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Written submission from Canadian Light Source Incorporated

Mémoire du Centre canadien de rayonnement synchrotron incorporé

In the Matter of the

Canadian Light Source Incorporated

Application by Canadian Light Source Incorporated for renewal of their Class IB Particle Accelerator Operating Licence

Commission Public Hearing

March 9 or 10, 2022
(Exact date to be confirmed later)

À l'égard de

Centre canadien de rayonnement synchrotron incorporé

Demande du Centre canadien de rayonnement synchrotron incorporé pour le renouvellement de son permis d'exploitation d'accélérateur de particules de catégorie IB

Audience publique de la Commission

9 ou 10 mars 2022
(date exacte à confirmer plus tard)

Canada

Table of Contents

1.0 Introduction

1.1 Background

Canadian Light Source Inc. (CLSI) operates a synchrotron particle accelerator in accordance with Canadian Nuclear Safety Commission (CNSC) Class IB licence number PA1OL-02.01/2022 [1] and Licence Conditions Handbook (LCH) LCH-CLSI-R007 [2]. The current licence was issued in 2012, and subsequently amended in 2015 to authorize processing of nuclear substances at the intermediate level Industrial Science Laboratory (ISL). The purpose of this document is to apply for renewal of the CLSI Class IB synchrotron operating licence prior to its expiry in 2022.

The CNSC uses Safety and Control Areas (SCAs), covering various technical topics, to evaluate licensee performance against regulatory requirements. Each SCA discussed in the LCH is addressed in a separate section of this document.

1.2 Highlights

Since 2012, CLSI has consistently demonstrated a willingness to change, and a desire to incorporate CNSC feedback to foster continuously improved compliance with the LCH. Significant organizational restructuring over the past eight years has, at times, prevented prompt action, but CLSI reliably responds to CNSC concerns and addresses them. With the exception of remaining improvements to be made to the management system, CLSI has consistently met regulatory requirements. CLSI continues to operate the Class IB accelerator safely to ensure the continued safety of staff, the public and the environment. CLSI will maintain current safe practices and foster continuous improvement, in order to continue to meet or exceed regulatory requirements over the next licence period.

2.0 Business Plan

CLSI's current Strategic Plan covers the fiscal period from April 1, 2017 through to March 31, 2022, which was the original duration of the funding cycle that CLSI is currently in. In 2019 some relatively minor revisions were made to the existing Strategic Plan to improve clarity. These changes included amendments to the Vision Statement and the creation of a single Mission Statement in place of the previously articulated Mission Statements. Small changes to values and CLSI's four Key Objectives were also made.

In fiscal 2020 and 2021 some additional changes were made to the overall strategic and management planning process including the addition of annual Management Objectives. Figure 1 provides an overview of CLSI's current management planning process.

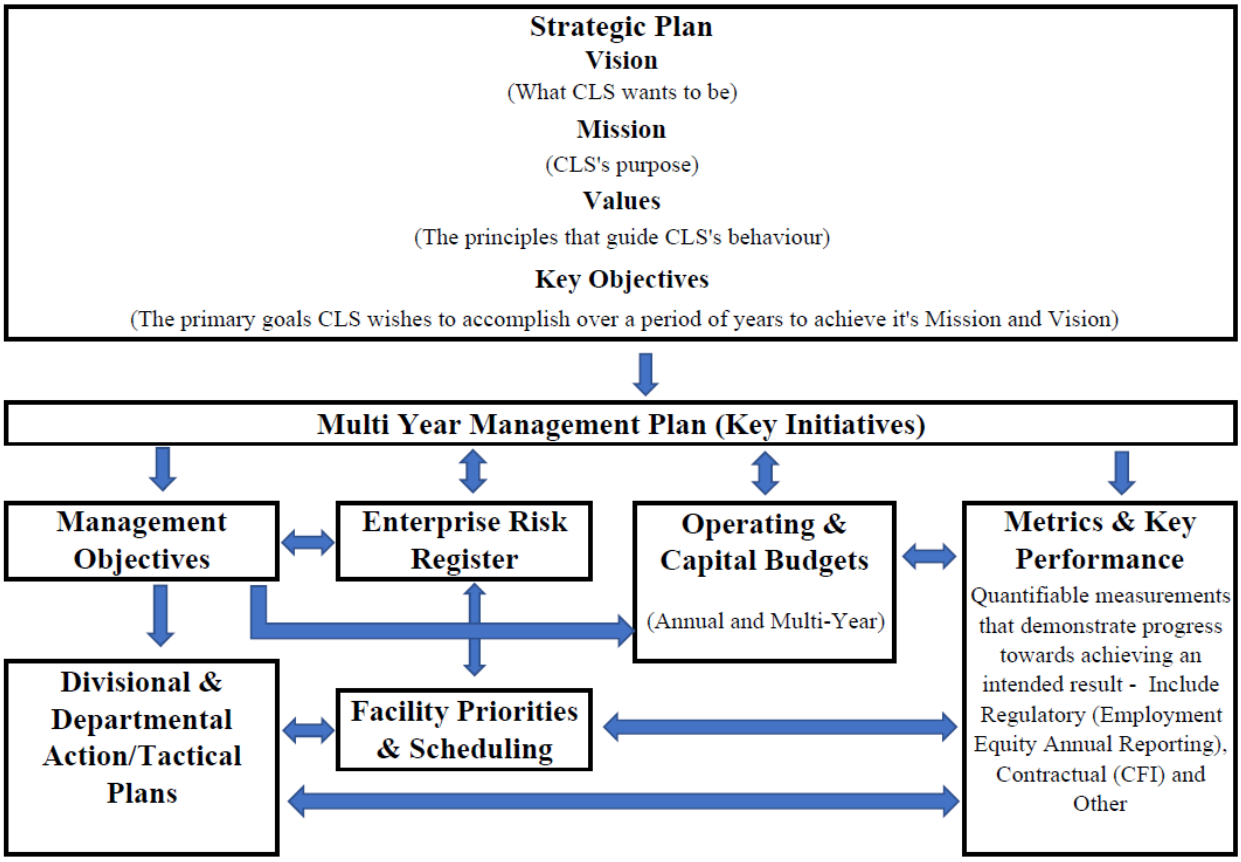

Figure 1 – CLSI management planning process overview.

The current estimated expected commercial life of the facility is expected to be until 2032. Effectively the period of the requested license.

CLSI is currently in the process of procuring a consultant to facilitate CLSI's preparation of an updated long-term Strategic Plan and Multi-Year Management Plan for the period April 1, 2022 through to the anticipated end of operational life for the facility, which corelates to the requested license period. This strategic planning process will commence in the current fiscal year and conclude in the summer of 2021.

For this period there are several factors that have significant effects on operations and thus the resulting product of the CLS namely high quality/quantity of scientific output.

For example, negative impacts to productivity include:

- Reliability of Future funding: Funding has typically been of 5 years duration. The last cycle was broken into 3 year and 2 year competitive rounds. This variability and resulting efforts involved in managing/writing funding applications and preparing contingencies, significantly influences the pattern of expenditure and concomitant productivity.

- Ageing facility - equipment failure: Specifically, both planned major equipment replacement such as cooling towers, replacement RF cavity and amplifiers, etc. and

unplanned but anticipated breakdown of the large scale components such as the electron gun and LINAC.

- The CLS was constructed from 2000 to 2005 but relies upon critical instrumentation installed in the 1960s and 1970s as part of the earlier Saskatchewan Accelerator Laboratory. The 2018 failure of these components resulted in a 6 month closure of the CLS. To date, despite best efforts, there has been no funding support (~$15M) secured to reduce the significant risk of a repeat.

- Ageing facility - dated technology: The next generation light sources are currently being commissioned worldwide. These vastly brighter instruments have significant advantages over the current 3rd generation facilities such as the CLS. The steady migration of the present scientific user base to these new facilities is inevitable. In response to this the CLS is:

    1. Developing new areas for potential users who do not require 4th generation light. A good example is agriculture research which has seen massive growth in users over the past 4 years at the CLS.

    2. Designing a 4th generation instrument to replace the existing CLS.

Positive impacts to productivity include:

- New operation modes -Top Up: Constant brightness mode in the ring is currently being tested. This will improve a variety of experimental arrangements and lead to an increasing number of possible scientific experiments.

- Electron source laboratory: Designed to stimulate Canadian innovation in 4th generation instrumentation, this will be dedicated to research in novel accelerator technologies. Increasing both scientific output and simultaneously setting a path for a future light source facility in Canada.

- Engagement with industry: CLS will take more advantage of its increasing beamlines and more focused efforts on specific international/national industry partners. This creates gains both financially and scientifically. The CLS has become one of the world leaders in industrial research and this will only grow.

As noted above, the development of new 4th generation light source for Canada is well underway. Significant developments over the past 4 years include:

- Conceptual design report: This summarizes a 4 year effort to develop a uniquely Canadian designed 4th generation synchrotron. It includes a peer reviewed ring design and how this will impact new beamlines and thus science. This will be published mid-2021.

- Science Case: Improvements to existing scientific capabilities and access to new facilities from a new machine forms the basis of this report due early 2022. Engagement with the

huge user base and alignment with Canadian science technological priorities is currently underway.

- Business Case: The social and economic impact of a new facility and the return on investment from what will be a $1 B+ investment is examined in detail. This is due early 2022.

- Technical Case: This creates the "blueprints" for construction of the facility and will begin once funding becomes available.

3.0 Safety and Control Areas

3.1 Management system

"The management system SCA covers the framework that establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture." ([3], 4.1)

Based on annual inspections performed by the CNSC from 2012 to 2020, CLSI performance in the Management System SCA left room for improvement. CLSI continued to work towards implementation of established improvement plans in order to meet or exceed regulatory requirements in the upcoming licence term. In September/October of 2020, CNSC staff observed "progress in the implementation of the CLSI's management system consistently across the organization." [4]

3.1.1 Relevance and management

The CLSI Quality Manual [5] is the Quality Management System (QMS) developed by CLSI to meet the requirements of the Canadian Standards Association (CSA) standard N286-12, Management System Requirements for Nuclear Facilities [6]. The QMS constitutes the top level of quality documentation in the company. The quality manual defines the management system processes, how they are applied throughout CLSI and the sequence and interaction of these processes.

Under the direction of the Management System Specialist, a project plan has been developed to revise the supporting document structure to ensure that all SCAs are adequately addressed in high-level documents, thereby significantly reducing the number of licensing documents. Documents currently supporting the management system SCA are listed in Table 1.

