Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

UNPROTECTED/NON PROTÉGÉ

ORIGINAL/ORIGINAL

CMD: 21-H109

Date signed/Signé le : 31 AUGUST 2021

31 AOUT 2021

Issue requiring approval for a change in licensing basis

Canadian Light Source Incorporated

Hearing in writing based solely on written submissions

Scheduled for:

September 2021

Submitted by:

CNSC Staff

Délivrer l'approbation requise pour

Canadian Light Source Incorporated

Audience fondée uniquement sur des mémoires

Prévue pour :

septembre 2021

Soumise par :

Le personnel de la CCSN

e-Doc 6610206 (WORD)
e-Doc 6632333 (PDF)

Canada

Summary

This CMD pertains to a request for a decision regarding:

- a change in CLSI's licensing basis to permit occupancy in a currently prohibited access area during beam-on

The following actions are requested of the Commission:

- approve the proposed change to CLSI's licensing basis to permit occupancy of rooms 0006 and 0006.1 when the beam is on

Résumé

Le présent CMD concerne une demande de décision au sujet de :

- un changement au fondement d'autorisation du Centre canadien de rayonnement synchrotron, pour permettre l'occupation d'une zone interdite lorsque le faisceau est allumé

La Commission pourrait considérer prendre les mesures suivantes :

- autoriser le changement au fondement d'autorisation du Centre canadien de rayonnement synchrotron, pour permettre l'occupation des salles 00006 et 0006.1 lorsque le faisceau est allumé

Signed/signé le

31 August 2021

OwenWhitred, Karen

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DN: C=CA, O=GC, OU=CNSC-CCSN, CN="OwenWhitred, Karen"
Reason: I am approving this document
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Karen Owen-Whitred

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EXECUTIVE SUMMARY

Canadian Light Source Incorporated (CLSI) holds licence PA1OL-02.01/2022 to operate a Class 1B particle accelerator, the "Canadian Light Source" (CLS) synchrotron in Saskatoon, SK.

The CLS consists of three major particle accelerator systems: a 250 MeV linear electron accelerator, a booster ring that accelerates electrons up to 2.9 GeV and a storage ring that keeps the electrons circulating at 2.9 GeV. Synchrotron light is produced by bending the path of the 2.9 GeV electrons using magnetic devices. This light is directed into shielded beamlines that direct, filter, and use the light in experiments.

Physical shielding ensures that many areas of CLSI are safe to access while the synchrotron is running, however, certain areas are designated as Prohibited Access Areas (PAA) when the beam is on, due to high radiation dose rates (>1 mSv/h). CLSI uses Access Control Interlock Systems (ACIS) to prevent access to prohibited access areas of the facility when the synchrotron is operating.

CLSI would like to repurpose an unused space in the subbasement of the CLS facility, rooms 0006 and 0006.1, to establish an Electron Source Lab (ESL). The space earmarked for the ESL is currently a prohibited access area. The repurposing of this space to permit access regardless of synchrotron operation status requires a change in licensing basis, therefore requiring approval by the Commission. The application includes a hazard analysis and proposed mitigating measures to ensure safe occupancy of the space affected by this change. This Commission Member Document (CMD) outlines the Canadian Nuclear Safety Commission (CNSC) staff review of CLSI's safety case. Based on this review, CNSC staff conclude that CLSI's application has met the applicable regulatory requirements. The mitigation measures proposed by CLSI adequately address the hazards brought about by the change in licensing basis.

Referenced documents in this CMD are available to the public upon request.

1 OVERVIEW

1.1 Background

Particle Accelerator Operating Licence PA1OL-02.01/2022 and associated Licence Condition Handbook authorizes Canadian Light Source Incorporated (CLSI) to operate the Class 1B synchrotron facility called the Canadian Light Source (CLS). The CLS is located on the campus of the University of Saskatchewan.

Figure 1 - Aerial view of CLS Facility and surrounding area. Credit: CLSI.

CLSI has been a licensee since 2000. The most recent licence changes include an amendment to permit processing of nuclear substances in a CLSI laboratory (CMD15-H106), and a change in licensing basis to permit top-up mode of operation (CMD17-H112).

On June 14, 2021, CLSI requested a change in its licensing basis to permit occupancy of rooms 0006.1 and 0006 of the subbasement for the establishment of the Electron Source Lab (ESL).

The first phase of the project involves preparation of the area for ESL occupancy: addition of shielding, modification of the Access Control Interlock Systems (ACIS) to remove rooms 0006 and 0006.1, and implementation of consequential fire code compliance recommendations.

