Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

UNPROTECTED/NON PROTÉGÉ

ORIGINAL/ORIGINAL

CMD: 22-H6

Date signed/Signé le : 16 DECEMBER 2021

A Licence Renewal
and
A Licence Transfer

TRIUMF Accelerator Incorporated

Particle Accelerator

Commission Public Hearing

Scheduled for:
March 23 and 24, 2022

Submitted by:
CNSC Staff

Un renouvellement de permis
et
un transfert de permis

TRIUMF Accelerator Incorporated

Accélérateur de particules

Audience publique de la Commission

Prévue le :
23 et 24 mars 2022

Soumise par :
Le personnel de la CCSN

e-Doc 6621780 (WORD)
e-Doc 6638314 (PDF)

Summary

This CMD presents information about the following matters of regulatory interest with respect to TRIUMF Accelerators Inc. (TAI):

- CNSC staff's review and assessment of TAI's application and recommendation regarding, the renewal of its particle accelerator licence PA1OL-01.00/2022 and the transfer of its licence from TAI to TRIUMF Inc.

CNSC staff recommend the Commission take the following actions:

- Renew the licence to operate TAI's particle accelerators until June 30, 2032
- Accept the revised financial guarantee for the decommissioning of TAI
- Transfer the licence from TAI to TRIUMF Inc.
- Authorize the delegation of authority as set out in Section 4.7 this CMD

The following items are attached:

- Current licence PA1OL-01.00/2022
- Current licence conditions handbook
- Proposed licence amendment
- Proposed licence PA1OL-01.00/2032
- Proposed licence PA1OL-01.01/2032 transferred to TRIUMF Inc.
- Draft licence conditions handbook

Résumé

Le présent CMD présente de l'information sur un ensemble de questions d'ordre réglementaire concernant TRIUMF Accelerator Inc. (TAI) :

- L'examen, l'évaluation et les recommandations du personnel de la CCSN à l'égard de la demande de TAI visant à renouveler son permis d'accélérateur de particules PA1OL-01.00/2022 et à transférer son permis à TRIUMF Inc.

La Commission pourrait considérer prendre les mesures suivantes :

- Renouveler le permis d'exploitation des accélérateurs de particules de TAI jusqu'au 30 juin 2032
- Accepter la garantie financière révisée pour le déclassement de TAI
- Transférer le permis proposé de TAI à TRIUMF Inc.
- Autoriser la délégation de pouvoirs, comme indiqué à la section 4.7 du présent CMD

Les pièces suivantes sont jointes :

- le permis actuel, PA1OL-01.00/2022
- le manuel des conditions de permis actuel
- la modification proposée au permis
- le permis proposé, PA1OL-01.00/2032
- le permis proposé, PA1OL-01.01/2032 transféré à TRIUMF Inc.
- l'ébauche du manuel des conditions de permis

Signed/signé le

16 December 2021

OwenWhitred, Karen

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Director General

Directorate of Nuclear Substance Regulation

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EXECUTIVE SUMMARY

TRIUMF Accelerators Inc. (TAI) operates 7 particle accelerators on the campus of the University of British Columbia:

- 1 520-MeV cyclotron
- 4 Class II cyclotrons
- 2 Class II linear accelerators.

In June 2012, pursuant to section 24 the *Nuclear Safety and Control Act*, the Canadian Nuclear Safety Commission (CNSC) issued licence PA1OL-01.00/2022 to TAI.

In March 2021, TAI applied to the CNSC for a 10-year renewal of its particle accelerator license, to continue operating its particle accelerators.

Since June 1, 2021, TRIUMF Inc., a not-for-profit corporation, has had a management agreement with TAI to operate the particle accelerators under licence PA1OL-01.00/2022.

In November 2021, TAI requested to transfer the particle accelerator licence, if renewed, to TRIUMF Inc.

CNSC staff's assessment of the licensee's regulatory performance concludes that the environmental and radiological risks remain low. Releases, effluent quality and radiation doses are effectively controlled and kept well below regulatory limits. Activities are conducted safely. Although staff have assessed the licensee's performance as Below Expectations for the Management System SCA, the risk significance of this rating is relatively low and does not impact staff's overall assessment regarding the safe operation of the facility.

Therefore, CNSC staff conclude that the proposed operation of the particle accelerator facilities remains within the bounds and intent of the current licensing basis.

CNSC staff recommend that the Commission:

- Renew particle accelerator licence PA1OL-01.00/2022 to operate TAI's particle accelerators for a period of 10 years commencing on July 1, 2022, and ending on June 30, 2032
- Accept the revised financial guarantee in the amount of $14.78M (as of March 31, 2023) for the decommissioning of TAI
- Transfer the licence from TAI to TRIUMF Inc.
- Authorize the delegation of authority as set out in this CMD.

This CMD has 2 parts. Part 1 presents a summary of CNSC staff's assessment of TAI's licence application and past performance since 2011. Part 2 provides the documentation pertaining to this hearing, including the proposed licence, and the current licence and Licence Conditions Handbook (LCH). A draft LCH is also included for information only. Referenced documents in this CMD are available to the public upon request.

PART 1

This Commission Member Document (CMD) is presented in 2 parts.

Part 1 includes:

1. an overview of the matter being presented;
2. overall conclusions and overall recommendations;
3. general discussion pertaining to the safety and control areas (SCAs) that are relevant to this submission;
4. discussion about other matters of regulatory interest; and
5. addenda material that complements items 1 through 4.

Part 2 provides all available information pertaining directly to the current and proposed licence, including:

1. current licence PA1OL-01.00/2022
2. current licence conditions handbook
3. proposed licence amendment
4. proposed licence PA1OL-01.00/2032
5. proposed licence PA1OL-01.01/2032 transferred to TRIUMF Inc.
6. draft licence conditions handbook

1. OVERVIEW

1.1 Background

TRIUMF Accelerators Inc. (TAI) is licensed to operate Class IB particle accelerator facilities, under licence PA1OL-01.00/2022. TAI is located on the campus of the University of British Columbia, near Vancouver, British Columbia. TAI operates a 520-MeV proton cyclotron, 4 cyclotrons with proton beam energies of less than 50 MeV and 2 linear accelerators. TAI is also operating to commission an electron accelerator facility under a separate Class II licence.

TAI is Canada's national laboratory for nuclear and particle physics research and related sciences. An aerial view of the TAI site is shown in Figure 1.1. TAI is also a major producer of radioisotopes used for medical diagnostic procedures. The 520-MeV cyclotron, shown in Figure 1.2, has been in operation since 1974. There are approximately 560 persons working at TAI.

Figure 1.1: Arial view of the TAI site

Source: TAI

Figure 1.2: Inside look of the 520-MeV proton cyclotron

Source: TAI

There has been no licence amendments for TAI since the issuance of the current licence PA1OL-01.00/2022 in 2012.

1.2 Highlights

On March 19, 2021, TAI submitted an application for renewal of the CNSC licence PA1OL-01.00/2022. The proposed operations are within TAI's current operating limits for their particle accelerators. CNSC staff assessed all aspects of TAI's application for the renewal of its CNSC particle accelerator licence PA1OL-01.00/2022.

Requested licence period

In TAI's application to renew the CNSC-issued licence, a 10-year licence term was requested.

Financial Guarantee

CNSC staff are also requesting approval of TAI's revised financial guarantee in the amount of $14.78M (as of March 31, 2023). In December 2018, TAI submitted an updated Preliminary Decommissioning Plan (PDP) and cost estimate for decommissioning of the TAI facility.

TRIUMF Inc. currently maintains TAI's financial guarantee in an Escrow Fund for the decommissioning of its facility.

Transfer of licence from TAI to TRIUMF Inc.

Until May 31, 2021, TRIUMF was a joint venture between several Canadian universities. Under an agreement, TRIUMF full member universities appointed TAI to operate the cyclotrons and provide certain services to TRIUMF. TAI was incorporated in 2008 to hold the current CNSC licence.

On June 1, 2021, TRIUMF Joint Venture transferred its assets, obligations, operations and employees to TRIUMF Inc., a not-for-profit corporation incorporated under the *Canada Not-for-profit Corporations Act*. To effect the transition from TRIUMF to TRIUMF Inc. as smoothly as possible in the near

term, TRIUMF proposed that TAI would continue to hold the CNSC licence and continue to provide certain services to TRIUMF Inc. until the licence renewal.

In November 2021, TAI requested that the licence be transferred to TRIUMF Inc. if the Commission accept to renew the operating licence. Operationally, the transition from TAI to TRIUMF Inc. does not impact any aspect of the facility`s operation, including any programs for the protection of the health and safety of persons and the protection of the environment; the same employees will be operating the same facilities under the same programs with oversight from the same member universities. CNSC staff regulatory oversight will also be the same after the transfer, meaning that any opened notices of non-compliance will be transferred to the new licence holder.

TRIUMF Inc. has already assumed, since June 1, 2021, TAI's financial guarantee. In consultation with CNSC staff, TRIUMF Inc. will amend the language of the financial guarantee instruments to reflect the change in the licence holder so the amended instruments become effective at licence renewal.

Implementation of CSA Standard N286-12, *Management system requirements for nuclear facilities*

TAI committed to comply with CSA Standard N286-12, *Management system requirements for nuclear facilities* by January 2018. However, TAI is still facing challenges to comply with this standard (details provided in Section 3.1 below).

N286-12, which was first published in 2005 under the title N286-05, *Management system requirements for nuclear power plants*, was expanded to all Class I nuclear facilities in 2012. TAI is a scientific organization, therefore very different than most of the other Class I nuclear facilities, which are often production-driven organizations. CNSC staff use a graded approach to reflect the relative risk and nature of the operation for the implementation of regulatory requirements, including implementation of standards such as N286-12. TAI has been operating safely for years under its own management system for its particle accelerators operation as well as managing multiple and diverse research projects that are continuously proposed, reviewed, assessed for safety and feasibility, and implemented. As it is for any organization, implementing N286-12 requirements at TRIUMF constitutes a good practice and promote an organizational culture which minimize risks of compromising safety.

