



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Record of Decision

In the Matter of

Applicant Canadian Light Source Incorporated

Subject Request for a change in licensing basis to allow for continuous electron top-up mode of operation

Date of Decision February 20, 2018

RECORD OF DECISION

Licensee: Canadian Light Source Incorporated

Address/Location: 44 Innovation Boulevard, Saskatoon, SK S7N 2V3
Canada

Purpose: Request for a change in licensing basis to allow for
continuous electron top-up mode of operation

Application received: May 3, 2017

Date of decision: February 20, 2018

Location: Canadian Nuclear Safety Commission (CNSC)
280 Slater St., Ottawa, Ontario

Panel of Commission: M. Binder, President

Change in licensing basis: Approved

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1.0 INTRODUCTION

1. Canadian Light Source Incorporated (CLSI) has submitted an application to the Canadian Nuclear Safety Commission¹ (CNSC) for an approval for a change to the licensing basis for its Class IB synchrotron facility to allow for the use of the continuous electron “top-up mode” of operation. CLSI’s current Particle Accelerator Operating Licence, PA1OL-02.01/2022, authorizes CLSI to operate the facility until May 31, 2022. CLSI’s current licensing basis authorizes operation in only the standard “decay mode” of operation.
2. CLSI’s synchrotron facility is located on the University of Saskatchewan Campus in Saskatoon, Saskatchewan. In its application, CLSI submitted to the Commission a revised safety case supporting the continuous top-up mode of operation.
3. The *Record of Proceedings, Including Reasons for Decision* from CLSI’s 2012 licence renewal hearing² provides that, should CLSI request to operate its facility in the continuous top-up mode of operation, and therefore outside of its licensing basis, an approval through a decision of the Commission would have to be sought prior to the implementation of this mode of operation.

Issues

4. In considering the application, the Commission considered:
 - a) what environmental assessment review process to apply in relation to this application;
 - b) whether CLSI is qualified to carry on the activity that the licence, including the proposed changes to the licensing basis, would authorize; and
 - c) whether, in carrying on that activity, CLSI would make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

¹ The *Canadian Nuclear Safety Commission* is referred to as the “CNSC” when referring to the organization and its staff in general, and as the “Commission” when referring to the tribunal component.

² CNSC *Record of Proceedings, Including Reasons for Decision* – Canadian Light Source Incorporated, *Application to Renew its Particle Accelerator Operating Licence*, paragraphs 29 – 30, 2012.

Hearing

5. Pursuant to section 22 of the NSCA, I established myself as a Panel of one Commission Member to hear the application. The Commission, in conducting a public hearing based on written materials, considered written submissions from CLSI (CMD 17-H112.1) and CNSC staff (CMD 17-H112).

2.0 DECISION

6. Based on its consideration of the matter, as described in more detail in the following sections of this *Record of Decision*, the Commission concludes that CLSI's revised safety case shows that CLSI can carry out the top-up mode of operation at its facility safely. Therefore,

the Commission approves the change in the licensing basis for the Particle Accelerator Operating Licence, PA1OL-02.01/2022, issued to Canadian Light Source Incorporated for its Class IB synchrotron facility located on the University of Saskatchewan campus in Saskatoon, Saskatchewan. The licence, PA1OL-02-01/2022, remains valid until May 31, 2022.

3.0 ISSUES AND COMMISSION FINDINGS

3.1 Application of *Canadian Environmental Assessment Act, 2012*

7. In coming to its decision, the Commission was first required to determine whether an Environmental Assessment (EA) under the *Canadian Environmental Assessment Act, 2012*³ (CEAA 2012) was required.
8. In its application, CLSI submitted a request to change the licensing basis for its Class IB synchrotron facility to allow for the continuous electron top-up mode of operation in addition to the decay mode of operation. The Commission notes CLSI's application is for the approval of a change in the licensing basis of its facility and notes that this change to top up mode of operation does not amount to a designated project under CEAA 2012.
9. The Commission considered the completeness and adequacy of the EA that CNSC staff conducted under the NSCA, assessing the proposed change in safety case supporting the requested change in CLSI's licensing basis. CNSC staff's conclusions included:
 - CLSI's current operation has minimal interactions between the environment and the licensee facility.

³ S.C. 2012, c. 19.

