Title:	Facility Licensing Manual			Doc. No.	CFM-FLM
Date Issued:	August 5, 1999	Date Revised:	July 28, 2020	Version:	10

Record of Revisions			
Version No.	Date	Description of Revision	Prepared/Revised by
1-6		For version history see version 9	N/A
7	September 8, 2011	This revision addresses the questions raised from the CNSC's letter dated July 5, 2011 titled "*CNSC staff review of Cameco Fuel Manufacturing Radiation and Environmental Protection Manual (R&EPM rev. 7)*". Please refer to CFM document PH7-9618.11 for complete details.	N/A
8	January 10, 2013	• Updated sections 7.2.13.3 & 7.2.13.4 to align with MSP 29-04 'Waste Management' • Updated section 7.2.14 to capture BMS extraction system • Updated Appendix D to reflect current facility configuration • Combined Appendices F & G from Rev #7 into a single Appendix F titled 'Plant Layout – Processing Lines' in Rev #8 Updated sections #14.1 & #14.2 under the heading 'Quality Assurance'	N/A
9	June 9, 2014	• Updated section 14.1 to align with the management system program requirements specified in CFM's LCH. • Deleted any historical reference to the R 213 Standard in section 14.1 • Updated a number of MSP/Work Instruction references #'s throughout document (to ensure they are in alignment with present practices). Deleted all reference to the Safety, Health, Environment and Quality "Statement" and updated to Safety, Health Environment and Quality "**Policy**" throughout the document.	N/A
10	July 28, 2020	Complete rewrite to align with the safety and control areas and Licence Conditions Handbook	Rebecca Peters

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1.0 INTRODUCTION

1.1 Scope

The Facility Licensing Manual (FLM) is a document that describes how Cameco Fuel Manufacturing Incorporated (CFM) meets the licence conditions defined in its Fuel Facility Operating Licence (FFOL) and associated Licence Conditions Handbook (LCH) issued by the Canadian Nuclear Safety Commission (CNSC). The FLM provides an overview of the CFM documents that describe the licensing basis organized by Safety and Control Areas (SCA), in order to comply with the licensing requirements under sections 24(4)(a) and (b) of the *Nuclear Safety and Control Act* (NSCA).

1.2 CFM Overview

CFM fabricates nuclear fuel for power and research reactors at its Fuel Fabrication Facility located in Port Hope, Ontario. The Port Hope facility is housed in a building that was originally constructed in the late 1950s and has operated as AMF Atomics, Westinghouse Canada and Zircatec Precision Industries before being acquired by Cameco in 2006 when CFM, a wholly owned subsidiary of Cameco, was created. The facility has been expanded and reconfigured several times during this period.

Cameco is a fully integrated resource development company with uranium mining operations and processing facilities in Canada and abroad. Cameco's Fuel Services Division (FSD) operates a uranium refinery, the Blind River Refinery (BRR), in Blind River, Ontario a uranium conversion facility known as the Port Hope Conversion Facility (PHCF) and CFM's fuel fabrication facility, both located in Port Hope, Ontario. CFM also operates a specialty metals fabrication facility in Cobourg, Ontario to facilitate the complete CANDU fuel supply cycle.

CFM-Port Hope is operated under a FFOL issued by the CNSC. Licence requirements are prescribed in the *NSCA*. The operations performed at CFM are also subject to supporting regulations issued by the Commission with respect to materials, transportation, security and safeguard obligations. Descriptions of the various processes and key safety systems have been summarized in this manual as have the site management system and associated programs that have been developed and implemented to meet corporate objectives and regulatory requirements. Key elements in specific programs are highlighted to demonstrate compliance to the facility licence as well as applicable federal and provincial statutes.

This document forms part of the licensing basis for the site and thus is structured in accordance with the CNSC Safety Control Areas (SCAs), as denoted in the current revision of the site Licence Conditions Handbook (LCH).

1.2.1 Description of the Site

CFM is located at 200 Dorset Street East, Port Hope, Ontario (Figure 1) in the Municipality of Port Hope (MPH). The facility is located on approximately 16 hectares, of which approximately 2.3 hectares, located on the southernmost portion of the property, is operated under a fuel facility operating licence from the CNSC and approximately 12 hectares is undeveloped (Figure 2). The facility is adjacent to the approved truck route for the municipality, which also links MPH with the Town of Cobourg to the south and to the north of the property is a Canadian Pacific Railway (CPR) right-of-way.

1.2.2 Location and Layout of the Facility

The CFM Port Hope site is shown in Figure 3 and is comprised of the main manufacturing building and three steel pre-fabricated buildings; the Waste Storage Building, the Maintenance Storage Building and the Fuel Storage Building. The legal description of the facility is provided in Appendix A.

Figure 1 Cameco Fuel Manufacturing in the Municipality of Port Hope

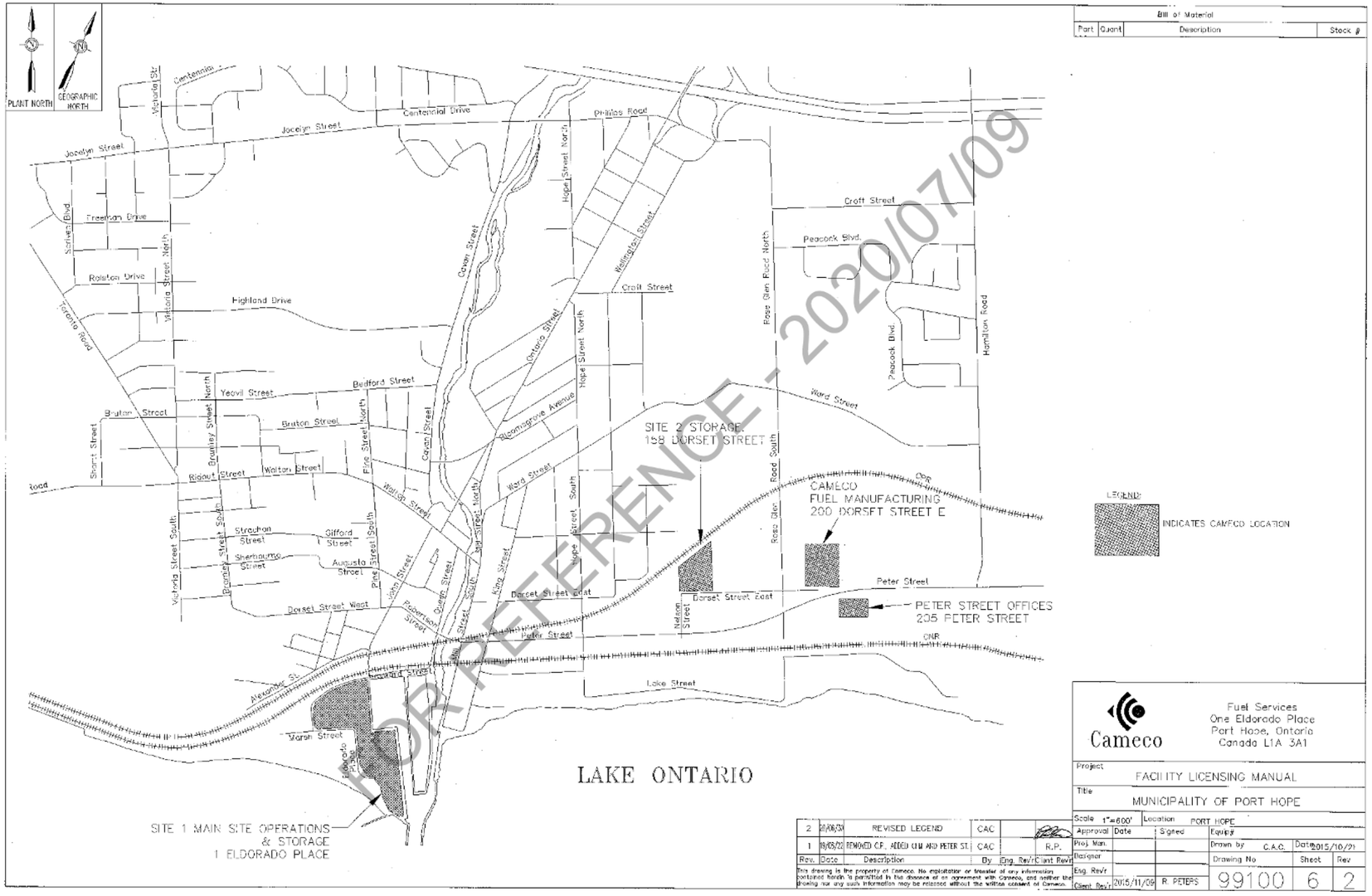

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Figure 2 Cameco Fuel Manufacturing Property