TAI has implemented an action plan in response to the 20 Notices of Non-Compliance (NNC) of the last management system inspection of February 2021, to verify compliance of TAI's management system to N286-12. TAI committed to complete all the actions by January 31, 2022. CNSC staff will assess the completion of these actions and provide an update to the Commission prior to the licence renewal date of June 30, 2022.

1.3 Overall Conclusions

TAI has programs, resources, and measures in place to ensure the health and safety of persons and the environment and of the measures related to security and Canada's international obligations during the proposed licence period.

From 2012 to 2018, TAI met expectations with respect to the Management System SCA (with the exception of a near miss event in 2014, noted in Table 3.1 and described in Appendix E). TAI committed to be compliant to N286-12 by January 2018. However, TAI did not meet its target date, and is still facing challenges in the implementation. As TAI has been working on implementing the requirements of N286-12, it has kept CNSC staff informed of progress and challenges through several conference calls and submission of documents for CNSC staff to review. CNSC staff note that TAI's progress has been slower than expected. While CNSC staff conclude that the progress toward full implementation is below expectations, CNSC staff also note that there are other controls in place such that there is no immediate risk to health and safety as a result of the delay. CNSC staff expect that TAI will substantively complete the implementation plan prior to the renewal date of June 30, 2022. CNSC staff will verify implementation through follow up compliance inspections.

CNSC staff conclude that the TAI's performance in all other areas during the licensing term was satisfactory and met regulatory requirements.

CNSC staff conclude that TAI's proposed financial guarantee amounts and instruments are acceptable.

1.4 Overall Recommendations

CNSC staff recommend the following:

1. The Commission accept the conclusions of CNSC staff that TRIUMF Inc. is qualified to carry out the activities authorized by the particle accelerator operating licence;
2. The Commission renew particle accelerator licence PA1OL-01.00/2022 to operate the particle accelerators for a period of 10 years commencing on July 1, 2022, and ending on June 30, 2032;
3. The Commission accept the financial guarantee consisting of an Escrow Fund in the amount of $14.78M (as of March 31, 2023), a Contribution Gap Agreement, and a Financial Security and Access Agreement;
4. The Commission transfer the renewed particle accelerator licence PA1OL-01.00/2032 from TAI to TRIUMF Inc.;
5. The Commission delegate authority as set out in section 4.7 of this CMD.

2. MATTERS FOR CONSIDERATION

2.1 Environmental Review

CNSC staff reviewed the licence application to determine what type of environmental review was required to be conducted, if applicable. CNSC staff determined that the *Impact Assessment Act* (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.

CNSC staff conduct Environmental Protection Reviews (EPRs) for all licence applications with potential environmental interactions, in accordance with CNSC's mandate under the *Nuclear Safety and Control Act* (*NSCA*) and associated regulations. The EPRs help support the Commission's conclusion on whether the proposal provides adequate protection of the environment and the health of people.

An EPR was conducted for this licence application. More information on CNSC staff's EPR can be found in section 3.6 of the CMD.

CNSC staff conclude that the information provided by TAI regarding environmental protection is sufficient to meet the applicable regulatory requirements under the *NSCA* and associated regulations for particle licences.

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 Relevant Safety and Control Areas (SCAs)

The functional areas of any licensed facility or activity consist of a standard set of safety and control areas (SCAs). Each SCA is comprised of "specific areas" of regulatory interest; however, the specific areas associated with each SCA vary between facility types. For further information regarding SCAs, see Appendix D, "Safety and Control Area Framework" of this CMD.

Table 2.1 lists the "Risk Ranking" and the "Rating Level" for each SCA. The "Risk Ranking" indicates the overall level of risk associated with each SCA, and the "Rating Level" indicates the overall compliance with regulatory requirements for implementation at TAI. Appendix A provides additional information related to "Risk Ranking" and Appendix B further defines the "Rating Levels".

Table 2.1: Safety and control areas relevant to TAI

Functional Area	Safety and Control Area	Risk Ranking*	Rating Level**
Management	Management System	M	BE
	Human Performance Management	H	SA
	Operating Performance	H	SA
Facility and Equipment	Safety Analysis	M	SA
	Physical Design	H	SA
	Fitness for Service	H	SA
Core Control Processes	Radiation Protection	H	SA
	Conventional Health and Safety	H	SA
	Environmental Protection	H	SA
	Emergency Management and Fire Protection	H	SA
	Waste Management	H	SA
	Security	L	SA
	Safeguards and Non-Proliferation	L	SA
	Packaging and Transport	M	SA

* H = High; M = Moderate; L = Low; BE = Below Expectation; SA = Satisfactory

** Overall rating level for the current licence period (July 1, 2012 to June 30, 2021).

The risk rankings provided in table 2.1 are all relevant to this CMD.

2.3 Other Matters of Regulatory Interest

The following table identifies other matters that are relevant to this CMD.

Table 2.2: Other matters of regulatory interest

Area	Relevant to this CMD?
Indigenous Engagement	Yes
Other Consultation	No
Cost Recovery	Yes
Financial Guarantees	Yes
Improvement Plans and Significant Future Activities	No
Licensee's Public Information Program	Yes
Nuclear Liability Insurance	No

The relevant "other matters" of regulatory interest are discussed in section 4 of this CMD.

2.4 Regulatory and Technical Basis

The regulatory and technical basis for the matters discussed in this CMD arise directly from the *Class I Nuclear Facilities Regulations* (*CINFR*) and the *General Nuclear Safety and Control Regulations* (*GNSCR*) as well as other regulatory requirements associated with the *NSCA*. Further information regarding the regulatory and technical basis for the matters discussed in this CMD are provided in Appendix C of this document.

3. GENERAL ASSESSMENT OF SCAS

CNSC staff's assessments provided in the following sections are based on a comprehensive review of TAI's past performance and a thorough evaluation of the safety and control measures to be implemented for the next licence period. These areas are outlined in TAI's licence application and supporting documentation submitted for this application.

The CNSC implements a risk-informed approach in the regulation of nuclear facilities and activities. The depth of regulatory reviews of the SCAs and the baseline frequency of regulatory compliance activities is informed by the risk ranking of that SCA (section 2.2, table 2.1).

The specific areas that comprise the SCAs for this facility or activity type are identified in Appendix D, Section D.1. If specific areas are listed for an SCA in section 3, then the related details about them are provided in Appendix D, Section D.2 of this document. If specific areas are not listed for a given SCA in Section 3, then a decision has been made to encompass them in an overall approach to that SCA. The assessment period referenced within this report is from July 1, 2012 to June 30, 2021.

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.

This CMD covers the following specific areas of Management System:

- Management System and Organization
- Performance Assessment, Improvement and Management Review
- Operating Experience (OPEX)
- Change Management, Configuration Management and Records Management
- Safety Culture
- Management of Contractors

3.1.1 Trends

The following table indicates the overall rating trends for the management system SCA over the current licensing period:

Table 3.1: Trends for Management System SCA

Overall Compliance Ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	BE	SA	SA	SA	BE	BE	BE
TAI has implemented a management system that complied with the LCH requirements between 2012 to 2017 except in 2014 where its performance resulted in a Below Expectation (BE) rating following a lockup incident in the electron accelerator facility (the same incident also affected the rating for the human performance management rating for 2014 – see Appendix E for more details). The CNSC introduced CSA N286-12, *Management System Requirements for Nuclear Facilities* as a new regulatory requirement for TAI in 2016, with a full implementation date for 2018. TAI was not able to fulfill its commitment and this subsequently led TAI to a BE rating for the Management system SCA over the last 3 years, 2018 to 2020. CNSC staff assessed TAI's progress in February 2021 to verify the status of implementation of their management system against the requirements of N286-12. The inspection resulted in the identification and issuance of 20 NNCs, all of low safety significance. In June 2021, TAI submitted an action plan to address these NNCs, with associated milestones. CNSC staff found the action plan satisfactory. Some of the actions have already been addressed, and, based on the milestones, all NNC will be addressed by January 31, 2022. CNSC will continue to monitor the progress and completion of the action plan and follow-up with inspections in the future to verify compliance.								

3.1.2 Discussion

The compliance verification criteria for management systems has evolved over the licensing period. For this reason, the discussion will focus on the latter half of the licensing period. Figure 3.1 presents the timeline of the events in the discussion.

In February 2016, CNSC staff performed a Management System inspection, which was a follow-up of the electron accelerator facility lockup incident described in Appendix E. In parallel to the inspection, CNSC staff made a presentation to TAI staff to introduced N286-12 as a regulatory requirement for TAI for the first time and requested TAI to commit to comply with N286-12 by January 2018.

With the introduction of the new regulatory requirement in February 2016, CNSC staff requested TAI to conduct a gap analysis of their current quality management system against the requirements of N286-12, submit the gap analysis to CNSC staff for review, and improve their management system to address the gaps. TAI committed to comply with the standard by 2018.

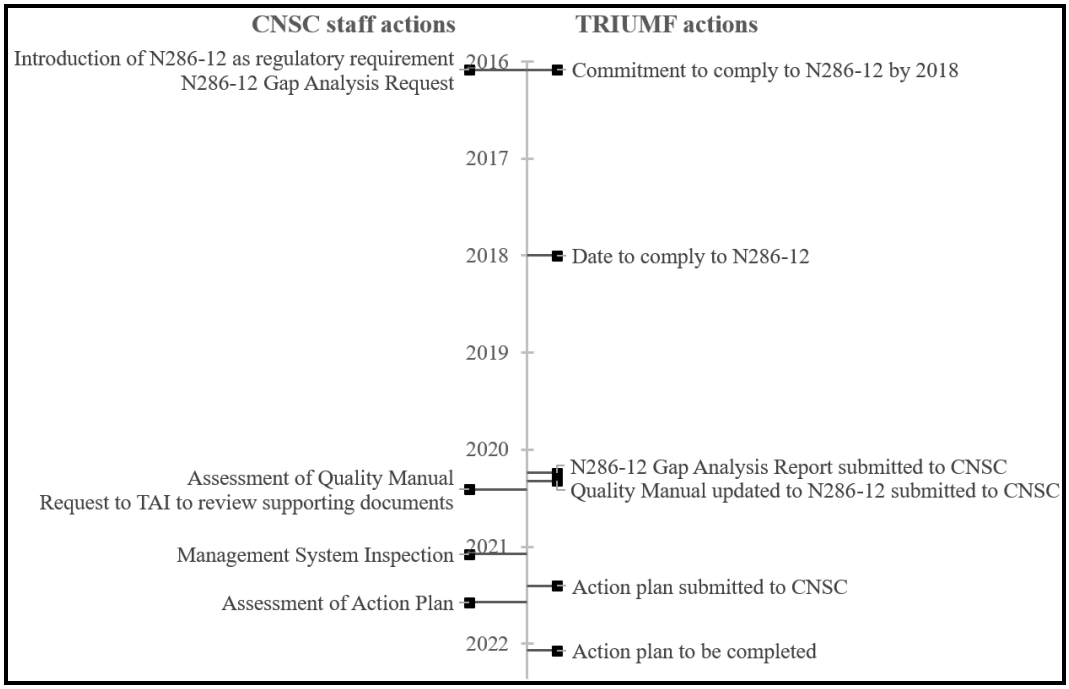
Also in February 2016, to assist TAI with the implementation, CNSC staff performed a preliminary gap analysis of TAI's top tier management system documents against the requirements of N286-12, and shared the results with TAI. With this preliminary gap analysis, CNSC staff concluded that TAI's current management system was not compliant yet, but several elements of N286-12 were already built in TAI's management system.