Table 1 - CLSI documents defining the management system.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.1.1.15	4	Organization Management	September 5, 2018	[7]	The CLSI governance and management structure

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.1.1.17	3	Purchasing Requisition Procedure	August 28, 2017	[8]	How CLSI ensures procurement of good or services from qualified, approved suppliers
0.1.1.41	6	Document and Record Control Process	May 26, 2020	[9]	Defines the document control process
0.7.1.3	3	Engineering Change Request & Engineering Change Order Procedure	May 8, 2020	[10]	How CLSI manages changes to equipment and systems
0.7.1.5	2	Quality Management System Review Procedure	August 27, 2018	[11]	How CLSI assesses the management system
0.13.1.1	7	Occupational Health and Safety Committee (OHSC) Terms of Reference	January 25, 2019	[12]	Roles and function of the OHSC
0.13.1.9	9	Procurement Process	April 11, 2019	[13]	How CLSI ensures procurement of good or services from qualified, approved suppliers
0.13.1.14	3	Board of Directors Health Safety and Environment (HSE) Committee Terms of Reference	December 5, 2019	[14]	Roles and function of the Board of Directors HSE Committee
0.24.1.1	2	Problem Identification and Resolution Process	February 27, 2020	[15]	How CLSI manages human error and continuous improvement of human performance
0.24.1.2	3	Training Process	April 3, 2019	[16]	How CLSI manages training
0.24.1.10	1	Work Management Process	September 20, 2018	[17]	How CLSI manages work
7.7.38.1	4	Test Equipment and Process Instrumentation Calibration Procedures	February 27, 2020	[18]	How CLSI performs calibration
10.7.1.2	2	Internal Quality Audit Procedure	August 27, 2018	[19]	How CLSI performs internal audits
10.12.1.1	10	Quality Manual	July 6, 2020	[5]	The CLSI management system

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.7.37.1	8	Control of Hazardous Energy	January 27, 2020	[20]	How CLSI ensures the containment of hazardous energy
11.9.1.1	5	Health Safety and Environment Manual	October 30, 2019	[21]	How CLSI ensures a safe workplace
11.9.53.3	4	Radiation Protection and Control Manual	November 25, 2019	[22]	How CLSI ensures safety from ionizing radiation
N/A	N/A	University of Saskatchewan and Canadian Light Source Licence Agreement	September 6, 2002	[23]	Outlines the operating agreement between University of Saskatchewan and CLSI

The CLSI organizational chart is shown in Figure 2.

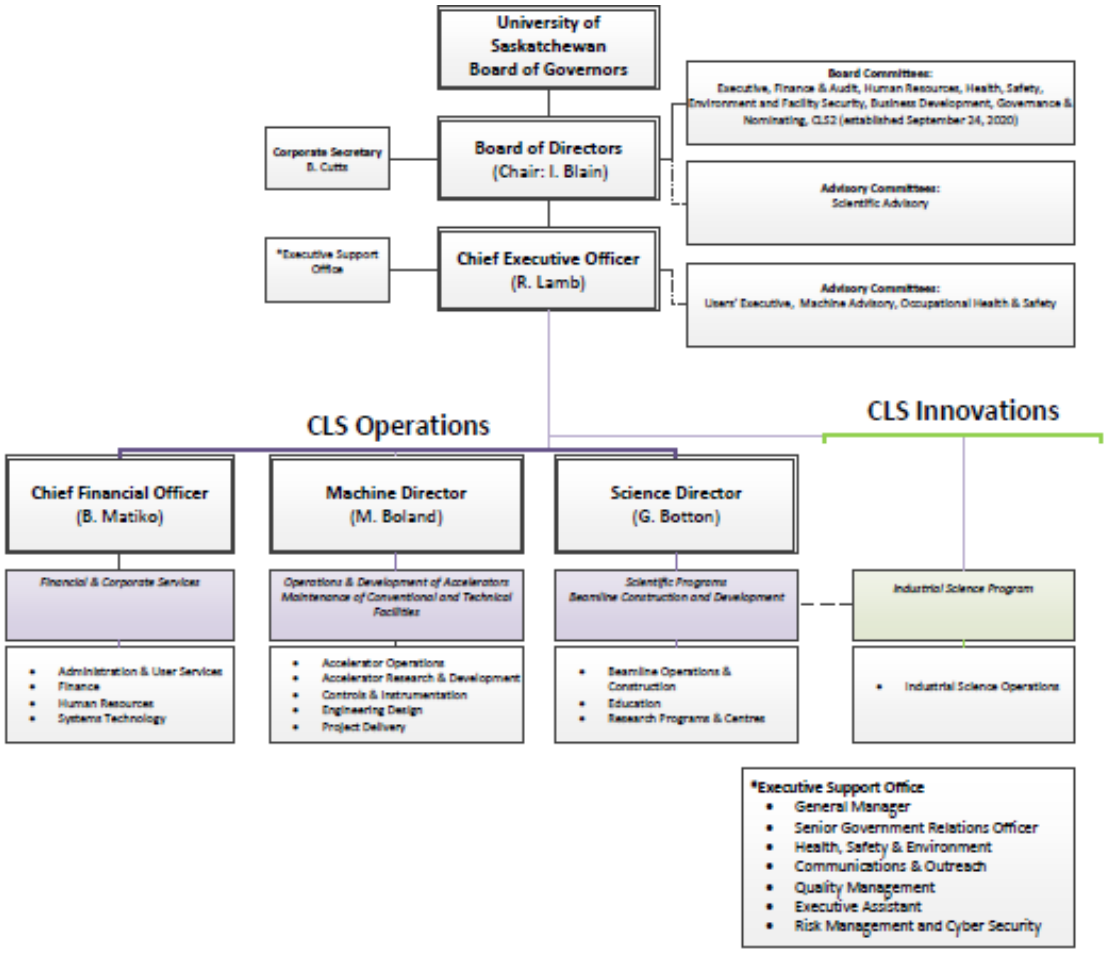

Figure 2 – CLSI organizational chart.

3.1.2 Past performance

Several annual CNSC inspections, performed during the current licensing period, have incorporated evaluation of the management system SCA. Following, is a brief summary of the inspection findings and results.

In 2011, concerns were raised regarding deficiencies in the management system and corrective actions were proposed by CLSI in response. In 2013 the progress made on corrective actions was not sufficient to resolve CNSC concerns. In 2014, the CNSC identified weaknesses in safety culture. A new Quality Assurance Coordinator position was established at the beginning of 2015 to provide oversight to the QMS [5]. In 2015, the CNSC shared a high-level gap analysis between the CLSI management system and CSA N286-12 [6] with CLSI. Specific concerns were addressed regarding the non-conformance and corrective action processes.

In 2016, CNSC observed that CLSI had implemented a work management process and a change control process. CNSC staff complimented CLSI staff on this successful outcome. During the inspection it was also noted that significant organizational restructuring since 2013 had hindered implementation of some corrective actions identified during the 2013 inspection. CNSC staff were concerned by a number of outdated documents and by the lack of adherence to procedures by CLSI personnel. Several functional areas did not have established Key Performance Indicators (KPIs) by which to evaluate the effectiveness of performance in their area. Corrective actions resulting from internal self-assessments and audits were not always tracked to completion or evaluated for effectiveness. A need for a single non-compliance reporting system was identified, as well as the need for non-compliance trending analysis and corrective action effectiveness reviews. In response, CLSI formed new committees tasked with process improvement. A Problem Identification and Resolution Project was initiated to define and implement a strategy to address deficiencies in the management system. Each department was responsible for developing KPIs for their functional area. A plan to significantly overhaul CLSI documentation was established, which would result in the revision of most licensing documents. The objective of this documentation revision plan was to reduce the number of licensing documents listed in the LCH to include only high-level process documents.

In 2018, CLSI developed a new Quality Manual, which was rewritten to reflect current practices and to align with the requirements of N286-12. The revised Quality Manual was issued in February 2019 and has subsequently been revised again and reissued in July 2020.

In 2019, CNSC staff again raised concerns regarding limited progress made to improve the management system in order to meet regulatory requirements. Further improvements to the management system were still required.

In 2020, CNSC staff "noted progress in the implementation of the CLSI's management system consistently across the organization" since the 2019 inspection. "In addition, CLSI has completed some actions from the 2019 inspection report." [4] Actions taken to improve the management system include a problem identification and resolution project. A JIRA-based software tool, called the Problem Reporting System (PRS), has been developed to track all non-conformances. The PRS was implemented on April 1, 2020. Staff training on the PRS was completed by June, as well as Root Cause Analysis training for selected staff. Corrective actions are tracked in the PRS, along with the responsible individuals and required completion dates.

Senior management review non-conformances in the PRS monthly to ensure that corrective actions are being completed and are effective. The Problem Identification and Resolution Process document [15] was revised in February 2020 to reflect the program changes and requirements.

3.1.3 Future plans

A revision to the CLSI Quality Manual [5] (the QMS) was issued in July 2020. The latest revision addresses some gaps that remained when evaluated against N286-12 [6]. A corresponding update was made to the N286-12 and QMS correspondence matrix in the QMS.

Initiatives currently being implemented by CLSI to improve the management system include:

- A document control improvement project – New document management software is being evaluated. A list of documents required for retention was solicited and received from all stakeholders. The QMS has been revised to address changes to record retention requirements. A master list of retained records has been prepared, along with the storage location and retention period for each. A new Records Management Process is currently under development.
- A work management and engineering change integration project – Revisions to the engineering change [10] and configuration control [24] procedures were made to improve the clarity of the processes. By June 2020, a review of existing work management process was completed for all departments. Different departments perform work of a very different nature, at different risk levels. Based on existing practices, the work management process at CLSI was added to the QMS revision. The QMS was also revised to include a new change management process. Supporting work management documents were issued and/or revised as necessary to align with the QMS. The new work management and engineering change process is now implemented throughout the organization. Analysis of the newly documented organizational work management process was completed to ensure that it aligns with the requirements of N286-12. A quarterly review of the process will be performed to confirm that each department has implemented it as required in program documents. New software has been purchased to replace the tools previously used to track and manage the work management and calibration processes.
- Self-assessment improvement project – All departments at CLSI have developed KPIs for use in measuring their performance. These indicators will be used in self-assessments to gauge areas of strength and areas needing improvement in order to meet performance targets. A revised procedure, Internal Quality Assessment Procedure [25], has been deployed to guide the performance of independent assessments. The Quality department prepares a Problem Report Summary which includes a list of corrective actions identified during internal assessments along with the progress made on each. The list is reviewed during Quarterly Management Review (QMR) meetings and actions arising are tracked to completion.
- Updating of the management plan up to 2022 is tied to the development 2022-2027 CLSI Strategic Plan, both of which are scheduled for 2021.