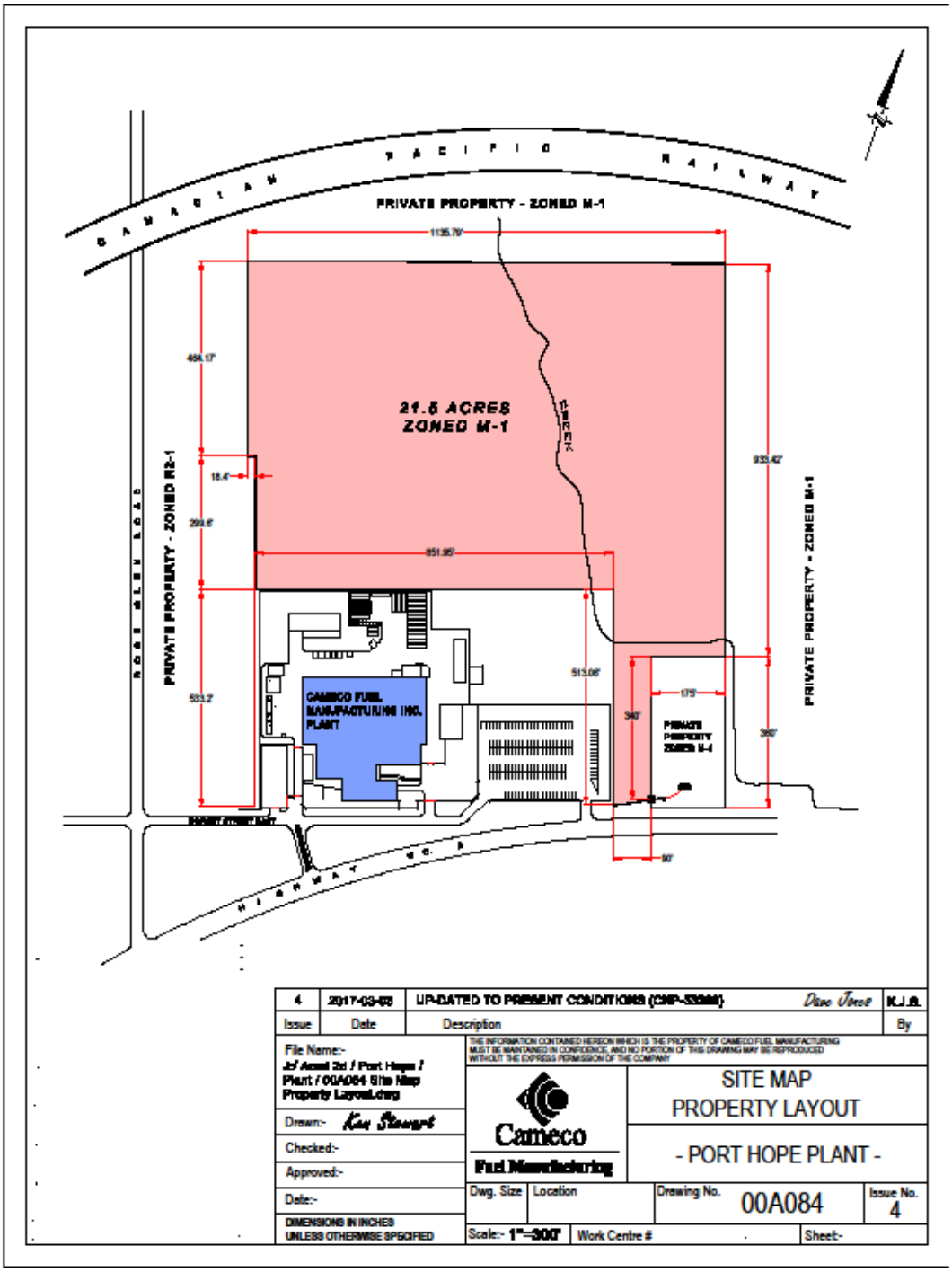
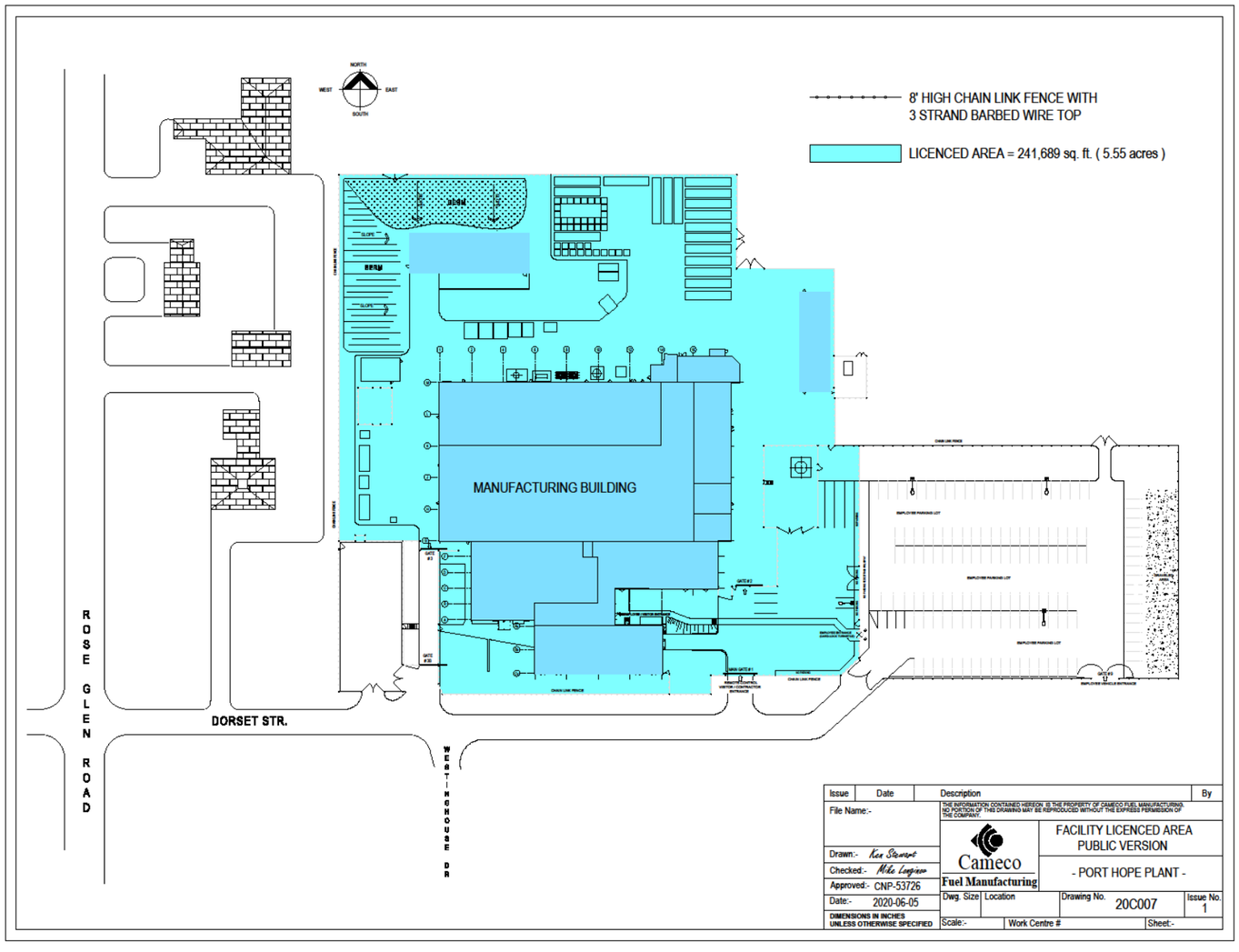


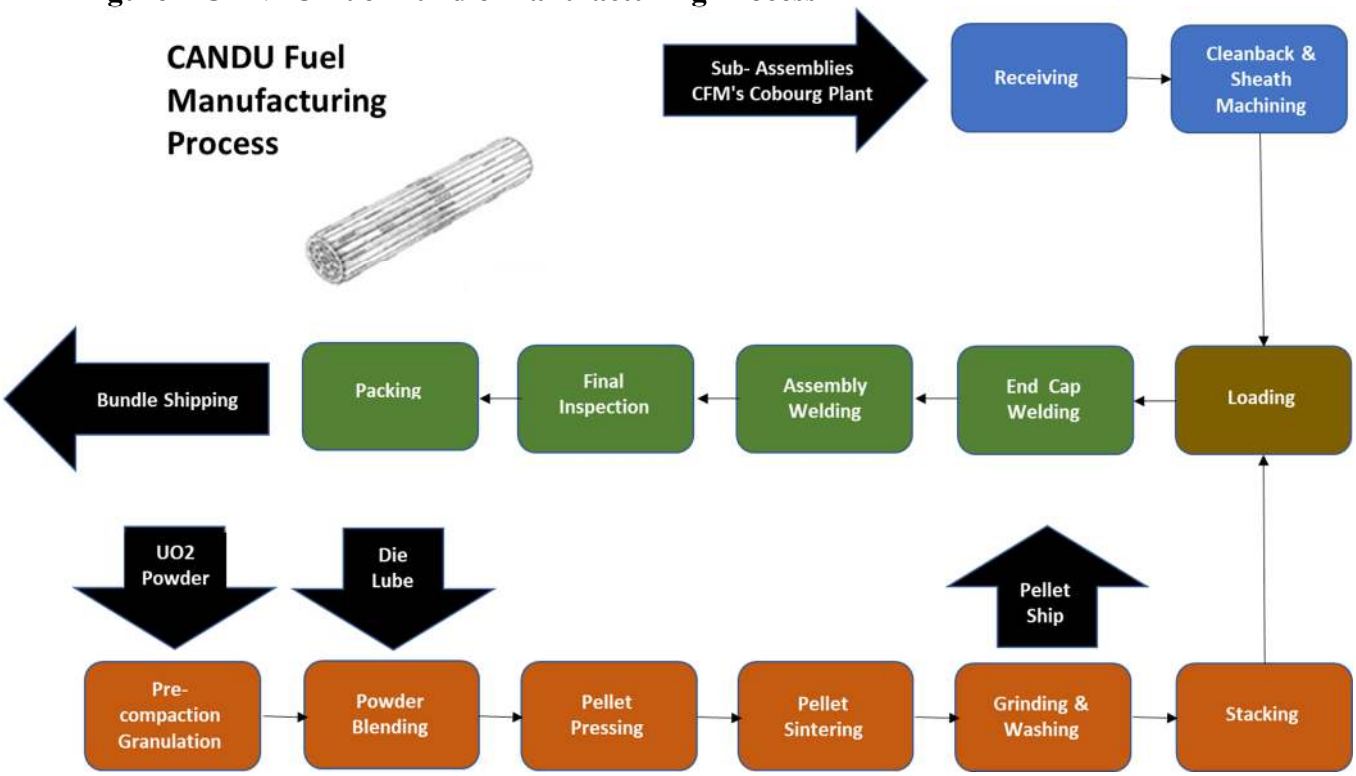
Figure 3 Facility Licensed Area



1.2.3 Fuel Fabrication Process

A simplified block diagram of the fuel fabrication process is provided in Figure 4. CFM has a licensed capacity of 125 Megagrams (Mg) of Uranium Dioxide (UO_2) as pellets during any calendar month.

Figure 4 CANDU Fuel Bundle Manufacturing Process



Note: Intermediate products at various stages of the manufacturing process are, at times and dependent upon market conditions, packaged and sold to other nuclear fuel producers.

1.2.4 UO_2 Pellet Operations

Uranium dioxide (natural or depleted) is received in drums and transferred into processing vessels and, along with any recycled material that might need to be added to it, is subjected to pre-compaction, granulation and blending operations in order to condition the powder for the pellet pressing operation. The conditioning of the powder is performed by conventional powder processing techniques. The conditioned powder is then transferred in its processing container to the pellet pressing operation.

Using a conventional tablet press, the conditioned powder is compressed within a die cavity to produce a cylindrical pellet compact of the appropriate size. The pressed pellet compact is of relatively low density and friable under severe handling conditions until it is passed through an electrically heated sintering furnace within a hydrogen atmosphere. This operation reduces the pellet compact to stoichiometric UO_2 composition and converts the pellet's physical form to a hard, high density, non-friable ceramic pellet.

Sintered pellets are ground using a through feed, conventional centreless grinder to produce a cylindrical part that conforms to the specification requirements for diameter and surface finish. Ground pellets then are washed, dried and inspected. Pellets may be packed into shipping containers for shipment to customers or stacked end to end to create pellet stacks of appropriate length for bundle assembly operations.

1.2.5 Bundle Assembly Operations

The stacks of uranium dioxide pellets are inserted into zirconium tube subassemblies received from CFM's Cobourg facility. A zirconium alloy end cap is resistance welded to each end of the subassembly tube containing a stack of fuel pellets. Prior to welding the endcaps, the ambient air around the pellets within the tube is purged with helium and then the fuel pellets are hermetically sealed from the atmosphere.