Since February 2016, CNSC staff and TAI have participated in several conference calls that are continuing today to discuss the implementation of N286-12 and for CNSC staff to answer TAI's questions. TAI has kept CNSC staff informed during these conference calls of the progress and challenges that they have been facing.

TAI was not able to fulfill its commitment and this subsequently led TAI to a BE rating for the Management System SCA over the last 3 years. Since Dec 2019, TAI has conducted the gap analysis and submitted the results to CNSC in April 2020. CNSC staff reviewed and accepted the gap analysis. TAI then amended their quality manual and submitted it to CNSC in May 2020. CNSC staff conducted a desktop review of TAI's quality manual in June 2020 and concluded that it met N286-12. Simultaneously, CNSC staff requested TAI to conduct a thorough review of their supporting documents referenced in the manual to ensure that they met requirements and have these documents made available to CNSC staff for the next inspection.

In February 2021, CNSC staff conducted a remote Management System inspection to verify the status of implementation of the updated TAI management system. The inspection resulted in the identification and issuance of 20 NNCs, all having low safety significance (even though the overall risk ranking for the Management System SCA is moderate, the safety significance is rated according to the risk of each NNC). TAI has submitted an Action Plan to address these NNCs with associated milestones, to meet the applicable CNSC regulatory requirements. The details of the NNCs, the required corrective action and the status of each are included in Appendix F. Additionally, TAI has created a Quality Council with members from various departments to oversee the implementation of the management system requirements in the organization. CNSC will continue to monitor the progress and completion of the action plan and follow-up with inspections in the future to verify compliance.

Figure 3.1 Timeline of the events discussed in this section



3.1.3 Summary

A summary of TAI's past performance, challenges and proposed improvements are presented in the following subsections.

3.1.3.1 Past Performance

Management System and Organization

CNSC staff determined that TAI has a management system in place over the licence period but not to the requirements of N286-12 for Nuclear Facilities.

Since the Management System inspection of 2016, CNSC staff observed that TAI has been working on meeting the requirements of the N286-12 standard requirements but fell short of their commitments. This resulted in a BE rating over the last 3 years of the current licensing period. During this period, CNSC staff monitored the progress through meetings and desktop reviews and decided to postpone additional compliance verification inspections until more progress was made. With the licence renewal pending CNSC staff decided at the end of 2020 to conduct a compliance verification inspection in February 2021, aimed at verifying TAI's implementation and compliance with the requirements of N286-12.

Due to the pandemic, the inspection was conducted remotely. This Type I inspection focused on document reviews and interviewing of TAI staff to verify TAI's management system compliance in addressing the requirements of N286-12. As a result of the inspection, CNSC staff issued 20 NNCs, all of low safety significance. The findings which resulted in some of these NNCs will be discussed throughout the following sub-sections.

In accordance with the scope of the Type I inspection, CNSC staff conducted a thorough review of all the management system elements and determined that TAI's management system continues to be a "work in progress". In June 2021, TAI submitted an action plan, with associated milestones and timelines, to CNSC staff to address these NNCs. The action plan has been assessed as acceptable to CNSC staff, who continue to monitor and assess the progress TAI is making towards completion of the plan.

With respect to organization, TAI describes their organization structure in charts and in TAI's governance documentation. One of the findings that led to a NNC during the inspection in February 2021 is that TAI's organization charts did not reflect the current organization nor were they in alignment with their governance. The ongoing changes to the organizational structure were not clearly defined nor communicated to workers in a timely manner.

As a corrective action, TAI has issued a TRIUMF Governance & Management to communicate the changes and will keep their organizational charts current via a "Workday" software package.

Performance Assessment, Improvement and Management Review

TAI's middle management and supervisors performed self-assessments of their area of responsibilities and the results were communicated at the quarterly safety and quality management review meetings. The purpose of the quarterly safety and quality management reviews is to assess the performance of their quality and safety programs as well as their divisional safety committee and operations. However, one of the findings that led to a NNC in the February 2021 inspection is that TAI has not effectively performed assessments of its programs and its overall management system to verify full implementation and compliance against regulatory requirements in these meetings. In addition, TAI could not demonstrate that they have conducted independent assessments during the current licensing period.

Operating Experience (OPEX)

During the inspection, TAI demonstrated that it has implemented lessons learned from problems or events identified in the work activities, within its organization, from external sources as well as from scientific and technical publications (for example, TAI is a member of the International Technical Safety Forum). Over the licensing period, CNSC staff identified weaknesses in certain elements of the management system at TAI and communicated these to TAI for corrective actions. CNSC staff found during the February 2021 inspection that TAI has not learned from these weaknesses nor had they identified them as part of their problem identification and resolution process, resulting in one NNC. CNSC staff also identified areas of improvement where an "established systematic approach" for sharing of knowledge would be beneficial and that this knowledge be made accessible and shared throughout the organization.

Change Management, Configuration Management and Records Management

TAI currently manages their changes through various mechanisms. CNSC staff determined that TAI has an engineering and design change control program in place that meets the regulatory requirements. However, CNSC staff found during the February 2021 inspection that TAI has not established a change management process, including relevant criteria, to effectively manage changes that apply to other operational, organizational and improvement initiatives to ensure changes made in the organization, processes, designs, systems, equipment, materials and documents are reviewed and approved before they are implemented, resulting in another NNC.

CNSC staff verified the configuration management of the systems, structures and components (SSCs) based on completed engineering change. The information reviewed indicates TAI has maintained the configuration of SSCs and is in compliance with its configuration management program.

TAI produces and keeps records which demonstrate completion, acceptance and verification of the work performed. However, during the February 2021 inspection, CNSC staff observed that not all records for the work performed were produced and where the records were produced, they were not always traceable to the related items and work, resulting in one NNC. CNSC staff determined that though the record management process met regulatory requirements, the implementation is not consistent across all licensed activities.

Safety Culture

Statements in TSN 1.0, *TRIUMF Policy on Safety in the Workplace* specify TAI's management responsibility to demonstrate commitment to safety, including encouraging participation of all workers in the identification and solution of safety problems in the workplace. This approach links with TAI's *Strategic Plan For Safety*, which has objectives related to safety culture and human performance.

A divisional safety officer role was instituted across all divisions, to act as the main communication link between the Division, Environment, Health and Safety (EHS) and the Safety Officers in other divisions. Together with the Associate Laboratory Directors, the Safety Officer role promotes a culture focused on maintaining and improving safety. This role also assists supervisors and workers to meet requirements by creating opportunities to propagate established processes and best safety practices across the division.

In 2015, a non-NEW exceeded the TAI quarterly action level for dose, and stricter restrictions were implemented for access to high radiation areas. Issues were found in dose management and recording, compliance with work permit requirements, radiation safety knowledge of non-NEWs, and project manager knowledge. CNSC staff's review of this event raised concerns about safety culture, which led to the 2017-2018 TAI independent safety culture assessment. This assessment was performed to establish a baseline.

Management of Contractors

During the February 2021 inspection, CNSC staff determined that process for management of contractors at TAI met regulatory requirements. Contractors are assessed for qualification prior to commencing work and are provided with the required training if gaps were identified. However, CNSC staff could not determine that controls are in place for the supply management program that meets regulatory requirements, resulting in the issuance of a NNC. Deficiencies identified in the program included supplier evaluation and acceptability, specifying of quality requirements and defining of acceptance criteria.

3.1.3.2 Regulatory Focus

CNSC staff issued NNCs to TAI to address the findings mentioned above and all others related to compliance to N286-12 in the inspection report following the remote Management System inspection of February 2021. All the findings had a low safety significance; nevertheless, maintaining a management system compliant to N286-12 creates a "defense in depth" system that ensures safe operation. Therefore, to ensure that progress was made even before issuing the final inspection report, CNSC staff requested at the closing meeting of the February 2021 inspection that TAI submit monthly reports of their progress towards compliance to N286-12 as part of a graduated enforcement strategy.

Following the final report issued in May 2021, TAI submitted an action plan in June 2021 and is currently taking measures to complete all actions by January 31, 2022. Once completed, CNSC staff will follow-up with a Management System inspection. CNSC staff will report to the Commission on the closing of these 20 NNCs prior to the licence renewal date of June 30, 2022.

CNSC staff will continue to monitor and assess TAI's compliance with the requirements in N286-12 through regular updates, documents and records reviews and will follow-up with inspections over the next licensing period.

3.1.3.3 Proposed Improvements

To fully meet the regulatory requirements, TAI shall ensure that all the corrective action to the NNC are implemented and verified for completion and effectiveness before closure. TAI management and top management shall perform critical periodic oversight activities and performance assessment of its programs and its overall management system to ensure it achieve the planned results consistently and safely.