CNSC staff reviewed and assessed the safety case for this increase in occupancy. This CMD summarizes the results of CNSC staff's review and CNSC staff recommendations.

1.2 Highlights

The request does not require a licence amendment. However, it does represent a change in the licensing basis. The licensee is requesting a change in the safety case, which prevents occupancy of the spaces in question while the synchrotron is running. If the application is approved, CNSC staff will review and accept CLSI's modified LCH documents. The updated safety analysis and fire protection program will reflect the change in licensing basis and facility modifications.

2 MATTERS FOR CONSIDERATION

The key matters for consideration of this request are:

- Environmental Assessment
- Radiation doses in the ESL area
- Changes in the fire hazard analysis

2.1 Environmental Assessment

CNSC staff reviewed Canadian Light Source Inc. (CLSI)'s licensing basis change application in the context of the *Impact Assessment Act* (IAA). CNSC staff determined that the IAA does not apply because the proposed activities are not captured in the IAA's *Physical Activities Regulations* nor are they considered a project on federal lands.

CLSI's proposed ESL project would involve limited project-environment interactions and an environmental protection review within the CNSC's licensing process was not warranted. CNSC staff will continue to verify and ensure that, through ongoing licensing and compliance activities and reviews, the environment and the health of persons are protected and will continue to be protected over the proposed licence period.

2.2 CLSI Facility Description

The Canadian Light Source (CLS) consists of three major accelerator systems: a 250 MeV electron linear accelerator, a booster ring which accelerates the

electrons to 2.9 GeV, and a storage ring which keeps the electrons circulating at 2.9 GeV.

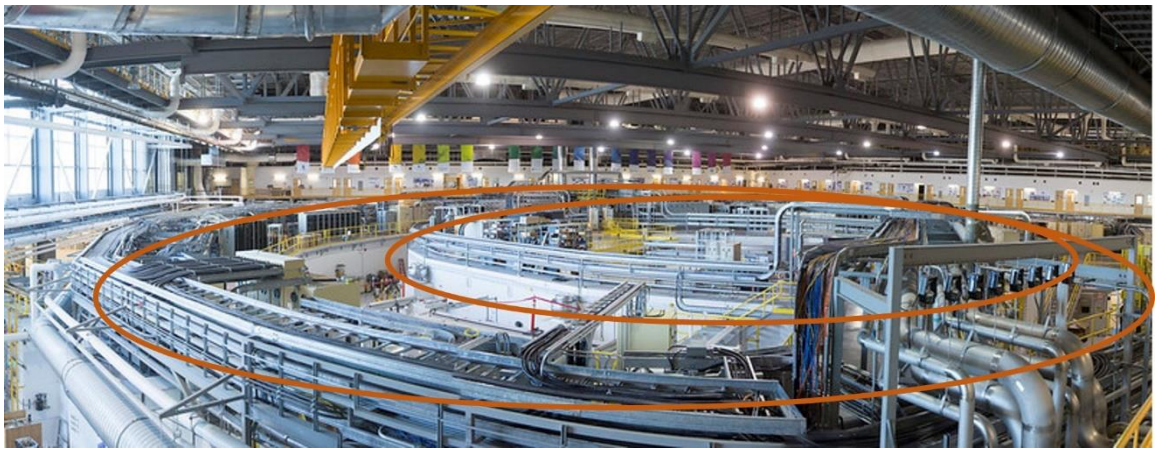

Figure 2 - CLS from the mezzanine level. The storage ring (outer circle) and booster ring (inner circle) shielding structures are outlined. Source: CLSI.

To produce the synchrotron light, magnetic devices bend the path of the electrons circulating in the storage ring. This change in direction creates a very narrow beam of bright light, which is directed into one of 15 beamlines, filtered, and then used to perform experiments. Two of the beamlines are shown in Figure 3.