After verification of the quality of the weld, individual fuel elements are assembled into a fixture that holds them to the required configuration while the zirconium alloy end plates are permanently attached to the element ends by resistance welding to create fuel bundles. Completed bundles are inspected via a series of non-destruction visual and dimensional tests. Accepted bundles are placed into an approved shipping container, and then moved to a secured storage area to await shipment.

1.2.6 Pre-Press and Granulate Process

CFM also processes UO_2 powder through the pre-press and granulate (PP&G) process for the PHCF. The PP&G UO_2 is required to meet specific customer specifications. This involves receiving the UO_2 in drums and pre-compacting it and granulating it in CFM's powder processing equipment and repackaging it for return to PHCF.

1.2.7 Waste Treatment Operations

Waste treatment operations support the operations by collecting UO_2 scrap, grinder cooling water, dust collector material to produce in-house recoverable (recycle add-back) or prepare the material to be returned to BRR or PHCF for uranium recovery and recycling.

1.2.8 Fuel Development/Ceramics Lab

The Fuel Development/Ceramics Lab is a commercial engineering laboratory, equipped for handling un-irradiated depleted, natural, or enriched nuclear fuels. The lab contains equipment for fuel fabrication development and prototyping. The area may be used for other purposes such as fuel pellet storage when development activities are not taking place.

A prototype enriched fuel development project typically requires 50 - 100 kg of uranium dioxide. The uranium is fabricated into various forms such as pellets or kernels in the laboratory. Sintering can be performed in the production area utilizing segregated and identifiable furnace carriers or in the laboratory itself. The fuel is assembled into zirconium alloy or other carrier materials, evaluated and shipped to licensed customer locations, typically for testing purposes.

Manufacturing processes and techniques utilized for prototype enriched fuel are typically the same as for natural uranium dioxide fuel processing described earlier; all operations are conducted in accordance with CFM's Nuclear Criticality Safety Program Manual and the CNSC regulatory requirements.

1.3 Fuel Facility Operating Licence

The Fuel Facility Operating Licence (FFOL-3641/current version) authorizes CFM to:

(i) operate its nuclear fuel facility for the production of nuclear fuel bundles from depleted, natural, and enriched uranium compounds, at 200 Dorset Street East, Port Hope, in the province of Ontario, as more particularly described in the Cameco Fuel Manufacturing Facility Licenced Area Drawing 05C144;
(ii) possess, transfer, use, process, import, package, transport, manage store and dispose of the nuclear substances that are required for, associated with, or arise from the activities described in (i);
(iii) possess and use prescribed equipment and prescribed information that are required for, associated with, or arise from the activities described in (i).

There have been no licence amendments within the current licence term.

1.3.1 Licensing Basis

The licensing basis is the boundary conditions for acceptable performance at the facility and is defined as the information upon which the Commission rendered their decision. It includes information provided in the licence application, its attachments and the documents referenced within, as well as commission member documents and transcripts from the relicensing hearings. The conditions and safety control measures of this Facility Licensing Manual (FLM) and the CNSC Licence Conditions Handbook, and the documents referenced within provide an overview of the licensing basis, and also provide a framework under which

facility changes may be made, documents supporting the licensing basis may be updated, and other requirements such as standards and REGDOCs may be implemented, within the licence term.

Table 1: CFM Documents Relevant to the Licensing Basis

Document Title	Site/Division/Corporate
Application for Renewal of Fuel Facility Operating Licence (FFOL-3641.0/2012) for a 10-year term (April 15, 2011)	Site

1.3.2 Notification of Changes

CFM may make continuous improvements to facility design, operating conditions, policies, programs, methods, studies and third-party reports referred to in the licensing basis that are directly relevant to safety and control measures during the licence term if they remain within the licensing basis.

The following questions are initial screening criteria which would trigger further evaluation of impact to the licensing basis and potential notification to CNSC.

1- Is this a new or different activity than what the licence specifies?
2- Will it require a change to any of the site documents listed in the LCH or licence?
3- Will this change the site layout?
4- Does this change have the potential to negatively impact the safety case for the facility?

In accordance with the operating licence, CFM will give CNSC written notification in advance of proposed changes with the potential to change designs, operating conditions, documentation or other elements that are integral to the licensing basis outside of the licensing basis approved by the Commission. This notification will include CFM's assessment of the change to confirm it remains within the licensing basis. Additional information and/or lead time may be required for CNSC staff to complete their assessment of the proposed change. If a change is determined to be outside of the licensing basis, it will be referred to the Commission before it can proceed.

2.0 SAFETY AND CONTROL AREAS

2.1 SCA – Management System

Legislative Requirement: The *General Nuclear Safety Control Regulations* require a licence application to contain the organizational structure, including the internal allocation

of functions, responsibilities and authority. The *Class I Nuclear Facilities Regulations* require that a licence application contain information on the proposed quality assurance program for the activity to be licensed, including the measures to promote and support safety culture.

Table 2: CFM Documents Relevant to Management System SCA

Document Title	Site/Division/Corporate
Safety, Health, Environment and Quality Policy	Corporate
Management Systems Program Manual (CFM-MS)	Site

CFM is in the operational phase of its nuclear life cycle. CFM produces uranium dioxide pellets and fuel bundles. The management system program at CFM is the framework that currently guides the processes and programs required to ensure safety objectives are achieved, performance is monitored and a healthy safety culture is maintained. The Management Systems Program Manual meets the requirements of CSA N286-12 (R2017): *Management System Requirements for Nuclear Facilities* and REGDOC 2.1.1: *Management System.*

2.1.1 Safety, Health Environment and Quality Policy

Consistent with our vision, values and measures of success, Cameco recognizes the safety and health of our workers and the public, protection of the environment, and quality of our processes as the highest corporate priorities during all stages of our activities, which include exploration, development, operations, restoration, decommissioning and reclamation. As such, we are striving to be a world class performer in all aspects of our business through a strong safety culture, environmental leadership, operational excellence and our commitment to the following:

- Preventing injury, ill health, and pollution;
- Fulfilling compliance obligations;
- Keeping risks at levels as low as reasonably achievable, taking into account economic and societal factors;
- Ensuring quality of processes, products and services; and
- Continually improving our overall performance.

These commitments are reflected in the safety, health, environment and quality (SHEQ) policy which is publicly available on the Cameco website (www.cameco.com). These

commitments are approved and supported by Cameco's board of directors. The officers, senior management and all employees are accountable for the performance of their jobs in compliance with this policy and all relevant legislation.

2.1.2 Organizational Structure

Cameco is a fully integrated resource development company and as such maintains a divisional structure to reflect the diversity of operations within the organization. Corporate offices are maintained in Saskatoon.

The organizational structures of the FSD and CFM are shown in Figures 5 and 6. The vice-president, fuel services, directs the operation of and maintains corporate responsibility for CFM. The general manager, CFM, has the responsibility of operating the facility in accordance with the corporate policies, principles and operating budgets approved by the company's board of directors. To facilitate administrative control within the facility, employees have been organized into a number of departments. Production and service-oriented departments have been segregated, but all departments report to the general manager. Designated personnel are responsible for all operations within their departments which must be carried out in a manner consistent with company policies, programs, plans and procedures.

In accordance with Section 15 of the *General Nuclear Safety and Control Regulation*s, the persons who have the authority to act for CFM in dealings with the Commission, and the names and position titles of the persons who are responsible for the management and control of the licensed activities are documented in writing and provided to CNSC staff. This information is considered confidential and is provided under separate cover. Any change to these names and positions shall be reported to the CNSC using form PHF 4449 "Persons Having Authority to Act for CFM in Dealings with the CNSC" within 15 days of the change.

