtained by summing the dose calculated each quarter.

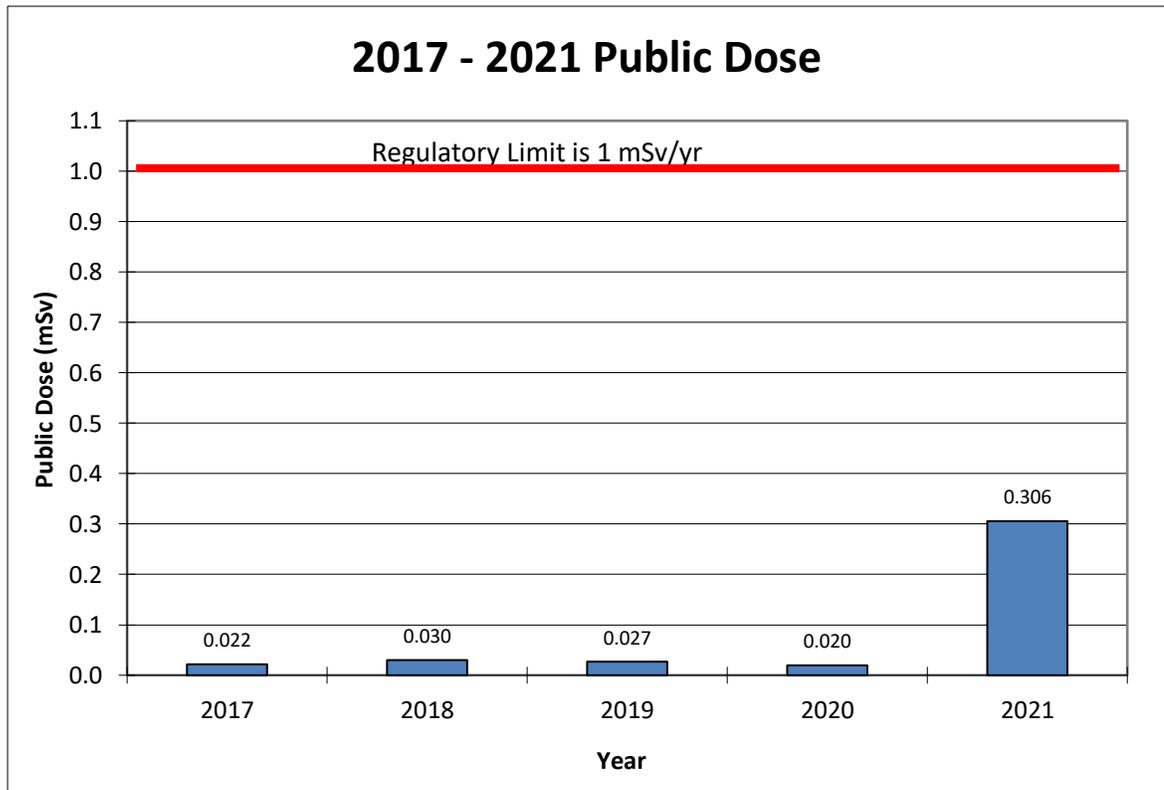
The table illustrates the total dose to the critical receptor as well as the individual contributions from air and gamma converted into mSv/yr units for comparison. The dose to the critical receptor remains low when compared to the dose limit; however, there is an increase to public dose for the reasons noted above.

Table 28

2017 – 2021 Dose to the Public (mSv/yr)					
Parameter	2017	2018	2019	2020	2021
Air (combined)	0.002	0.004	0.004	0.003	0.021
Air (process stacks)	-	-	-	-	0.000
Air (building ventilation)	-	-	-	-	0.021
Liquid	-	-	-	-	0.004
Gamma (Location 12)	-	-	-	-	0.281
Gamma (Location 1)	0.020	0.026	0.023	0.017	0.002*
Total dose to Previous Critical Receptor (Location #1)	0.022	0.030	0.027	0.020	0.027*
Total Dose to Critical Receptor (Location #12)	-	-	-	-	0.306 ⁺

*Data calculated using location #1 gamma dose as well as revised DRL's and including liquid dose
⁺Data calculated using location #12 gamma dose as well as revised DRL's and including liquid dose
 - not calculated in specified time period

Figure 15



Gamma Monitoring

In order to ensure that local residents are not exceeding the public dose limit, environmental dosimeters are strategically placed (at chest height) around the exterior perimeter of the licensed facility. The dosimeters are deployed on a quarterly basis and measure gamma levels in mSv and are converted into $\mu\text{Sv/hr}$ when the number of hours the dosimeters were deployed are taken into account. Twelve locations have been selected around the licensed facility's fenced perimeter.

The perimeter gamma for the critical receptor at location #12, in the 2020 DRL, is 1.35 $\mu\text{Sv/hr}$ and the action level remains at 1.0 $\mu\text{Sv/hr}$ respectively. The other DRL's listed for gamma monitoring are for location #1 and location #2 at 4.96 $\mu\text{Sv/hr}$ and 0.46 $\mu\text{Sv/hr}$ respectively. There were no exceedances of the DRL's or the action levels in 2021.

Table 29 provides the average quarterly and maximum gamma levels in $\mu\text{Sv/hr}$ for all fence line monitoring locations (i.e., 1-12) in 2021. The location with the highest gamma level in 2021 was location 12. This is due to the proximity of the location to the Fuel Storage Building and is within the typical range.

Table 29

2021 Gamma Monitoring Results ($\mu\text{Sv/hr}$)				
Location	Regulatory Limit (DRL)	Action Level	Annual Average	Quarterly Maximum
1	4.96	0.2	0.01	0.02
2	0.46	0.2	0.03	0.05
3	-	1.0	0.00	0.00
4	-	1.0	0.00	0.00
5	-	1.0	0.00	0.00
6	-	1.0	0.00	0.00
7	-	1.0	0.00	0.00
8	-	1.0	0.00	0.00
9	-	1.0	0.03	0.05
10	-	1.0	0.00	0.00
11	-	1.0	0.33	0.37
12	1.35	1.0	0.38	0.41

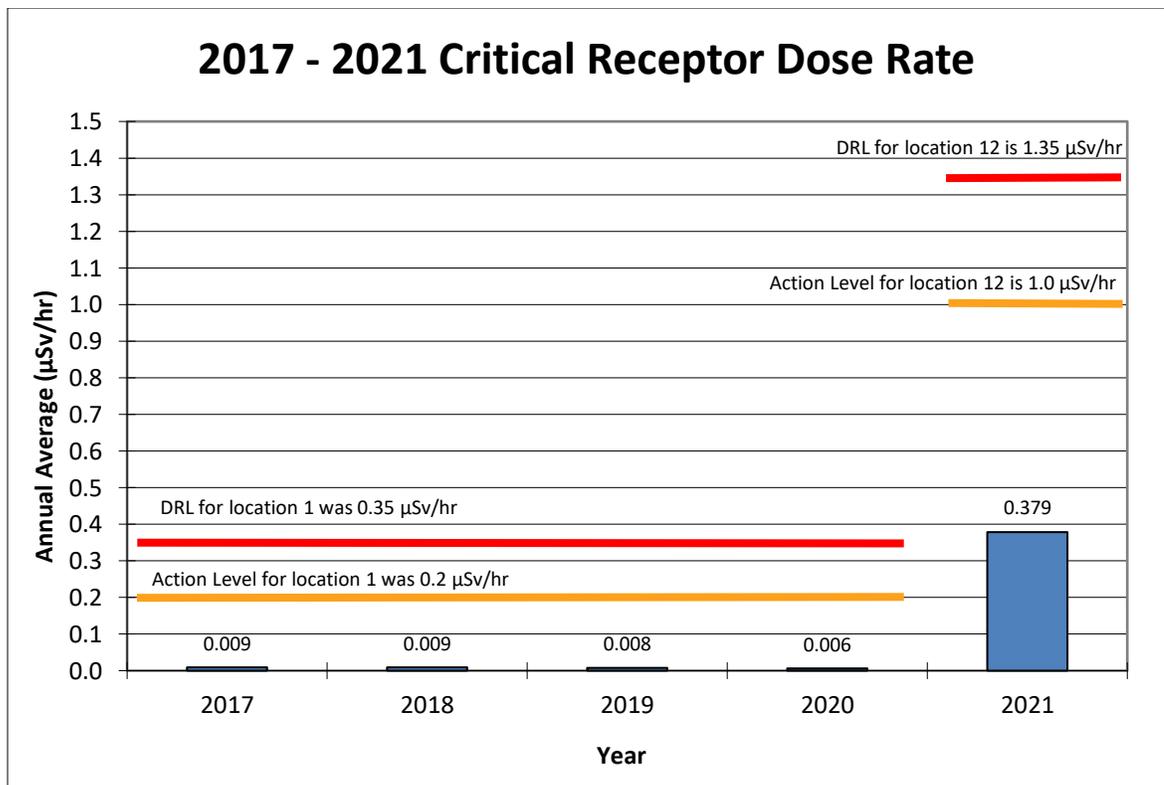
The annual average monitoring results for location 1 (previous critical receptor location) and location 12 (critical receptor from 2020 DRL report) are provided in Table 30 and Figure 16. Results have been corrected to take into account background gamma levels by subtracting 0.08 $\mu\text{Sv/hr}$.

Table 30

2017 – 2021 Critical Receptor Gamma Monitoring Results ($\mu\text{Sv/hr}$)			
Period	Regulatory Limit (DRL)	Action Level	Annual Average
2017	0.35	0.2	0.009*
2018	0.35	0.2	0.009*
2019	0.35	0.2	0.008*
2020	0.35	0.2	0.006*
2021	1.35	1.0	0.379+

*Uses location #1 as the critical receptor and 2002 DRLs
+ uses location #12 as the critical receptor and 2020 DRLs

Figure 16



Discharge to Air

Discharge to air is calculated from the releases of particulate UO_2 to air from process stacks and through building ventilation. Process stacks are sampled and analyzed daily for uranium emissions. In addition, each process area also has its own separate ventilation system. Emissions from this system are determined using in-plant air sampling data and exhaust discharge rates.

Stack Emissions

Samples of the gaseous effluent released from the plant are obtained by stack sampling which has been designed to meet the requirements of ANSI N13.1 *Guide to Sampling Airborne Radioactive Materials at Nuclear Facilities*. The samples are analyzed by alpha counting to obtain the uranium concentration. In 2021 CFM sampled 9 process stacks throughout the year for uranium emissions.

A variety of pollution control equipment including baghouses, and absolute filters are used at the facility to control and reduce emissions to air. The release limit for air emissions is 14 kg/yr. The stack effluent action level is $2.0 \mu\text{g}/\text{m}^3$ uranium concentration for a single stack reading. There were no exceedances of the release limit or the action level with respect to air emissions.

Table 31 provides the 2021 average and maximum daily uranium concentration in $\mu\text{g}/\text{m}^3$ by stack. The maximum for all the stacks was $1.69 \mu\text{g}/\text{m}^3$ and occurred in Waste Treatment Area Absolute Filter stack in the third quarter. An investigation into the elevated result identified corrective actions that were implemented to address the issue (related to the time the stack was run).

Table 32 and Figure 17 provide the estimated uranium emitted in kilograms from 2017 to 2021. The total amount of uranium dioxide released to the environment during the year in gaseous effluent from stacks was 0.01 kg (8 grams). As indicated in the tables, stack emissions remain low and are well below the annual release limit.