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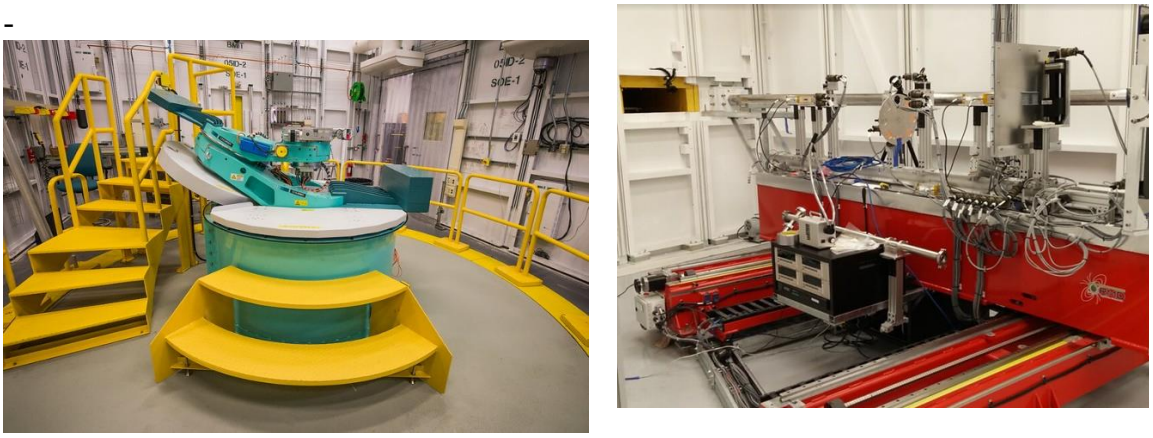

Figure 3 Large Animal Positioning Device, located on the Biomedical Imaging and Therapy beamline (L) and Secondary Optical Enclosure 2, Brockhouse Beamline (R). Source: CLSI.

Physical shielding of the three accelerator systems and beamlines ensures that many areas of CLSI are safe to access while the synchrotron is running. Areas where the radiation levels are >1 mSv/h during synchrotron operation are designated Prohibited Access Areas (PAA). Access Control Interlock Systems (ACIS) ensure that no one is in a prohibited area before the beam is turned on. If someone attempts to access a prohibited area while the synchrotron is operating, the access control interlock shuts off the beam, thereby eliminating the prompt radiation hazard.

2.3 Proposed Change in Occupancy

A 2018 failure of CLS's electron source (an integral component of the 250 MeV electron linear accelerator) resulted in an extended outage. CLSI has identified the need for a location within the facility to test and develop electron sources so that electron source failures do not result in extended outages. The proposed ESL area is located in the subbasement of the CLS facility, in rooms 0006 and 0006.1, as shown in Figure 4.