Figure 5: Organizational Structure – Fuel Services Division and Corporate

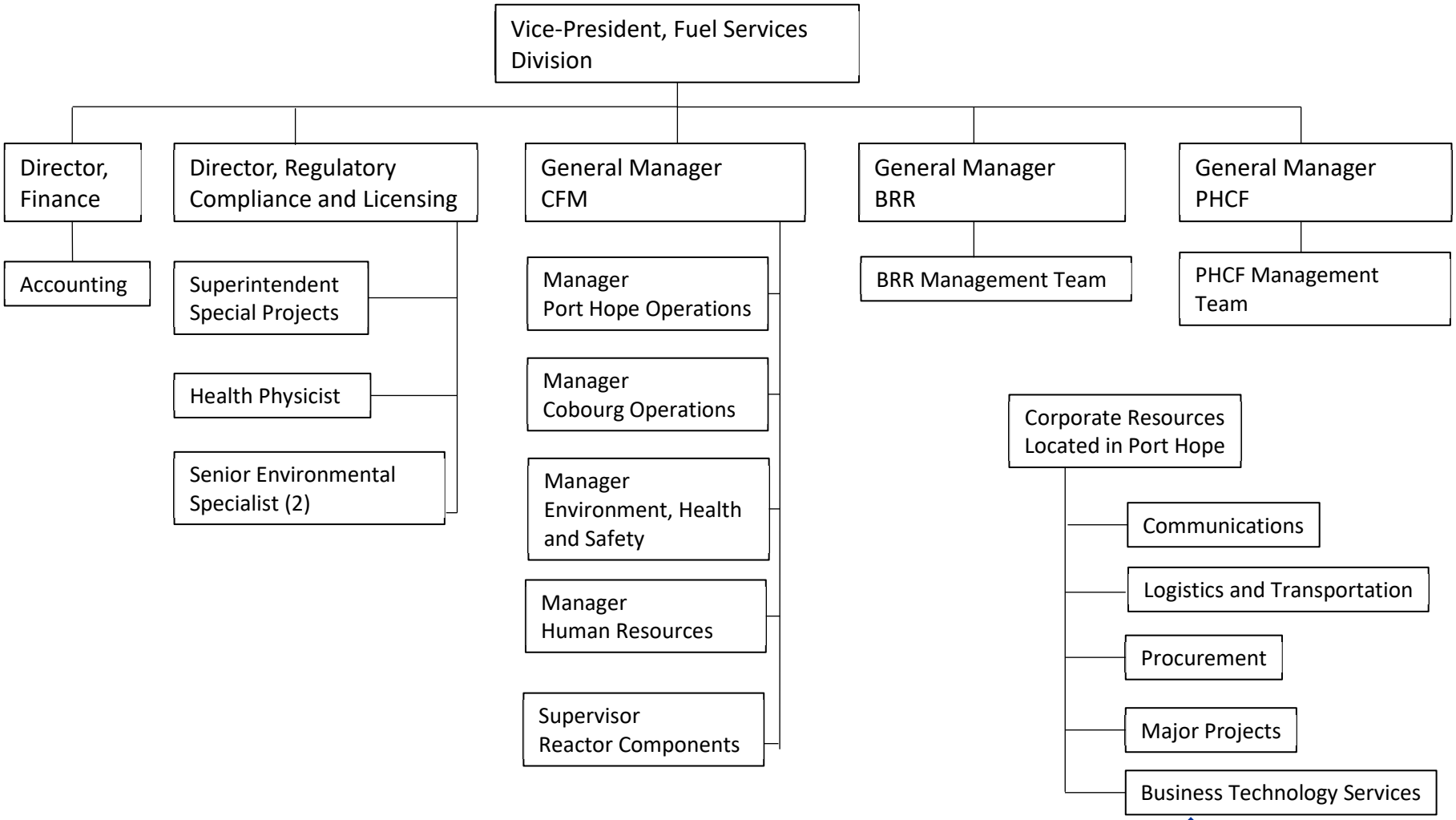
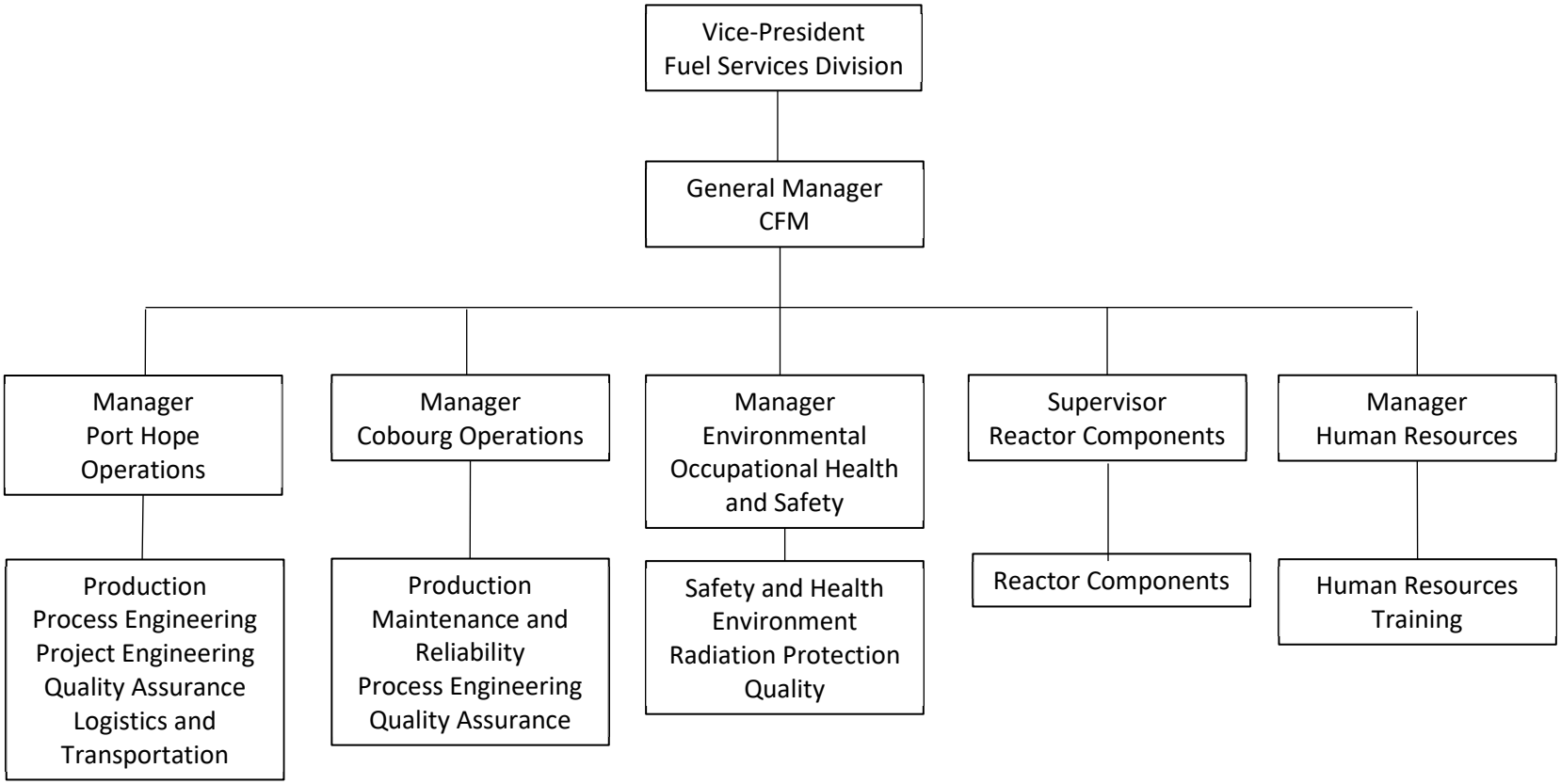


Figure 6: CFM Organizational Structure



2.1.3 Management System Program

The Management Systems Program Manual (CFM-MS) describes the management system program that is in effect to ensure that licensed activities are effectively controlled.

This section of the FLM provides an overview of how CFM-MS meets the requirements of the CNSC SCA-Management System. The CFM-MS is a part of the licensing basis for CFM and is a controlled document that is periodically reviewed and revised to ensure its continued effectiveness.

Many of the licensed activities are controlled by simply documenting procedures or providing qualified personnel. Additional controls are established commensurate with the safety significance of the activity or system. The equipment and systems with the highest safety significance, with respect to protection of people and the environment, are:

a) Emission control systems;
b) Hydrogen storage and distribution systems; and,
c) Criticality monitoring.

The management system is based on the following principles, which are described in more detail in CFM-MS, and applied in a graded manner commensurate with risk.

- Safety is the paramount consideration guiding decisions and actions;
- The business is defined, planned and controlled;
- The organization is defined and understood;
- Risks are identified and managed;
- Resources, generally captured as financial, human and infrastructure, are identified and managed;
- Communication is necessary and must be effective to achieve business objectives;
- Information is identified and managed;
- Work is identified and managed;
- Problems are identified, assessed for significance and resolved as appropriate to the significance;
- Changes are identified and controlled;
- Assessments are performed;
- Experience is sought;
- The management system is continually improved; and
- Corporate oversight is defined and performed to ensure the management system meets the business needs of the organization.

2.1.4 Safety Culture

Cameco's corporate focus on its management system through governance, quality and safety culture drives accountability and oversight at all operations.

Divisional oversight and collaboration is enhancing the FSD safety culture through consistency, management system enhancements and/or divisional program development, to improve safety and environmental performance.

The following are examples of some of the tools that are in place at CFM to support a strong safety culture:

- In order to enhance and continue support of a questioning attitude in employees and to ensure that an appropriate level of investigation and/or corrective action, the Corrective Action Process and the associated Cameco Incident Reporting System (CIRS) are used to drive continual improvement. CIRS is available to all employees for initiating records for events, concerns and conditions.

- CFM's leadership team has an ongoing expectation to ensure their presence in different areas of the facility and to continually improve communications between operators and the leadership team.

- Cameco has joined the CANDU Owners Group (COG), and is working through other nuclear industry affiliations to share experiences and learn from other organizations in addition to ongoing sharing of best practices across sites within Cameco.

Cameco conducts safety culture surveys (also called safety culture assessments) on a five-year cycle at all sites within the FSD. These surveys gauge the perception of employees in relation to safety culture in a scientifically meaningful way. From these surveys/assessments action plans are developed in areas where opportunities for improvement are identified. Action plans are entered into CIRS for tracking and follow-up.

The CFM and FSD leadership teams are committed to enhancing a sustainable safety culture and will continue to work diligently to ensure that all employees remain engaged to the extent possible.

2.1.5 Public Information and Disclosure

Legislative Requirement: The *Class I Nuclear Facilities Regulations* require that an application for a licence contain the proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the

environment and the health and safety of persons that may result from the activity to be licensed.

The objective of the public information program is to foster open dialogue between the company and persons living in the vicinity of Cameco's Ontario operations. The program has been designed to meet the requirements of REGDOC 3.2.1: *Public Information and Disclosure*. The PIP also describes Cameco's Indigenous outreach in both the Blind River and Port Hope areas.

Table 3: CFM Documents Relevant to Public Information

Document Title	Site/Division/Corporate
Public Information Program (PIP)	Division

Cameco will provide information to the community regarding how activities affect the environment and the health and safety of employees and the community. A key component of the program is a formal public information and disclosure protocol, which has been made available to local residents and other interested parties and is available on Cameco's website.

3.1 SCA – Human Performance Management

Legislative Requirement: The *General Nuclear Safety Control Regulations* require the licensee to: ensure the presence of sufficient number of qualified staff; train the workers; and ensure the workers follow procedures and safe work practices. The *Class I Nuclear Facilities Regulations* require that a licence application contain information on the proposed human performance program, including measures to ensure workers' fitness for duty.

The *Class I Nuclear Facilities Regulations* require that licence applications include the proposed responsibilities of and qualification requirements and training programs for workers, including the procedures for the requalification of workers; and the results that have been achieved in implementing the program for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility. The *Class I Nuclear Facilities Regulations* requires every licensee to keep a record of the status of each worker's qualifications, requalification, and training, including the results of all tests and examinations completed in accordance with the licence.

Table 4: CFM Documents Relevant to Human Performance Management

Document Title	Site/Division/Corporate
Systematic Approach to Training Program (CFM-HR-01)	Site

CFM maintains programs to ensure that personnel are qualified to perform tasks associated with licensed activities to ensure protection of workers, the public and the environment.

3.1.1 Human Performance Management

CFM maintains processes to support human performance in its operations. Aspects of human factors have been considered in the development and continual improvement of site management system programs, work instructions, engineering and operations activities, change control and the corrective action process.

Corporately, Cameco has defined competencies for Cameco employees and which describe expectations for performance and behaviour for all levels of the organization including individual contributors, those leading others and those leading the organization. Supervisors are provided support to effectively coach their employees during performance feedback to develop the critical behaviours of accountability and respect in all employees.

Work instructions and operating documents are developed in consideration of the physical interaction of people and the production plant equipment or systems. Various risk assessment tools are used as part of continual improvement, project design and implementation and change control to identify and control error-likely situations.

Corporate requirements for self-check, personal accountability, fitness for duty, and safety and radiation protection apply to all Cameco facilities to support human performance. These are embedded into the site's operating philosophy through multiple tools and practices intended at engaging employees, promoting awareness of operational status, correcting issues and improving communication within and between crews.

CFM maintains the minimum complement of sufficient personnel to safely operate the facility and respond to emergency situations. Further detail regarding the minimum complement scenarios for production and security personnel is security-sensitive and considered commercially confidential.

3.1.2 Training

CFM maintains a training program that meets the requirements of REGDOC-2.2.2: *Personnel Training* and the Corporate Training Program.

The Systematic Approach to Training (SAT) consists of five sequential phases – Analysis, Design, Development, Implementation and Evaluation. Each phase has an outcome that feeds the subsequent phase. Each phase is necessary to ensure that the training program is systematically based. By utilizing the SAT, the CFM training program follows a logical progression from the identification of qualifications required to perform a job to the development and implementation of training to achieve these qualifications and competencies, and the subsequent evaluation of this training.