- The proposed change to CLSI's licensing basis is not expected to produce environmental releases.
 - CLSI has and will continue to maintain adequate environmental protection programs that meet CNSC requirements.
10. Based on the information examined and provided on the record for this hearing, the Commission is satisfied that an EA under CEEA 2012 was not required in this matter. The Commission concludes that an EA conducted under the NSCA and its regulations was appropriate for CLSI's licensing basis change request. Further, the Commission is satisfied that CLSI has made, and will continue to make, adequate provision for the protection of the environment and the health of persons in relation to the licensed activities throughout the current licence period.

3.2 Matters for Consideration

11. The Commission considered the regulatory basis for CLSI's request for Commission approval to change the licensing basis for its Class IB synchrotron facility. The Commission notes that licence condition (LC) 1.1, *Licensing Basis*, of CLSI's PA10L states that

"The licensee shall conduct the licensed activities described in Part IV of this licence in accordance with the licensing basis described in the LCH, unless otherwise authorized by this licence."

where Part IV refers to the authorized licensed activities.

12. The Commission also notes that LC 1.2(b), *Changes to CLSI Documents*, states that

"Changes that are outside of the licensing basis are not permitted without the prior written approval of the Commission."

Further, the Commission recognizes that the current licensing basis for the CLSI facility includes only the decay mode of operation, as described in documentation in the CLSI Licence Conditions Handbook (LCH) associated with LC 1.2, *Changes to CLSI Documents*; LC 4.1, *Operating Program*; LC 5.1, *Safety Analysis Program*; and LC 5.2, *Documentation*.

13. In making its decision in this matter, the Commission considered the issues related to the acceptability of CLSI's proposed change to the licensing basis for its Class IB synchrotron facility to include the top-up mode of operation.

3.2.1 Current “Decay Mode” of Operation

14. The Commission considered the information submitted by CLSI and CNSC staff regarding the mode of operation that is currently approved as part the licensing basis for CLSI’s synchrotron facility. CLSI submitted that it currently operated its facility in decay mode during which new electrons were injected by the 300 MeV linear electron accelerator into the storage ring approximately every 8 to 12 hours. CLSI also submitted that this electron injection was required since, during the decay mode of operation, electrons were lost through various beam loss mechanisms resulting in a decay of the stored electron beam current.
15. In regard to radiation protection during the decay mode of operation, CLSI explained that, during the injection cycle, the beamline shutters were closed, protecting personnel and equipment from radiation being emitted from the storage ring.
16. CNSC staff confirmed the information provided by CLSI and submitted additional information about the CLSI’s current mode of operation, noting that the synchrotron produced electromagnetic radiation which was distributed to 18 operational beamlines for use in experiments.

3.2.2. Proposed “Top-Up” Mode of Operation and Revised Safety Case

17. The Commission considered the information submitted by CLSI and CNSC staff regarding the safety case submitted by CLSI for the proposed top-up mode of operation for its synchrotron facility. CLSI informed the Commission that the top-up mode involved the linear accelerator and booster ring injecting a small number of electrons into the storage ring every few minutes.
18. CLSI submitted information about four risks, as well as proposed mitigation measures, specific to the proposed top-up mode of operation for CLSI’s synchrotron facility. CNSC staff reported to the Commission that CLSI’s revised safety case supporting the top-up mode of operation and licence basis change request, including the additional risks to this mode of operation, was reviewed and assessed. The Commission notes that the additional radiation risks may originate from the beamline or the storage ring.
19. CLSI submitted that existing beamline shielding may be inadequate when safety shutters were opened for electron injection during the top-up mode of operation. CLSI provided information about proposed mitigation measures for this potential inadequacy in beamline shielding which included radiation measurement and monitoring; analytical models, used to assess radiation inside and outside the beamline enclosure during conditions of normal operation and in the event of an accident; and a shielding installation plan.