Table 31

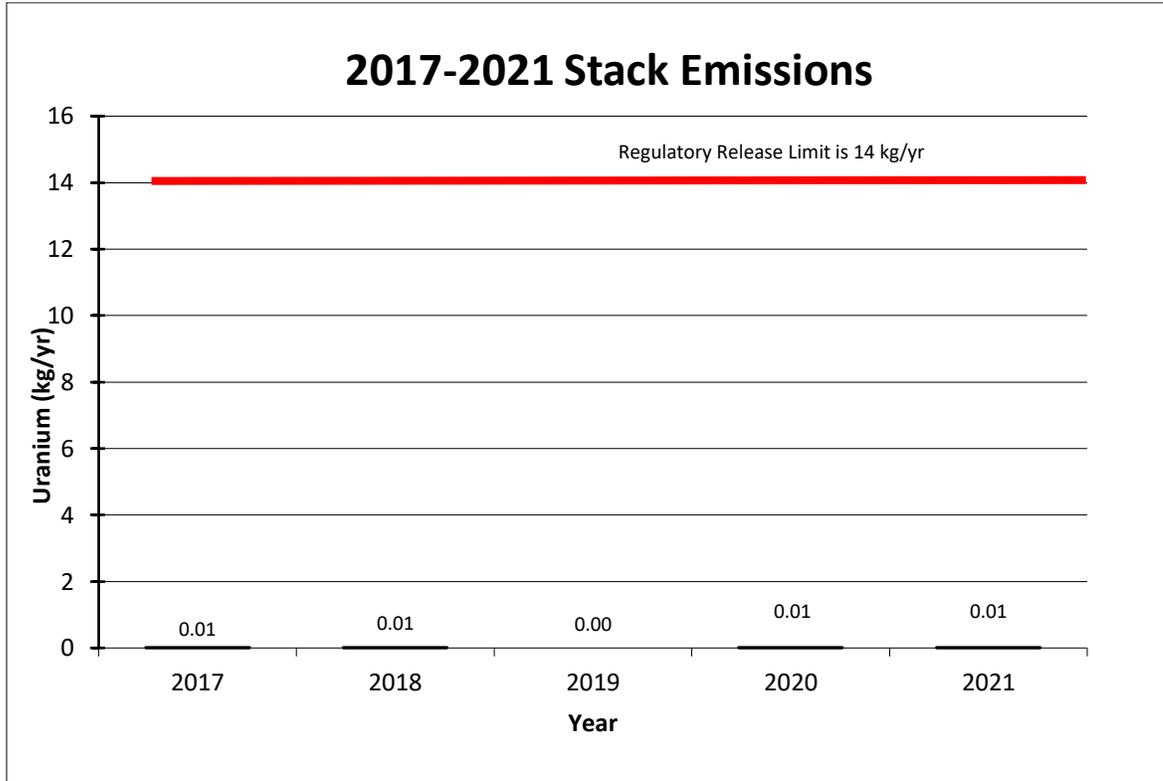
2021 Stack Sampling Summary ($\mu\text{g}/\text{m}^3$)			
Source	Action Level ($\mu\text{g}/\text{m}^3$)	Average Annual Result ($\mu\text{g}/\text{m}^3$)	Maximum Annual Result ($\mu\text{g}/\text{m}^3$)
BMS Extraction	2.0	0.01	0.06
Furnace Burn-off	2.0	0.01	0.06
Hoffman Vacuum	2.0	0.01	0.08
Mist Collector	2.0	0.04	0.29
PP2 East	2.0	0.04	0.15
PP2 West	2.0	0.01	0.25
Pangborn North Dust Collector	2.0	0.04	0.31
Pangborn South Dust Collector	2.0	0.01	0.09
Waste Treatment Area Absolute Filter	2.0	0.18	1.69
Overall Average & Maximum	2.0	0.04	1.69

Table 32

2017-2021 Stack Emissions (kg/yr)						
	Release Limit	2017	2018	2019	2020	2021
Annual Stack Emissions	14	0.01	0.01	0.00*	0.01	0.01

*Air emissions for 2019 was 4 grams and reported as 0.00 kg

Figure 17



Building Ventilation Emissions

Emissions from the main Pelleting Area building ventilation system are determined using in-plant air sampling data and exhaust discharge rates. Emissions in the PP2 area are calculated using alpha continuous air monitors and the exhaust discharge rate for the area. As the exhaust in this area uses HEPA filtration, a 90% efficiency factor is also applied in the calculation.

The DRL for air emissions is 280 kg per year. The release limit for uranium emissions through aerial releases is 14 kg/yr. The action level for building ventilation is 1.0 g/hr monitored on a daily basis for the Pelleting Area and 0.5 g/hr for the PP2 area. In July 2021 CFM implemented a PP2 area action level of 0.4 g/hr. There were no exceedances of the CNSC release limit or the building ventilation action levels in 2021.

Table 33 and Figure 19 provides the estimated release of uranium concentration through exhaust ventilation from 2017 to 2021. The estimated release of UO₂ from all exhaust ventilation in 2021 was 0.89 kg, with the majority of the amount coming from the Pelleting Area (approximately 90%).

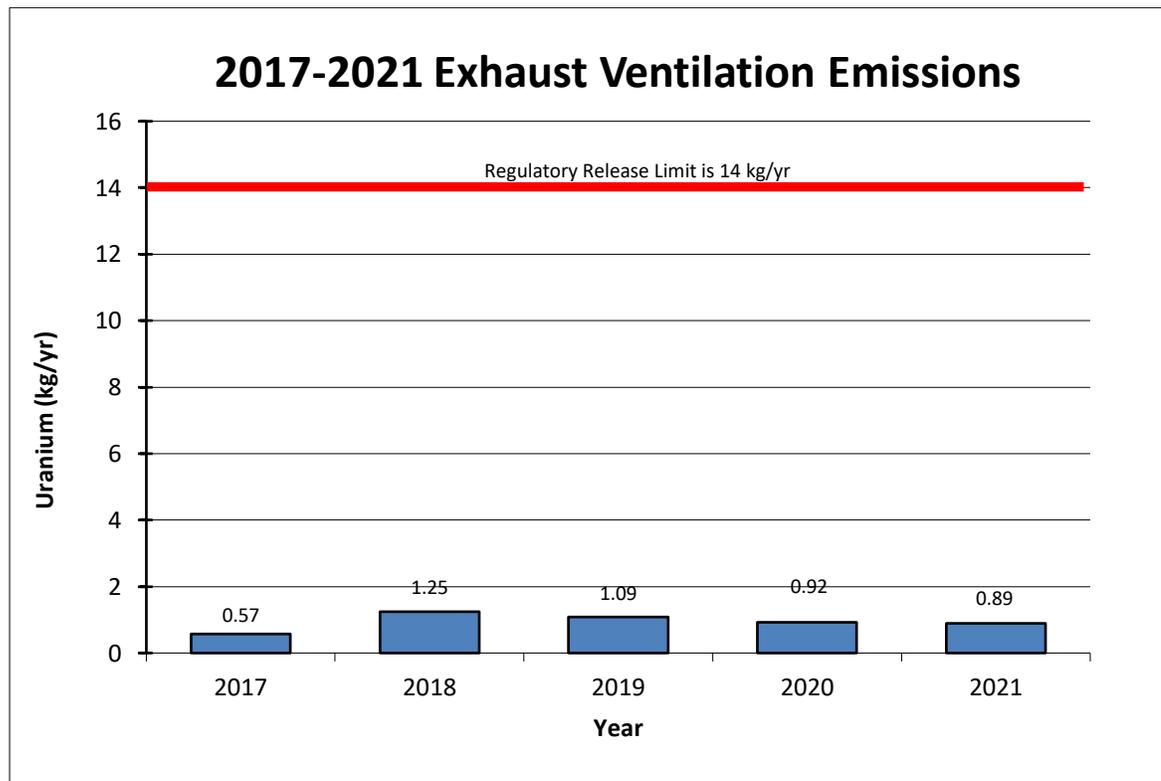
In 2017 the annual value was calculated by adding the quarterly results. Since 2018 the annual value is calculated on a daily basis with a total sum provided for the year. This capability was built into the environmental monitoring software (EC) that was implemented in 2018 and is a better reflection of the day to day operation compared to using an average result. This has caused the annual results since 2018 to be higher when compared to 2017 results. The amount emitted in 2021 was less than previous years using the more representative calculation of emissions.

Table 33

Exhaust Ventilation Emissions (kg/yr)						
Parameter	Release Limit	2017	2018	2019	2020	2021
Annual Exhaust Emissions	14	0.57	1.25	1.09	0.92	0.89

The 2017 value was calculated by adding the quarterly results. Since 2018 the annual value is calculated using the daily result with a total sum provided for the year.

Figure 18



The daily average concentration of uranium emitted through exhaust ventilation in the Pelleting Area in 2021 was 0.1 g/hr and the maximum concentration of uranium was 0.3 g/hr which is comparable to the average from previous years with the maximum lower than the maximum from previous years. The average and maximum in the PP2 area in 2021 was 0.0 g/hr and 0.1 g/hr respectively which is the same as previous years. Table 34 provides the average and maximum uranium concentration emitted through the building ventilation system in g/hr from 2017 to 2021 for the Pelleting Area and the PP2 area. Figure 19 provides the average and maximum uranium concentration emitted through the Pelleting Area and Figure 20 provides the average and maximum uranium concentration emitted through the PP2 area.

The table and figures demonstrate that the PP2 area has much lower emissions through building ventilation than the Pelleting Area.

Table 34

Building Ventilation Rates by Year (g/hr)							
Parameter	Action Level	Measure	2017	2018	2019	2020	2021
Uranium Emissions from Pelleting Area	1.0	Average	0.2	0.2	0.2	0.1	0.1
		Maximum	0.6	0.9	0.5	0.5	0.3
Uranium Emissions from PP2 Area	0.5 Until June 30 / 0.4 Starting July 1	Average	0.0	0.0	0.0	0.0	0.0
		Maximum	0.1	0.1	0.1	0.1	0.1