- Integrating the management system into the culture of CLSI – This is a key focus of the executive group and management team. A QMR process has been established and is now conducted monthly by the executive team. QMR helps to ensure that a regular review of CLS performance, the QMS and resulting action items are carried out in a timely manner and that those actions effectively address the issues raised. During an inspection that took place in the fall of 2020, focused on the Management System SCA, CNSC staff noted that CLSI is committed to implementing improvements in the governing management system. However, more work is required to fully integrate the management system into the culture of CLSI.
- Procurement improvement project – The supplier evaluation and approval process is being assessed and improved in order to ensure alignment with N286-12. Improvements to strengthen the procurement process have been incorporated into a new document, the Procurement Guideline [26]. A plan has been developed and implemented to ensure that complete records are kept for purchased items and services. The procurement process has been migrated to a new software tool which improves tracking of purchases and associated records from the beginning of the process to the end. During an inspection that took place in the fall of 2020, focused on the Management System SCA, CNSC staff found that progress has been made in implementation of the procurement improvement plan. As a result, the associated Action Notice was closed.
- Preventive maintenance project – CLSI has developed a plan to demonstrate that monthly preventive maintenance is performed as required. The preventive maintenance process has been improved such that the appropriate manager is notified of the tasks that must be performed on a monthly basis. Follow-up is required to ensure that all tasks are either completed as planned or that appropriate alternate steps have been taken and documented. Improvements to the preventive maintenance process have strengthened oversight so that records are generated to ensure completion of tasks and that those records are retained upon completion of the tasks.

3.1.4 Requests

CLSI requests that the set of licence documents listed under the Management System SCA in the LCH be reduced to include only the CLSI Quality Manual [5]. CLSI will continue to work with CSNC staff to revise the LCH to reduce the number of licence basis documents throughout.

3.2 Human performance management

“The human performance management SCA covers activities that enable effective human performance through the development and implementation of processes that ensure that a sufficient number of licensee personnel are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.” ([3], 4.2)

Based on annual inspections performed by the CNSC from 2012 to 2020, CLSI performance in the Human Performance Management SCA has been satisfactory over the course of the term of the current licence. CLSI will continue to meet or exceed regulatory requirements in the upcoming licensing period.

3.2.1 Relevance and management

CLSI is required to implement and maintain a human performance management program ([2], 3.1). The CLSI Quality Manual [5], Section 10.2 describes the Human Performance Management system in place within the organization. Supporting documents that provide further detail regarding the management of human performance at CLSI are shown in Table 2.

Table 2 - CLSI documents supporting the human performance program

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.1.1.14	8	CLS Employee Hours of Work Procedure	October 30, 2019	[27]	How CLSI monitors personnel hours of work
0.7.1.28	0	Fit for Duty Program	January 24, 2017	[28]	How CLSI ensures staff is fit for duty
8.1.1.6	4	Routine Operation Limits and Conditions	November 10, 2015	[29]	Defines minimum staff complement at CLSI.
11.9.1.1	5	Health Safety and Environment Manual	October 30, 2019	[21]	How CLSI ensures a safe workplace, including a safety culture
11.9.37.1	2	Occupational Health and Safety Manual	January 18, 2019	[30]	How CLSI provides organizational support for safe work activities
11.9.53.3	4	Radiation Protection and Control Manual	November 25, 2019	[22]	
11.9.55.1	5	Biological, Chemical and Nanomaterial Safety Manual	November 14, 2018	[31]	
0.24.1.1	2	Problem Identification and Resolution Process	February 27, 2020	[15]	How CLSI manages human error and continuous improvement of human performance

CLSI ensures a minimum staff complement for operational shifts as described in the Routine Operations – Limits and Conditions procedure [29]. During ‘Normal Mode’ operation a minimum of two Operators are on duty and must be on site at all times. During ‘Development Mode’ at least one Operator and one other CLSI staff member trained for development mode duties must be on site.

CLSI is committed to promote, foster, and maintain a healthy safety culture. The Health Safety and Environment Manual, Section 9.2 [21] describes the attributes of a healthy safety culture and

how safety culture is monitored. In 2021, CLSI plans to have an external safety culture assessment performed in order to ensure continuous improvement.

3.2.2 Past performance

Following is a selection of incidents involving human performance that have occurred during the current licensing period, along with actions taken to prevent recurrence.

In July 2012, an Operator disconnected the oxygen monitoring system annunciation horn in the control room. While the Operator continued to monitor the alarm lights and clear faults as they occurred, disconnection of the horn was a procedural violation. The individual was coached by their manager that safety system notification alarms may not be bypassed without appropriate measures put in place to ensure the ongoing safety of personnel. A root cause investigation was performed which determined that several factors, including false positive detector faults, alarm annunciation system design, staff irritation with false alarms, and a lack of compliance with the procedural requirement, led to the incident. In order to prevent recurrence, the following actions were taken:

- New oxygen-sensing detectors were installed.
- The alarm acknowledgement process was redesigned to reduce the frequency of alarm notifications following acknowledgement.
- The alarm volume in the control room was lowered to reduce irritation to the control room operator.
- A ‘Do Not Remove’ label was posted at the control room horn location.

This incident is also mentioned under the Conventional Safety SCA.

In January of 2017, ineffective communication lead to a situation where HSE staff were not signed into the control room logbook during development mode operation as required by procedure. HSE staff were present at the facility so that minimum complement was maintained, however it was not properly documented. A process of education and oversight was implemented to ensure proper sign-in and sign-out of minimum staff complement staff. During a 2018 CNSC inspection a review of operations sign-in logs found the process was strictly adhered to for the period reviewed.

In July of 2019, an incident occurred when minimum staff compliment was not present at the facility for a short period of time. In order to prevent a recurrence, changes to the communication processes and protocols for calling in minimum compliment staff were implemented.

In 2017 during a maintenance shutdown period two incidents of pierced beamline shielding occurred due to human performance issues. In order to prevent a recurrence of this repeat event, changes to the shielding control process were implemented.

In October 2016 a near miss incident occurred when an electrical disconnect switch was not properly locked into the off position prior to work being performed on a 600 V power supply. An investigation was completed, resulting in several recommendations. In order to prevent recurrence, the following actions were taken:

- Revision of the Lock Out-Tag Out (LOTO) process.
- Development of an SAT-compliant LOTO training program.
- Improved demarcation and monitoring of 'keep clear' areas around electrical panels.
- Revision of the Fit for Duty Program [28] to expand upon the importance of mental fitness when performing tasks that may pose an unusual risk to health and safety.

3.2.3 Training Program

CLSI is required to use a Systematic Approach to Training (SAT) for programs that include personnel who may be required to perform duties having an impact on safety and/or security. Under the direction of the Training Coordinator, CLSI has implemented a SAT process for safety-significant roles to ensure the provision of qualified workers. Section 10.2.1 of the CLSI Quality Manual [5] generally describes the systematic training program. The Training Process document [16] provides further detail on how the SAT is managed and implemented. CLSI documents supporting the training program are shown in Table 3.

Table 3 – CLSI documents supporting the training program.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.24.1.2	1	Training Process	April 3, 2019	[16]	How CLSI implements a SAT
0.12.1.4	2	Floor Coordinator Roles, Responsibilities and Training Plan	January 24, 2019	[32]	How SAT is carried out for the Floor Coordinator role
0.12.91.1	8	Accelerator Operations Personnel Qualification and Training Plan	September 17, 2017	[33]	How SAT is carried out for Operations roles

Health and Safety training at CLSI ensures that all personnel are competent to work safely. Different training modules are provided, based on the location and type of work being performed. The level of training provided is commensurate with the relative magnitude and risk of potential hazards involved in the work assignment. The requirement for specific safety training courses is determined based on the SAT.

In 2019, some new training positions were established. A Training Specialist position was introduced to oversee the implementation of training and qualification programs at CLSI. CLSI also changed the Operator position so that it is now a full-time position, responsible for the Floor Coordinator, operations, and development mode staff roles. The role of Floor Coordinator is still in place; however, the associated duties are now performed by full-time Operators. As a result, no changes to program or training documentation will be made; documents will continue to refer to the Floor Coordinator role. Personnel selected for the new Operator role received six weeks of classroom and on-the-job training prior to assuming their new duties. Operators now work on a 12-hour shift schedule.

Based on annual inspections performed by the CNSC from 2012 to 2020, CLSI has implemented a training process that meets the requirements of the management system and N286-12 [6].

3.3 Operating performance

"The operating performance SCA includes an overall review of the conduct of the licensed activities and the activities that enable effective performance." ([3], 4.3)

Based on annual inspections performed by the CNSC from 2012 to 2020, CLSI performance in the Operating Performance SCA has been fully satisfactory over the course of the term of the current licence. CLSI will continue to meet or exceed regulatory requirements in the upcoming licence term.

3.3.1 Relevance and management

CLSI is required to implement and maintain a program for operation of the Canadian Light Source (CLS) facility such that normal operations are carried out safely. The QMS, Section 9.4 [5] defines the operations process. The QMS also addresses work management requirements for experimental science and maintenance and repair of the equipment. Supporting documents, listed in Table 4, provide further detail regarding operational procedures.

Table 4 – CLSI documents supporting the operating program.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.7.91.4	2	Accelerator Operations Configuration Process	May 1, 2019	[34]	How CLSI transitions the accelerator systems between the four different modes of operation
0.24.1.1	2	Problem Identification and Resolution Process	February 27, 2020	[15]	How CLSI addresses non-conformances
0.24.1.10	1	Work Management Process	Sep 20, 2018	[17]	How CLSI manages work
8.1.1.6	4	Routine Operation Limits and Conditions	March 22, 2019	[29]	OLCs put in place by CLSI
8.7.9.1.1	8	Canadian Light Source Normal Operations – Machine Operating Procedure	November 28, 2019	[35]	How CLSI operates the accelerator

In 2017 CLSI applied to use an alternate mode of operation, called top up mode, in addition to the decay mode of operation. This constituted an expansion of the existing licence basis, which was reviewed and accepted by the CNSC in February 2018. CLSI began successfully operating

in top up mode in May 2018. Evaluation of the shielding at all beamline primary optical enclosures confirmed that operation in top up mode meets safety requirements.

3.3.2 Beamlines

Beamlines at the CLS are accessed, operated, and monitored according to established and approved procedures. The design and operation of all new beamlines at CLSI is carried out in accordance with the CLS Commissioning Phase III Frontends, Insertion Devices, Beamlines procedure [36]. A list of documents supporting beamline operations is provided in Table 5.