3.1.4 Conclusion

Despite a BE rating and the notices of non-compliance found during the 2021 inspection, the deficiencies did not pose an immediate risk to the environment, and health and safety of persons. The timely completion of TAI action plan as well as heightened regulatory oversight will provide assurance that this continues in a consistent manner.

3.1.5 Recommendation

CNSC staff recommend that the licence condition 2.1 associated with the Management System SCA be retained without change.

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 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.

This CMD covers the following specific area of Human Performance Management:

- Personnel Training
- Human Performance Management
- Human Performance Program
- Work Organization and Job Design
- Fitness for Duty

Although these specific areas are applicable to TAI, the CMD will focus on Personnel Training, Human Performance Program, and Work Organization and Job Design, in order to provide a more integrated picture of TAI's performance.

3.2.1 Trends

The following table indicates the overall rating trends for the human performance management SCA over the current licensing period:

Table 3.2: Trends for Human Performance Management SCA

Overall Compliance Ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	BE	SA	SA	SA	SA	SA	SA

Comments

TAI has implemented and maintains a Systematic Approach to Training (SAT). In 2014, an electron accelerator facility lockup incident that occurred during commissioning led to a BE rating (Apprendix E provides details of the incident). All associated corrective actions were completed and closed. Since then, the trend for this SCA has remained stable across TAI site. Recently, TAI has assigned additional resources to update and improve the training programs for specific operations groups.

TAI Quality Management System (QMS) is being aligned with N286-12, which provides a more integrated approach for management, including for the human and organizational factors, which influence human performance. The nonconformity process to improve performance aims to provide a transparent, non-punitive approach to reporting and learning from adverse events, near misses and unsafe conditions, and provides impetus for continual improvement, including for human performance.

TAI conducted an internal self-assessment of its core programs, which was reviewed by

an international panel of safety professionals from other accelerators and industry. This led to the Strategic Plan for Safety, which prioritizes the planning and implementation of work to resolve issues in the core safety programs.

TAI has made changes to support safe and effective operation, which included adding new personnel for core programs related to safety, a review of the controlled work process to review hazards, and development of Job Hazard Assessments in conjunction with Pre-Job Briefings to support workers in identifying and mitigating hazards before starting the work tasks.

The 2017-2018 TAI independent safety culture assessment establishes a baseline and considered the maturity of 14 aspects and 7 dimensions of safety culture.

3.2.2 Discussion

TAI is required to ensure there is a sufficient number of qualified workers to carry on the licensed activity safely. Every person is required to use health and safety-related equipment and comply with measures established by TAI related to health, safety, security and the environment. Workers must take all reasonable precautions to ensure their own safety and the safety of others, and inform TAI of a significant increase in risk to the environment, health and safety or failure to comply with the Act, regulations or the licence. TAI must implement and maintain training programs for workers in accordance with the requirements set out in REGDOC-2.2.2, *Personnel Training*.

3.2.3 Summary

A summary of TAI's performance, challenges and proposed improvements are presented in the following subsections.

3.2.3.1 Past Performance

Personnel Training

Since 1999, TAI has implemented and maintained a SAT to provide assurance that staff attained and maintained competence in performing their duties.

TAI maintains training governance documentation and has implemented training procedures that meet the requirements of REGDOC-2.2.2, *Personnel Training*.

During the current licensing period CNSC staff conducted 4 inspections and numerous document reviews of the training program at TAI. It is important to note that the training system and program at TAI has been significantly augmented and includes visitor and researcher training for accessing and operating new facilities. Many positive aspects of the SAT at TAI were noted, including the progress made towards fully implementing a SAT in all operations areas and building access training for visiting researchers.

A Training Implementation Panel oversees the work of the training department and ensures a timely implementation of training requirements for all groups on

site. Additionally, this panel has been reviewing, updating and standardizing training programs for operations groups to align with TAI's SAT program.

Stemming from the 4 aforementioned inspections, CNSC staff issued a total of 16 NNCs pertaining to: visitor and contractor building access and safety refresher training, training records, consistent form usage, a comprehensive corrective action plan involving exclusion area and lockout training, document control and training documentation alignment. In all cases TAI staff, implemented suitable corrective actions and all NNCs have been closed in an effective in a timely manner.

In 2014, following a root cause analysis report concerning an electron accelerator facility lockup incident that occurred during commissioning (details in Appendix E), a suite of corrective actions along with a comprehensive training improvement plan was undertaken by TAI staff. During that time, CNSC staff conducted numerous reviews and a reactive inspection to assess and ensure that the corrective actions being taken were effective. All corrective actions were implemented and closed in a timely manner.

TAI continues to be a leader in timely, accessible training, with the majority of training required to access the site available to researchers and visitors online, prior to their arrival on site.

There are no open NNCs or compliance actions pertaining to this SCA. CNSC staff continues to monitor personnel training at TAI through general and specialist supported inspections as well as annual compliance reports. The next scheduled inspection at TAI is in 2022.

Human Performance Program

This specific area considers the overview of all practices and activities that aim to improve human performance, and how these are planned, managed, implemented, controlled, and monitored.

In the majority of cases, events will have a human performance component due to people conducting the work associated with them.

In 2015, TAI conducted an internal self-assessment of its core programs, which was reviewed by an international panel of safety professionals from other accelerators and industry. This led to TAI's *Strategic Plan for Safety* (Document-121747), which prioritizes the planning and implementation of work to resolve issues in the core safety programs. The *Strategic Plan for Safety* is refreshed regularly to ensure that key issues are addressed and projects are coordinated.

In 2017, there was emphasis on the nonconformity process to improve performance. The process aims to provide a transparent, non-punitive approach to reporting and learning from adverse events, close calls and unsafe conditions, and provides impetus for continual improvement.

In this licensing period, the TAI Quality Management System (QMS) is being aligned with N286-12, which will result in a more integrated approach for management, including for the human and organizational factors, which influence human performance.

Work Organization and Job Design

TAI has made changes that aimed to support safe and effective operation, which included:

- Revision of TRIUMF Standard Operating Procedures (TSOPs);
- Adding new personnel for core programs related to safety in the areas of EHS, QMS, Training and Computing, to correct an identified lack of resources;
- A review of the controlled work process to review hazards and inform workers; and,
- A TSN 3.9, *Job Hazard Assessments and Pre-Job Briefings* (Document-178912) has been under development for several years. Training in its use was in progress in 2020. This process aims to support workers in identifying and mitigating hazards before starting the work tasks. Development of a job hazard assessment form and work instruction, to be used with the pre-job briefing, for outside contractor work and for jobs internal to TAI.

There were no reported non-conformities related to minimum staff complement over this licensing period. The optimum level of staffing and the minimum level of staffing are specified in the *TRIUMF Emergency Preparedness Plan*, Release 6, November 2019 (Document-4952).

3.2.3.2 Regulatory Focus

CNSC staff will continue to monitor performance in this area through regulatory oversight activities, inspections, and desktop reviews of TAI's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.2.3.3 Proposed Improvements

There are no major changes anticipated in the near future for this SCA.

3.2.4 Conclusion

Overall TAI has strengthened the training program and provided a robust methodology to assure the competence of its operational staff.

The regulatory requirements have been met for human performance, for work organization and job design as well as for fitness for duty, and there are no concerns.

CNSC staff conclude that TAI is performing satisfactorily with respect to this SCA.

3.2.5 Recommendation

CNSC staff recommend that the current licence conditions 3.1 and 3.2 associated with the Human Performance Management SCA be retained without change.

3.3 Operating Performance, Safety Analysis, Physical Design, and Fitness for Service

This section groups together several SCAs: operating performance, safety analysis, physical design, and fitness for service. For a particle accelerator, these safety and control areas are tightly linked, and address different aspects of the same key programs. Addressing these SCAs together provides a more integrated picture of TAI's performance over the licensing period.

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 preventative measures and strategies in reducing the effects of such hazards.

The operating performance SCA includes an overall review of the conduct of the licensed activities and the activities that enable effective performance. The specific areas that comprise this SCA are not addressed individually in this document.

Physical Design relates to activities that impact the ability of structures, systems and components to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

Fitness for Service covers activities that impact the physical condition of structures, systems and components to ensure that they remain effective over time. This area includes programs that ensure all equipment is available to perform its intended design function when called upon to do so. The specific areas that comprise this SCA are not addressed individually in this document.

3.3.1 Trends

The following table indicates the overall rating trends for the safety analysis, physical design, fitness for service, and operating performance SCA over the current licensing period:

Table 3.3: Trends for Operating Performance, Safety Analysis, Physical Design and Fitness for Service SCAs

Overall Compliance Ratings									
Year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Operating Performance	SA	SA	SA	SA	SA	SA	SA	SA	SA
Safety Analysis	SA	SA	SA	SA	SA	SA	SA	SA	SA
Physical Design	SA	SA	SA	SA	SA	SA	SA	SA	SA
Fitness for Service	SA	BE	SA	SA	SA	SA	SA	SA	SA

Comments

TAI's performance in the safety analysis, physical design, operating performance and fitness for service SCA's has been satisfactory over the course of the licensing period.

TAI has a mature program that ensures the facility is operated according to the limits defined by the up-to-date safety analysis, and key equipment is maintained and calibrated to in order to perform its protective functions. However, in 2013, TAI reported 2 events related to the malfunction of safety related systems (rupture of a xenon-123 gas target used for medical isotope production and under-reporting of airborne emissions from 2009 to 2012 due to a malfunction of the stack monitoring system). Neither of these events had any adverse radiological effects on the environment or resulted in workers or the general public receiving doses in excess of the regulatory limits. The rating of BE for the fitness for service SCA is a direct consequence of these 2 reported events.

3.3.2 Discussion

At TAI's site, the largest radiation hazard is present as prompt radiation[1] when the beam is on. Each accelerator and beamline is shielded so that adjacent areas can be safely occupied when the beam is on. An Access Control Interlock System (ACIS) ensures that no one is present in a Prohibited Access Area (PAA) when the beam is on, and automatically shuts off the beam if access is attempted or if an emergency off button is pressed.

When the beam is off, smaller residual dose rates are present in the prohibited access areas, due to the beam activating materials in the accelerator components. The radiation hazards from activated materials are significantly less than the dose rates present when the beam is on. Access to these areas is not prevented by the ACIS but is managed using procedural controls because of the reduction in radiation dose rates.