Figure 19

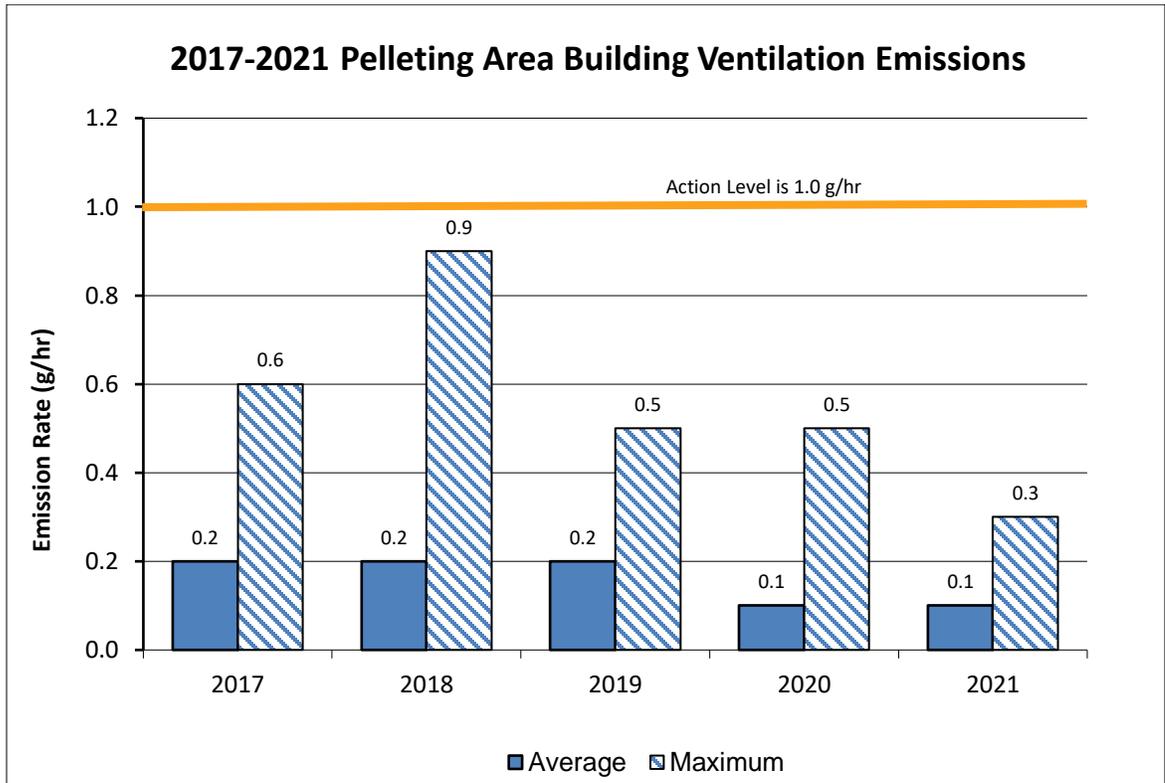
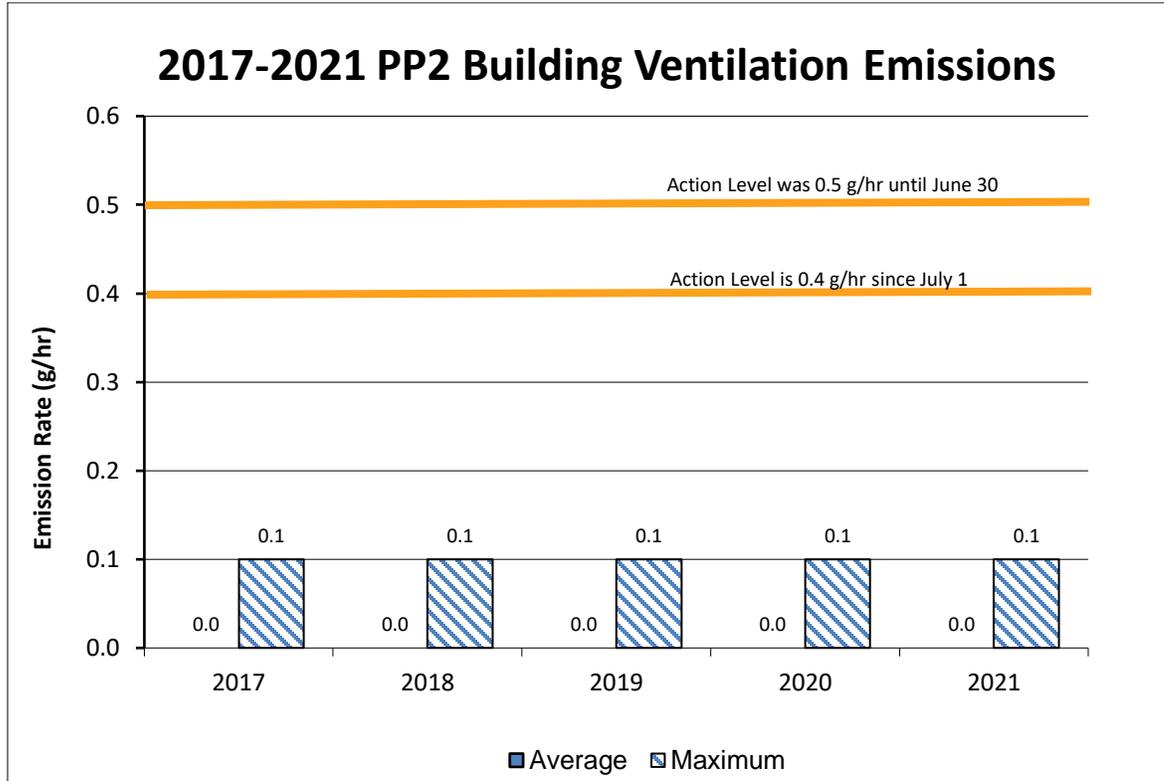


Figure 20



Discharge to Sewer

Liquid effluent generated from production processes is collected and treated to remove the majority of the UO₂ using an evaporator process. The condensed liquid is sampled and analyzed prior to a controlled release to the sanitary sewer. Liquid effluent generated from sanitary sewer systems (i.e., showers and bathroom facilities, laundry facilities, etc.) are released directly to sanitary sewer.

Liquid effluent is monitored for uranium content to ensure compliance with various federal, provincial, and municipal regulations. Automated sampling takes a sewer sample from the plant sewer line at regular intervals 24 hours per day at the point of discharge to create a composite. A composite sample is taken twice a week and is analyzed for uranium concentration. The composite sample is representative of liquid effluent discharged from the facility, including the condensate liquid effluent and the discharge from the groundwater treatment system.

The annual uranium loading remains a small fraction of the release criteria of 475 kg/yr that applies to liquid releases to the sewer as outlined in Appendix A of CFM’s licence FFOL-3641.00/2022. The action level for the uranium concentration in sewer emissions

discharged to the municipal sewer system is 0.1 mg/L for a weekly composite. The action level for pH is greater than or equal to 6.5 and less than or equal to 9.0.

The total amount of uranium released to the sanitary sewer in 2021 was estimated to be 0.29 kg (less than 1% of release limit). The average concentration of uranium in the sewer effluent for the year was 0.01 mg/L with a maximum result for a single composite sample of 0.03 mg/L.

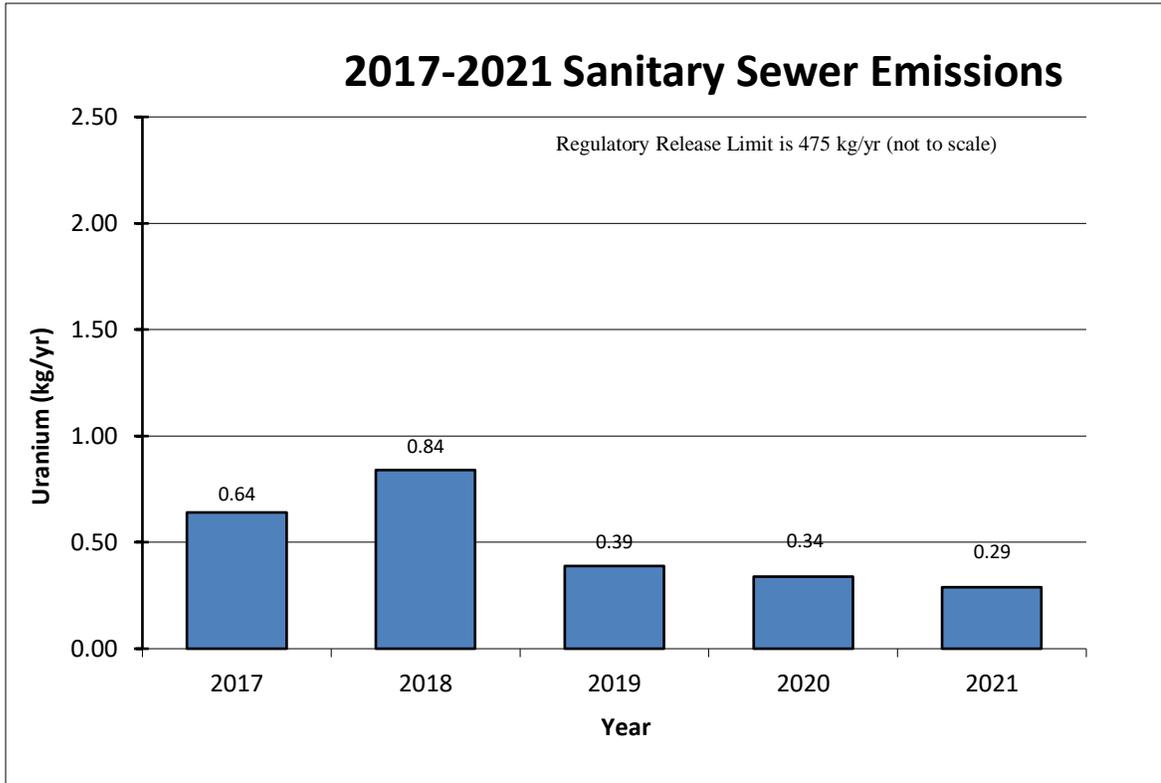
Since 2019 there continued to be a reduction in the amount of uranium emitted through the sanitary sewer. This is most likely attributed to the installation and commissioning of the automated pellet grinding equipment in 2017 and 2018. The pellet wash water on the automated lines is processed in the waste treatment circuit and not released to the sewer. This has reduced the amount of uranium emitted in liquid effluent.

Table 35 provides the average and maximum uranium concentration for single composite samples from 2017 to 2021. Also provided are the 2021 minimum and maximum pH measurements along with the volume of water discharged and the emission results. Figure 21 provides the estimated amount of uranium discharged through the sanitary sewer. The estimated annual discharge in 2021 was lower than previous years.

Table 35

2017-2021 Sanitary Sewer Emissions							
Parameter	Measure	Action Level	2017	2018	2019	2020	2021
Uranium	Avg.	2.0	0.02	0.02	0.01	0.01	0.01
(mg/L)	Max.	2.0	0.10	0.11	0.03	0.05	0.03
pH	Min.	6.5	7.3	7.3	7.4	7.3	6.8
(pH units)	Max.	9.0	8.1	8.4	8.2	8.9	8.9
Volume of water (m3)	-	-	35 306	36 022	29 064	24 172	20 998
Estimated Discharge (kg)	-	-	0.64	0.84	0.39	0.34	0.29

Figure 21



Ambient Air Monitoring

In addition to onsite monitoring of emissions, CFM has a comprehensive ambient monitoring program including sampling of ambient air, soil, and groundwater.

CFM uses hi-volume air samplers to measure the concentration of UO₂ that has been emitted from gaseous emissions (i.e., stack as well as building ventilation emissions) along the plant boundary at ground level. The system provides information on the impact to the public as well as the environmental impact from facility operations. High volume air samples are collected in the four corners within the CFM fence line. The samplers are run for 24 hours per day on a continuous basis. The sample filter is changed once a week and analyzed for uranium concentration.