Table 5 – CLSI documents supporting the commissioning, operation, and monitoring of beamlines.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
6.7.1.2	0	Performance Monitoring of Beamlines Process	December 7, 2016	[37]	How CLSI monitors the performance of the beamline operation process
8.12.90.1	1	CLS Commissioning – Phase III Frontends, Insertion Devices, Beamlines	May 18, 2007	[36]	How CLSI commissions new beamlines
8.24.1.1	0	CLSI Beamtime Access Process	October 28, 2019	[38]	How CLSI provides access to beamlines

During a Type II inspection carried out in 2018 [39], the CNSC concluded that:

- Beamlines are commissioned in accordance with CLSI procedures
- Beamline radiation shielding is adequately controlled
- Target radiation dose rates surrounding beamlines are set lower than required
- Beamline commissioning records are comprehensive

3.3.3 Bio-medical Imaging and Therapy Beamline use on Humans

The Bio-Medical Imaging and Therapy Beamline (BMIT) will not be used on humans without prior approval of the CNSC. CLSI currently has no intention of conducting experiments on humans in the future.

3.3.4 Reporting Requirements

CLSI submits Annual Compliance Reports (ACRs) to the CNSC each year, summarizing performance within each SCA during operation over the previous year. Selected significant or unusual events that have occurred over the current licensing period are discussed in the relevant sections of this document.

3.3.5 Past performance

CLSI operating performance over the previous licensing period balanced maintenance of a high level of beam availability, while implementing continuous improvements to support world-leading science and upgrading facility infrastructure. The linear accelerator equipment sections and the LINAC modulators were upgraded during the licence period to replace equipment from the former Saskatchewan Accelerator Laboratory. Three new phase 3 beamlines were added and successfully commissioned to add to the suite of beamlines already in use. An enhancement to the facility, and a corresponding licence amendment in 2018, added the top up mode of operation to the licensing basis.

Facility infrastructure enhancements included completion of a second floor office space above the BMIT beamlines, a building addition to accommodate the Brockhouse Beamline, and an expansion of office space to accommodate growth in staffing levels.

In July of 2018 CLSI suffered a major outage due to failure of the electron gun. This resulted in a significant reduction in beam availability for that year. A replacement electron gun was installed and began operation in January of 2019, returning the facility to routine operation. In 2020, due to the COVID-19 pandemic, CLSI adapted on-site protocols to allow staffing levels sufficient to maintain the safe operation and maintenance of the facility while following public health recommendations.

3.3.6 Future Plans

As a consequence of the 2018 electron gun failure, noted in Section 3.3.5, CLSI is planning the development of an Electron Source Laboratory (ESL). The laboratory will be contained within the former Saskatchewan Accelerator Laboratory area. A small area not required for CLS operation will be renovated to provide a facility to perform research with electron sources. In addition, the ESL will provide a means to ensure any future failure of an electron gun at the CLS facility can be quickly addressed, as a replacement electron source will already be tested and ready for installation.

3.3.7 Challenges

Maintaining a national research facility such as a synchrotron raises many challenges. CLSI has shown itself capable of safely meeting these challenges while delivering high-quality science.

3.3.8 Requests

CLSI plans to request addition of operation of the Electron Source Laboratory to the Operating Performance SCA in the LCH as the facility approaches commissioning.

CLSI has abandoned any plans to use the Biomedical and Imaging Therapy (BMIT) beamline for research on humans. CLSI therefore requests that consideration be given to removing licence condition 4.3 from the LCH.

3.4 Safety analysis

"The safety analysis SCA covers maintenance of the safety analysis that supports the overall safety case for the facility. 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 preventive measures and strategies in reducing the effects of such hazards." ([3], 4.4)

3.4.1 Relevance and management

CLSI has prepared a detailed Safety Report [40] describing safety analysis of the CLS facility due to both ionizing radiation and non-ionizing radiation hazards. The Safety Report is reviewed and revised periodically as required to reflect current operations and to support changes to operation. Other supplementary safety analysis documents are listed in Table 6.

Table 6 – CLSI documents providing safety analysis of the CLS.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.2.37.2	3	CLS Safety System Development Strategy	December 21, 2016	[41]	Provides design input for various safety systems developed at CLS
11.18.40.2	14	CLSI Safety Report	April 24, 2018	[40]	Provides the safety analysis of the facility and its operation in detail
26.2.37.1	8	BMIT Hazard and Risk Analysis	January 18, 2019	[42]	Provides hazard analysis specifically for the BMIT

3.4.2 Documentation

CLSI is required to maintain an up to date set of design documents, technical references, safety analysis reports and drawings for the nuclear facility. The CLSI Safety Report [40] provides a comprehensive analysis of the facility and its operation. Table 7 provides a list of the other design documents, drawings, and safety analyses in place, describing operation of the CLS.

Table 7 – CLSI documents supporting the safety analysis of the CLS.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
N/A	Various	Facility Drawings	Various	N/A	Provide documentation of the CLS facility systems and layout

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
1.9.52.1	2	LINAC Access Control and Interlock System (ACIS) Design Manual	March 9, 2011	[43]	Provides detailed design information
6.1.37.1	0	Photon Beamline Safety Guidelines – Personnel Safety System and Equipment Protection Systems	October 15, 2003	[44]	Provides design principles used for equipment protection and personnel safety systems on beamlines
7.9.39.4	6	Booster/Storage Ring/Beamlines Access Control and Interlock System (ACIS) PLC Component Manual	June 9, 2020	[45]	Provides detailed system component information
11.18.40.2	14	CLSI Safety Report	April 24, 2018	[40]	Provides the safety analysis of the facility and its operation in detail
26.2.37.1	8	BMIT Hazard and Risk Analysis	January 18, 2019	[42]	Provides hazard analysis specifically for the BMIT
26.9.52.1	4	Bio-medical Imaging and Therapy Beamline (BMIT) Access Control and Interlock System (ACIS) Design Manual	March 12, 2018	[46]	Provides detailed design information

3.4.3 Operational Specifications and Limits

The QMS, Section 9.4 [5] describes operation of the accelerator, within the licensing limits. The documents listed in Table 8 provide the boundaries within which the CLS will continue to operate. Specific operational limits are listed in Table 9, and nuclear substances limits are shown in Table 10, Table 11 and Table 12. CLSI also maintains a detailed activated components inventory [64].

Table 8 – CLS documents describing operational specifications and limits.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
8.1.1.6	4	Routine Operation Limits and Conditions	March 22, 2019	[29]	OLCs put in place by CLSI
11.7.53.6	4	Canadian Light Source Inc.	August 8, 2018	[48]	Provides contamination

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
		Surface Contamination Surveys			limits beyond which response is required
11.9.37.2	3	Industrial Science Laboratory Manual	June 20, 2019	[49]	Provides the nuclear substance inventory limits at the intermediate level ISL
11.18.40.2	14	CLSI Safety Report	April 24, 2018	[40]	Provides safety analysis of operation of the facility at the specified limits

Table 9 – CLS operational limits [40].

Property	Limit
Injection Linear Accelerator	
Electron Beam Energy:	250 MeV
Average Electron Beam Current:	14 nA
Booster Accelerator	
Average Electron Beam Energy:	2.9 GeV
Electron Beam Current:	10 mA
Storage Ring	
Average Electron Beam Energy:	2.9 GeV
Electron Beam Current:	500 mA[1]

Table 10 – Sealed source nuclear substance limits for possession, processing, use, transfer, import and storage.

Isotope	Maximum Activity per Source (MBq)	Storage Location
Na-22	1	Room 1608.12
Mn-54	1	Room 1608.12

[1] CLS is currently operating in normal mode at a maximum current of 300 mA. Routine operations at a beam current greater than 300 mA requires the prior verification of the effectiveness of storage ring shielding at that beam current.

Fe-55	370	Room 1608.12, Room 0014
Co-57	185	Room 1608.12
Co-60	1	Room 1608.12
Ru-106	3.7	Room 1608.12
Cd-109	1	Room 1608.12
Ba-133	1	Room 1608.12
Cs-137	7.4	Room 1608.12, Room 0013.2
Eu-152	1	Room 1608.12
Am-241	37	Room 1608.12
Am-241/Be	1000	Room 1608.12
Cf-252	3.7	Room 1608.12

Table 11 – Unsealed source nuclear substance limits for possession, processing, use, transfer, import and storage.

Isotope	Maximum Activity per Source (GBq)	Storage Location
Mo-99	1	Room 1608.12, Room 0013.1, Room 0013.2
Tc-99m	46	Room 1608.12
Tc-99	1.3	Room 1608.12

Table 12 – Nuclear substance limits for possession, processing, use, transfer, and storage.

Isotope	Maximum Activity per Unsealed Source	Storage Location
H-3[2]	37 GBq	Room 0014
Natural Uranium	300 kBq	Room 1608.12, Room 1080

3.4.4 Past performance

Detailed safety analysis was completed in 2017 to describe the impact and mitigation of changes to the facility to allow the addition of the top up mode of operation. A rigorous theoretical beam loss analysis was performed for top up mode, along with tests of potential worst case accident scenarios. Both analyses indicated that top up mode could be implemented safely at the CLS. The documentation supporting the change was accepted by the CNSC in 2018.

More recently, a preliminary review of safety requirements for the development of an Electron Source Laboratory (ESL) have been completed. Safety analysis for the ESL includes computer

[2] Located in Valco model 140 gas chromatograph detector.

modeling to determine radiation shielding requirements for the ESL. A third-party review of the impact of the ESL on the facility fire protection requirements has been forwarded to CNSC staff for review.

3.4.5 Future plans

CLSI will pursue development of the Electron Source Laboratory. Any change to facility design that may impact safety will be carefully reviewed with the CNSC and incorporated into the CLSI facility safety analysis.

3.4.6 Challenges

It is anticipated the Electron Source Laboratory will pose challenges as a consequence of facility renovations at the sub-basement level. Anticipated challenges include aligning modifications with current building and fire code requirements.

3.4.7 Requests

CLSI will request addition of the Electron Source Laboratory to the Safety Analysis SCA as the facility approaches commissioning.

3.5 Physical design

“The physical design SCA relates to activities that affect the ability of structures, systems and components (SSCs) to meet and maintain their design basis, given new information arising over time and taking changes in the external environment into account.” ([3], 4.5)

CLSI will continue to meet or exceed regulatory requirements related to the physical design SCA in the upcoming licence term.

3.5.1 Relevance and management

Section 9.1 of the QMS [5] provides an overview of the design process implemented at CLSI. The design process is closely inter-related with the project management process, as projects can drive design activities.

A detailed description of the CLS buildings, systems and equipment is provided in the Safety Report [40]. Safety significant systems described include, but are not limited to, the access control system (Sections 8.2 and 8.5), radiation monitoring system (Section 8.3), shielding calculations, design and commissioning (Sections 8.4 and 10.3), the accelerator systems (Sections 7 and 8.5.2) and the beamline systems (Sections 7.4 and 8.5.3). The CLSI Radiation Protection and Control Manual [22] provides detailed information regarding radiation monitoring systems in place at the CLS.