The Cameco training plan:

- Ensures employees are competent on the basis of appropriate education, skills, experience and behaviour(s);
- Provides a means of measuring, monitoring and improving the capability of employees to meet organizational objectives;
- Ensures all training is as efficient and effective as possible;
- Provides a continuous improvement mechanism for the training program.

Employees are required to meet specified qualification requirements prior to performing assigned task(s) in an unsupervised environment. A qualification consists of related knowledge, skills and attitudes (or behaviours) required to perform a task or set of related tasks.

Training delivery is a formal activity to offer training identified in the needs analysis utilizing various media, (e.g., instructor led, computer based, mentoring). It may take place on or off-site.

The evaluation stage measures the effectiveness of the training program through internal/external evaluations. The evaluations validate and identify areas where improvement may be required. The employee is evaluated on how well they have learned the delivered materials and/or how well they can perform specific tasks. Training evaluation includes course and instructor evaluations, and validation assessment with knowledge assessments and/or performance evaluations
Qualifications have been established for trainers. Trainers are trained in the necessary knowledge, skills and attitudes to fulfil these qualifications. These trainers include all training department staff and other subject matter experts who provide training at CFM.

3.1.2.1 Supervisor and Management Training

In addition to the CNSC's regulatory requirements, the requirements of the *Canada Labour Code* apply to CFM. Under Part II of the *Canada Labour Code*, management and supervisors must take every reasonable precaution for the protection of workers, including

ensuring workers use prescribed protective equipment and are advised of potential and actual hazards. It is a requirement that supervisors and management are trained to fully execute these responsibilities and this training is part of the required health and safety related training for supervisors.

In addition, to ensure nuclear security, supervisors and management are trained to anticipate and respond to changes in employee behaviour in accordance with both the violence prevention requirements under Part II of the *Canada Labour Code,* and the *Nuclear Security Regulations.*

3.1.2.2 Contractor Training

The Cameco procurement processes ensure that contractors are qualified to carry out the work they are contracted to do and would typically not require contractors to complete a SAT-compliant qualification process. Contractors and some other non-site personnel who will be performing work in designated areas of the facility are provided an orientation to the site consisting of general health and safety, radiation and environmental information. The level of orientation received is dependent on the length, location, and risks of the job.

4.1 SCA- Operating Performance

Legislative Requirement: The *Class I Nuclear Facilities Regulations* requires that a licence application contain the following information: the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility. The *Nuclear Substances and Radiation Devices Regulations* has requirements for records to be kept and retained for nuclear substances.

Table 5: CFM Documents Relevant to Operating Performance

Document Title	Site/Division/Corporate
Environmental Protection Program (CFM-EP)	Site
Radiation Protection Program (CFM-RP)	Site
Radioisotope Source Control (HSI-048)	Site

This safety and control area defines how the facility ensures that it operates in a safe manner.

4.1.1 Regulated Activities

Cameco Fuel Manufacturing is primarily federally regulated by the CNSC as a Class1B nuclear facility. In addition to the CNSC, CFM is also regulated by other government agencies through statute, regulation, permit, approval and/or licence. Table 6 provides a list of these agencies along with an overview of the key activities they regulate.

Table 6: Agencies with Jurisdiction over CFM's Operations

Agency	Activities Under Jurisdiction
Environment and Climate Change Canada (ECCC)	National Pollutant Release Inventory, halocarbon regulations, spills reporting, deleterious substances enforcement under the *Fisheries Act*
Ontario Ministry of the Environment Conservation and Parks (MECP)	Air discharges and approvals, Permit to take water, spills reporting, noise
Municipality of Port Hope	Sanitary sewer and noise bylaws
Department of Employment and Social Development Canada (ESDC)	Conventional health and safety issues through the Canada Labour Code
Ontario Ministry of Labour (MOL)	Contractors at the facility may fall under provincial health and safety regulation
Canadian Nuclear Safety Commission	Dosimetry Licence
Ontario Technical Standards and Safety Authority (TSSA)	Regulate boiler and pressure vessels at the facility
Transport Canada	Transportation of Dangerous Goods (TDG), Emergency Response Assistance Plan (ERAP)

4.1.2 Corporate Oversight

CFM licensed activities are managed and controlled by the site. The site is owned and operated by Cameco. Direction and overall accountability resides with the site. The corporate office provides policies and guidance to the operating sites which are translated into site-specific management programs. The implementation of these programs is regularly monitored, audited and reported on to assure the site management that these programs are implemented, adequate and effective. Corporate performs audits of CFM's management programs on a regular basis to verify that site performance meets both corporate requirements and complies with all applicable regulatory requirements.

4.1.3 Operating Limits

Operating limits are defined in the licensing basis upon which the Commission rendered their decision to renew and/or amend the facility's FFOL.

The Production Limit for CFM is:

- 125 Megagrams (Mg) of UO_2 as pellets during any calendar month

Environmental release limits and radiation protection limits are established to ensure the protection of workers, the public and the environment. These are also defined in the licensing basis and documented in the respective programs (see sections 8.1 and 10.1).

4.1.4 Nuclear Substances and Radiation Devices

CFM maintains an inventory of sealed sources and tracks and reports their transfer as required by REGDOC 2.12.3: *Security of Nuclear Substances: Sealed Sources and Category 1, II, and III Nuclear Material, Version 2*.

4.1.5 Reporting Requirements

CFM reports information to the Commission as required under the *NSCA*, its regulations and the operating licence.

Routine reporting includes:

- an annual compliance and performance report covering the period January 1 to December 31 by March 31 by March 31 of the following year
- an annual groundwater and surface water monitoring review
- quarterly compliance reports within eight weeks of the end of each quarter

Non-routine reporting includes events as defined in sections 29-32 of the General Nuclear Safety and Control *Regulations*, section 27 of the *NSCA*, and the Licence Conditions Handbook.

5.1 SCA – Safety Analysis

Legislative Requirement: The *General Nuclear Safety and Control Regulations* require that a licence application contain information that includes a description and the results of any test, analysis or calculation performed to substantiate the information included in the application. The *Class I Nuclear Facilities Regulations* require that a licence application contain information that includes a final safety analysis report demonstrating the adequacy of the design of the nuclear facility, and the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Table 7: CFM Documents Relevant to Safety Analysis

Document Title	Site/Division/Corporate
Safety Analysis Report for Cameco Fuel Manufacturing Inc. (Port Hope Facility)	Site
Fire Hazard Analysis	Site
Environmental Risk Assessment	Site
Derived Release Limit	Site
Nuclear Criticality Safety Program Manual	Site
Environmental Aspects Registry	Site

The protection of the environment and health and safety of persons is a fundamental principle of the *NSCA*, the associated regulations and the regulatory approval process.

The design, construction and operation of CFM is intended to eliminate or minimize 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. The hazards, preventative measures and mitigating controls associated with the licensed activities at the CFM have been systematically reviewed and documented from several perspectives, including but not limited to the following assessments.

5.1.1 Safety Analysis Report

CFM uses a Process Hazard Analysis (PHA) methodology to systematically identify and analyze hazards associated with its operations. Hazard categorization is performed on a "per process" basis in order to evaluate potential hazards and establish their consequence and probability of occurrence. In addition, a listing of safety equipment and systems for mitigating each hazard was prepared. From these, a Safety Analysis Report (SAR) is generated which describes the conditions, safe boundaries, and hazard controls that ensure operational safety. The SAR is used to show, for all systems including systems that could be hazardous to the worker, public, and/or the environment, that adequate safety systems are in place to prevent unreasonable risk to persons and the environment. The SAR includes an analysis of the probable worst-case release event. The SAR is reviewed and updated at least every five years.

5.1.2 Fire Hazard Analysis

Cameco maintains a site Fire Hazards Analysis (FHA) that meets the requirements of CSA N393-13 *Fire Protection for Facilities that Process, Handle or Store Nuclear Substances* and supporting reference materials. The FHA evaluates the impact of fire on the facility and demonstrates that the fire protection objectives can be met under foreseeable fire events. To satisfy this objective, safety significant systems and equipment as well as fire hazards have been identified. An analysis has been made of the potential for a worst-case fire event to impact safety related systems and equipment. This assessment is also relevant to the Emergency Management and Fire Protection SCA.

5.1.3 Environmental Risk Assessment

Cameco maintains an Environmental Risk Assessment (ERA) in accordance with the requirements of CSA N286.6: *Environment Risk Assessments at Class 1 Nuclear Facilities and Uranium Mines and Mills*. The most recent assessment found there were no undue risks to the environment or to human health as a result of CFM operations. The ERA is updated on a minimum five-year frequency. This assessment is also relevant to the Environmental Protection SCA.

5.1.4 Derived Release Limit

CNSC regulations require that no member of the public receive more than 1 mSv/year. In order to demonstrate that this requirement has been met, the site maintains a derived release limit (DRL) report in accordance with CSA N288.1-14: *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*. The DRL is reviewed every five years to ensure that considering the most relevant scientific literature, the facility operations are maintained well below the public dose limit. This report is also relevant to the Environmental Protection SCA.

5.1.5 Nuclear Criticality Safety

The Nuclear Criticality Safety Program Manual (NCSPM) has been developed to guide the generation and implementation of CFM's criticality prevention practices as they pertain to licensing and criticality prevention issues. This document is structured to meet the requirements of REGDOC-2.4.3 *Nuclear Criticality Safety*. The manual has been designed into two main categories depending on the potential risk associated with enriched uranium dioxide and criticality. These categories are partial scope (handling enriched uranium material with an on-site possession of less than 0.8 smallest critical masses (SCM)) and full scope (handling enriched uranium material with an on-site possession of greater than and equal to 0.8 SCMs). The full scope category ensures that the operations with enriched uranium materials are such that the upper sub critical limits established in the Nuclear

Criticality Safety Program Manual will not be exceeded under both normal and credible abnormal conditions. This assessment is also relevant to the Radiation Protection SCA.

5.1.6 Environmental Aspects Registry

In accordance with the requirements of ISO14001 – Environmental Management Systems, CFM has documented and analysed its activities, products and services to determine the interactions of the facility with the environment. These interactions may result in environmental impacts of varying significance. Interactions are categorized into actual and potential environmental impacts. Actual environmental aspects (i.e. interactions) are those that result from the plant operation, such as emissions to the air, water and land. Potential environmental aspects are those that may result from the plant operation and for which controls are in place to prevent an event from happening or mitigating the impact if the event occurs. This information is documented in the site Environmental Aspects Registry which is reviewed, and updated as required, on an annual basis. In addition, where opportunities to improve the aspects exist, this information is considered in the annual environmental objectives and targets.

6.1 SCA – Physical Design

Legislative Requirement: The *Class I Nuclear Facilities Regulations* require that a licence application contain the proposed measures, policies, methods and procedures to maintain the nuclear facility. The *Class I Nuclear Facilities Regulations* require that a licence application contain a description of the structures, systems and equipment, including the relevant design information for the facility.