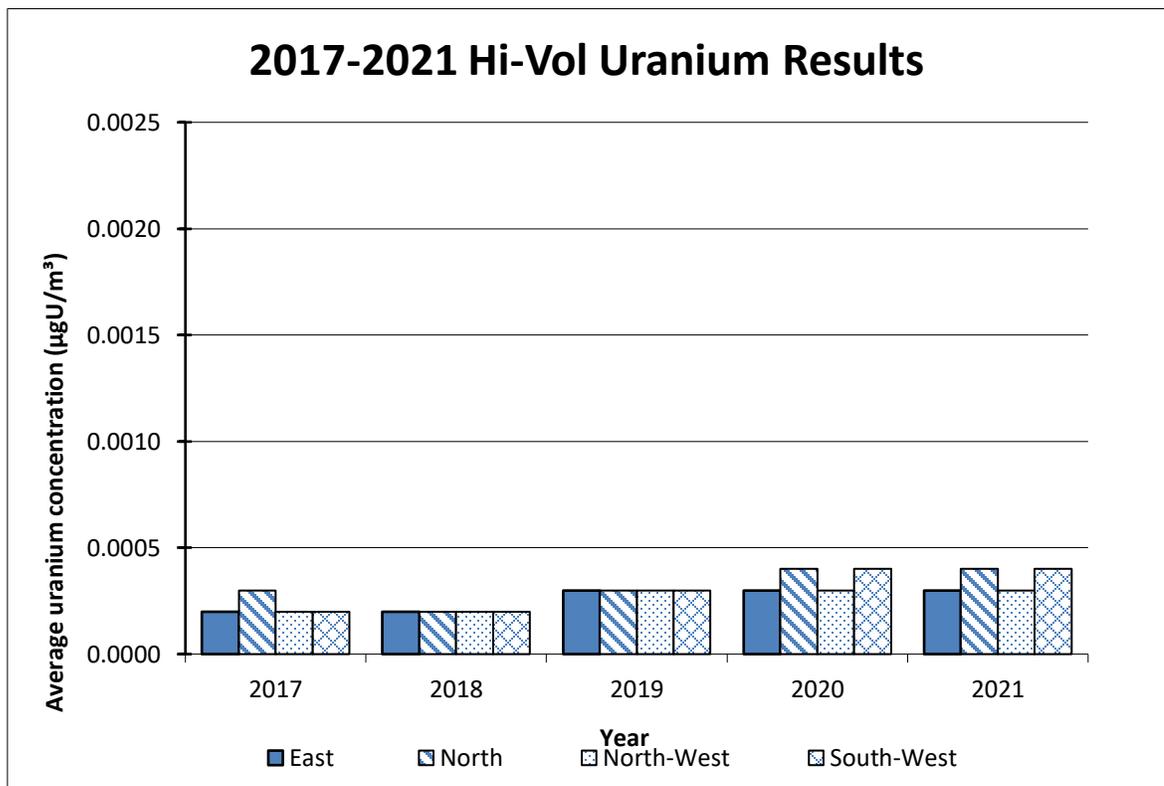
The maximum concentration of uranium in 2021 was 0.0056 µg/m³ and occurred during the second quarter in the South West location. Annual results from all stations remain well below the MECP standard annual average limit of 0.03 µgU/m³ that came into effect in July 2016 as well as the provincial ambient air quality criteria (AAQC) of 0.06 µgU/m³ TSP.

Table 36 and Figure 22 present results of the annual average and maximum uranium in air concentrations for 2017 – 2021 at the four locations.

Table 36

Annual Uranium-in-Air Concentration at Hi-Vol Stations						
		2017	2018	2019	2020	2021
East	Average	0.0002	0.0002	0.0002	0.0003	0.0003
	Maximum	0.0009	0.0005	0.0008	0.0014	0.0039
North	Average	0.0003	0.0002	0.0003	0.0004	0.0004
	Maximum	0.0008	0.0005	0.0014	0.0024	0.0050
North West	Average	0.0002	0.0002	0.0003	0.0003	0.0003
	Maximum	0.0006	0.0006	0.0016	0.0012	0.0042
South West	Average	0.0002	0.0002	0.0003	0.0004	0.0004
	Maximum	0.0010	0.0005	0.0015	0.0014	0.0056

Figure 22



Soil Monitoring

As part of CFM's commitment to protecting the community and the environment, samples from the soil and vegetation are routinely collected from specific locations surrounding the facility for analysis. The purpose of the survey is to measure and document uranium concentrations in the soil and vegetation to verify that no significant build up from emissions of uranium have been released from the facility.

At least every three years, vegetation and core samples are each separately collected at 23 locations surrounding the Port Hope facility (locations are provided in Figure 22). From 2008 to 2010 CFM was performing soil monitoring on an annual basis until the decision was made to go back to the three year sampling schedule that was in place previously.

Core samples are taken in five areas within each location. Each core sample is divided into three sections (0-5 cm, 5-10 cm, and bottom 10-15 cm) and combined with the other cores taken from the same site to obtain a representative sample of that location. In addition, a representative sample of the surface vegetation growing within the sampling site is taken. Uranium samples are sent to an external laboratory and are reported in micrograms per gram ($\mu\text{g/g}$).

Soil sampling was not conducted in 2021 as the last campaign was in 2019; therefore, the next round of soil sampling will occur in 2022. The average and maximum results of the soil sampling conducted in 2019 are provided in Table 37 and Figure 23 along with the last five sampling campaigns. The results in 2019 were lower than previous years with the maximum of $7.6 \mu\text{g/g}$ measured in location 11 which is located on the south east side of the employee parking lot. All results were below the CCME Guideline for residential/parkland use of $23 \mu\text{g U/g}$.

Table 37

2009 – 2019 Soil Results (µg/g)						
Depth	Average / Maximum	2009	2010	2013	2016	2019
Vegetation	Average	1.1	1.5	1.3	0.7	0.3
	Maximum	4.5	6.0	2.9	3.4	1.3
Surface	Average	6.4	5.2	4.1	-	-
	Maximum	14.5	18.6	13.1	-	-
0 - 5 cm	Average	6.8	5.6	4.7	3.0	2.9
	Maximum	17.0	21.1	17.4	10.2	7.6
5 - 10 cm	Average	6.7	5.6	4.8	3.2	3.0
	Maximum	17.0	19.1	17.3	11.2	7.5
10 - 15 cm	Average	-	-	-	3.2	3.2
	Maximum	-	-	-	11.1	7.5

- results are not available due to change in sampling approach.

Figure 23

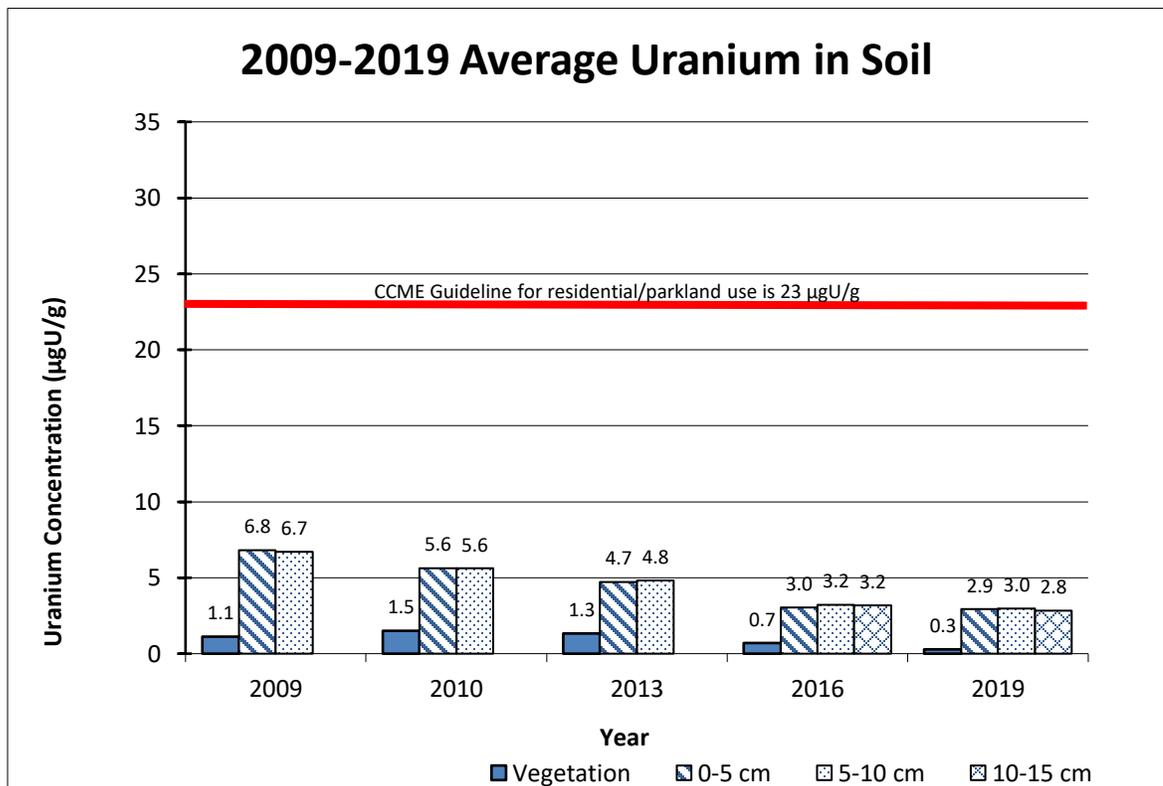
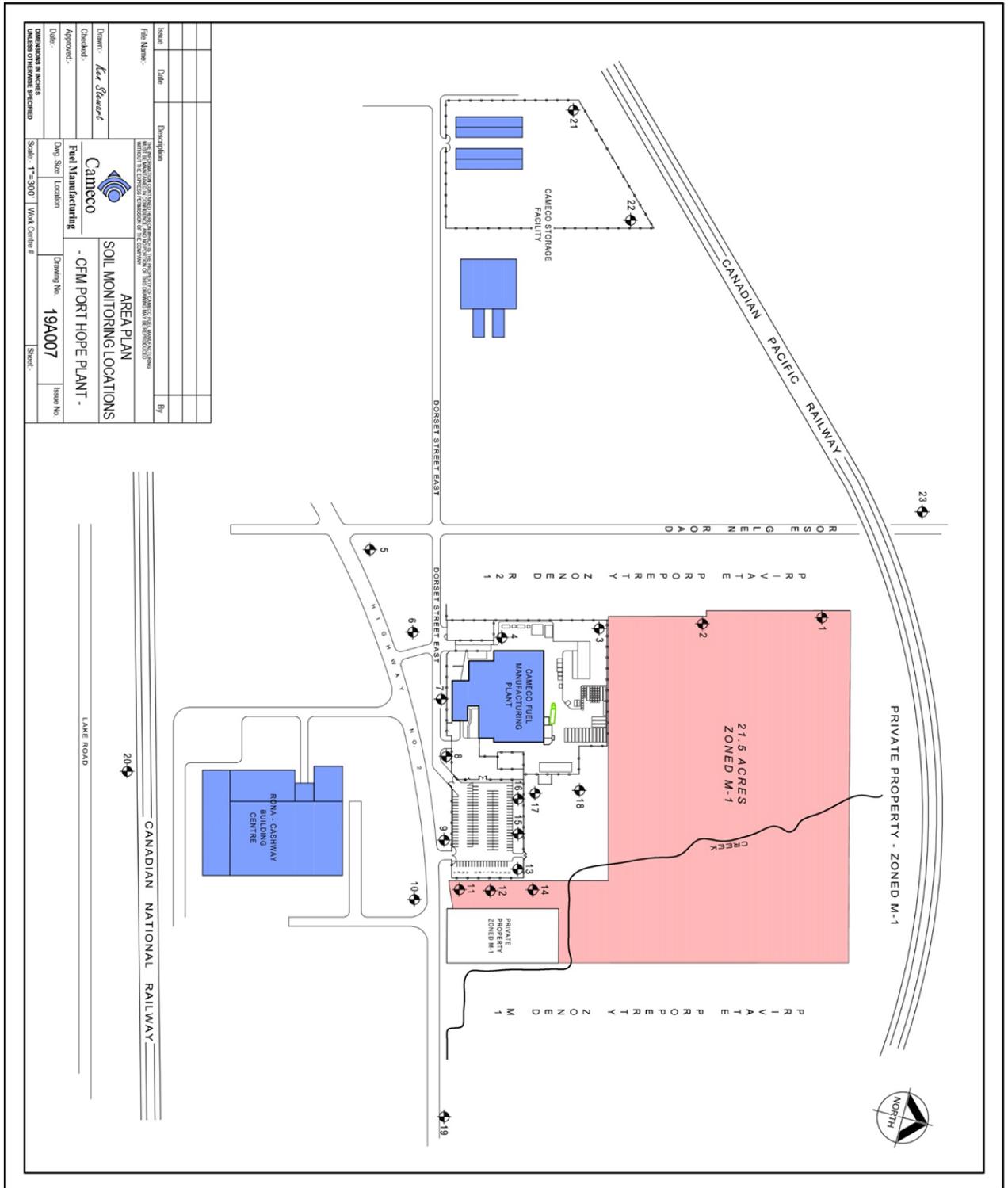


Figure 24: Soil Sampling Locations



Groundwater Monitoring

CFM has an extensive groundwater monitoring program in place. Groundwater monitoring locations are sampled semi-annually in the spring and fall of each year, while the surface water and storm sewer intermittent drainage feature (drainage ditch) locations are targeted for sampling three times per year in the spring, summer and fall in association with precipitation events. Samples are collected by a third-party consultant and are sent to an independent laboratory for analysis. Results of the groundwater monitoring program, among other items, are summarized and discussed in third party annual groundwater and surface water review reports. These reports are submitted to the CNSC and the MECP under separate covers.