Table 13 summarizes other documents supporting the design program SCA.

Table 13 – CLSI documents supporting the design program.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.2.37.2	3	CLS Safety System Development Strategy	December 21, 2016	[41]	Provides design input for various safety systems developed at CLS
0.7.1.3	3	Engineering Change Request and Engineering Change Order Procedure	May 8, 2020	[10]	How CLSI manages changes to design
0.24.1.10	1	Work Management Process	September 20, 2018	[17]	How CLSI manages work
0.24.69.1	4	Design Process	November 28, 2018	[50]	Defines how design is documented and controlled.
1.9.52.1	2	LINAC Access Control and Interlock System (ACIS) Design Manual	March 9, 2011	[43]	Detailed system description
7.9.39.4	6	Booster/Storage Ring/Beamlines Access Control and Interlock System (ACIS) PLC Component Manual	June 9, 2020	[45]	Detailed component description
7.9.52.1	4	Oxygen Monitoring and Liquid Nitrogen Distribution Component Manual	October 20, 2017	[51]	Detailed component description
11.18.40.2	14	CLSI Safety Report	April 24, 2018	[40]	Provides the safety analysis of the facility and its operation in detail
26.9.52.1	4	Bio-Medical Imaging and Therapy Beamline (BMIT) Access Control and Interlock System (ACIS) Design Manual	March 12, 2018	[46]	Detailed system description

3.5.2 Past performance

CLSI design and project processes are an integral component in the defence in depth approach to safety at the CLS. Engineering resources were increased over the licensing period to ensure capable and well qualified personnel either from an internal pool of engineers or through procurement of external consultants were used. Designs are carefully tested and implemented, and in some cases retested regularly based on a graded approach to safety.

3.6 Fitness for service

"The fitness for service SCA covers activities that affect the physical condition of SSCs 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." ([3], 4.6)

Based on an annual inspection performed in 2012, the CNSC concluded that CLSI was performing very well within the fitness for service SCA. CLSI performance has been satisfactory over the course of the term of the current licence. CLSI will continue to meet or exceed regulatory requirements in the upcoming licence term.

3.6.1 Relevance and management

The purpose of the CLSI maintenance strategy is to control equipment failure and enhance reliability. The QMS, Section 9.5 [5] lists the range of maintenance activities, which includes monitoring, surveillance, inspection, testing, assessment, calibration, service, overhaul, repair and replacement of parts.

CLS systems and equipment are maintained according to the CLSI Maintenance Plan [52]. The Fire Protection Program [53] describes the requirement for third part reviews of the fire suppression system. Fire detection, alarm and suppression equipment at the facility undergoes an annual third-party verification to confirm compliance with the applicable codes and standards. Fire extinguishers on site are verified each month and tested annually. The fire extinguishing system is inspected semi-annually by qualified technicians. Quarterly inspections of the sprinkler system are also conducted by an external party. Further fire equipment checks and inspections are performed by CLSI staff. The fire protection system inspection, testing and maintenance processes undergo a third-party audit every two years.

Table 14 – CLSI documents supporting equipment fitness for service.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.2.37.2	3	CLS Safety System Development Strategy	December 21, 2016	[41]	Provides design input for various safety systems developed at CLS
7.7.38.1	4	Test Equipment and Process Instrumentation Calibration Procedures	February 27,2020	[18]	How equipment and instrumentation is calibrated
8.12.1.2	1	CLSI Maintenance Plan	October 21, 2016	[52]	How CLSI implements the maintenance strategy
11.9.53.3	4	Radiation Protection and Control Manual	November 25, 2019	[22]	Requirements for radiation monitoring instrumentation

3.6.2 Past performance

Following are a selection of incidents involving equipment fitness for service that have occurred during the current licensing period, along with actions taken to prevent recurrence.

In November of 2013, an input-output controller failed, resulting in failure of the electron gun to interlock with the Active Area Radiation Monitoring System (AARMS). The Operator noticed the failure and did not inject electrons while the problem persisted. Communication was restored to the controller and the AARMS virtual machine was modified to ensure that the electron gun would interlock with the AARMS system pending any future input-output controller failure. The system interlock was verified and validated. An investigation into the incident revealed weaknesses in the software communication interface. An interim solution was implemented to reduce the risk of recurrence of a similar type of error. A redesign of the AARMS control software and hardware was undertaken. Full implementation of the upgraded system was completed in 2019.

In February of 2017, a wiring error was found in the linear accelerator (LINAC) Access Control and Interlock System (ACIS) hardwire system during annual ACIS validation and verification testing. The wiring error was corrected, and the LINAC ACIS validation and verification were repeated. The incident resulted in a review of the ACIS design and installations. Other issues were also found during the ACIS review, which were each promptly corrected. In each case, the issue discovered would have required an additional failure in the ACIS in order to result in a hazardous situation.

In March of 2018, a neutron probe was found to be in service two days past its annual calibration date. Corrective actions were implemented to strengthen the calibration process. These actions included enhancement of the review and oversight of calibration requirements to ensure work was assigned and completed as scheduled.

In June of 2018, the high voltage power supply for the electron gun failed. Despite repair efforts, the issue was not resolved. Further investigation revealed that significant damage had occurred to several electron gun components. This resulted in an extended six-month long shutdown (July to December). Repairs were completed by mid-December and electron gun operation was restored. In order to prevent recurrence of a significant outage, CLSI plans to develop an Electron Source Laboratory to provide an already tested and available alternate electron source.

During the current licensing period several storage ring trips have occurred due to equipment issues (see Table 15). Due to this trend in equipment reliability CLSI has worked to improve preventative maintenance programs to help address issues before they result in beam loss.

Table 15 – Storage ring trips due to equipment issues over the current licensing period.

Date	Required Maintenance
January 9, 2013	Superconducting cavity replaced
December 12, 2015	Fuses replaced
December 16, 2015	Software coding error corrected

Date	Required Maintenance
February 6, 2018	Software logic corrected
March 22, 2018	Wiggler gap changed
May 9, 2018	Power supply replaced
June 5, 2018	CPU module replaced
Jan 30, 2019	Faulty module replaced
Jan 31, 2019	Limit switch replaced
February 6, 2019	Fuse replaced
February 9, 2019	PLC coding issue addressed
February 14, 2019	Maglock plate adjusted
May 12, 2019	Screw tightened
June 18, 2019	Relay replaced
September 30, 2019	Power supply replaced

3.6.3 Future plans

CLSI is planning a major change to its equipment maintenance process: implementation of a new software program that will improve identification and assignment of routine maintenance tasks, and improve trending of failures for equipment. The new software system is currently under development, with testing and roll-out expected to begin in 2021.

3.6.4 Challenges

The proposed significant change in the equipment maintenance process discussed in Section 3.6.3 will result in work management changes for maintenance personnel. Roll out of new processes will require attention to detail and verification that the changes are implemented effectively.

3.6.5 Requests

No changes are requested for the Fitness for Service SCA at this time. A revision to the CLSI maintenance plan and other relevant documentation will be completed prior to implementation of changes to maintenance processes.

3.7 Radiation protection

“The radiation protection SCA covers the implementation of a radiation protection program in accordance with the Radiation Protection Regulations. This program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained as low as reasonably achievable (ALARA).” ([3], 4.7)

Based on an annual inspection performed in 2014, the CNSC concluded that CLSI demonstrated good radiation protection work practices and adequately controlled worker doses. CLSI performance has been satisfactory over the course of the term of the current licence. CLSI will continue to meet or exceed regulatory requirements in the upcoming licence term.

3.7.1 Relevance and management

CLSI has established a robust Radiation Protection and Control Program [22] that includes monitoring of personnel dose in accordance with the ALARA principle.

Table 16 – CLSI documents supporting the radiation protection program.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.9.53.3	4	Radiation Protection and Control Manual	November 25, 2019	[22]	How CLSI meets regulatory requirements and keeps radiation levels ALARA

Doses to CLSI personnel, facility users and contractors have remained low over the current licensing period (Table 17). The maximum total effective dose to an individual over the current dosimetry period[3] will be provided to the CNSC at the end of February 2021.

Table 17 – CLSI dosimetry results over the current licensing period.

		2012	2013	2014	2015	2016	2017	2018	2019
NEWs	People Monitored	152	151	154	165	174	176	171	139
	Collective Dose (mSv)	6.19	9.17	1.05	1.00	1.14	0.74	1.31	3.36
	Maximum Dose (mSv)	0.23	0.31	0.14	0.19	0.12	0.08	0.17	0.15
Non-NEWs	People Monitored	85	97	115	113	111	110	101	58
	Collective Dose (mSv)	0.74	1.29	0.24	0.16	0.22	0.60	0.55	0.42
	Maximum Dose (mSv)	0.18	0.19	0.05	0.08	0.03	0.11	0.10	0.09
Users	People Monitored	737	807	721	649	765	733	561	0
	Collective Dose (mSv)	1.88	14.15	0.21	0.08	0.53	2.56	0.21	N/A
	Maximum Dose (mSv)	0.11	0.18	0.02	0.04	0.05	0.09	0.04	N/A
Contractors	People Monitored	210	207	85	82	79	180	93	16

[3] 2016 to 2020

	Collective Dose (mSv)	0.34	2.42	0.12	0.06	0.04	0.93	0.38	0.06
	Maximum Dose (mSv)	0.14	0.17	0.02	0.06	0.01	0.07	0.11	0.05
Total Individuals Monitored		1184	1262	1075	1009	1129	1199	926	213

In 2018, analysis of personnel dose over the previous years revealed that there was justification for reducing the number of individuals assigned dosimetry. CLSI therefore restructured the personnel dosimetry assignment requirements, resulting in a reduction of 400 to 500 less dosimeters required per month. Facility users, contractors, administrative staff, and some science staff working in Controlled Access Zones (CAZs) are no longer required to wear personal dosimetry. Instead, any dose assignment for these individuals is made based on the results of passive area radiation dosimeters. In 2019, no such dose was assigned due to low doses measured in the CAZs. In 2019, no facility users were assigned dosimetry, and 16 contractors working in Restricted Access Zones (RAZs) were assigned dosimetry.

Surface and water contamination levels are monitored regularly at the CLS, and no unusual results have been observed during the current licensing period.

The surface contamination monitoring program involves measuring contamination levels at various random and routine sample locations. The results of surface contamination surveys for this licensing period are shown in Table 18. The results are presented as the average of all results measured in each year. For each year, the average surface contamination measured remained well below the CLSI internal investigation and response level of 100 cpm[4] [48].

Table 18 – Surface contamination measurement results over the current licensing period.