Table 8: CFM Documents Relevant to Physical Design

Document Title	Site/Division/Corporate
Change Control (MSP 13-02)	Site
Drawing no. 00A084	Site
Drawing no. 05C144, version 4	Site
Pressure Containing Components (MSP 27-16)	Site
Authorized Inspection Agency Services Agreement	Site

These processes assess the ability of structures, systems and components to meet and maintain their design basis given new information arising over time and manage changes to ensure that safety is maintained.

6.1.1 Current Facilities

Site details are provided in section 1.2. The licensed area is secured by a metal fence that encloses the entire perimeter.

6.1.2 Current Plant Equipment

CFM contains conventional industrial equipment including storage tanks and associated piping as well as specialized robotic equipment for the production of uranium pellets and uranium fuel bundles.

6.1.3 Facility and Process Changes

All changes to the physical design of equipment, processes and the facility are evaluated from project planning through to the completion of the project. These changes may be physical changes completed through capital projects or maintenance work or may be administrative through training, procedures or other controls. The change control process identifies impacts and potential impacts to the environment and health and safety. It also triggers review by appropriate personnel as per MSP 13-02 Change Control to ensure all applicable codes and legal requirements are observed. For some changes, third party review and/or CNSC notification is also required.

6.1.4 Third Party Review for Fire Protection

Modifications for which the initial assessment indicates a potential impact on fire protection design basis, goals, or criteria are subject to a qualified third-party review. All third-party reviews are conducted by qualified persons from organizations whose management and financial operations are independent of the design organization. All third-party fire reviews are submitted to CNSC staff as required by the licence and LCH.

6.1.5 Pressure Boundary Program

As required by the its operating licence, CFM maintains an agreement with an Authorized Inspection Agency (AIA) for the registration, inspection and other activities related to pressure systems. The AIA is the Technical Standards and Safety Authority (TSSA) for CFM.

7.1 SCA – Fitness for Service

Legislative Requirements: The *Class I Nuclear Facilities Regulations* require that a licence application contain information including the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Table 9: CFM Documents Relevant to Fitness for Service

Document Title	Site/Division/Corporate
Preventative Maintenance Execution Management (AP 018)	Site

Critical requirements for maintaining a safe facility are effective maintenance and quality assurance programs. This is to ensure any changes to plant equipment are adequately controlled and authorized, and do not adversely affect the safety of the facility. This SCA covers activities that impact the physical condition of structures, systems and components to ensure that they remain effective over time. This area includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.

7.1.1 Preventative Maintenance

CFM has an established preventative maintenance program. All preventative maintenance work is initiated and documented through the maintenance management system in SAP. The site maintenance program ensures that equipment functions as designed, remains available and that equipment failures are minimized. This is accomplished by completion of predictive, preventive, and corrective maintenance activities along with routine inspections on system components to ensure that they remain in good operating condition.

7.1.2 Periodic Inspection and Testing for Fire Protection Systems

Fire protection systems are tested according to an established schedule developed using the National Building Code, current version, and the National Fire Code, current version. Reviews of aspects of the fire protection systems are completed as required by CSA N393-13:*Fire protection for facilities that process, handle, or store nuclear substances.*

8.1 SCA – Radiation Protection

Legislative Requirements: The *Radiation Protection Regulations* require that the licensee implement a radiation protection program and also ascertain and record doses for each person who performs any duties in connection with any activity that is authorized by the *NSCA* or is present at a place where that activity is carried on. This program shall ensure that doses to workers do not exceed prescribed dose limits and are kept as low as reasonably achievable (ALARA), social and economic factors being taken into account.

Table 10: CFM Documents Relevant to Radiation Protection

Document Title	Site/Division/Corporate
Radiation Protection Program Manual (CFM-RP)	Site
Nuclear Criticality Safety Program Manual (NCSPM)	Site
Sealed Source (HSI-048)	Site
Dosimetry Service Licence	Divisional
FSD Internal Dosimetry Program Technical Basis Document (FSD-PRG-RAD-01)	Divisional

Radiation protection measures are in place to minimize and control the potential for radiation exposure to both employees and members of the general public arising from the operation. This exposure is due to the alpha, beta and gamma radiation emitted from the natural uranium compounds received, processed and produced at the facility. Exposure can be from beta or gamma radiation outside the body, or alpha, beta or gamma radiation from inside the body as a result of inhalation, ingestion or absorption through the skin of uranium bearing materials.

Uranium levels in the air, water and soil in the vicinity of the facility are monitored to ensure that they are minimized and maintained below levels that affect the environment or the public. The following is a summary of the radiation protection program that meets the requirements of the *Radiation Protection Regulations*. The full details are of how the program ensures that contamination levels and radiation doses received by individuals are monitored, controlled and maintained ALARA are documented in the Radiation Protection Manual (CFM-RP).

8.1.1 Potential Radiological Hazards

Radiation hazards at CFM are primarily associated with natural, depleted and enriched uranium. The hazards associated with natural uranium are of greater concern due to the quantities processed. Working in the presence of uranium, internal exposure can result from inhalation, ingestion or contamination of an open wound. The primary hazards are chemical damage to the kidney, radiation dose to the bone, and radiation dose to the lung. CFM-RP further details the dose implications of uranium compounds found at CFM.

8.1.2 Nuclear Energy Workers

Employees or contractors that have a reasonable probability of receiving a radiation dose greater than 1 mSv are designated as Nuclear Energy Workers (NEWs). As required by the *Radiation Protection Regulations*, all NEWs are notified in writing of this designation, the

risks associated with radiation that they may be exposed to in the course of their work and the applicable effective and equivalent dose limits. Female NEWs are also notified in writing of their rights related to pregnancy and breast feeding, including the benefits of notifying Cameco, as soon as they are aware of their pregnancy or planning to breast feed.

All NEWs receive training in radiation safety when first hired or returning to work after an extended absence. Regular refresher training is completed on a set frequency.

8.1.3 ALARA

Cameco recognizes that the responsibility of the health and safety of its employees is of the foremost importance. To meet this responsibility, Cameco acknowledges and accepts the as low as reasonably achievable (ALARA) principle that doses of ionizing radiation should be kept As Low As Reasonably Achievable, with social and economic factors taken into account. An ALARA program that meets regulatory requirements is described in CFM-RP.

8.1.4 Personal Dosimetry

The annual dose assignment of NEWs working at CFM consists of both external and internal dosimetry inputs. The annual dose assignment is the sum of their whole body dose as measured by dosimeter badges plus dose from lung burden and is reported to the NEW on an annual basis. Dose from uranium in urine may be assigned for significant uptakes of uranium. Each of the three components of the personal dosimetry program is described below.

External Dosimetry

Individually assigned dosimeters are used to determine external dose as both deep-dose equivalent and shallow-dose equivalent exposure from external sources of radiation. The external dosimetry service for Cameco is provided through a CNSC approved external dosimetry service provider. Action levels for external dosimetry are shown in Table 11. These action levels are also referenced in CFM-RP and in the appropriate site radiation protection procedures. Extremity dose measurements are also performed using ring-type personal dosimeters that are processed in the same manner as the regular assigned dosimeters.

Table 11: Action Levels for External Dosimetry

External Dosimetry Parameter	Frequency	Regulatory Action Level (mSv)
Whole Body Exposure	Monthly - NEW	1.6
	Quarterly - NEW	1.0
	Quarterly – non-NEW	0.2
Skin Exposure	Monthly - NEW	20.0
	Quarterly - NEW	5.0
	Quarterly – non-NEW	2.0
Extremity Exposure	Quarterly – NEW	55.0

Internal Dosimetry

Cameco's Fuel Services Division holds a licence from the CNSC that authorizes Cameco to provide internal dosimetry services to the PHCF, BRR and CFM. Additional information regarding this program may be found in FSD's Internal Dosimetry Program Technical Basis Document (TBD).

Internal dose may be assessed and assigned through two programs – urine analysis and lung counting. As described in the TBD, the urine analysis program is most appropriate for fast (soluble) uranium material, which is not present at CFM. When a dose is assigned due to a lung burden, it is assumed that slow (insoluble) uranium material is present for CFM workers.

Urine Analysis

Because of the solubility of the form of uranium present at CFM, lung counting will capture all internal doses as there is very little uranium present in the urine for low intakes. However, urine analysis samples can be used to screen for potential kidney toxicity, for an indication of upset or unusual conditions and for the dose assessment of abnormal intakes together with lung counting results. CFM-RP and site procedures describes which employees are required to submit routine urine samples for the analysis of uranium. Non-routine urine samples can be provided by any individual at any time. The action level for Urine Analysis is shown in Table 12. This action level is also referenced in CFM-RP and in the appropriate site radiation protection procedures.

Table 12: Action Levels for Urinalysis

Frequency	Action Level
Bi-Weekly Pre shift (Cameco Employees)	10 µg U/L

Lung Counting

The dose assessment of uranium in lungs is performed using a germanium detector-based lung counting system. A group-counting technique is used for dose assignment where all employees in a similar work group are assigned an average internal dose. This method involves creating appropriate groupings of individuals based on similar exposure potential and measuring and assessing each individual's spectrum, taking detection criteria and physical conditions (e.g. individual chest wall thickness) into account. The frequency of lung counting of NEWs is based on the work group to which the employee belongs and is described in CFM-RP. Administrative support staff and contractors have internal dose based on lung exposure determined through prorating the average dose from the production group(s).

Individuals with lung count results above the detection criteria for lung counting are assigned their own dose and this dose is not included in the group average. The dose from lung counting is assigned to NEWs annually as part of their annual dose report. Individuals with lung burden above the detection criteria are informed of their dose as soon as possible after completing their lung count. The action level for dose due to lung burden has been set at 5 mSv/year.

8.1.5 Zone Control – Contamination Control

CFM maintains zone control and monitoring programs as described in CFM-RP to identify areas of potential contamination and prevent the spread of contamination from these areas. The site has been delineated into four control zones, and the zones are simply referred to as Zone 1, Zone 2, Zone 3 and Zone 4. The possibility of contamination increases with increasing zone numbers.

8.1.6 Radioisotope Control

The facility uses a number of radioisotope sources that are regulated under the CNSC *Nuclear Substances and Radiation Devices Regulation*. Cameco maintains a record of the specific radioisotope sources on site that are present above an exemption quantity, the radioisotope used and the maximum activity of the device as described in HSI-048. These sources are typically used as calibration sources.

The controls associated with sealed sources, unsealed sources and radiation devices are described in HSI-048 and associated procedures and include training, certification, and leak testing where required, radiation warning signs and limited access to areas where sources are stored.

8.1.7 Worker Dose Control

Radiation safety refresher training is done on an on-going basis through regular scheduled training sessions for all employee groups.

Routine work has radiation protection requirements built into the tasks. Non-routine work uses a Non-Routine Work Order (NRWO) permitting process to cover Radiation Protection requirements (among other safety and quality requirements) in which the radiation safety group is contacted and consulted prior to starting work. Specific areas and activities in the facility that require a radiation work plan are identified in the NRWO.