Up to 10 of 12 pumping wells and up to two sumps (internal and external) were in operation during 2021. The 2021 mean recovery rate was approximately 28.3 m³/day, a decrease from the 2020 mean rate of 35.6 m³/day. Extended periods of treatment system downtime were experienced in November and December 2021 in relation to consecutive air stripper feed pump and air stripper discharge pump failures and associated replacement equipment lead times.

Figure 25 and Figure 26 illustrate the monitoring well locations and groundwater elevation contours for the 2021 spring and fall sampling campaigns. Groundwater in overburden is interpreted as entering the site from the west to northwest and flowing to the east and southeast in the direction of Gages Creek. Groundwater pump-and-treat system operations result in local influence of overburden groundwater flows.

Effluent and Environmental Monitoring Program Performance

The facility Environmental Protection Program sets out the effluent and environmental monitoring requirements for the facility to ensure adequate environmental protection measures are in place. The performance criteria of these programs is that at least 90% of planned samples are collected and analyzed to meet the data acceptance criteria. Please find below the performance criteria for the data collected during the year:

- Water samples (i.e., sanitary discharge) – 99% of planned samples were collected
- Air samples (i.e., stacks, in-plant air, CAM heads) – 99% of planned samples were collected
- Environmental Samples (i.e., surface water, groundwater, hivol, fenceline gamma, soil, vegetation) – 99% of planned samples were collected

Therefore, the samples collected and analyzed throughout the year meet the data acceptance criteria. In 2021, any chemical analysis that was completed external to CFM as well as data meeting acceptance criteria was reported.

Figure 25: Groundwater Elevation Contours – Spring

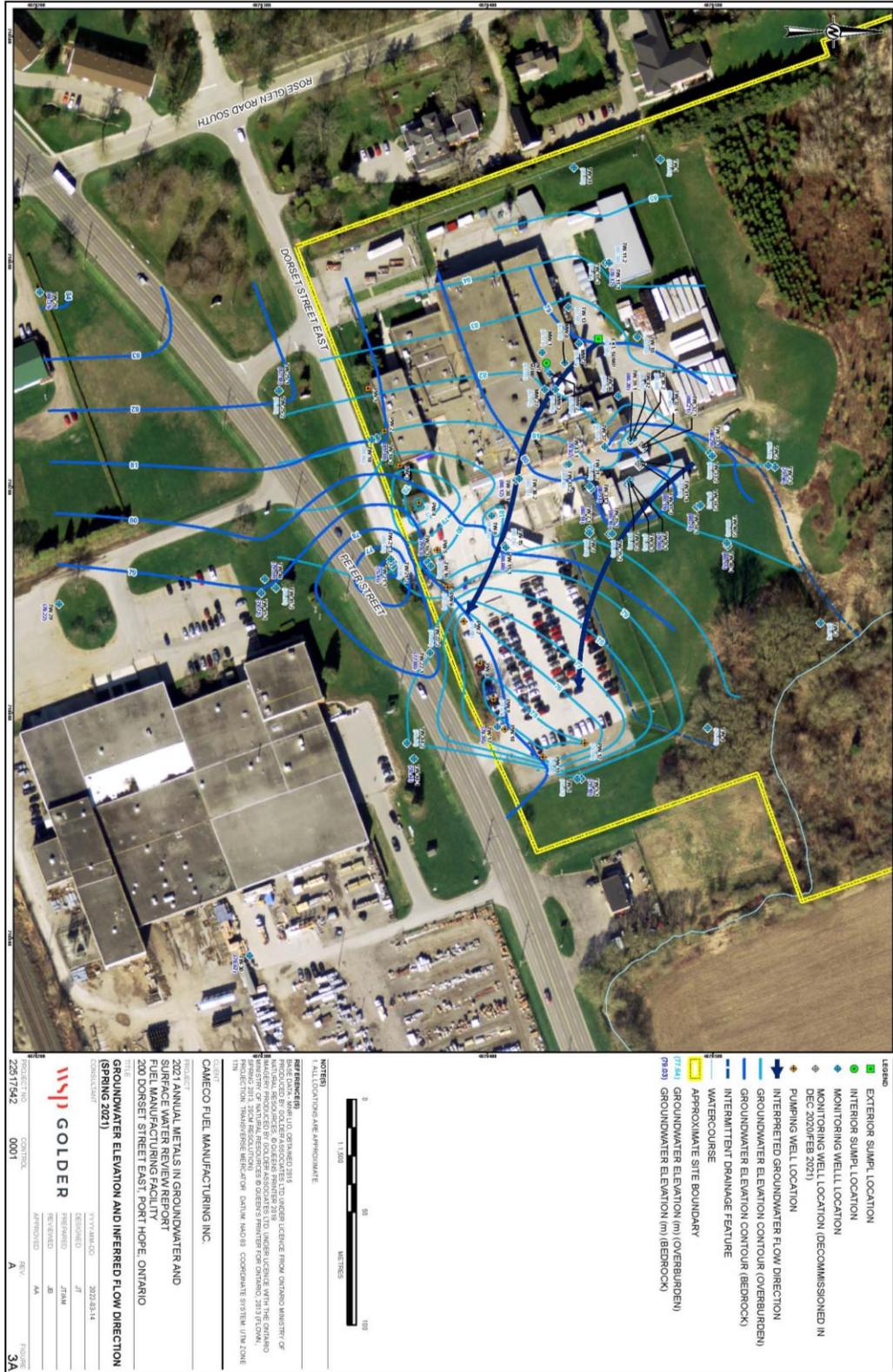
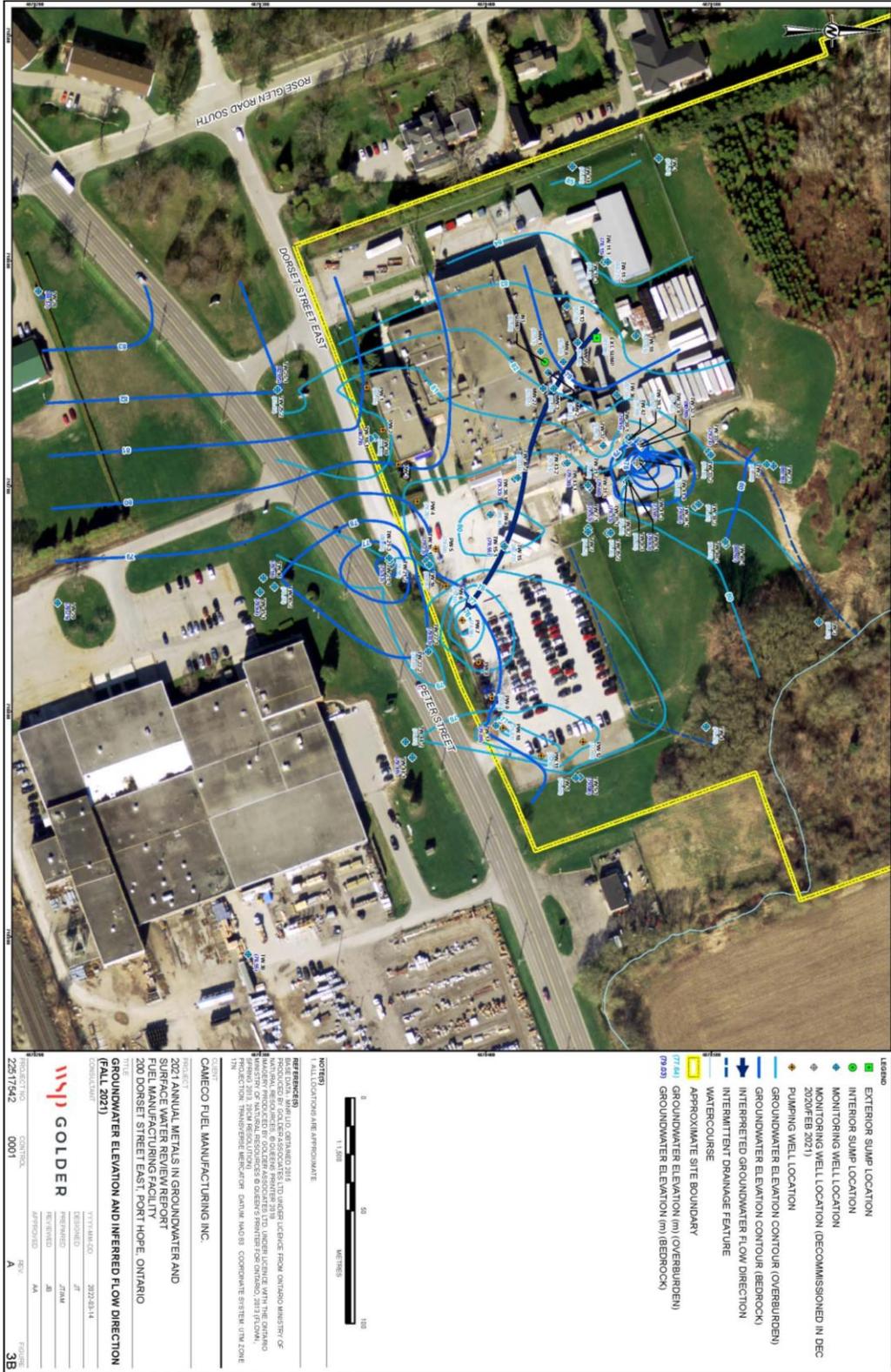


Figure 26: Groundwater Elevation Contours – Fall



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 CFM's Emergency Preparedness and Response Procedure. The plan assigns specific accountabilities and sets out processes and procedures to protect the health and safety of employees, contractors, the public and the environment in the case of an emergency.

As the primary response provider for the facility, the Port Hope Fire and Emergency Services (PHFES) have the resources in place to effectively respond to emergencies at the facility. CFM has a memorandum of understanding with the PHFES and the Municipality of Port Hope which provides the framework for successful emergency response to the facility. Also, as part of the agreement, CFM provides PHFES with the necessary equipment and training to effectively respond to emergencies at the facility.