Surface Contamination Measured (cpm)								
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Average	35	37	38	37	35	37[5]	33	34
Maximum	49	50	50	51	49	57	45	53

Water samples from the accelerator heat exchangers, cooling water systems and holding tanks are analyzed for activation. The results of water contamination surveys for this licensing period are shown in Table 19. The results presented are the maximum value measured in each year. For each year, the water contamination level measured remained well below the CLSI internal investigation level of 10 Bq/mL [55].

Table 19 – Water contamination measurement results over the current licensing period.

Maximum Water Contamination Measured (Bq/L)

[4] Different contamination limits are in place for Mo-99, Uranium and Tc-99m for ISL locations.

[5] This result only represents the spring survey results for 2017, as they were measured using the same instrument used in other years. The average value of all surface contamination measurements taken in 2017 including measurements taken using a different instrument while the usual instrument was temporarily unavailable is 19 cpm.

2012	2013	2014	2015	2016	2017	2018	2019
1.06	1.00	0.83	0.44	1.03	1.58	0.28	2.92

3.7.2 Past performance

During the current licensing period there have been multiple incidents of false, elevated dosimetry results reported, and later corrected. In each case, the cause has been determined to be outside of CLSI control. The reduction in the number of individuals assigned dosimetry has significantly reduced the occurrence of this issue.

In February 2017, approximately one litre of 1.22 Bq/mL tritiated water spilled onto the floor and a worker's shoes during transport of used water filters. The resulting tritium contamination was cleaned up. A requirement for the use of secondary containment, during movement of filters, was implemented in order to prevent recurrence.

3.7.3 Dose Action Levels

Dose action levels are put in place to identify any abnormal doses to personnel during normal operations to prevent reaching regulatory dose limits and allow correction of any issues discovered. The dose action levels in place at CLSI are 2 mSv/quarter for Nuclear Energy Workers (NEWs) and 0.2 mSv/quarter for Non-NEWs. If an action level is reached, the CNSC must be notified and an investigation is required, to determine the cause. No dose action limits have been exceeded during the current licensing period.

Dose action levels are reviewed by the HSE Manager and Radiation Protection and Control Lead annually. The most recent review of CLSI dose action levels was completed in February 2020 to validate their effectiveness. No changes to action levels were recommended. The review and outcome are documented in meeting minutes [56].

3.7.4 Future plans

The development of the Electron Source Laboratory will impact the radiation protection program. A revision to the Radiation Protection and Control Manual [22] will be required to reflect the development of any associated procedures and process required continue good radiation protection practices with the new facility in place.

The CLSI Active Area Radiation Monitoring System (AARMS) is comprised of equipment that will be discontinued by the manufacturer in the coming years. CLSI intends to review and redesign the AARMS during the upcoming licencing period.

3.7.5 Challenges

CLSI has kept radiation exposures ALARA for staff, facility users, contractors, and members of the public. Radiation doses measured have all been well below regulatory limits over the current licensing period. This has been achieved through the use of defense in depth and ALARA

processes. Staff adherence to radiation safety protocols is strong but will require ongoing oversight and assessment to ensure that procedural adherence is maintained.

3.7.6 Requests

CLSI requests that the set of licence documents listed under the Radiation Protection SCA in the LCH be reduced to include only the CLSI Radiation Protection and Control Manual [22]. CLSI will continue to work with CNSC staff to revise the LCH to reduce the number of licence basis documents throughout.

3.8 Conventional health and safety

"The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment." ([3], 4.8)

Based on an annual inspection performed in 2017, the CNSC concluded that CLSI met regulatory requirements for conventional safety. CLSI performance has been fully satisfactory over the course of the term of the current licence. CLSI will continue to meet or exceed regulatory requirements in the upcoming licence term.

3.8.1 Relevance and management

The QMS [5] overlaps with the Health, Safety and Environment system [21] at CLSI. Hazards are identified and controlled, unusual events are investigated and reported and monthly workplace safety inspections are performed by the Occupational Health and Safety Committee. Supporting documents that provide further guidance regarding safety requirements and measures taken at CLSI are listed in Table 20.

Table 20 – CLSI documents supporting the occupational health and safety program.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
8.1.15.1	3	Machine Shop Procedure	April 19, 2016	[57]	Specific safety measures for the Machine Shop
11.7.54.3	5	Hot Work Procedure	January 18, 2019	[58]	Specific safety measures for hot work
11.9.1.1	5	Health Safety and Environment Manual	October 30, 2019	[21]	How CLSI ensures a safe workplace
11.9.37.1	2	Occupational Health and Safety Manual	January 18, 2019	[30]	How CLSI ensures a safe workplace and strong safety culture

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.9.55.1	5	Biological, Chemical and Nanomaterial Safety Manual	November 14, 2018	[31]	Specific safety measures for biological, chemical and nanomaterial hazards
11.18.40.2	14	CLSI Safety Report	April 24, 2018	[40]	Provides the safety analysis of the facility and its operation in detail

The number of occupational injuries has been consistently low over the licensing period; there were no injuries during 2018 and 2019 (Table 21).

Table 21 – Occupational injuries, 2012 to 2019.

	Occupational Injuries								
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Injuries requiring medical attention	3	4	4	2	3	2	0	0	2
Lost time injuries	0	0	0	1	0	1	0	0	1

Following amendment to Canada's Hazardous Products Act and Regulations, all CLSI staff received training in the new Workplace Hazardous Materials Information System (WHMIS 2015).

CLSI received a Public Health Agency of Canada (PHAC) Biosafety Licence in 2016 permitting the conduct of Risk Group 2 work at designated spaces within the facility. CLSI is currently maintaining the Group 2 License as well as Canadian Food Inspection Agency (CFIA) import permits, as required. In early 2020, CLSI received an Analytical Testing Licence from PHAC for the use of Cannabis in research. There were no reportable events for biological safety in 2019.

3.8.2 Past performance

CLSI has a very good safety record with a low injury rate. CLSI recently achieved a period of 1275 consecutive days without a lost time injury.

Following are a selection of incidents involving conventional safety that have occurred during the current licensing period, along with actions taken to prevent recurrence.

In July 2012, an Operator disconnected the oxygen monitoring system annunciation horn in the control room. While the Operator continued to monitor the alarm lights and clear faults as they occurred, disconnection of the horn was a procedural violation and presented a potential reduction to personnel safety. The individual was coached by their manager that safety system notification alarms may not be bypassed without appropriate measures put in place to ensure the

ongoing safety of personnel. A root cause investigation was performed. In order to prevent recurrence corrective actions were carried out. Details regarding the corrective actions are provided in Section 3.2.2 under the Human Performance SCA.

In July 2015, an oxygen deficiency event occurred when the oxygen level fell to 18.6%. No personnel were present in the affected area at the time of the oxygen deficiency. A liquid nitrogen leak occurred following completion of an automated fill process. During the task, a pressure release valve froze in the open position, releasing nitrogen, displacing oxygen, resulting in an oxygen deficiency warning alarm. An investigation took place, and determined that the probable cause was filling of the liquid nitrogen line too frequently. Frequent filling resulted in repetitive freezing of small amounts of water vapour until the pressure release valve froze in the open position. Equipment testing was carried out to determine the optimal automated fill sequence that allowed ample time for water vapour to evaporate before the next autofill was requested by the system.

In October 2016, a near miss incident occurred when an electrical disconnect switch was not properly locked in the off position prior to work being performed on a 600 V power supply. An investigation was completed, resulting in several recommendations to reduce the risk of recurrence of this type of event. Actions taken are discussed in Section 3.2.2 under the Human Performance SCA.

3.8.3 Future plans

CLSI is planning to conduct a Safety Culture Assessment in 2021. The assessment will be completed by an external consultant and include an employee survey as well as in person interviews with certain staff. CLSI expects the assessment to provide benchmark data to assist in ongoing efforts to monitor and improve safety and security culture within the facility.

3.8.4 Challenges

A challenge with any safety program is maintaining a strong safety culture. Efforts to continuously monitor and improve CLSI safety culture will be required in order to maintain the historically low injury rate.

3.8.5 Requests

CLSI requests that the following documents be removed from the set of licence documents listed under the Conventional Health and Safety SCA:

- Machine Shop Procedure, 8.1.15.1 [57]
- Hot Work Procedure, 11.7.54.3 [58]

These documents provide detailed procedures for which the program level requirements are described in other licence basis documents listed.

3.9 Environmental protection

"The environmental protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities." ([3], 4.9)

Based on an annual inspection performed in 2017, the CNSC concluded that CLSI met regulatory requirements for the environmental protection SCA. CLSI performance has been fully satisfactory over the course of the term of the current licence. CLSI licensed activities have a minimal impact on the environment. CLSI will continue to meet or exceed regulatory requirements in the upcoming licence term.

3.9.1 Relevance and management

The CLSI Health, Safety and Environment Manual [21] explains that CSLI is committed to "the protection of the general public and the environment from unacceptable risks" (Table 22).

Table 22 – CLSI documents supporting the environmental protection program.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.9.1.1	5	Health Safety and Environment Manual	October 30, 2019	[21]	How CLSI ensures protection of the environment

During the 2017 inspection [59] the CNSC noted that CLSI has developed and implemented "approved policies and procedures that define a framework for establishing, conducting and maintaining environmental protection programs in accordance with the requirements of REGDOC-2.9.1." [60]

3.9.2 Release of Hazardous or Nuclear Substances

The operation of the synchrotron accelerators at the CLS do not result in any significant releases of radioactive and/or hazardous substances to the environment. There are therefore no Derived Release Limits (DRLs) in place for the operation of the synchrotron. To ensure that there continues to be no radioactive airborne release to the environment due to CLSI operations, building exhaust is monitored using a real-time gamma dose rate monitor, installed in the exhaust stack.

CLSI monitors environmental radiation levels around the perimeter of the main building using a network of passive, low-level, Optically Stimulated Luminescent Dosimeters (OSLDs). Dosimeters located in the Public Access Zone (PAZ) indicate that dose exposures are within the range of normal background values in the PAZ. The highest net dose measured by an environmental OSLD in the current licensing period was 0.20 mSv/quarter, in 2019. If a member of the public were to stand at this location for 80 hours then they would receive a dose of 7.3 µSv, orders of magnitude lower than the 1 mSv annual regulatory limit for a member of the public.

Potentially contaminated wastewater generated at all locations in the CLS facility is collected and stored in a 2000 L holding tank. The water is then sampled and analyzed prior to release to the municipal sewer system.

3.9.3 Past performance

Following are a selection of incidents involving releases to the environment that have occurred during the current licensing period, along with actions taken to prevent recurrence.

In June of 2015, approximately 7000 L of cooling water was unintentionally released to the municipal sewer over a five-day period. The radioactivity released was 2280 Bq, the normal background level. Normal operations of the CLS are not expected to result in activated cooling water due to the design of the system. Cooling water is monitored regularly (twice yearly) to verify that there is no activation occurring.