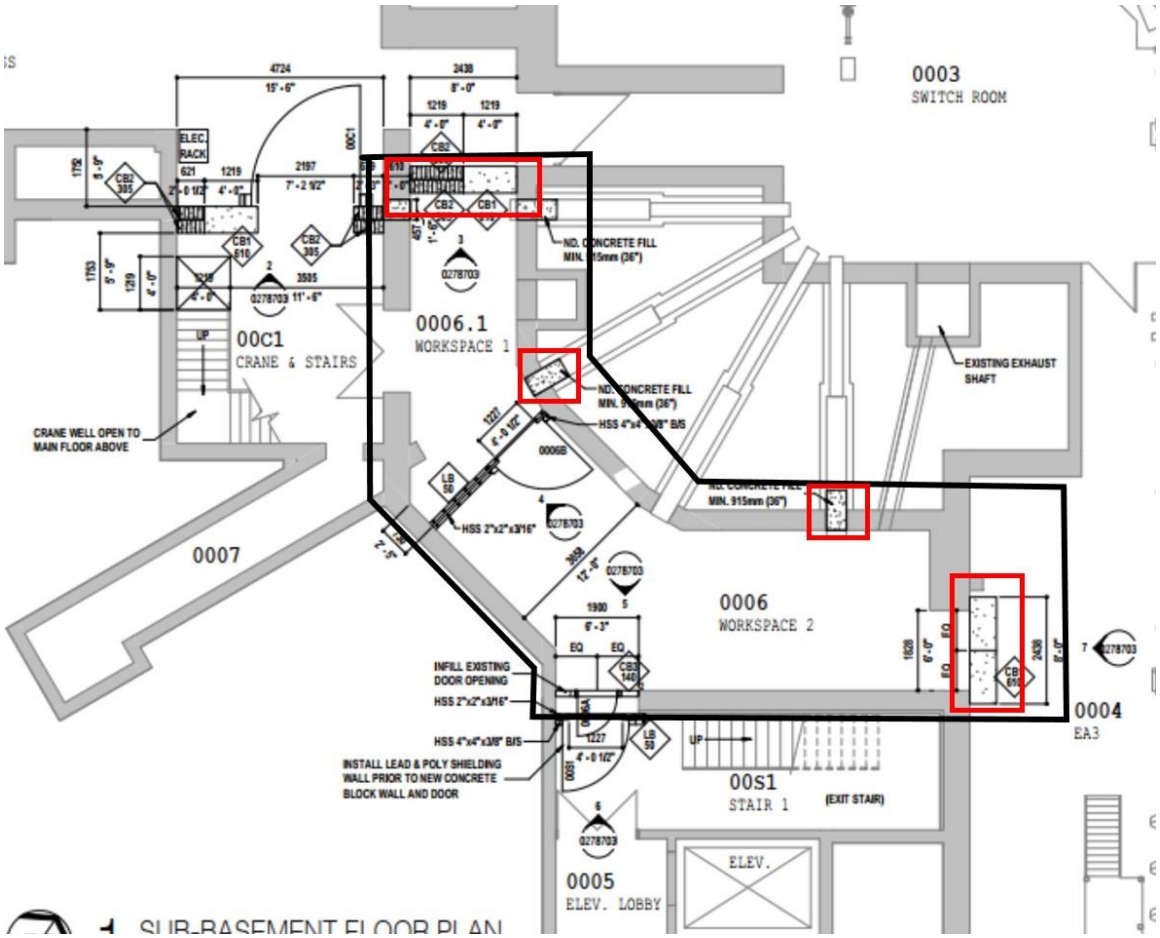

Figure 4- ESL lab (0006 and 0006.1) outlined in black with planned area modifications indicated in red. Other planned modifications shown will be completed at later stages of the project. Source: CLSI submission with CNSC staff markup.

2.3.1 Regulatory roadmap

The ESL project is a multi-phase, multi-year endeavor. The request before the Commission to approve a change in licensing basis is the first of many CLSI applications to the CNSC. Should the Commission approve the ESL occupancy change, CLSI will immediately make the ACIS and Fire Safety program changes required, while the synchrotron is off for planned maintenance. CLSI must submit commissioning results as described in the "Return to normal synchrotron

operations" row of Table 1 for CNSC staff for approval prior to the return to normal synchrotron operation. An overview of the regulatory roadmap for the entire ESL project is included in Table 1.

Table 1 - Outline of regulatory roadmap for CLSI ESL project

CLSI Request	Required CLSI Submissions	Approval Authority	Estimated Completion (Calendar Quarter)
Approve increased occupancy to rooms 0006 and 0006.1	Application for change to licensing basis	Commission	Q3 2021
Return to normal synchrotron operations	Results of verification and validation testing of the modified ACIS Survey results of ESL area as per CLSI submission Confirmation of implementation of all applicable code compliance recommendations	CNSC staff	Q4 2021
Acceptance of updated LCH documents	CLSI Safety Report, Fire Protection Program	CNSC staff	Q4 2021
Class II facility licence to construct, to install an electron source > 1 MeV	Application for Class II licence to construct Confirmation of Phase 2 implementation of fire protection performance based assessment recommendations	Designated Officer	Q1 2022
Class II facility licence to operate an electron source > 1 MeV	Class II licence to operate application	Designated Officer	Q2 2022

This proposed change in the facility introduces new hazards:

1. Radiation doses in the ESL when the synchrotron is operating
2. Changes in the fire hazard analysis due to modifications in facility layout

CLSI has submitted a risk analysis and proposed mitigation measures for each of the hazards described. The CNSC staff assessment of CLSI's safety case is in the following sections.

2.3.2 Hazard 1 - Radiation doses in the ESL when the synchrotron is operating

The nature and magnitude of the radiation hazard at the CLS facility will not change because of this occupancy increase. The key change is that the ESL area is now an occupied area.

CLSI's existing radiation protection program addresses high dose rates produced by the synchrotron and has appropriate controls in place to handle the change in occupancy. CLSI's current dose control program include measures such as introducing radiation work permits if the dose rates in the area are between 0.025 -1 mSv/h, classification of any ESL workers as Nuclear Energy Workers (NEWs), and conservative action levels (2 mSv/quarter). Radiation work permits control doses, as they require measured dose rates prior to the start of work. Based on these dose rates, a total permitted dose for the job, and a total time for the job are determined. Classifying workers as NEWs brings them under stricter control at CLSI. NEWs undergo additional training specific to their roles, and NEWs are assigned personal dosimetry. CNSC staff assessed CLSI's radiation protection program during a remote inspection in January 2021 and confirmed that CLSI's implementation of their radiation protection measures is satisfactory. CLSI's radiation protection program currently in place, when applied to the ESL area, will adequately ensure that doses resulting from occupancy of the ESL area will be controlled.