The shielding provides more than enough protection to adjacent areas from the residual dose rates because it is designed for high radiation dose rate beam-on conditions. The activated components are contained within the accelerator or

[1] Gamma rays and neutrons produced by the interactions of the beam of protons hitting targets and appearing less than a second after the interaction.

associated structures and are not dispersible. Activated components do not require cooling or other special storage conditions except appropriate shielding.

Since TAI does not possess material that could self-sustain chain reaction of nuclear fission, criticality control is not required.

3.3.3 Summary

A summary of TAI's past performance, challenges and proposed improvements are presented in the following subsections.

3.3.3.1 Past Performance

CNSC staff assessed TAI's performance in the operating performance, safety analysis, physical design and fitness for service SCAs in several ways over the licensing period:

- CNSC staff performed desktop reviews of events and annual reports
- CNSC staff reviewed and accepted TAI documents listed in the LCH when they underwent a revision change
- CNSC staff performed SCA-specific inspections of TAI's site

Table 3.4 describes CNSC staff SCA-specific inspection activities throughout the licensing period.

Table 3.4: SCA specific inspection activities during TAI's current operating licence period

SCA	Year(s) SCA-specific inspections performed	Results and Comments
Operating Performance	2017, 2019	SA
Safety Analysis	2017 Compliance with the safety analysis SCA is assessed by performing desktop reviews of the outputs of the safety analysis, and SCA-specific inspections of Operating Performance, Fitness for Service, Radiation Protection and Fire Protection.	SA
Physical Design	2017	SA
Fitness for Service	2017	SA

Operating Performance

CNSC staff have confirmed that TAI's procedures adequately describe the operation of the facility, and TAI operated in accordance with its operating procedures throughout the licensing period.

Safety Analysis

TAI continues to maintain a comprehensive hazard analysis in its safety analysis reports. CNSC staff confirm that TAI adequately maintained the safety measures in place in accordance with the Facility Safety Report during the licencing period.

Physical Design

Through CNSC staff review of TAI's documentation, CNSC staff concluded that the physical design program meets requirements. For the current licensing period, CNSC staff rated TAI's overall performance for the physical design SCA as satisfactory.

In 2014, a new control room was designed and constructed to support the operation for commissioning of the new electron accelerator. This control room design implemented a human factor engineering program plan, with verification and validation activities conducted in 2015. These human factors in design reports were reviewed by CNSC staff and found to be acceptable.

Also, in 2014, an employee was missed in a pre-lockup search of the electron accelerator facility, prior to its operation, which resulted in corrective actions related to the access control system (details in Appendix E). The electron accelerator commissioning licence was suspended to enable TAI to implement corrective actions to prevent a similar event occurring. A human factors analysis of the TRIUMF Exclusion Area Lock-up / Secure Systems was completed in 2015, which considered defense in depth concerning administrative procedures and engineered features. Improvements included:

- review of the number and location of Watchman Stations to ensure that search is thorough to ensure that an area is unoccupied
- training to understand alarm sounds in relation to removing the hazard through pressing an emergency trip pushbutton, and improved ANSI standard signage on all exclusion area Emergency Trip Pushbuttons
- determining the duration of start-up alarms for all 40 exclusion areas
- automated annunciator systems in the 5 largest exclusion areas
- changes in the work permit application to confirm that holders have left exclusion areas after completing their tasks, and operators ensuring that work permits have been returned prior to search and lock-out of exclusion areas
- addition of A/C disconnect hardware for each beam inhibit device to improve the electron accelerator facility Access Control System

The licence to resume the electron accelerator commissioning was issued in August 2015, with limits to the maximum energy and beam power.

Fitness for Service

Based on the results of compliance inspections and desktop reviews, CNSC staff rate TAI's performance in the Fitness for Service SCA as Satisfactory (SA) for the current licensing period, except for a rating of BE in 2013 following the occurrence of 2 events as described above. CNSC staff found the the corrective actions put in place following these events were satisfactory and brought back the rating to SA in 2014.

There are no open NNCs or compliance actions pertaining to these SCAs.

3.3.3.2 Regulatory Focus

There are no challenges with respect to the safety analysis, operating performance, fitness for service, or physical design SCAs. CNSC staff will continue to monitor TAI's performance in these areas through desktop reviews of TAI's event and annual reporting, review and acceptance of revisions to program documentation relating to these SCA, and inspections.

3.3.3.3 Proposed Improvements

There are no major changes anticipated in the near future for these SCAs.

3.3.4 Conclusion

CNSC staff confirm that TAI meets regulatory requirements in the safety analysis, physical design, operating performance, and fitness for service SCAs. TAI's performance is satisfactory.

3.3.5 Recommendation

CNSC staff recommend that licence conditions 4.1 and 4.2 associated with the Operating Performance SCA be retained without change.

CNSC staff recommend that licence conditions 5.1, 5.2, and 5.3 associated with the Safety Analysis SCA be retained. However, CNSC staff recommend to remove the text "facility design" from licence condition 5.1 as it will now be covered in a separate licence condition under the Physical Design SCA. CNSC staff also recommend to rename the licence condition 5.2 title to "Documentation".

CNSC staff recommend to add the following licence condition under the Physical Design SCA: "Design Program: The licensee shall implement and maintain a design program".

CNSC staff recommend that the licence condition 7.1 associated with the Fitness for Service SCA be retained without change.

3.4 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations* (*RPR*). The program must ensure that radiation doses received by individuals and

contamination levels are monitored, controlled and maintained as low as reasonably achievable (ALARA).

The specific areas that comprise the Radiation Protection SCA at TAI are as follows:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control

3.4.1 Trends

The following table indicates the overall rating trends for the radiation protection SCA over the current licensing period:

Table 3.5: Trends for Radiation Protection SCA

Overall Compliance Ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	FS	FS	SA	SA	SA	SA	SA
Comments								
TAI has implemented and maintained an effective radiation protection program, as required by the *RPR*. Over the current licence period, no worker received a radiation dose in excess of regulatory limits as a result of the licensed activities conducted at TAI. Changes between FS and SA reflect changes in the CNSC's grading methodology and does not reflect an increase or decrease in TAI's performance.								

3.4.2 Discussion

The CNSC requires TAI to implement a radiation protection (RP) program. As part of that program, TAI must also keep effective and equivalent doses received by and committed to persons ALARA, taking into account social and economic factors, through the implementation of: management control over work practices, personnel qualification and training, control of occupational and public exposures to radiation, and planning for unusual situations.

The *RPR* also prescribe dose limits for Nuclear Energy Workers (NEWs) and persons who are not NEWs.

3.4.3 Summary

A summary of TAI's past performance, challenges and proposed improvements are presented in the following subsections.

3.4.3.1 Past Performance

Application of ALARA

TAI's commitment to the ALARA principle has been demonstrated through the implementation of a policy on personnel radiation exposure, developed by the Safety Advisory Committee and managed by the Radiation Protection Group. TAI's application of ALARA includes management commitment and oversight, personnel qualification and training, and facilitation of ongoing dialogue and promotion of a culture of continuous improvement.

CNSC staff are satisfied with TAI's efforts in applying the ALARA principle to keep doses to workers ALARA over the current licensing period.

Worker Dose Control

TAI uses a combination of action levels, staff training and qualification, and dose management tools (work planning and management oversight) to ensure radiation doses to workers are controlled and kept ALARA. Engineered controls, such as the extensive use of shielding, and administrative controls are also established to ensure protection of workers at TAI.

Sources of radiation at TAI can be either prompt radiation fields present outside shielding during beam operation, or residual radiation fields due to activated components inside shielding when the beam is off for personnel access. Personnel access controls during operation and radiation monitors located outside shielding manage the risks associated with prompt radiation. Doses for TAI personnel are almost exclusively from exposure to residual radiation fields when performing maintenance and repair work on activated components. Work on a variety of systems that may include high radiation areas is controlled through the use of a work-permit process which requires a characterization of the radiation hazards before the work can begin.

For internal exposures, TAI implements specific internal monitoring protocols when required, depending on the type of research project and the associated potential for intakes of nuclear substances.

External Dosimetry

TAI uses 2 forms of dosimetry for monitoring and controlling whole body exposures of both NEWs and non-NEWs: Optically Stimulated Luminescence (OSL) badges and Direct Reading Dosimeters (DRDs). The OSL dosimeters, from a licensed dosimetry service provider, are used as the official "dose of record", but do not provide timely results for day-to-day dose management. The extensive use of DRDs allows TAI to react instantly to situations in which workers may approach or exceed TAI's internal administrative dose guidelines and limits.

Internal Dosimetry

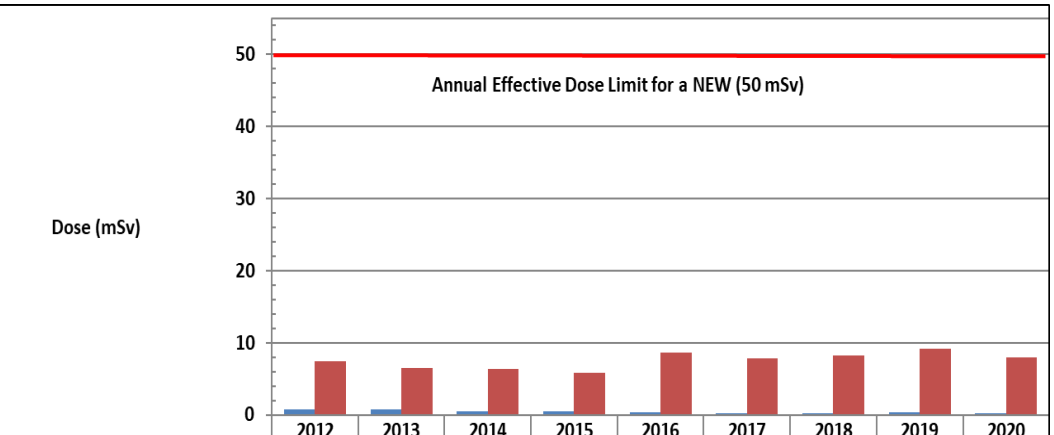
During the current licensing period, from 2012-2014, internal doses were evaluated for chemists involved with the fabrication of depleted uranium and thorium targets. In all cases, the results were at background level concentrations or below minimum detection limits.