Emergency response is a key component of an effective FPP. The FPP at the facility meets both internal Cameco requirements, and it also meets the requirements of the standards: *N393-13; Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances, National Fire Code of Canada, 2015*, and the *National Building Code of Canada, 2015*. In developing the FPP, a defense-in-depth approach was used to ensure that the fire protection measures are adequate for the fire safety of the facility. The FPP is comprised of the FHA and other fire protection supporting documents. The fire protection supporting documents involve a number of areas which include fire prevention and fire protection. 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.

In 2021, CFM submitted the 2020 annual third party fire protection review reports along with the corrective actions and associated timelines to address items noted in the report. The third party review completed in 2021, will be submitted in 2022, and included one element according to the three year cycle outlined in CSA N393. The annual Site Condition Inspection report was completed and identified five new findings under the categories of fire separations and sprinkler systems. As a result of the findings, six activities were entered into CIRS. Of the activities, two remain open and on schedule.

CFM completed the annual emergency response training virtually to the internal emergency response team, consisting of senior managers, supervisors as well as immediate responders. The training department continued to deliver the emergency

response training in a virtual format in 2021. Starting in September 2021, Immediate Responder qualifications are reviewed on a monthly basis. If any qualifications are not current, the Immediate Responder is deemed “inactive” and is informed they are not to take on an active role during an emergency situation. At the end of 2021 only one Emergency Responder was inactive. All other training qualifications were current.

In 2021 there were two emergency response drills:

- Virtual Emergency Operations Centre (EOC) Activation drill
- On-Site Fire Response drill with Port Hope Fire Emergency Services

The objective of the EOC activation drill was to go through a medical related emergency scenario that would require activation of CFM’s Emergency Operations Centre (EOC) and its emergency response plan. The specific objectives of the exercise were to practice responding to an emergency situation, activating the EOC and practicing decontamination of a patient and responders as required. The exercise resulted in a good discussion on when the EOC would be activated. The exercise did not generate any follow-up activities or corrective actions.

The objective of the on-site drill was to go through a realistic emergency scenario that would require a response from the PHFES and require activation of CFM’s Emergency Operations Centre (EOC) and its emergency response plan. The specific objectives of the exercise were to practice the establishment of an Incident Command Post and ensure effective communication between CFM’s Incident Commander and PHFES’s Incident Commander. As a result of the exercise and following recommendations from the Fire Chief, four activities were entered into CIRS. This exercise assisted CFM meet the drilling requirements of CSA N393.

The two exercises met the requirements of *MSP 30-02 Emergency Response Plan* to perform an EOC activation drill twice per year.

Immediate Responder training occurred as planned and there is enhanced visibility on Immediate Responder qualifications.

The Site Condition Inspection concluded that there is sufficient evidence to conclude that the fire protection program is being followed and effectively maintains the condition of the facility in compliance with that required by CSA N393, the NFCC-2015, and other applicable codes and standards.

CFM continues to have a strong positive relationship with the Port Hope Fire Emergency Services (PHFES). During the annual drill it was reinforced that there is a clear relationship and that the response plan and incident command was understood by both parties.

With the positive outcomes from the emergency exercise with PHFES and the findings from the site condition inspection, the Emergency Management and Fire Protection has been deemed effective.

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 waste materials contaminated with 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 disposal.

Wastes generated at CFM are segregated as non-hazardous, contaminated hazardous or non-contaminated hazardous waste at the point of generation. Non-hazardous waste is either recycled or transferred to an appropriate waste management facility. Contaminated hazardous waste and non-contaminated hazardous waste is stored in appropriate containers pending assessment of recycling or disposal options in accordance with site procedures.

During 2021, CFM continued to improve the existing waste management program in accordance with Canadian Safety Association (CSA) standards *N292.3-14 Management of low and intermediate-low radioactive waste* and *N292.0-14 General principles for the management of radioactive waste and irradiated fuel*. Removal activities were undertaken in 2021 to address some of the accumulated legacy radioactive waste that has been stored at CFM for many years. This included sorting, removal of nuclear material and repackaging of legacy drums. Disposal of this material at an appropriately permitted facility continued in 2021 with three shipments removing just over 36 667 kg of legacy waste from the facility.

There was no significant generation of by-products at the facility in 2021.

All contaminated waste material was packaged and shipped in accordance with applicable Transportation of Dangerous Goods regulations. All waste was shipped to facilities that are licensed to accept the waste material.

CFM has waste processing and disposal streams in place for Contaminated Combustible materials that are generated through current production as well as a stream for marginally contaminated material. CFM also performs decontamination of other materials for recycling (metal) or disposal through domestic waste streams. As a result of the waste minimization effort and the removal of legacy waste along with inspection and audit results completed in 2021, management determined the waste management program to be considered effective.

Table 38 provides the amount of waste generated and recycled for hazardous and non-hazardous materials in 2021. The hazardous waste disposed in 2021 was lower than in 2020, the hazardous waste recycled was lower; however, the contaminated combustible waste that was shipped off site was higher in 2021.

Table 38

2021 Waste Management Results (kg)	
Hazardous Waste Disposed via Certified Waste Disposal Co.	600
Hazardous Waste Recycled	790
Hazardous (Contaminated) Combustible Waste Shipped BRR or other facility	6306

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.

CFM'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 plan and related procedures are considered prescribed information, subject to the requirements of the *Nuclear Safety and Control Regulations*.

Though CFM's security program is well managed and remains in compliance with CNSC regulatory requirements, the facility continues to look for enhancement opportunities. Management determined the security program at CFM is suitable and was reviewed to be effective by reviewing audit and inspection findings along with reviewing security concerns or incidents.

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/ International Atomic Energy Agency (IAEA) Safeguards and Non-proliferation Agreement. CFM maintains compliance with the CNSC regulatory document, *Accounting and Reporting of Nuclear Material, RD-336*.

All required reporting obligations to the regulators for 2021 were submitted either prior to the deadline or on time.

Additionally, starting in 2021, CFM started digitally submitting supporting documents / reports after completion of the audits to the regulators.

CFM participated in four safeguard inspections/activities in 2021:

- Short Notice Random Inspection, February 2021
 - Findings: No major findings
 - Performed by: IAEA inspectors.
- Design Information Verification (DIV), April 2021
 - Findings: No major findings
 - Performed by IAEA inspectors and CNSC personnel (participated remotely).
- Physical Inventory Verification/Design Information Verification, July 2021
 - Findings: No major findings
 - Performed by: IAEA inspectors and CNSC personnel (participated remotely).
- Short Notice Random Inspection, December 2021
 - Findings: No major findings
 - Performed by: IAEA inspectors and CNSC personnel (participated remotely).

All of the above activities were successfully completed without event or any notable non-conformance.

CFM is maintaining an effective safeguards program and is ensuring all measures required to ensure safeguards are implemented at the facility.

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.

UO₂ powder is transported by road from the PHCF to CFM. As well, UO₂ in the form of finished fuel bundles is transported in shipping containers that meet the package requirements as specified in the CNSC *Packaging and Transport of Nuclear Substances Regulations, 2015*.

There were no reportable events which occurred at CFM in 2021 that were in violation of the CNSC *Packaging and Transport of Nuclear Substances Regulations, 2015* or the *Transport of Dangerous Goods Act*. CFM determined the program is effective and suitable after reviewing the frequency and severity or lack of incidents.

Cameco has in place an Emergency Response Assistance Plan (ERAP) describing the system used by Cameco to respond to off-site transport incidents for Class 7 products. The plan which has been accepted by Transport Canada is pursuant to federal transportation of dangerous goods requirements and applies to transportation emergencies. Transportation activities related to the shipping and receiving of goods to or from CFM are included in the plan.

3. OTHER MATTERS OF REGULATORY INTEREST

3.1.1 Public Information Program

In 2021, CFM continued to fully meet the requirements of the CNSC *REGDOC 3.2.1, Public Information and Disclosure*.

Many communications and public engagement activities were once again impacted by the ongoing COVID-19 pandemic. Efforts were made to adapt where possible. For 2021, the communications team at Cameco's FSD was comprised of a manager of public and government affairs and one communications specialist. The divisional communications team is part of Cameco's corporate Sustainability and Stakeholder Relations department.

Impacts of COVID

The ongoing pandemic continued to create an uncertain environment that affected various initiatives. Some of the events that did not occur in 2021 include:

- Career Day
- Community BBQ
- Port Hope Fall Fair

Other activities were altered or adapted to virtual platforms. These include:

- CNA Conference
- Step Up for Mental Health 5K (virtual)
- Cameco annual charity golf tournament (non-traditional format)

Due to COVID, many community events typically sponsored by Cameco were cancelled in 2021. Examples include the Cobourg Sandcastle Festival, Day of Caring, Port Hope Movies in the Park, Canada Day Parade, Cobourg Waterfront Festival, Float Your Fanny Down the Ganny and others.

However, Cameco was able to sponsor events that ran in a modified format, or that took place when restrictions were loosened. These events included the Cobourg Highland Games Pop-Up Patio events in August and September, the Northumberland Rocks Back United Way Fundraiser on August 20, An Evening with Steven Page at the Capitol Theatre on November 5, the Remembrance Day ceremonies in Port Hope and Cobourg on November 11, the Free Film Series at the Capitol Theatre in October, November and December, the Port Hope Santa Claus Parade on November 27, and the Capitol Theatre Festival of Trees throughout the month of December.

COVID Positive Cases

Over the holiday shutdown period in December 2021 there were several presumed and confirmed positive cases of COVID at the CFM.

Positive cases of COVID within the workforce were not unexpected given the highly transmissible Omicron variant and the level of community spread that was occurring. All of Cameco's employees are fully vaccinated. There was no impact to operations.

Employees were informed of these cases via communication from the VP, Fuel Services Division or the general manager.

Education and Awareness

Cameco leverages a range of communications tools to help inform and educate interested persons and/or groups of CFM's operations and activities.

Cameco issues its Energize newsletter to help keep the Port Hope community up to date. Three issues were published in 2021 and mailed to all addresses in the Municipality of Port Hope. Each issue was posted to camecofuel.com promoted on social media.



Spring 2021: <https://www.camecofuel.com/community/stories/energize-spring-2021>

Summer 2021: <https://www.camecofuel.com/community/stories/energize-summer-2021>

Fall 2021: <https://www.camecofuel.com/community/stories/energize-fall-2021>

Each issue provided readers with a variety of updates about Cameco's activities such as operational updates, community initiatives and survey results.

Public Inquiries: Ensuring stakeholders and residents have access to information about Cameco is an important component of the Public Information Program. Interested persons can contact Cameco via email (cameco_ontario@cameco.com) or phone (905.800.2020).

Public Polling



On August 31, 2021, Cameco announced the results of its annual Public Polling. Cameco has been polling the local community since 2004. The survey found that 91% of residents support the continuation of Cameco's operations in Port Hope. For the past decade, Cameco has maintained an approval rating above 80% and remains a trusted corporate citizen in the local community.

Other key findings from the 2021 survey include:

- Eight out of 10 respondents (85%) agree that Cameco does everything possible to protect people and the environment
- Seven out of ten (73%) respondents recall receiving a newsletter from Cameco; 92% of them read the newsletters.
- 82% of respondents think that Cameco makes information about its operations in Port Hope readily available to residents.
- Nine out of ten (90%) are aware that nuclear energy provides more than half of the electricity generated in Ontario, including 65% who are very aware.
- Nine out of ten (90%) respondents agree Vision in Motion is a step in the right direction and benefit for the community.