CLSI's application included a description and plans for additional shielding to be installed in order to reduce dose rates to levels that permit occupancy according to CLSI's current procedures (<1 mSv/h). CNSC staff have performed independent calculations for the ESL area with the proposed additional shielding in place, and they are in-line with CLSI's estimates of the dose rates when the synchrotron is operating. CNSC staff find CLSI's proposed dose rate survey plan prior to permitting occupancy while the synchrotron is operational to be acceptable. It includes dose rate measurements under various worst-case electron beam conditions at different points in the ESL. The maximum synchrotron current and electron energy used during the dose rate surveys submitted to the CNSC (see Table 1) will become the administrative operating limit of the CLS. CLSI must perform new surveys if they want to operate the synchrotron at parameters higher than those used on the initial survey.

CLSI must modify the ACIS in order to permit occupancy of the space. The ESL area will be removed from ACIS control. CLSI will merge the small section of space adjacent to the ESL that remains under ACIS protection with an existing ACIS zone. CLSI's ACIS design manuals and safety system development strategy listed in the LCH adequately describe the design and verification and validation of ACIS. CNSC staff have assessed the proposed ACIS design change, and confirm that it is acceptable. CLSI is required to submit the results of surveys, and

verification and validation results for CNSC staff to review and accept prior to the operation of the synchrotron.

2.3.3 Hazard 2 – Changes in the fire hazard analysis

The proposed changes to the occupancy and layout of the ESL will result in a change to how this space meets CSA N393-13 *Fire protection for facilities that process, handle or store nuclear substances* and the National Building Code of Canada (2015). CLSI has proposed a performance-based compliance approach for the subbasement.

The CSA N393 permits the use of alternative or performance-based approaches that are in accordance with the intent of the requirements of the standard. Alternative materials, means, measures, procedures, approaches, or technologies are permitted, as long as supporting documentation is provided to demonstrate that the alternative approach meets the intent of the CSA N393 Standard.

The proposed alternative/ performance-based approach by CLSI for the ESL space include limiting the number of people in the ESL at any given time, adding directional exit signage, and restricting materials brought into the ESL.

CNSC staff have reviewed the proposed performance-based solutions for the space, and find that it is acceptable. CNSC staff will continue to follow-up on CLSI implementation of all recommendations from the performance-based assessment, including review and acceptance of CLSI procedures supporting the recommendations.

CLSI is seeking permission to allow staff to work in the ESL when the beam is on, but not to install an electron source within the ESL. As the ESL project progresses towards the installation of electron sources through the appropriate regulatory process (see Table 1), CNSC staff will continue to closely monitor the proposed installations to confirm that CLSI remains in compliance with the LCH.

3 OVERALL CONCLUSIONS AND RECOMMENDATIONS

3.1 Overall Conclusions

CNSC staff conclude that CLSI's request to increase the occupancy of the ESL has met the applicable regulatory requirements. The mitigation measures proposed by CLSI adequately address the hazards brought about by the change in licensing basis.

3.2 Overall Recommendations

CNSC staff recommend the following:

- To approve the change of the licensing basis to permit occupancy of the ESL

REFERENCES

1. Particle Accelerator Operating Licence, Canadian Light Source Inc., PA1OL-02.01/2022 (CNSC Document No. 4703454)
2. CLSI Licence Conditions Handbook, Revision 8. (CNSC Document No. 6629153)
3. The documents attached to CLSI email dated June 14 2021 (CNSC Document No. 6585818)
4. CMD15-H106 Request for license amendment to permit processing of nuclear substances (CNSC Document No. 4646980)
5. CMD17-H112 Request for change in licensing basis to permit top-up mode of operation (CNSC Document No. 5400349)
6. Memo: Prolonged unplanned outage of Canadian Light Source synchrotron, for information only. (CNSC Document No. 5607782)
7. EDAD staff review of CLSI updated code compliance review and third party review for the Electron Source Lab Shielding Installation. April 12, 2021. (CNSC Document No. 6535227)

A. BASIS FOR THE RECOMMENDATIONS(S)

A.1 Regulatory Basis

The regulatory basis for the recommendations presented in this CMD is as follows:

Operating Performance

The regulatory basis for this request is licence condition 4.1 *"The licensee shall implement and maintain a program for operation of the facilities. This shall include direction and documentation for safely operating the nuclear facility and shall, as a minimum, reflect the safety analyses that have been previously submitted to the Commission."*

Fire Protection

The regulatory basis for this request is licence condition 11.2 "*The licensee shall implement and maintain a fire protection program.*"