Effective and Equivalent Doses for NEWs and non-NEWs at TAI

At TAI, workers are identified as NEWs if there is a reasonable probability of receiving an occupational dose greater than 1 mSv per year. Many workers at TAI do not meet this criterion and are classified as non-NEWs. Radiation exposures to NEWs and non-NEWs are monitored to ensure compliance with the CNSC's regulatory dose limits and to maintain radiation doses ALARA.

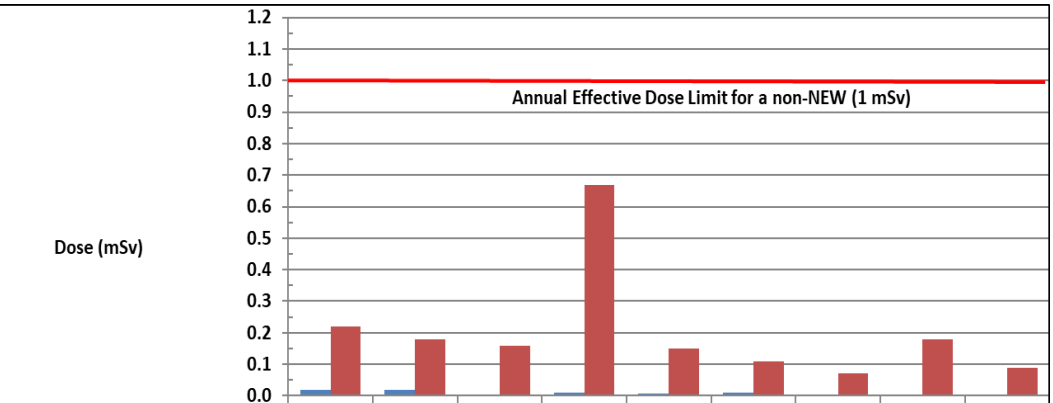
During the current licensing period, TAI consistently maintained doses to NEWs and non-NEWs well below the applicable regulatory dose limits. Figure 3.2 and 3.3 depict the total effective dose statistics for NEWs and non-NEWs at TAI over the current licensing period. The maximum annual effective dose received by a NEW was 9.18 mSv, received in 2019, which is approximately 18% of the regulatory effective dose limit of 50 mSv in a 1-year dosimetry period. The maximum annual effective dose received by a non-NEW during the current period was 0.67 mSv, received in 2015, which is approximately 67% of the regulatory effective dose limit of 1 mSv in a 1-year dosimetry period. This dose was associated to an action level exceedance, which was reported to the CNSC. TRIUMF performed a thorough investigation, including a TapRoot analysis, and has since implemented corrective actions. Because this dose is below the regulatory limit for members of the public, no health risks or impacts are associated with this exposure. The trend of total effective doses received by NEWs and non-NEWs over the current licensing period have remained relatively constant and low.

Figure 3.2: Total effective dose statistics for NEWs at TAI, 2012-2020



	2012	2013	2014	2015	2016	2017	2018	2019	2020
Average Effective Dose (mSv)	0.75	0.77	0.52	0.49	0.33	0.29	0.29	0.30	0.26
Maximum Effective Dose (mSv)	7.5	6.49	6.32	5.87	8.62	7.85	8.3	9.18	7.93
Number of NEWs Monitored	259	183	275	280	356	390	405	433	405

Figure 3.3: Total effective dose statistics for non-NEWs at TAI, 2012-2020



	2012	2013	2014	2015	2016	2017	2018	2019	2020
Average Effective Dose (mSv)	0.020	0.020	0.004	0.010	0.008	0.009	0.002	0.003	0.004
Maximum Effective Dose (mSv)	0.22	0.18	0.16	0.67	0.15	0.11	0.07	0.18	0.09
Number of non-NEWs Monitored	603	206	1146	1137	976	960	907	1092	701

During the current licensing period, there have been 2 5-year dosimetry periods. For the 5-year dosimetry period from 2011 to 2015, the maximum cumulative effective dose received by a NEW at TAI was 29.2 mSv. For the 5-year dosimetry period from 2016 to 2020, the maximum cumulative effective dose received by a NEW at TAI was 40.7 mSv. These radiation dose results represent approximately 29% and 41%, respectively, of the CNSC regulatory dose limit of 100 mSv in a 5-year dosimetry period.

Table 3.2 provides the equivalent dose to the skin statistics for NEWs at TAI, during the current period. The maximum annual equivalent dose to the skin that was received by a NEW at TAI during the period was 9.37 mSv occurring in 2016, representing approximately 1.9% of the regulatory equivalent dose limit of 500 mSv per year.

Table 3.6: Equivalent dose to the skin statistics for NEWs at TAI, 2012-2020

	2012	2013	2014	2015	2016	2017	2018	2019	2020	Regulatory dose limit
Average skin dose (mSv)	N/A	N/A	0.46	0.29	0.29	0.24	0.48	0.47	0.28	--
Maximum individual skin dose (mSv)	N/A	N/A	6.36	5.65	9.37	7.92	8.37	8.71	7.81	**500 mSv/year**

Table 3.3 provides the equivalent dose to the extremities statistics for NEWs at TAI, during the current licensing period. The maximum annual equivalent dose to the extremities (hands) that was received by a NEW at TAI during the period was 59.8 mSv occurring in 2012, representing approximately 12% of the regulatory equivalent dose limit of 500 mSv per year.

Table 3.7: Equivalent dose to the extremities (hands) statistics for NEWs at TAI, 2012-2020

	2012	2013	2014	2015	2016	2017	2018	2019	2020	Regulatory dose limit
Average extremity dose (mSv)	6.60	6.03	4.42	5.00	2.96	3.27	3.94	4.24	3.28	--
Maximum individual extremity dose (mSv)	59.8	52.2	46.2	27.5	19.1	14.5	28.3	42.9	50.0	**500 mSv/year**

CNSC staff are satisfied that effective and equivalent doses to NEWs at TAI are being controlled below CNSC regulatory dose limits.

Radiation Protection Program Performance

CNSC Compliance Activities

RP program performance at TAI was assessed during the current licensing period through various CNSC staff compliance verification activities, including desktop reviews of annual compliance reports. Aspects of the Radiation Protection SCA have been assessed during all CNSC inspection activities. In addition, 3 focused RP inspections at TAI occurred in 2012, 2016 and 2019. CNSC staff's assessment of TAI's RP program performance identified areas of strength and some opportunities for improvement (for example, post maximum activity allowed in hotcells, improve the layout of some contamination control barriers and post instructions on putting on/taking off personal protective equipment at the barriers). These are only recommendations of low risk significance. As a result, TAI implemented positive enhancements to the RP program and established appropriate corrective actions to address areas requiring improvement. TAI has adequately addressed all action items raised during inspections focused on the Radiation Protection SCA over the current licence period.

Radiological Action Levels

TAI has established action levels well below regulatory dose limits, that when reached, may be indicative of a potential loss of control for that specific parameter. Action levels have been established for external whole body doses for NEWs on an annual basis, and non-NEWs on a quarterly basis. These action levels serve as warnings of conditions that warrant further investigation and reporting to the CNSC if reached. In addition, TAI has established several lower-tier internal administrative levels, which are set well below the action levels to provide very early warnings of potential concerns, and if reached, would also trigger an internal investigation. When a worker's dose approaches any of the administrative levels which are established based on a sliding monthly, quarterly and annual basis, the DRDs management software sends an automated email to the Health Physicist, the worker and the worker's supervisor requesting the completion of what TAI calls a Dose Status Report. This report documents the

circumstances under which the dose was accrued and the measures that will be taken to mitigate further dose accrual for that worker.

There was only 1 action level exceedance reported during the licensing period at TAI. In 2013, a badge worn by a non-NEW visitor at TAI during July and August was measured to have a dose of 1.75 mSv. The investigation of the circumstances surrounding the potential exposure indicated that the dose was, in all likelihood, non-personal, as the areas the non-NEW would have occupied had no significant radiation sources that could result in such a dose. In addition, the people who were working closely with the non-NEW showed negligible doses on their badges.

The most recent set of action levels continue to be acceptable to CNSC staff and have been incorporated into the proposed LCH for TAI.

Radiation Protection Program Improvements

During the current licensing period, TAI revised and enhanced their RP program as part of their continual improvement activities. An example of these improvements include a new dosimetry management system that incorporates both DRDs and licensed dosimeters into a web-based database that allows for automated dose reporting of worker exposures to responsible managers. In addition, many of the old style ion-chamber based DRDs were replaced with alarming electronic DRDs which modernizes the dose control capabilities. Other improvements include a variety of new training initiatives, such as available courses in basic RP, contamination monitoring and control for lab workers, and surveying and decontamination for operators.

Other examples of RP related improvements include the introduction of monthly extremity dose administrative levels, and new portable and locally alarming neutron and gamma monitors for the experimental halls. In addition, in response to a 2016 RP focused CNSC inspection, TAI implemented a complete site-wide modernization of all radiation safety-related warning signs, compliant with the *RPR*.

Currently, TAI is preparing a new “TRIUMF Radiation Protection Program” document, based on the CNSC’s latest REGDOC-2.7.1, *Radiation Protection*, to ensure consistency with the most recent amendments to the *RPR*.

CNSC staff are satisfied with the performance of TAI’s RP program over the current licencing period.

Radiological Hazard Control

Radiation and contamination control programs have been established at TAI to control and minimize radiological hazards and the spread of radioactive contamination. Access to and within the facility is controlled via a card access system. The facility has been classified based on the expected radiation levels for each area.

The primary defence against exposures to the operational radiation fields inside the accelerator shielding is the Access Control Interlock Systems (ACIS) and the procedures that control access. The ACIS denies access to any interlocked area

unless the area is defined as safe. Once access has been granted, the devices that prevent the particle beams from being accelerated, transported to, or steered into the open area are disabled by the interlock system.