The summary of findings was posted to the website [Port Hope Community Survey Results 2021 - Making a Difference - Community - Cameco Fuel Services](#) and promoted on social media. The results were also featured in the fall issue of Energize.

Social Media



Social media remains a key tool in sharing information with the public and provides an opportunity for some engagement through sharing, comments, and private messages.

In 2021, the Cameco Ontario Facebook page grew by 102 followers ending the year with 1021 followers. The 102 posts over the course of the year shared information about Cameco’s operations, community initiatives and sponsorships.

The Cameco Ontario Twitter page grew by 39 followers with 372 followers by the end of the year.

The Cameco Instagram page continued to grow in 2021, reaching 655 followers, an increase of 145 followers. The content was primarily the same as what was posted to Facebook.



Top posts by Impressions

Post Title	Date	Impressions
Energize your career with Cameco	Jan 25, 19:38	7855
After 37 years, Blind River Refinery general manager Chris Astles is retiring. We wish you all the best!	Jan 08, 19:50	5642
Cameco Ontario has announced a \$100,000 combined donation to the Northumberland Fare Share Food Bank and Green Wood Coalition.	Dec 17, 20:46	4606

Public Disclosure

In 2021, CFM made no public disclosures.

Community Investment

2021 was once again impacted by changing government and public health restrictions creating an environment of uncertainty for events to be planned and/or executed. Wherever possible, events were delayed or executed virtually.

For the second year in a row, Cameco partnered with Dalewood Golf Club to offer the Cameco Charity Golf Package from August 1 to September 30, offering a socially distanced alternative to a traditional golf tournament. Cameco matched a portion of all player registration fees and matched all sponsorships at 100 per cent to raise a grand total of over \$35,000. An additional \$8,000 was raised from Ontario participants in the virtual Step Up for Mental Health 5K event held from October 1 to October 6.

On November 23, Cameco announced via a news release and social media that a total of \$43,000 was raised through the golf tournament, virtual 5K run/walk and other donations. Applications for the funds were accepted from November 23, 2021, to January 6, 2022. The news release was posted to the website: [Cameco Announces Over \\$43,000 Raised for Local Mental Health Initiatives - News Archive - Media - Cameco Fuel Services](#)

Over the course of 2021, Cameco provided support to 34 community organizations including Northumberland Hills Hospital, Northumberland Fare Share Food Bank, Green Wood Coalition, Northumberland United Way, Rebound Child and Youth Services, the Northumberland YMCA, Cornerstone, Curve Lake First Nation, and more. This does not include the organizations that were supported through the 2021 Step Up for Mental Health Fund.

Cameco also donated PPE to 10 local organizations to assist with the COVID-19 pandemic. Organizations that received PPE included Extendicare Cobourg, Food 4 All Northumberland, Community Care Northumberland, the Canadian Mental Health Association, Northumberland Humane Society, Northumberland United Way, Cobourg Fire Department, Hastings Fare Share Food Bank, Cramahe, Alnwick and Port Hope Fire Departments.



In December, Cameco's president and CEO was in Port Hope to announce a \$100,000 combined donation to Northumberland Fare Share Food Bank and Green Wood Coalition. Local media and

elected officials were invited to a small event and a news release was issued and posted to camecofuel.com. Photos from the event and a link to the release were posted to social media. [Cameco Announces \\$100,000 for Northumberland Fare Share Food Bank and Green Wood Coalition - News Archive - Media - Cameco Fuel Services](#)

Indigenous Engagement

Progress was made with Indigenous engagement over the course of 2021. Regular meetings were established with Curve Lake First Nation beginning in March 2021. Rama First Nation, Alderville, Hiawatha and the Mohawks of the Bay of Quinte expressed interested in receiving updates. While Cameco strives to keep Indigenous communities informed, it adapts its approach based on the interests and requests from the respective communities.

On October 29, 2021, Cameco submitted its Indigenous Engagement Report (IER) to the CNSC which was developed in support of CFM’s 20-year licence renewal request to fulfill the requirements of the CNSC’s REGDOC 3.2.2 Indigenous Engagement.

The information provided in this section describes CFM's activities under the PIP and the IER.

In the IER, Cameco committed to sending follow up letters to Indigenous Communities three weeks after submitting the licence renewal application to the CNSC. This activity was completed on October 27, 2021. Letters were sent to all seven Williams Treaty First Nations, Mohawks of the Bay of Quinte and the Métis Nation of Ontario. Hiawatha First Nation acknowledged receipt and Scugog Island First Nation requested an introductory meeting which took place on November 5, 2021. Cameco continues regular meetings with Curve Lake First Nation which have focused on CFM licensing.

The table below details the information emailed to First Nation Communities in 2021. Public Disclosures after March 2021 were also emailed to Curve Lake First Nation at their request and further discussed in monthly meetings.

Table 39

Topic	Method of Communication	Date	Indigenous Communities Contacted
Q4 2020 Compliance Report	Email	March 2, 2020	Hiawatha, Alderville, Curve Lake, Scugog Island, Rama, Beausoleil, Georgina Island, Mohawks
CFM 1-year licence renewal	Letter via email	March 10, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island, Rama, Beausoleil,

			Georgina Island, Mohawks and Métis Nation of Ontario
2020 Annual Compliance Report	Email	April 14, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island
Energize – Spring	Email	April 14, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island
Q1 2021 Compliance Report	Email	July 27, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island, Rama, Mohawks
Energize – Summer	Email	July 27, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island, Rama, Mohawks
CFM – Letter of Intent 20-Year Licence	Letter via email	September 29, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island, Rama, Beausoleil, Georgina Island, Mohawks and Métis Nation of Ontario
CFM – 20-Year application	Letter via email	October 27, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island, Rama, Beausoleil, Georgina Island, Mohawks and Métis Nation of Ontario
Q2 2021 Compliance Report	Email	November 4, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island, Rama, Mohawks
Q3 2021 Compliance Report	Email	December 10, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island, Rama, Mohawks
Energize – Fall	Email	December 20, 2021	Hiawatha, Alderville, Curve Lake, Scugog Island, Rama, Mohawks

Cameco held meetings with three Indigenous communities in 2021 – Curve Lake, Hiawatha and Scugog Island First Nations. Cameco established monthly meetings with Curve Lake and spent the majority of 2021 discussions focused on CFM due to CFM’s licensing activities. Curve Lake has expressed interest in environmental aspects such as emissions, monitoring and ERAs, as well as identifying opportunities to incorporate Indigenous Knowledge. Cameco consulted with Curve Lake on the development of its land acknowledgement which is available to employees to use. Cameco and Scugog Island First Nation agreed to establish regular meetings in 2022 and work towards building a meaningful relationship.

In the table below is a summary of the meetings and topics covered in 2021:

Table 40

Indigenous Community	Date of Meeting	Topics
Curve Lake First Nation	March 10	Introduction to Cameco - CFM & PHCF
	April 28	CFM 1-year
	May 26	CFM 1-year Environmental Performance
	June 30	Waste Management
	August 25	Community Investment, Sustainability and COVID Response
	Sept 22	CFM 20-year and production increase
	October 12	Facility tour – PHCF and CFM
	October 27	CFM Environmental Risk Assessment
	December 7	Preliminary Decommissioning Plans – PHCF and CFM
Hiawatha First Nation	March 30	Introduction to Cameco – CFM & PHCF
Mississaugas of Scugog Island First Nation	November 5	Introduction to Cameco – CFM & PHCF

Licence Renewals

On June 1, representatives from Cameco joined Port Hope Municipal Council to provide a delegation regarding CFM’s request to the CNSC to renew its operating licence for one year.

On September 29, 2021 CFM sent letters to the seven William’s Treaty First Nations, Mohawks of the Bay of Quinte and the Métis Nation of Ontario to inform these Indigenous groups that CFM submitted a letter of intent to the CNSC to renew its operating licence for a period of 20-years. The letter of intent was also provided.

On October 27, 2021 CFM sent letters to the seven William’s Treaty First Nations, Mohawks of the Bay of Quinte and the Métis Nation of Ontario to inform these Indigenous groups that CFM submitted its application to the CNSC to renew its operating licence for a period of 20-years.

On December 8, 2021, Cameco emailed letters to 71 community stakeholders and/or elected officials regarding CFM’s application to renew its licence for a 20-year period.

The letter provided a link to licence information on Cameco's website [20 Year Licence Renewal - Cameco Fuel Manufacturing - Business - Cameco Fuel Services](#) and offered tours (pending COVID situation) and/or meetings.

CFM's 20-year licence application was posted to the website [20 Year Licence Renewal - Cameco Fuel Manufacturing - Business - Cameco Fuel Services](#).

Information about CFM's licence renewals were included in the Spring and Fall issues of the Energize newsletter.

Industry

Cameco was a sponsor of the Canadian Nuclear Association conference which took place virtually from September 15 to 17. Cameco was a 'Gigawatt-level sponsor' and staffed a virtual booth.

In 2021, Cameco also continued its sponsorship of the Canadian Nuclear Isotope Council.

Cameco attended the Northumberland Manufacturers Association (NMA) Virtual Career Fair on May 6, 2021. The event was attended virtually by students and recent graduates looking for employment in Northumberland County. <https://thenma.ca/careerfair/>

Earned Media

Cameco received media coverage throughout the year covering a range of activities:

Cameco Fund for Mental Health 2020:

- **\$43,000 handed out through Cameco Fund for Mental Health**

Gonorthumberland.ca – Jan 20, 2021

<https://www.gonorthumberland.ca/2021/01/20/43000-handed-out-through-cameco-fund-for-mental-health/>

- **Six Northumberland organizations awarded Cameco mental health grants**

Northumberland News – January 20, 2021

<https://www.northumberlandnews.com/news-story/10310937-six-northumberland-organizations-awarded-cameco-mental-health-grants/>

Employee giving campaign fundraiser for the United Way:

- **Cameco Crushes It! \$55,000 for Northumberland United Way**

Newsnownetwork.ca – March 23, 2021 [Cameco Crushes It! | News Now Network - Community News Magazines](#)

- **Cameco Crushes It! \$55,000 for Northumberland United Way**

Porthopenow.com – March 23, 2021 [Cameco Crushes It! | Port Hope Now - News Magazine](#)

Cameco Fund for Mental Health:

- **\$43,000 handed out through Cameco Fund for Mental Health**

Gonorthumberland.ca – January 20, 2021

<https://www.gonorthumberland.ca/2021/01/20/43000-handed-out-through-cameco-fund-for-mental-health/>

- **Six Northumberland organizations awarded Cameco mental health grants**

Northumberland News – January 20, 2021

<https://www.northumberlandnews.com/news-story/10310937-six-northumberland-organizations-awarded-cameco-mental-health-grants/>

- **Cameco Mental Health Fund supporting creation of new program at Rebound Child & Youth Services**

Gonorthumberland.ca – March 2, 2021 [Cameco Mental Health Fund supporting creation of new program at Rebound Child & Youth Services | 93.3 myFM \(gonorthumberland.ca\)](#)

Award Nomination from the Northumberland Manufacturers Association:

- **Manufacturers' Association unveils 2021 excellence award nominees**

Northumberland News – September 8, 2021

<https://www.northumberlandnews.com/news-story/10472555-northumberland-manufacturers-association-unveils-2021-excellence-award-nominees/>