In February of 2019, a pump isolation joint ruptured, leaking approximately 5000 L of 30% ethylene glycol into the sewer system. The pump was shut down, repairs were made and the glycol/water was replaced in the system. The spill was reported to the CNSC, the University of Saskatchewan, City of Saskatoon, Saskatchewan Spill Report Centre, and Environment Canada. An investigation was performed, which determined that several other insulated rubber isolation joints carrying 80°C glycol were also at risk of failure. A recommendation was made to replace all 150 rubber isolation joints with steel joints. All joints in the 80°C glycol circuit were replaced. The remainder of joints in the glycol cooling system are scheduled for replacement in the spring of 2021.

3.9.4 Future plans

There is negligible impact on the environment due to CLSI operations. There are currently no planned changes relevant to the Environmental Protection SCA.

3.9.5 Requests

The operation of the synchrotron accelerators at the CLS do not result in any significant releases of radioactive and/or hazardous substances to the environment. There are therefore no Derived Release Limits (DRLs) in place for the operation of the synchrotron. CLSI requests that licence condition 10.2 be reworded to reflect this. If any changes to operation were to occur (with prior consultation and acceptance of the CNSC) that may result in radioactive releases to the environment, then DRLs will be calculated for each relevant radionuclide.

3.10 Emergency management and fire protection

“The emergency management and fire protection SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This area also includes any results of participation in exercises.” ([3], 4.10)

CLSI will continue to meet or exceed regulatory requirements related to the emergency management and fire protection SCA in the upcoming licence term.

3.10.1 Relevance and management

CLSI has developed an Emergency Response Plan [61], which provides information on how to respond to the various emergencies that could be reasonably expected to occur at the CLS facility. The QMS [5], Section 9.0 explains which process to follow in the event of specific types of emergencies. In the event of any release of radioactive material or hazardous substance from the CLS, the requirements of the HSE Manual [21], Section 9.7.4, Unplanned Release Response, will be followed. For any other emergency situation, the response defined in the HSE Manual, Section 9.8, Emergency Preparedness and Response will be followed. Documents supporting emergency preparedness at CLSI are listed in Table 23.

Table 23 – CLSI documents supporting the emergency preparedness program.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.7.37.2	9	Building Evacuation Procedure	January 18, 2019	[62]	How CLSI safely evacuates the building
11.9.1.1	5	Health Safety and Environment Manual	October 30, 2019	[21]	How CLSI responds to specific emergencies
11.12.57.1	6	Canadian Light Source Inc. Emergency Response Plan	June 25, 2018	[61]	How CLSI responds to emergency situations

Items of note relevant to the emergency preparedness program that have taken place during the current licensing period are described below.

In 2012, 25 staff members from the University of Saskatchewan Campus Safety group received orientation training at the CLS. The orientation included a facility tour and training on the CLS modes of operation, security systems and emergency response.

In 2017, minor changes were made to the Emergency Response Plan to allow CLSI personnel to take shelter in a nearby University of Saskatchewan building in the event of a building evacuation during inclement weather.

In 2018, a joint training effort was carried out between CLSI staff and the Saskatoon Fire Department on confined space rescue. Personnel responsible for rescue from confined spaces at the fire department used the CLS facility as a training ground for their refresher training. The training provided CLSI staff who occasionally perform work in confined spaces with the opportunity to witness how rescue would be performed and provided fire department staff with a better understanding of confined spaces at the facility.

3.10.2 Fire Protection Program

The documents that govern the fire protection program are listed in Table 24.

Table 24 – CLSI documents supporting the fire protection program.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.7.54.3	5	Hot Work Procedure	January 18, 2019	[58]	Special fire protection precautions in place for hot work
11.12.54.1	10	Fire Protection Program	January 10, 2020	[53]	How CLSI protects the facility and personnel from fire

A fire drill is performed each year at the CLS in conjunction with the University of Saskatchewan Safety Resources Department. Each year during the current licensing period, the time taken to evacuate the building was well within the acceptable limit.

In 2012, 55 fire fighters from Saskatoon Fire and Protective Services received orientation training at the CLS. The orientation included a tour of the facility and information regarding the fire alarm system, fire suppression systems, hazardous material storage and emergency response.

In 2014, an upgrade to the CLS fire alarm panel was completed. The original panel was replaced, and a second panel was added to accommodate an increase in the number of devices at the facility since the first panel was installed. A third-party inspection, testing and maintenance review of the fire protection program was also completed. Seven recommendations for improvement were made involving improvements to the CLS internal processes and procedures for completing and tracking of routine tests and inspection as required by NFP-801 [63]. Each of these improvements were made by June 30, 2015.

Fire protection program assessments and reviews are performed as described in NFP-801 [63], and any deficiencies are corrected promptly. A fire protection group meets monthly to monitor progress in addressing corrective actions identified during inspections, or any other issues that arise.

3.10.3 Past performance

CLSI personnel response time for total building evacuation during annual fire drills has been very good at 3 to 5 minutes. Fire Wardens assist with building evacuation, which enhances the process. In particular, Fire Wardens provide direction to help ensure that facility users and contractors know how to evacuate the building correctly during an alarm.

CLSI engages with local authorities regularly, including University of Saskatchewan Protective Services, the Saskatoon Police Department, the Saskatoon Fire Department, RCMP, and Public Safety Canada. The joint confined space training effort carried out in 2018 with the Saskatoon Fire Department proved useful both for the firefighters to practice rescues in an operating facility, and for our staff to gain confidence in the rescue process should it be required.

3.10.4 Future plans

CNSC staff have informed CLSI that the current guidance publication, CSA N393-13, Fire Protection for Facilities that Process, Handle, or Store Nuclear Materials, will become a Compliance Verification Criteria in the LCH revision associated with the licence renewal. CLSI has completed a review of CSA N393-13, and anticipates full compliance with the standard by the date of licence renewal.

CLSI has begun efforts to develop a shelter in place program for use if an emergency situation should warrant such action. In January 2019, a test of the expected response to such an emergency was successfully planned and carried out at the CLS in conjunction with the University of Saskatchewan Safety Resources group. CLSI anticipates further testing and education of staff on the shelter in place process.

Commissioning of the Electron Source Laboratory will result in changes to the Fire Protection Program. CLSI has completed a building and fire code compliance review of the planned changes. A third-party review of the code compliance review was also performed, on contract. Procedural changes that will impact access to the sub-basement level of the former Saskatchewan Accelerator Laboratory are being proposed and evaluated.

3.10.5 Challenges

Addition of the Electron Source Laboratory to the operating licence will require changes to staff work habits in the sub-basement level of the facility. Clear communication and training will be required to ensure the new processes are followed as intended.

3.10.6 Requests

CLSI requests that the Hot Work Procedure, 11.7.54.3 [58] be removed from the list of licence basis documents under licence condition 11.2, Fire Protection Program. The Fire Protection Program, 11.12.54.1 [53] is the governing program document, and CLSI requests that it be the only licence basis document listed under licence condition 11.2.

3.11 Waste management

“The waste management SCA covers internal waste-related programs that form part of the facility’s operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning.” ([3], 4.11)

Based on an annual inspection performed in 2018, the CNSC concluded that CLSI met regulatory requirements for the waste management SCA. CLSI performance has been satisfactory over the course of the term of the current licence. CLSI will continue to meet or exceed regulatory requirements related to waste management in the upcoming licence term.

3.11.1 Relevance and management

At the CLS, the amount of waste generated is minimized where possible. Potentially radioactive waste is characterized according to the requirements of the Procedure for the Storage/Release of Potentially Activated Material [64]. Waste is segregated into chemical, biological, and radiological streams. Waste inventories for each stream are maintained, along with records of the destruction of biological wastes. Access to radiological waste storage areas is controlled. CLSI maintains detailed records of released items on a formalized release form, including a unique identification number, photos of the item, radiological survey data and swipe test results. The various types of waste are managed according to the documents listed in Table 25.

Table 25 – CLSI documents supporting the waste management program.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.7.56.1	1	Procedure for the Storage/Release of Potentially Activated Material	July 19, 2018	[64]	How CLSI controls release of radioactive materials
11.9.55.1	5	Biological, Chemical and Nanomaterial Safety Manual	November 14, 2018	[31]	How CLSI manages biological, chemical and nanomaterial wastes

3.11.2 Planning for Decommissioning

The QMS [5], Section 8.4 provides an overview of the decommissioning regulatory process.

The Preliminary Decommissioning Plan (PDP) and the PDP Cost Estimate documents were reviewed and revised in 2019 to fulfill the 5-year review requirement. A revised PDP and PDP Cost Estimate were forwarded to the CNSC for review and acceptance on January 6, 2021. Documents dealing with decommissioning of the facility are listed in Table 26. CLSI continues to ensure, through the University of Saskatchewan, that a letter of credit is secured to cover the decommissioning cost estimate (see licence condition 15.2 [2]).

Table 26 – CLSI documents supporting planning for decommissioning.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.12.1.1	5	Canadian Light Source Preliminary Decommissioning Plan	October 18, 2018[6]	[66]	How CLSI intends to decommission the facility

[6] A more recent revision of the PDP is currently under review.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.12.1.2	5	Canadian Light Source Preliminary Decommissioning Plan: Decommissioning Cost Estimates	October 18, 2018[7]	[67]	Estimated costs of decommissioning according to the PDP
11.18.40.2	14	CLSI Safety Report	April 24, 2018	[40]	Detailed description of CLS buildings, systems, and equipment

3.11.3 Past performance

Improvements to the chemical waste management program were made over the course of the licencing period. A monthly laboratory inspection program was implemented in 2015. Inspections identified chemical waste management compliance issues that required attention, ultimately resulting in the creation of a dedicated Lab Manager position. With the development of the Lab Manager role, the number of chemical waste management non-compliances has reduced and inventory control has significantly improved.

CLSI has reviewed and revised the PDP and associated cost estimate every 5 years during the licence period as required. The most recent revision is currently undergoing review for comment by CNSC staff.

3.12 Security

"The security SCA covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity." ([3], 4.12)

3.12.1 Relevance and management

CLSI has programs in place to ensure the security of information, nuclear substances and the facility itself as described in the documents listed in Table 27.