Outside the shielding, a number of active radiation protection systems prevent exposure to elevated radiation fields either by denying access to those areas where high fields may exist or by shutting off the accelerator when high beam losses or high fields are detected. In order to limit beam losses, which can cause an increase in radiation fields outside the shielding, TAI designed and maintains a beam loss monitoring system consisting of several strategically placed detectors. The beam loss monitor readings are displayed in the Main Control Room and compared 4 times per second to reference values. If a monitor exceeds twice the reference value, the cyclotron is shut off automatically within 250 milliseconds. TAI has demonstrated that even for the worst hypothetical beam loss, the most exposed individual would be below the annual regulatory limit of 1 mSv.

In addition to the prompt radiation monitoring, TAI also implements routine monitoring of the residual radiation fields due to the activation of materials, using both fixed and hand-held instruments. Fixed monitors are activated when a key is requested for entry into an area. If any monitor in the area exceeds a warning level, the corresponding interlock system denies access. In addition, detailed radiation surveys are performed whenever an accelerator enclosure or proton beam line is first opened for access after a period of operation. The results are posted to inform personnel entering the area.

Since activated components may rust, collect dust, or otherwise deteriorate there is also a risk of spreading loose contamination from the accelerator areas through the facility. There are contamination monitors located near the entrance to each of the accelerator enclosures, proton beam lines and radiochemical laboratories. Personnel leaving these areas are required to perform a survey of their person, as well as any equipment. At control points where there is a high volume of traffic, TAI has implemented automated contamination monitoring ensuring that personnel and equipment are free of any detectable contamination before release to the unrestricted areas. As a final check, TAI has installed radiation monitors at the main personnel entrance and the vehicle gate, which trigger an alarm if any radiation is detected.

Finally, TAI has implemented a routine contamination monitoring program in all areas where such contamination is probable, such as the cyclotron vaults and the beam line enclosures. If removable contamination is found in these areas, they are cleaned down to below the detection limit. Other areas, such as radiochemistry laboratories, are monitored more frequently and on a continuing basis.

There are no open NNCs or compliance actions pertaining to this SCA.

CNSC staff are satisfied that radiological hazards have been adequately controlled at TAI during the current licence.

3.4.3.2 Regulatory Focus

CNSC staff will continue to monitor performance in the Radiation Protection SCA through regulatory oversight activities including inspections and desktop reviews of TAI's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.4.3.3 Proposed Improvements

There are no other proposed improvements for this SCA.

3.4.4 Conclusion

CNSC staff assessed TAI's documentation and analyses under the Radiation Protection SCA and found them to be acceptable. CNSC staff conclude that the overall performance for this SCA is satisfactory and that TAI is qualified to carry out the authorized activities at their facility in this SCA.

3.4.5 Recommendation

CNSC staff recommend that licence conditions 7.1 and 7.2 associated with the Radiation Protection SCA be retained. CNSC staff recommend that the time to file a written report following a dose action level exceedance be reduced from 30 working days to 21 days of becoming aware of the matter.

3.5 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. The specific areas of this SCA discussed in this CMD are:

- Performance
- Practices

3.5.1 Trends

The following table indicates the overall rating trends for the conventional health and safety SCA over the current licensing period:

Table 3.8: Trends for conventional Health and Safety SCA

Overall Compliance Ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA	SA
Comments								
TAI has maintained an acceptable conventional health and safety program to identify and control risks. CNSC staff monitor implementation of this program to ensure protection of workers. TAI's conventional health and safety program and its implementation continues to improve, be effective and meet applicable regulatory requirements.								

3.5.2 Discussion

Most workplaces in British Columbia are regulated by WorkSafeBC. TAI is required to create and manage a healthy and safe workplace under the requirements of WorkSafeBC's *Occupational Health and Safety Regulation* (*OHSR*).

In 2018, TAI reported to WorkSafeBC a possible uptake of lead by a worker. TAI proceeded with a site-wide investigation of the prevalence of lead on surfaces in experiments halls. It was found that areal densities of lead on some surfaces were above the regulatory levels. The source of lead in these areas were a combination of unpainted lead bricks and sheets used for radiation shielding, and paint historically used over large concrete shielding blocks. Measurement to determine whether individual workers might be exposed to airborne lead dust and bioassays of workers handling lead did not show any evidence that the dust found on surfaces was also airborne. Nevertheless, TAI proceeded to a major remedial program to address the problem. The program was completed in 2020 when the final areas that were above-threshold were assessed to be below threshold following cleaning. TRIUMF has now a *Lead Exposure Control Plan* that documents the ongoing monitoring and mitigation measures and whose acceptance by WorkSafeBC was the final requirement to close the program.

During compliance activities focused on other SCAs, CNSC staff discussed any potential conventional health and safety hazards noted and issued notices of non-compliance when required.

Performance

A key performance indicator for conventional health and safety SCA is the lost-time injury rate per 100 person-years. A lost-time injury is an injury or illness resulting in lost days beyond the date of the injury as a direct result of an occupational injury or illness incident. The ultimate target is to have a lost-time injury rate of 0.

WorkSafeBC has assigned TAI in the "Advanced Education" classification unit along with similar businesses in British Columbia, such as institutions which provide post-secondary education including university, college, business, computer, career training, trade, and vocational programs. For the current

licencing period, TAI has maintained a lost time injury rate per 100 person-years below the "Advanced Education" classification unit yearly average, except for 2015 and 2019 when it was comparable to the average. For the licencing period, the lost time injury rate has been presented in details in the Regulatory Oversight Report on Class IB Particle Accelerator Facilities as well as a short description of the injuries. Note that WorkSafeBC has not calculated the lost time injury rate per 100 person-years for 2020 due to the pandemic.

In 2020, TAI adapted to the COVID-19 pandemic by developing protocols for limiting the spread of the virus. This involved specifying minimal on-site staffing, physical distancing, situation-dependent personal protective equipment, and scaling back or postponing planned maintenance and construction activities and on-site scientific activities to meet occupancy requirements. TAI received a copy of the Canadian Light Source Incorporated's COVID-19 lessons learned, which reinforced the need for TAI to stay vigilant and to continue repeating messages to staff to ensure that COVID-19 practices remained a priority and were diligently followed. Throughout 2020, site occupancy levels were gradually increased as community transmission conditions improved but ended the year at levels well below full on-site staffing (additional details provided in the COVID-19 response paragraph of Sub-section 3.7.3.1).

Practice

TAI is required to create and manage a healthy and safe workplace under the requirements of WorkSafeBC's *OHSR*.

TAI has a Joint Health and Safety Committee as required by the *OHSR*. Co-chairs and members of this committee are representing both management and employees. The committee meets monthly. The members are required to receive training as specified by WorkSafeBC and conduct regular inspections across the entire site, including radiation areas.

TAI reports any workplace injury or disease to WorkSafeBC as required by the regulation. TAI reports these injuries to CNSC when required by subsection 29 of the *GNSCR* and reports all injuries resulting in lost time in its annual compliance report.

3.5.3 Summary

A summary of TAI's past performance, challenges and proposed improvements are presented in the following subsections.

3.5.3.1 Past Performance

CNSC staff routinely verify TAI's conventional health and safety program through several means, including onsite inspections, desktop review of annual reports and review of TAI's Joint Health and Safety Committee minutes.

For the current licensing period, CNSC staff rated TAI's overall performance for the conventional health and safety SCA as satisfactory.

3.5.3.2 Regulatory Focus

CNSC staff conducted 4 inspections throughout the licensing period that included conventional health and safety criteria. TAI addressed all conventional health and safety notices of non-compliance identified during the current licensing period.

CNSC staff will continue to monitor TAI's performance in this SCA through onsite and remote inspections, and desktop reviews of relevant program documentation. There are no open NNCs for this SCA.

3.5.3.3 Proposed Improvements

There are no proposed improvements for this SCA.

3.5.4 Conclusion

CNSC staff conclude that TAI has effectively managed workplace safety hazards at the TAI site. Compliance verification activities will continue to be conducted at the facility to confirm that TAI continues to view conventional health and safety as an important consideration.

TAI's conventional health and safety program and implementation continue to be effective, meet applicable regulatory requirements, and are rated as SA.

3.5.5 Recommendation

CNSC staff recommend that the licence condition 8.1 associated with the Conventional Health and Safety SCA be retained without change.

3.6 Environmental Protection

The environmental protection SCA covers programs that identify, control and monitor all releases of nuclear and hazardous substances and effects on the environment from facilities or as the result of licensed activities.

This SCA encompasses the following specific areas:

- Effluent and Emissions Control (Releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of People
- Environmental Risk Assessment (ERA)

3.6.1 Trends

The following table indicates the overall rating for the environmental protection SCA over the current licensing period:

Table 3.9: Trends for Environmental Protection SCA

Overall compliance ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA	SA
Comments								

During the licensing term, CNSC staff rate TAI's performance in the environmental protection SCA as satisfactory. TAI has developed, implemented and maintained an effective environmental protection program that protects the environment and the public in accordance with CNSC regulatory requirements.

Releases to the environment were well below the Derived Release Limits specified in the CNSC licence. CNSC staff monitor TAI's implementation of the environmental protection program through compliance verification activities.

3.6.2 Discussion

During the current licence period, CNSC staff verified TAI's performance with respect to environmental protection through inspections and desktop reviews. In total, CNSC staff conducted 2 focused environmental protection inspections in 2015 and 2017. CNSC staff classified all findings from these inspections as low safety significance and all enforcement actions associated with these inspections are closed to CNSC staff's satisfaction.

3.6.3 Summary

A summary of TAI's past performance, challenges and proposed improvements are presented in the following subsections.

3.6.3.1 Past Performance

Effluent and Emissions Control (Releases)

TAI controls and monitors its airborne emissions and waterborne effluent to the environment through its effluent and emissions monitoring program. This program is based on CSA N288.5-11, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills and includes monitoring of radiological and hazardous substances*.