Virtual Step Up for Mental Health run:

- **Cameco – Step Up for Mental Health Run Goes Virtual**
Todays Northumberland – May 13, 2021:
<https://todaysnorthumberland.ca/2021/05/13/cameco-step-up-for-mental-health-run-goes-virtual/>
- **Cameco Step Up for Mental Health Run/Walk to support mental health programs in Northumberland**
Brightontoday.ca – May 25, 2021
<https://www.brightontoday.ca/2021/05/25/25744/>

Student Mission to Mars Competition:

- **Cobourg students part of winning virtual 'Mission to Mars Competition'**
Northumberland News – May 19, 2021:
<https://www.northumberlandnews.com/community-story/10394009-cobourg-students-part-of-winning-virtual-mission-to-mars-competition-/>

Week of Caring for Northumberland Eats:

- **'Week of Caring for Northumberland Eats' supports food voucher program amid COVID-19**
Northumberland News – June 3, 2021:
<https://www.northumberlandnews.com/news-story/10408381--week-of-caring-for-northumberland-eats-supports-food-voucher-program-amid-covid-19/>
- **Northumberland raises \$19,250 for Northumberland Eats through Week of Caring**
Northumberland News – June 16, 2021:
<https://www.northumberlandnews.com/news-story/10416964-northumberland-raises-19-250-for-northumberland-eats-through-week-of-caring/>

Cameco Fund for Mental Health 2021 total:

- **Cameco announces over \$43,000 raised for local mental health initiatives**

Today's Northumberland – November 23, 2021: [Cameco Announces Over \\$43,000 Raised for Local Mental Health Initiatives - Today's Northumberland - Your Source For What's Happening Locally and Beyond \(todaysnorthumberland.ca\)](#)

Cameco \$100,000 combined donation to Green Wood Coalition and Northumberland Fare Share Food Bank:

- **Cameco donates \$50K each to Northumberland Fare Share Food Bank, Green Wood Coalition**

Global News – December 17, 2021: [Cameco donates \\$50K each to Northumberland Fare Share Food Bank, Green Wood Coalition - Peterborough | Globalnews.ca](#)

- **Cameco Announces \$100,000 for Northumberland Fare Share Food Bank and Green Wood Coalition**

Today's Northumberland – December 17, 2021: [Cameco Announces \\$100,000 for Northumberland Fare Share Food Bank and Green Wood Coalition - Today's Northumberland - Your Source For What's Happening Locally and Beyond \(todaysnorthumberland.ca\)](#)

- **Cameco donates \$100,000 locally**

Port Hope Now – December 21, 2021: [Cameco Donates \\$100,000 Locally | Port Hope Now - News Magazine](#)

COVID-19 cases at CFM:

- **Seven presumed and confirmed cases of COVID at Port Hope Conversion Facility and at Cameco Fuel Manufacturing**

Today's Northumberland – December 22, 2021: [Seven Presumed and Confirmed Cases of COVID at Port Hope Conversion Facility and at Cameco Fuel Manufacturing - Today's Northumberland - Your Source For What's Happening Locally and Beyond \(todaysnorthumberland.ca\)](#)

Advertising

Cameco conducts advertising to support various activities in the local community. In 2021, much of the advertising was conducted through social media platforms and local radio.

Social media advertising was used to build awareness of Cameco’s Step Up for Mental Health activities including the virtual run/walk, golf package and application process. The three social media campaigns on Facebook and Instagram ran at various times through the year:

- Virtual Step Up for Mental Health: Ads ran from May 20 to June 1, 2021, to promote the virtual Step Up for Mental Health event being held in October 2021.
- Cameco Charity Golf Package: Ads ran from July 26 to September 4, 2021, promoting the Cameco Charity Golf Package, raising funds for the Cameco Fund for Mental Health.
- Cameco Fund for Mental Health Applications: Ads ran from December 8, 2021, to January 6, 2022, promoting the application process for the Cameco Fund for Mental Health.



Online ads were placed with Today’s Northumberland, Port Hope Now, Cobourg Now and Go Northumberland.

Radio advertising was used to promote Cameco’s Step Up for Mental Health virtual run/walk and promote the application process. A Christmas greeting also ran at the end of the year. The three radio campaigns ran at the following times:

- Cameco Charity Golf Package – July 31 to August 29, 2021
- Christmas Greetings – December 7 to December 26, 2021
- Cameco Fund for Mental Health Applications – December 15, 2021 to January 2, 2022

Cameco also continued the monthly community partner advertising program with the local radio station. With this program, a one-month radio advertising package is donated to a local charity or community organization each month.

Cameco placed print ads in Northumberland Hills Hospital Gala booklet and the Northumberland News

Government Stakeholders

Government relations (GR) involves building strong relationships and positive interactions with local elected officials. Cameco engages in GR activities at the municipal, provincial, and federal levels. The majority of federal engagements take place through Cameco's GR experts located in Ottawa and Saskatoon. Locally, the focus is primarily on municipal and provincial officials.

In 2021, Cameco and the Municipality of Port Hope agreed to discontinue the practice of posting quarterly and annual reports from Cameco. Cameco remains committed to providing the Municipality with open and transparent information and providing at least one update to council each year – or more as needed.

On June 1, representatives from Cameco joined Port Hope Municipal Council to provide a delegation regarding CFM's request to the CNSC to renew its operating licence for one year.

Cameco was represented on the Ontario Vaccine Support Council where Cameco was able to confirm its interest in securing vaccine doses for its essential workers in Ontario. Cameco also worked with the Ontario government, including with the local MPP's office to secure COVID-19 testing kits for its facilities. A letter of thanks was sent to the MPP for his support in the process.

Tours

As a result of the ongoing COVID-19 global pandemic, tours were extremely limited.

However, members of Curve Lake First Nation were able to tour PHCF and CFM on October 12, 2021. They were provided with an overview of Cameco's operations by the VP, Fuel Services Division and the general managers of both facilities led their respective facility tour.



Website

Cameco has a dedicated website for its Ontario operations: [Home - Cameco Fuel Services](#). Cameco updated its website with information throughout 2021 including:

- Three Energize newsletters
- Public polling results
- Cameco Step Up for Mental Health activities
- Quarterly and annual CNSC reports
- CFM's 20-year licence application was posted to the website
- [20 Year Licence Renewal - Cameco Fuel Manufacturing - Business - Cameco Fuel Services](#)
- A recording of the presentation to the Municipality of Port Hope was posted to the website:
- [CFM Presentation to Port Hope Municipal Council – June 1, 2021 - News Archive - Media - Cameco Fuel Services](#)
- Unionized workers at CFM accept contract offer
- Cameco announcement of \$100,000 donation to the Northumberland Fare Share Food Bank and Green Wood Coalition.

Communications Products

Cameco strives to provide accurate and timely information to stakeholders and other interested parties. Information products are developed to support various communications and engagement vehicles and activities. The COVID-19 pandemic impacted the normal cycle of events, however Cameco continued to keep the community informed through its Energize newsletter and digital channels such as the website and social media.

- Three issues of Energize – mailed to Port Hope addresses and posted online
- Leveraging social media to link to Energize and other key updates for the public
- Public Polling summary of results – posted online and linked from social media
- Advertising on local media

3.1.2 Site-Specific

CFM's Ceramics lab has the capabilities and equipment to produce small quantities of special material fuel containing enriched uranium. These fuel types are manufactured in a similar manner but on a smaller scale than natural uranium manufacturing. As CFM has the ability to handle enriched UO_2 in batch processes and in solid form, nuclear criticality safety is achieved by employing engineered and administrative controls over batch size (Smallest Critical Mass) in processing and storage areas. CFM has a *Nuclear Criticality Safety Program Manual* (CFM-NC) to address the handling and processing of enriched uranium. The CFM-NC has been developed to guide generation and implementation of CFM's criticality prevention practices as they pertain to licensing and criticality prevention issues. This safety program meets the CNSC regulatory document *REGDOC - 2.4.3 CNSC Regulatory Document Safety Analysis Nuclear Criticality Safety v1.1*. The manual was updated in 2021 to reflect changes in the acronym to align with CFM's updated document structure, include reference to the revised REGDOC, revise the CCC meeting frequency and to update the format.

Processing of any amount of enriched material at CFM is governed by a criticality control committee (CCC) as described in the CFM-NC.

There were no processing activities of enriched material conducted on site in 2021.

Cameco maintains the required nuclear liability insurance for CFM as required under the Canadian *Nuclear Liability Act*.

CFM has a CNSC approved Preliminary Decommissioning Plan (PDP), which was updated in 2021 in accordance with the CNSC guidance documents *G-219, Decommissioning Planning for Licensed Activities*, and *G-206, Financial Guarantees for the Decommissioning of Licensed Activities*. With the update of CFM's Preliminary Decommissioning Plan in 2021, this reduced liability allowed for a reduction of financial guarantee required by the G-206.

CFM met all site-specific reporting requirements.

3.1.3 Improvement Plan and Future Outlook

Some of the improvement plans and the future outlook at CFM for 2022 include:

- continue to reduce workplace hazards.
- continue to improve ergonomics through implementation of the upcoming corporate ergonomic standard and updating the Industrial Athlete program.
- continue promotion and involvement of all personnel in continuous improvement.
- improve effectiveness of internal communications by ensuring various departments are open in their communication with each other and that employee recognition is given a renewed priority.
- incorporate 360-degree feedback from exercise completed in 2021 for people leaders, focusing on Emotional Intelligence.
- continue to implement recommendations from Waste Reduction Plan and Waste Audit.
- continue to support plan to remove legacy waste from site.
- continual adaptation and deployment of COVID protocols as required; and
- maintain compliance to regulatory, industry and corporate standards.
- support nuclear safety through continual product quality improvement.

Other than relicensing, CFM is not planning any other major changes in 2022 that may require approval from the Commission.

3.1.4 Safety Performance Objectives for Following Year

CFM 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.

The following is a summary of the projected facility operations, changes to equipment, procedures, production capacity, organization, and licensing documents that are planned for 2022:

- support activities for licence applications.
- submit updated Environmental Program manual.
- implement changes needed to run a depleted uranium bundle campaign; and
- submit updated Radiation Protection Program manual.

4. CONCLUDING REMARKS

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

CFM management systems continue to be effective in providing an appropriate level of management direction to CFM. Opportunities for continual improvement continue to be identified and acted upon. As such, CFM is positioned to effectively manage operational risks and needs while continuing to improve.

Improvements will include continued work to clarify expectations through improved procedures and training material, continued responsiveness to employee identified and data driven SHEQ improvements, and continuing to stabilize equipment reliability, particularly of those processes that have been recently installed.

Overall, it was determined during the management review that the CFM Management Systems, adhering to the N286, N299.1 and N285.0 standards, and the CFM License Conditions (LCH) are suitable, adequate, and effective.

As a result of the effective programs, plans and procedures in place, CFM was able to maintain individual radiation exposures well below regulatory dose limits. In addition, environmental emissions and public radiation exposures continued to be controlled to levels that are a fraction of the regulatory limits.

In 2021, there was one action level exceedance associated with an employee's internal dose. There were no other action level exceedances in the radiological or environmental monitoring program.

CFM remains committed to continual improvement and will continue to engage all employees in the identification and implementation of activities that reduce injury risks, increase environmental protection, improve product quality and efficiency in 2022.