Uranium in air is sampled during periods of operation throughout the process areas where there is a higher likelihood of airborne uranium dust being present and are operated. Air samples serve to assist in identifying process upsets, equipment breakdowns or other instances of loss of containment. Additional details on the facility air-sampling may be found in CFM-RP. Respiratory protection is required in areas where the airborne concentration of uranium exceeds the criteria (Derived Air Concentration – DAC) which is indicated by the air sampling monitors.

8.1.8 Nuclear Criticality Control

The Nuclear Criticality Safety Program Manual (NCSPM) has been developed to guide the generation and implementation of CFM's criticality prevention practices as they pertain to licensing and criticality prevention issues. This document is structured to meet the requirements of REGDOC 2.4.3 Nuclear Criticality Safety.

Where practicable, the design of processing facilities and equipment handling enriched material includes geometric limitations to prevent a criticality accident. A key limitation to prevent a criticality accident is the present limit on the mass of enriched nuclear materials permitted on site at any one time. The NCSPM applies to all CFM equipment and operations that are licensed by the CNSC with respect to the handling of fissile materials.

The manual has been designed into two main categories depending on the potential risk associated with enriched uranium dioxide and criticality. These categories are as follows:

- Partial Scope – this category addresses the issues with handling enriched uranium material with an on-site possession of less than 0.8 smallest critical masses (SCM).

- Full Scope – this category address the issues with handling enriched uranium material with an on-site possession of greater than and equal to 0.8 SCMs. This category ensures that the operations with enriched uranium materials such that the upper sub critical limits established in the Nuclear Criticality Safety Program Manual will not be exceeded under both normal and credible abnormal conditions.

9.1 SCA – Conventional Health and Safety

Legislative Requirement: the *Class I Nuclear Facilities Regulations* require that a licence application contain information including the proposed worker health and safety policies and procedures. As a federally regulated site, CFM is also subject to the requirements of Part II of the *Canada Labour Code* and the *Canada Occupational Health and Safety Regulations*.

Table 13: CFM Documents Relevant to Conventional Health and Safety

Document Title	Site/Division/Corporate
CFM-SH Safety and Health Program	Site

Cameco's SHEQ provides the direction for site programs and procedures. The Health and Safety Program manual describes the health and safety program manages workplace safety hazards to ensure protection of personnel and equipment at the site. The manual meets the requirements set out in the corporate Health and Safety Program Manual and Part II of the *Canada Labour Code*.

9.1.1 Conventional Safety Program

A key element of a safe, clean and reliable operation is a comprehensive and well-established worker protection program, which is in place at CFM. The regulations made pursuant to the NSCA and Part II of the *Canada Labour Code* prescribe specific health and safety requirements that are met by CFM. In addition, Cameco's SHEQ policy and corporate Health and Safety Program provide direction for site programs and procedures. The Safety and Health Program (CFM-SH) describes the health and safety program at the site.

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

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

- we are a learning organization.

The health and safety of workers at CFM is ensured through site-specific safety and health management programs. Key components of the program include:

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

9.1.2 Hazards

CFM is a Class IB nuclear facility. There are radiological hazards associated with the various forms of uranium found at the facility. Chemicals at the facility include bulk hydrogen as well as smaller quantities of laboratory chemicals, water treatment chemicals and materials used for maintenance activities.

There are also a variety of physical hazards that are monitored and controlled at the site such as heat, lighting, noise, vibration, traffic and extreme weather.

9.1.3 Work Controls

All site personnel have a general awareness of the occupational health and safety hazards that exist at the site and the various means of minimizing these risks. All groups attend regular department safety meetings where employees are encouraged to discuss safety issues or concerns. Safety awareness, training and re-training are done through in-class sessions, safety meetings, and computer based training depending on the topic.

Hazardous materials are labeled or identified to meet applicable regulations. The proper identification of hazardous materials decreases the likelihood of improper use, handling and disposal, which reduces potential risks and negative consequences. Purchasing procedures are in place for the procurement of chemicals. Safety Data Sheets (SDS) are requested from vendors for each type of chemical purchased. The SDS information is available in the areas where the chemicals are used.

Work instructions, procedures, and job hazard analysis (JHA), are some of the tools used to identify and control hazards in the workplace.

Personal protective equipment (PPE) is provided as necessary and is specified in the work instruction, for the job. All PPE is approved to ensure that the correct PPE is available for each job. Respiratory protection with appropriate respirator cartridges are available for tasks where inhalation of uranium, chemicals and/or dust is possible above the respective DAC or exposure limit.

Personal and area monitoring is performed to assess workplace exposures. These include in-plant uranium in air levels, and urine analysis programs for uranium. Monitoring for other parameters (e.g. asbestos, lead in paint, heat, lighting etc.) is performed on an "as needed" basis.

9.1.4 Health and Safety Committee

CFM has a Joint Health and Safety Committee (JHSC) that is implemented and maintained that complies with the legal requirements outlined under Part II of the *Canada Labour Code*.

The intent of the committee is to provide a forum whereby worker and management representatives can come together on a regular basis to identify and resolve health and safety concerns in the workplace and also to work together on preventative-type actions that will improve overall health and safety in the workplace.

10.1 SCA – Environmental Protection

Legislative Requirement: The *Class I Nuclear Facilities Regulations* require that a licence application contain the proposed environmental protection policies, procedures, effluent and environmental monitoring programs. The *General Nuclear Safety and Control Regulations* require that every licensee take all reasonable precautions to protect the environment and the health and safety of persons and to maintain the security of nuclear facilities and of nuclear substances. The *Radiation Protection Regulations* prescribe the radiation dose limits for the general public of 1 mSv per calendar year.

Table 14: CFM Documents Relevant to Environmental Protection

Document Title	Site/Division/Corporate
FSD Environmental Management System (FSD-PGR-EMS-001)	Divisional
CFM-EP Environmental Protection Program (CFM-EP)	Site
Environmental Risk Assessment for Cameco Fuel Manufacturing	Site
Derived Release Limits Report	Site
Review of Environmental Action Levels to Support the Environmental Protection Program	Site

CFM maintains an Environmental Protection Program that meets the requirements of CSA *N288.4: Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* and CSA N288.5: *Effluent Monitoring Programs at Class 1 Nuclear Facilities and Uranium Mines and Mills*. Cameco Corporation is registered to the ISO 14001 Standard and CFM is included in that corporate registration. The program identifies, controls and monitors releases of radioactive and hazardous substances and the effects on the environment as a result of licensed activities.

10.1.1 Environmental Management Program

The FSD EMS describes the program elements that meet the requirements of the ISO 14001 standard and applicable CSA N288 series standards. The site environmental protection program (CFM-EP) describes site-specific aspects associated with the environmental sampling that is carried out in support of the EMS and the ERA. This monitoring data is then compared to applicable action levels and limits to ensure operations remain in compliance with applicable regulations and licence limits.

10.1.2 Environment and Public Assessments

As described in earlier sections, CFM has developed multiple risk assessments which are periodically revised to reflect changes to the facility, corporate or divisional policies and/or external standards and guidance as well as verify that CFM operations do not pose an unreasonable risk to employees, the public or the environment.

The most relevant for the Environmental Protection SCA are the:

- Environmental Risk Assessment
- Environmental Aspects Registry
- Emission Summary and Dispersion Modelling Report

- Derived Release Limit
- Safety Analysis Report

10.1.3 Environmental Regulation

Airborne and liquid effluent discharge quality is defined and regulated by federal and provincial regulators. For Cameco, the federal regulators are the CNSC and ECCC. Provincial regulation is performed through the Ontario MECP. The acts (and associated regulations) enforced by these groups include the *NSCA, Canadian Environmental Protection Act, 1999, Fisheries Act, Ontario Water Resources Act,* and the *Environmental Protection Act.* CFM must also comply with applicable municipal bylaws related to storm and sanitary sewers.

10.1.4 Airborne Emission Program

The primary air emissions associated with CFM operations is uranium. These contaminant emissions are measured using source monitoring and/or estimated using emission calculations based on emission rates established in the Emission Summary and Dispersion Modelling Report (ESDM).

Source Monitoring

The facility is designed with discrete discharge points along the production line. The airborne effluent monitoring program therefore is designed so that each stack in the production line is monitored when that area of the plant is operating. The details of this program are provided in CFM-EP.

The current air emissions action levels and limits are presented below.

Table 15: Summary of Air Discharge Limits and Environmental Action Levels

Source	Parameter	Action Level	Averaging Period	Annual Limit
Process Stack Emissions	Uranium	2 µg/m^3	Daily	14,000 g/year
Building Ventilation – PP2	Uranium	0.5 g/hr	Daily	
Building Ventilation – All other areas	Uranium	1 g/hr	Daily	

Air emissions are also regulated by the MECP under O. Reg. 419/05 *Air Pollution - Local Air Quality*. Site air emissions are documented and compared against point of impingement standards in the site ESDM. The ESDM predicts contaminant concentrations from the

facility at the facility fence line and into the community using a developed worst-case emission scenario and an air dispersion model that meets the requirements of O. Reg. 419/05. The ESDM report is updated annually to reflect the most recent air emissions data.

In support of the source sampling program, an ambient air sampling program has been established to measure the concentration of uranium in the air in the vicinity of the facility. Four high-volume (hi-vol) sampling stations are located inside the perimeter fence line. Soil sampling for uranium in the vicinity of the facility is also done for uranium on a periodic basis. Additional information on ambient monitoring can be found in CFM-EP.

10.1.5 Liquid Emission Program

The waterborne effluent from the CFM facility is discharged to the MPH sanitary sewer system and is monitored in accordance with operating licence requirements and the municipal sewer use by-law. Automatic, composite sampling based on an equal volume/time sampling methodology is used to collect representative samples of the discharges to the sanitary sewer from the uranium processing portion of the facility and the groundwater treatment system. An additional output to the sanitary sewer from non-production areas as well as the inlet and outlet of the groundwater treatment system is verified twice annually to ensure there is no uranium or VOC (groundwater only) contamination.

Table 16: Summary of Liquid Effluent Discharge Limits and Action Levels

Parameter	Regulatory Limit	Action Level
Uranium	475,000 g/year (CNSC)	0.1 ppm (twice weekly composite)
pH	< 6.0 or > 9.5 (MPH by-law)	≤6.5 or ≥9.0 (twice weekly composite)

Groundwater collection and treatment is also regulated under a Permit to Take Water (PTTW) from MECP. Groundwater sampling and groundwater level monitoring is completed semi-annually at numerous monitoring wells and pumping wells throughout the facility. A comprehensive review of the groundwater monitoring is completed and submitted to the CNSC and MECP annually.

The aquatic environmental monitoring program is intended to collect data to monitor discharges to the municipal sewer infrastructure and drainage features discharging to Gages Creek. An environmental consultant collects ambient water samples three times per year from up to nine sampling points adjacent to the licensed facility.