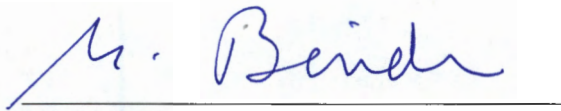
20. CNSC staff submitted that past operational and compliance data showed that the proposed top-up mode of operation would not change the radiation dose around the linear accelerator and the doses was close to background radiation. CNSC staff also submitted that CLSI had installed area monitoring systems around the storage ring and the beamlines that were designed to stop the injection of electrons if the dose rate exceeded 2.5 $\mu\text{Sv/h}$ at any time.
21. CNSC staff informed the Commission that it had assessed CLSI's proposed measures to mitigate additional beamline radiation risks during the top-up mode of operation, including analytical models and the measurements plan to commission the top-up mode of operation, and found that CLSI had adequately anticipated and planned for radiation risks associated with the open shutter when utilizing the continuous electron top-up mode of operation.
22. CLSI submitted that, in the top-up mode of operation, there was the potential for electrons to travel down to the beamline enclosures rather than staying in the storage ring. CLSI reported on a probability model of mis-steered electrons injected into the storage ring that were used to predict trajectories of injected electrons. CLSI further submitted that, to mitigate the potential for beamline radiation, electron injection would only be permitted while the energy level of the stored beam existed above an established threshold (stable minimum current threshold practice).
23. CNSC staff reported to the Commission that it had reviewed CLSI's proposed stable minimum current threshold practice, had assessed CLSI's model and was of the opinion that it showed that there were no trajectories that would permit electrons to escape from the storage ring. CNSC staff also submitted that CLSI's proposed beam current monitors, beam tracking monitors and magnetic interlocks would further mitigate any radiation risks from mis-steered electrons to an acceptable level.
24. CLSI provided the Commission with information about two operational risks specific to the storage ring when operating in the top-up mode of operation. Specifically, CLSI reported that radiation could be caused by an energy mismatch between the storage ring and the electron injection system and that poor injection efficiency of electrons into the storage ring during both normal and top-up operations. CLSI submitted that, in order to mitigate radiation resulting from the different energy levels between the storage ring and the injection system, several existing interlock, collimator and monitoring systems would be used and complemented as needed.
25. CNSC staff submitted that it was of the opinion that modelling showed that the proposed mitigation measures including additional monitoring, magnetic interlock systems and collimators to restrict injected beam size and orbit were adequate to protect workers and the environment from radiation concerns arising from energy mismatch risks.

26. CNSC staff reported to the Commission on its assessment of CLSI's proposed measures to mitigate the injection efficiency related risks identified by CLSI, including injection interlock systems and two monitoring parameters, as well as the operating criteria, that would have to be met prior to electron injection. CNSC staff submitted that its review of the proposed mitigation measures of the identified risks showed that they were acceptable.
27. CLSI submitted that, should the Commission approve its licensing basis change request, the safety analysis report, *CLSI Safety Report*, and associated documents would be amended to reflect the top-up mode of operation.
28. CNSC staff confirmed to the Commission that its assessment of CLSI's proposed safety case for the top-up mode of operation at its Class IB synchrotron facility showed that CLSI could carry out this mode of operation safely at its facility. CNSC staff also submitted that CLSI's documentation referred to in the LCH in relation to LCs 1.2, 4.1, 5.1 and 5.2 would be updated to reflect the top-up mode of operation should the Commission approve CLSI's licence basis change request.

4.0 CONCLUSIONS

29. The Commission has considered the information, submissions and assessments from CLSI and CNSC staff.
30. The Commission considers the environmental review that was conducted by CNSC staff under the NSCA to be acceptable and thorough. The Commission is satisfied that an EA under CEAA 2012 was not required for this licensing basis change request. The Commission further notes that the NSCA and its regulations provide for the protection of the environment and the health and safety of persons, and is satisfied that CLSI will continue to adequately provide these protections.
31. The Commission is satisfied with the safety case presented by CLSI for the proposed continuous electron top-up mode of operation for CLSI's synchrotron facility and CNSC staff's assessment of the proposed safety case. The Commission concludes that the top-up mode of operation can be safely implemented and that the identified risks have and will be adequately mitigated through modelling, monitoring, and shielding, as proposed by CLSI.
32. On the basis of its conclusions, the Commission approves the change in licensing basis of PA1OL-02.01/2022 issued to CLSI for its Class IB synchrotron facility to include the top-up mode of operation, as recommended by CNSC staff in CMD 17-H112.

33. With this decision for approval to the change to the CLSI's licensing basis, the Commission directs that all documentation in the LCH associated with LC 1.2, *Changes to CLSI Documents*; LC 4.1, *Operating Program*; LC 5.1, *Safety Analysis Program*; and LC 5.2, *Documentation*, be amended to reflect the updated safety case supporting the top-up mode of operation for CLSI's facility prior to the implementation of that operating mode.



Michael Binder
President
Canadian Nuclear Safety Commission

FEB 20 2018

Date