Table 27 – CLSI documents supporting site security.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
Drawing RAD/0038800	14	Canadian Light Source Zones and Area Designation	July 19, 2018	[68]	Layout of the CLS facility

[7] A more recent revision of the PDP Cost Estimate is currently under review.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.9.1.1	5	Health Safety and Environment Manual	October 30, 2019	[21]	How CLSI ensures physical security
11.12.57.2	1	CLSI Security Plan (Confidential-Prescribed Information)	December 15, 2020	[69]	CLSI highest-level security document
11.18.40.2	14	CLSI Safety Report	April 24, 2018	[40]	Detailed description of CLS buildings, systems, and equipment

The Health, Safety and Environment Manual [21], Section 9.10 provides an overview of the physical and administrative systems in place to control facility security and access. The facility is divided up into four zones, depending on the types of hazards present in the area: Public Access Zone (PAZ); Free Access Zone (FAZ); Controlled Access Zone (CAZ); Restricted Access Zone (RAZ). The zones are further divided into Controlled Areas. Personnel access to the different zones and controlled areas is managed using an electronic access control system with identification badges and access cards. Each card is programmed to allow access to restricted areas as required, following completion of the required training.

CLSI staff work together with the University of Saskatchewan Electronic Protection Group to ensure site security. Biannual tests of the security monitoring system are performed each year. An independent security firm is employed by CLSI to provide security personnel to man the front desk, patrol the building, monitor the camera surveillance system, and liaise with emergency services as required.

The QMS ([5], Section 10.4) and the Radiation Protection and Control Program ([22], Section 11.3) briefly discuss security measures for information and sealed sources, respectively.

Details regarding the systems and processes in place to ensure the security of the facility and its activities and equipment are described in the CLSI Security Plan [69], which is verified at least annually and updated as required.

CLSI will continue to meet or exceed regulatory requirements for the security SCA in the upcoming licence term.

3.12.2 Past performance

The CLSI Security Plan [69], requires annual review and revision, as necessary. In July 2019 CNSC staff noted that CLSI has not always documented this annual review. A revision of the Security Plan has since been developed and was accepted by the CNSC on October 6, 2020.

Following are a selection of incidents involving site security that have occurred during the current licensing period, along with actions taken to prevent recurrence.

In October of 2012, custodial staff discovered that the north exterior door to the Brockhouse expansion was unlocked. The door was then locked. The next morning the same door was found closed but again unlocked. A root cause investigation was performed, which determined that contractors working in the area did not understand the security requirement to keep the door locked. In order to prevent recurrence, a sign was placed on the door clearly identifying it as an emergency only exit. Contractors working in the area were also instructed that the door must not be unlocked.

In March 2017, a courier driver arrived at the CLS loading dock. The driver was admitted to the building by a contractor and was able to gain unescorted access into the facility. In order to prevent recurrence new signs were posted in the area indicating that only authorized personnel were permitted entry.

In March 2018, a former facility user was able to gain facility access into the FAZ. Improvements were made to the facility access process to both more clearly identify personnel arriving for training, and moving the training center for new users and staff to an area under the supervision of reception to prevent the risk of recurrence.

3.12.3 Future plans

CLSI will improve facility security cameras to include monitoring of additional areas important to security. Security personnel will continue to be posted at CLS reception outside normal business hours.

3.12.4 Challenges

Maintaining a strong security program requires that CLSI staff are aware of the security requirements and comply with the requirements. Education and frequent communication to staff regarding the importance of compliance with security protocols, as well as the importance of reporting security issues will continue. Interaction with external police and security representatives will continue.

3.13 Safeguards and non-proliferation

This SCA is not relevant to operation of the CLS as no safeguarded materials or activates have been possessed or carried out by CLSI over the current licensing period. There are no plans to possess safeguarded materials or perform safeguarded activities in the future.

3.14 Packaging and transport

“The packaging and transport SCA covers programs for the safe packaging and transport of nuclear substances to and from the licensed facility.” ([3], 4.14) CLSI will continue to meet or exceed regulatory requirements in the upcoming licence term.

3.14.1 Relevance and management

The Radiation Protection and Control Manual [22], Section 8.2.3 describes the shipping and receiving requirements for radioactive material. The majority of shipments sent and received at CLS are for exempt quantities of nuclear substances used in beamline experiments. From 2012 to 2019, import and export permits for beamline samples were managed under a separate CNSC licence (07114-1-23.1). In January 2020, CLSI was granted an Export Licence, EL-A1-27344.0/2022 [70] and an Import Licence, IL-A1-27345.0/2021 [71] and will now be managing import and export permits.

Higher levels of radioactive material are generated at the facility through the Medical Isotope Project (MIP), then transported to the Sylvia Fedoruk Centre for Nuclear Innovation. The activities and transport of radioactive materials that are carried out at the MIP are regulated by a separate CNSC licence (14127-2.21.12).

Table 28 – CLSI document describing shipping and receiving requirements for radioactive materials.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
11.9.53.3	4	Radiation Protection and Control Manual	November 25, 2019	[22]	How CLSI manages shipment and receipt of radioactive materials

3.14.2 Past performance

CLSI has developed transportation of dangerous goods training and delivered training to shipping and receiving staff as well as Health, Safety and Environment staff responsible for the transport of radioactive materials and other hazardous goods. Although the total number of staff in the two groups is small, the volume of hazardous materials moving in and out of the CLS facility is safely managed by current staff.

3.14.3 Future plans

CLSI anticipates that packaging and handling of dangerous goods will continue to be effectively and safely managed using current processes.

4.0 Other Matters of Regulatory Interest

4.1 Public Information and Disclosure

The Executive Support office oversees communications with the general public regarding the CLS facility and CLSI activities according to the documents listed in Table 29.

Table 29 – CLSI documents supporting the provision of public information and disclosure.

Document Number	Revision	Document Title	Issue Date	Ref	Relevance
0.7.1.6	1	Canadian Light Source Inc. Crisis Management Plan	September 15, 2018	[72]	How CLSI would communicate with the public in the event of a crisis situation
0.12.1.5	4	Canadian Light Source Inc. Public Information Program Plan	February 25, 2020	[73]	How CLSI communicates with the public

The CLS website provides a description of the CLSI Safety Culture, and Public Disclosure Protocol. There is a list of informative safety Frequently Asked Question (FAQs), based on questions commonly received from the public, that the public can access any time. CLSI will disclose "any circumstances arising from a crisis event, such as a fire, natural event, serious worker accident, significant interruptions of facility operations, routine and non-routine releases of radiological and hazardous materials to the environment, unplanned events including those exceeding regulatory limits, and other events or developments that may have an impact on the health and safety of the public or the environment." [74] This information would be disclosed via social media, news release and/or the website.

In June of 2018 an issue with CLSI electron gun that prevented routine operation was found. After several repair efforts failed it became clear that a significant delay to operations was imminent. A communications plan for disclosure of the event was developed and implemented. The affected audiences were informed of the issue using various communication platforms including media outlets.

A variety of community outreach events have been held since 2014, some annually:

- Ag in the City, Science Odyssey/Science Rendezvous after-hour tours, Global Biotech Week, International Day of Light talks, Innovation 150 after-hour tours and Expo, educational light and colour display at the Saskatoon airport, 10th anniversary public open house, CIHR/THRUST open house
- Nuit Blanche Saskatoon is an annual event involving an interactive science and art display that uses 3D images produced at CLS. Approximately 10 000 members of the local community attend annually.

In addition to information gleaned through outreach events, standard media and social media releases, thousands of people tour the CLS annually, as shown in Table 30.

Table 30 – Number of CLS tour guests by year.

Year	Number of Tour Guests
2014	3892
2015	3736

Year	Number of Tour Guests
2016	4712
2017	5116
2018	5454
2019	4571

4.2 Financial guarantees

CLSI continues to ensure, through the University of Saskatchewan, that a letter of credit is secured to cover the estimated cost of decommissioning the CLS [67].

References

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[4] CNSC, Canadian Light Source Incorporated Remote Type II Inspection Preliminary Report, October 9, 2020.

[5] CLSI, 10.12.1.1, Revision 10, Quality Manual, July 6, 2020.

[6] CSA, N286-12 (R2017), Management System Requirements for Nuclear Facilities, May 11, 2017.

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[9] CLSI, 0.1.1.41, Revision 6, Document and Record Control Process, May 26, 2020.

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[21] CLSI, 11.9.1.1, Revision 5, Health Safety and Environment Manual, October 30, 2019.

[22] CLSI, 11.9.53.3, Revision 4, Radiation Protection and Control Manual, November 25, 2019.

[23] University of Saskatchewan and Canadian Light Source Licence Agreement, September 6, 2002.

[24] CLSI, 0.7.1.9, Revision 2, Configuration Control, March 9, 2020

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[26] CLSI, 0.1.1.47, Revision 0, Procurement Guideline, August 7, 2020.

[27] CLSI, 0.1.1.14, Revision 8, CLS Employee Hours of Work Procedure, October 30, 2019.

[28] CLSI, 0.7.1.28, Revision 0, Fit for Duty Program, January 24, 2017.

[29] CLSI, 8.1.1.6, Revision 4, Routine Operations – Limits and Conditions, November 10, 2015.

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[31] CLSI, 11.9.55.1, Revision 5, Biological, Chemical and Nanomaterial Safety Manual, November 14, 2018.

[32] CLSI, 0.12.1.4, Revision 2, Floor Coordinator Roles, Responsibilities and Training Plan, January 24, 2019.

[33] CLSI, 0.12.91.1, Revision 8, Accelerator Operations Personnel Qualification and Training Plan, September 17, 2017.

[34] CLSI, 0.7.91.4, Revision 2, Accelerator Operations Configuration Process, May 1, 2019.

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Acronyms and Abbreviations

AARMS	Active Area Radiation Monitoring System
ACIS	Access Control and Interlock System
ACR	Annual Compliance Report
ALARA	As Low as Reasonably Achievable
BMIT	Bio-Medical Imaging and Therapy Beamline
CAZ	Controlled Access Zone
CFI	Canadian Foundation for Innovation
CFIA	Canadian Food Inspection Agency
CLS	Canadian Light Source
CLSI	Canadian Light Source Incorporated
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DRL	Derived Release Limit
ESL	Electron Source Laboratory
FAZ	Free Access Zone
HSE	Health, Safety and Environment
ISL	Industrial Science Laboratory
KPI	Key Performance Indicators
LCH	Licence Conditions Handbook
LINAC	Linear Accelerator
LOTO	Lock Out-Tag Out
MIP	Medical Isotope Project
NEW	Nuclear Energy Worker
OHSC	Occupational Health and Safety Committee
OLC	Operating Limits and Conditions
OSLD	Optically Stimulated Luminescent Dosimeter
PAZ	Public Access Zone
PDP	Preliminary Decommissioning Plan
PRS	Problem Reporting System
QMR	Quality Management Review
QMS	Quality Management System
RAZ	Restricted Access Zone
SAT	Systematic Approach to Training
SCA	Safety and Control Area
SSC	Structures, Systems and Components
WHMIS	Workplace Hazardous Materials Information System