10.1.6 Derived Release Limit - Estimated Dose to the Public

The Derived Release Limit (DRL), in simplified terms, is the amount of radioactivity released by a nuclear facility that results in a radiation dose of 1 mSv/year to a representative member of the public. For CFM, there are three components to the DRL: dose to the public arising from discharges of radioactivity in water, dose to the public arising from discharges of radioactivity from the manufacturing processes in air, and dose to the public arising from gamma radiation emitted from the facility.

Each of the components has a different critical receptor, or most exposed member of the public. The following table summarizes the most restrictive DRL values for each component; corresponding to a 1 mSv/y dose.

Table 17: DRL Values Corresponding to a 1 mSv/y Dose

	Air Emissions (kg/year U)	Water Discharges (kg/year U)	Gamma Radiation (µSv/h)
DRL	380	9500	0.35

The total dose to a member of the public can be controlled through the use of the following sum rule:

$$1 \geq \frac{r_{air}}{DRL_{air}} + \frac{r_{water}}{DRL_{water}} + \frac{\gamma_{water}}{DRL_{gamma\ TLD\ 1}}$$

where, r_{air} = the release rate of uranium from the facility air sources (kg U/year);
r_{water} = the release rate of uranium from the water sources (kg U/year);
γ_{gamma} = the gamma exposure rate for the receptor component (µSv/h).

The DRL values in the equation will vary based on which receptor is being used to calculate the public dose. However, as long as the total of the ratios in the above equation is less than one, the public dose at that particular receptor will remain below 1 mSv/year. The DRL calculates a dose to the public that is higher than the actual public exposure during normal facility operations.

10.1.7 Reported Dose to the Public

Dose to the public from air and water emissions is a very small fraction of the DRL and has negligible impact on the calculated public dose. Gamma emissions from the radioactive material stored and processed at the facility dominate the reported dose to the public. Therefore, it is essential to monitor gamma emissions at the fence line to ensure that the dose to the public is maintained as low as reasonably achievable and well below the public dose limit of 1 mSv/year. The gamma emissions are measured at key locations using dosimeters supplied by a licensed dosimeter service. The action level for the critical receptor at fenceline station 1 is 0.2 µSv/h on a quarterly averaging period. The action level for all other fenceline stations is 1.0 µSv/h on a quarterly averaging period.

11.1 SCA – Emergency Management and Fire Protection

Legislative Requirement: The *Class I Nuclear Facilities Regulations* require measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of national security, including measures to assist, notify, report to off-site authorities including the testing of the implementation of these measures.

Table 18: CFM Documents Relevant to Emergency Management & Fire Protection

Document Title	Site/Division/Corporate
Emergency Response Plan (MSP 30-02)	Site
Fire Protection Program (MSP 30-07)	Site
Fire Safety Plan (MSP 30-03)	Site

CFM maintains emergency preparedness and fire protection programs to ensure that licensed activities do not result in an unreasonable risk to the health and safety of persons and the environment.

11.1.1 Emergency Planning

Emergency planning for nuclear facilities is a requirement of the *NSCA* (Section 24 (4)) and the *Class 1 Nuclear Facilities Regulations* (Section 6(k)). The CFM Emergency Response Plan (MSP 30-02) is compliant with the requirements of REGDOC 2.10.1: *Nuclear Emergency Preparedness and Response*.

11.1.2 Emergency Preparedness and Response Organizations

Depending on type and magnitude of an incident, the site may activate any or all of the following response organizations for the protection of human health, the environment and property: Immediate Responders, Emergency Response Organization, Local Crisis Management Team, and the Corporate Crisis Management Team. CFM's initial response capability is consistent with the on-site planning basis with full emergency response support provided by CFM to the respective local/municipal emergency services organizations.

11.1.3 Fire Protection Program

The Fire Protection Program (FPP) has been developed and implemented to comply with the requirements of the National Fire Code, National Building Code, and with CSA N393-13: *Fire Protection for facilities that process, handle, or store nuclear substances*.

The FPP consists of the following main elements: the Fire Hazard Analysis (FHA), the Fire Safety Plan (FSP), Pre-incident Plans and related fire safety procedures. These documents are reviewed and updated on a periodic basis by qualified personnel, as required.

Routine inspections and testing of the fire protection system are conducted by or under the direction of Cameco personnel. A system is in place to enable detection and notification of fire. Emergency pull stations are located strategically throughout the facility. Areas with potential fire hazards are equipped with appropriate fire detection and/or suppression systems. Fire safety equipment is maintained with the use of preventive maintenance and periodic inspections.

11.1.4 Recovery Program

The recovery plan will depend on the nature of the emergency situation, i.e., whether the emergency is local (within the plant), external (off-site) or a transportation event. Depending on the situation, the recovery plan may require regulatory review and approval. Recovery plans would be developed to minimize the impact to personnel involved in the clean-up, the environment and the general public. Additional information on recovery plans is provided in the MSP 30-02.

12.1 SCA – Waste Management

Legislative Requirement: The *General Nuclear Safety and Control Regulations* requires that a licence application contain information related to the in-plant management of radioactive waste or hazardous waste resulting from the licensed activities. The *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed

procedures for handling, storing, loading and transporting nuclear substances and hazardous substances.

Table 19: CFM Documents Relevant to Waste Management

Document Title	Site/Division/Corporate
CFM Waste Management Plan (CFM-EP-02)	Site
FSD Waste Management Program (FSD-PGR-WM-01)	Divisional
Preliminary Decommissioning Plan (PDP)	Site

The divisional and site waste management documents define the wastes generated as part of licensed activities, how it is managed onsite and removed from the facility to a separate waste management facility.

12.1.1 Waste Management

The waste management activities are conducted with the following objectives:

- To manage and dispose of wastes in accordance with applicable laws and generally accepted industry practices so as to minimize the potential adverse impact to personnel and to the environment;
- To minimize and reduce the quantity of stored onsite waste through recycle, re-use and recovery to the extent possible;
- To segregate radioactively contaminated and non-contaminated waste materials;
- To maintain an inventory of waste materials produced, received, disposed of and stored, including quantities and location on site;
- To store waste materials only when re-use, recycle or recovery is not possible and then to do so with proper management systems and controls in place; until an acceptable method has been identified for their eventual disposal; and
- To continually evaluate disposal alternatives and new technologies for waste reductions.

12.1.2 Preliminary Decommissioning Plan

Cameco maintains a Preliminary Decommissioning Plan (PDP) and financial guarantee for CFM. The PDP is reviewed and approved as appropriate every five years. The financial guarantee is updated as required after every PDP update has been reviewed and accepted by the CNSC.

13.1 SCA – Security

Legislative Requirement: The *General Nuclear Safety and Control Regulations* require that a licence application contain information including the proposed measures to control access to the site of the activity to be licensed and the nuclear substance, prescribed equipment or prescribed information. The *Class I Nuclear Facilities Regulations* require that a licence application contain information including the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility, including measures to alert the licensee to such acts. In addition, Part 2 of the *Nuclear Security Regulations* apply to CFM.

Table 20: CFM Documents Relevant to Security

Document Title	Site/Division/Corporate
Security Plan (MSP 30-01)	Site

The security plan outlines how the security requirements stipulated in the regulations and the licence are met.

Cameco maintains a security program to comply with the requirements of the *General Nuclear Safety and Control Regulations*, the *Nuclear Security Regulations* and any additional requirements such as designated officer orders.

CFM's Security Plan presents an overview of the security operations at CFM and identifies the systems and processes in place to meet security program objectives. Accordingly, this document is considered prescribed information.

14.1 SCA – Safeguards

Legislative Requirement: The *General Nuclear Safety and Control Regulations* require the licensee to take all necessary measures to facilitate Canada's compliance with any applicable safeguards agreement and defines reporting requirements for safeguards events. The *Class I Nuclear Facilities Regulations* require that a licence application contain information on the licensee's proposed measures to facilitate Canada's compliance with any applicable safeguards agreement.

Table 21: CFM Documents Relevant to Safeguards

Document Title	**Site/Division/Corporate**
FSD Safeguards Program (FSD-PGR-SG-01)	Divisional

CFM complies with the obligations arising from the Canada/International Atomic Energy Agency (IAEA) safeguards agreements, as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*. Cameco complies with REGDOC 2.13.1 *Safeguards and Nuclear Material Accountancy.*

The site maintains separate inventories for natural, depleted and enriched uranium where receipts and shipments are recorded. Monthly inventory reports are distributed to the CNSC that include safeguarded natural, depleted and enriched uranium as well as the inventory of non-safeguarded material.

Periodic audits of the inventory system are conducted by the IAEA, the CNSC and by Cameco internal auditors. Uranium accountability controls and practices are in place through the accountability system in order to comply with the applicable requirement for nuclear materials safeguards of the CNSC.

15.1 SCA – Packaging and Transport

Legislative Requirement: The *Class I Nuclear Facilities Regulations* require that a licence application contain information on the proposed procedures for handling, storing, loading and transporting nuclear substances.

Table 22: CFM Documents Relevant to Packaging and Transport

Document Title	Site/Division/Corporate
FSD Packaging and Transportation (FSD-PGR-TRN-01)	Divisional

Cameco maintains corporate standards and site procedures that cover the safe packaging and transport of nuclear substances to and from the licensed facility.

Radioactive materials are packaged and transported on public roadways in accordance with Transport Canada regulations and specifically, the CNSC *Packaging and Transport of Nuclear Substances Regulations*. Employees are trained in the safe handling, packaging and shipping of dangerous goods commensurate with their responsibilities.

Monitoring of packages being sent off-site is covered in various site procedures.

3.0 NUCLEAR FACILITY SPECFIC CONDITIONS

16.1 Financial Guarantee

Legislative Requirement: The *General Nuclear Safety and Control Regulations* requires that a licence application contain a description of any proposed financial guarantee relating to the activity being licensed.

Table 23: CFM Documents Relevant to Financial Guarantee

Document Title	Site/Division/Corporate
Cameco Fuel Manufacturing Preliminary Decommissioning Plan	Site

CFM maintains a financial guarantee in the form of an irrevocable letter of credit in the amount of $21,000,000. Each time the PDP is reviewed, the financial guarantee is revised, as applicable, and approved by the Commission.

16.2 Nuclear Liability Insurance

CFM maintains an appropriate level of nuclear liability insurance as required by the *Nuclear Liability and Compensation Act*.

Appendix A: Facility Legal Description

The CFM Fuel Fabrication Facility is located on part of Lot 2, Concession 1, Municipality of Port Hope, County of Northumberland and more particularly described in Instrument Number 89833 Parts 1 & 2 deposited in the Land Registry Office for the Registry Division of Port Hope, on the 4th of November, 2005. The facility is located at 200 Dorset Street East, Port Hope, Ontario, adjacent to Peter Street (formerly Highway #2) which links the towns of Port Hope and Cobourg. The Town of Port Hope is situated on the north shore of Lake Ontario approximately 100 kilometers east of Metropolitan Toronto.