Atmospheric Emissions

The possible sources of airborne emissions at TAI are the particle accelerators and containment systems such as fume hoods and hot cells where open sources of radioactive materials are being handled. The emissions are vented through the 520 MeV cyclotron vault, beamline 1A, ISAC, and BL2C Solid Target facility exhaust systems. These emissions contain short-lived positron emitting radionuclides (carbon-11, nitrogen-13 and oxygen-15) and argon-41. There are continuous air monitors and controls such as high efficiency particulate air (HEPA) or charcoal filters at each exhaust stack. The exhausted air is also analyzed for releases of tritium, noble gases and volatile and particulate radioactivity.

Particulate sampling is performed at stacks where the exhausted airborne emissions generate particulates. The sampling is done by placing a small charcoal filter in the stream of the exhaust of the shielded enclosure of the continuous air monitor.

Table 3.10 shows the total annual releases of β+ emitters, Argon-41 and tritium to the atmosphere and Table 3.11 shows the total annual releases of noble gases and volatile & particulates to the atmosphere in terms of the total actual release and

total release as a percentage of the Derived Release Limit (DRL). Throughout the licensing term, airborne releases have been orders of magnitude below their respective DRLs.

Table 3.10: Total annual releases of β+ emitters, Argon-41 and tritium to the atmosphere

Year	β+ emitters		Argon-41		Tritium	
	Total Release (10^{12} Bq)	Total Release (% DRL)	Total Release (10^{12} Bq)	Total Release (% DRL)	Total Release (10^{12} Bq)	Total Release (% DRL)
2012	32.1	0.67	3.56	0.09	0.34	<0.01
2013	48.5	1.01	4.85	0.14	0.54	<0.01
2014	66.7	1.39	5.39	0.19	0.78	<0.01
2015	65.9	0.78	6.48	0.15	1.28	<0.01
2016	66.4	0.88	6.46	0.15	1.22	<0.01
2017	67.8	0.53	6.46	0.11	1.20	<0.01
2018	53.9	0.38	5.91	0.08	0.98	<0.01
2019	68.4	0.48	7.58	0.11	1.22	<0.01
2020	27.2	0.19	3.00	0.04	0.49	<0.01

Table 3.11: Total annual releases of noble gases and volatile & particulates to the atmosphere

Year	Noble Gases		Volatile & Particulates	
	Total Release (10^{12} Bq)	Total Release (% DRL)	Total Release (10^{6} Bq)	Total Release (% DRL)
2012	0.87	<0.01	733	<0.01
2013	1.01	<0.01	584	<0.01
2014	0.42	<0.01	47	<0.01
2015	1.02	<0.01	417	<0.01
2016	0.78	<0.01	432	<0.01
2017	0.78	<0.01	123	<0.01
2018	5.32	<0.01	56	<0.01
2019	2.41	0.02	262	<0.01
2020	2.41	0.02	71	<0.01

Liquid Effluent Discharges

The most significant source of liquid effluent releases on site is from the target and beam dump cooling water for the 520 MeV cyclotron and associated facilities. The dominant species in the cooling water from these systems is tritium in the form of tritiated water formed from neutron activation in the water.

Liquid effluent from throughout TAI that may contain radionuclides are directed to sumps. Each sump has a warning indicator that sends an alarm signal when the sump is 50% full and a full indicator that sends an alarm signal when the sump is 75% full. When a sump surpasses the 50% level, TAI staff collect a sample and assay it to determine its radioactive contents. The results of the assay are compared against the approved radiological liquid effluent releases to the sanitary

sewer and internal control levels. If the results are below these levels, the contents of the sump are released to the sanitary sewer.

There are no direct releases of liquid effluent to surface water at TAI.

Table 3.12 shows the total annual radionuclides released to the sanitary sewer in terms of the total actual release and total release as a percentage of the DRL. Throughout the licensing term, waterborne releases to the sanitary sewer have been orders of magnitude below their respective DRLs.

Table 3.12: Total annual radionuclides released to the sanitary sewer

Year	Total Release (10^9 Bq)	Total Release (% DRL)
2012	101	<0.01
2013	683	<0.01
2014	36	<0.01
2015	50	<0.01
2016	52	<0.01
2017	114	<0.01
2018	49	<0.01
2019	50	<0.01
2020	84	<0.01

Derived Release Limits (DRL)

TAI established and implemented DRLs that were calculated in accordance with CSA N288.1-14: *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*. A DRL for a given radionuclide is the release rate that would cause an individual of the most highly exposed group to receive a dose equal to the regulatory annual dose limit due to release of the radionuclide during normal operation of a nuclear facility over the period of a calendar year. CNSC staff reviewed TAI's DRL document in 2017 and confirmed that they followed the methodology described in CSA N288.1-14.

TAI has environmental action levels that are based on 5% of the DRL. There were no exceedances of environmental action levels during the licensing period.

Environmental Management System (EMS)

CNSC REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures* requires that licensees maintain an environmental management system (EMS) to describe the activities and practices that are in place to protect the environment. TAI's EMS is described in their Environmental Management System Document. This document identifies environmental aspects associated with the TAI operation and highlights the mitigation techniques that are in place to reduce the impact to the environment.

As per the EMS, TAI is required to perform environmental audits for all activities with potential environmental aspects. The aspects reviewed for these activities shall include waste management, emissions, handling of hazardous materials, emergency response procedures, and training. TAI is also required to perform an

annual management review of their environmental protection program. During the management review, TAI reviews the results of the internal audit and previous management reviews, reviews the status of any corrective and preventive actions and identifies recommendations for improvement.

CNSC staff review and assess the outcomes of the EMS as part of compliance verification activities, such as desktop reviews and inspections.

Assessment and monitoring

TAI has an environmental monitoring program that is based on CSA N288.4-10, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills*.

TAI's environmental monitoring program serves to demonstrate that the site emissions of nuclear materials are properly controlled. The monitoring activities, as described in the following paragraphs, are focused on monitoring of storm sewer water, radio-assays of building drains and vegetation samples, as well as gamma/beta measurements at the site boundary. Due to the low levels of emissions from the TAI facility, very little is detected in the environmental monitoring program.

Airborne Monitoring

TAI has access to data collected by a Health Canada detector located 350 meters away from TAI's most active stack. TAI uses the Health Canada detector to conduct continuous environmental air sampling to monitor the presence of β+ emitters. TAI uses the results to determine the dose to the critical receptor. TAI also uses the data to verify their DRL models by comparing the estimated dose to public calculations with the estimated β+ concentrations based on the Health Canada detector.

Water Monitoring

TAI conducts sampling of building drains and storm sewer water located near the facility twice per year. The results from all of the samples taken during the licensing period show that only natural background radioactive isotopes were detected.

Vegetation Monitoring

TAI conducts vegetation sampling at 11 locations twice per year. Of the 11 samples, TAI collects 8 samples consisting of grass and weeds taken near the edge of the perimeter fence. The other 3 samples are taken 250 – 300 meters away from the facility, near the boundaries of new and proposed housing locations. Throughout the licensing term, the only radionuclide detected that could be attributed to TAI operation continues to be Beryllium-7 (Be-7), though this radionuclide is also naturally present in the environment as a result of cosmic ray activation. The measured Be-7 activity levels are similar to background levels indicating little to no measurable contribution from TAI.

Gamma/Beta Monitoring

TAI conducts gamma/beta dose monitoring at 9 locations along TAI's security fence. The gamma/beta radiation effective dose rates are measured using environmental dosimeters from a licensed dosimetry service provider.

The dose rate limit at the site perimeter is governed by the nuclear facility regulatory requirements for dose to a member of the public and exposure scenarios for the maximally impacted member of the public. TAI has a maximum dose rate at the TAI site fence boundary of 150 nSv/h above background. This value is derived assuming a 2-week exposure with an occupancy factor of 1 and an annual dose limit to a member of the public of 50 μSv. During the licensing term, dose rates at the fence line are below the maximum dose rate of 150 nSv/h.

CNSC Independent Environmental Monitoring Program

To complement ongoing compliance activities, the CNSC implements an Independent Environmental Monitoring Program (IEMP) to independently verify that the public and the environment around licensed nuclear facilities are protected. The IEMP involves taking samples from public areas around the facilities and measuring and analyzing the amount of nuclear and hazardous substances in those samples.

In 2016 and 2019, as part of the IEMP, CNSC staff took samples of vegetation, soil, and air in publicly accessible areas near the TAI facility. The IEMP results show that the radioactivity in those samples were below the CNSC's conservative screening levels. The detailed results are available on the CNSC's IEMP webpage. The IEMP results indicate that the public and the environment in the vicinity of the TAI facility are protected, and there are no expected health impacts as a result of the operation of TAI's particle accelerator.

Protection of People

TAI is required to demonstrate that the health and safety of people are protected from exposures to hazardous and radioactive substances released from the facility. There were no releases of hazardous substances to the environment during the licensing period from TAI that would pose a risk to people or the environment.

Based on review of the results of the programs at TAI, CNSC staff conclude that people continue to be protected from the facility's effluent and emissions releases.

Estimated dose to public

As previously discussed, TAI calculates the estimated dose to public using their DRL model. The results are shown in Table 3.13 and are orders of magnitude below the regulatory public dose limit of 1 mSv/yr. TAI also uses the results from the Health Canada detector to compare it to the value that is obtained using their DRL model.

Table 3.13: Estimated dose to public as calculated by TAI using their DRL model

Year	Estimated dose to public (mSv/yr)
2012	0.0120
2013	0.0076
2014	0.0089
2015	0.0075
2016	0.0079
2017	0.0083
2018	0.0063
2019	0.0061
2020	0.0024

Environmental Risk Assessment

An ERA of nuclear facilities is a systematic process used by licensees to identify, quantify and characterize the risk posed by contaminants and physical stressors in the environment on human and other biological receptors, including the magnitude and extent of the potential effects associated with a facility. CNSC staff use CSA Standard 288.6-12 *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills* to help determine if licensees comply with regulatory requirements regarding protection of the environment and human health.

In 2017, CNSC staff reviewed TAI's screening level ERA to determine the licensee's compliance with CSA standard N288.6-12 and provided technical comments and recommendations to the licensee in order to improve the ERA. A screening level ERA is a broad, very conservative risk assessment generally used to eliminate potential stressors that are clearly not of concern for a particular facility. In October 2017, TAI submitted their revised screening level ERA to address the comments made by CNSC staff. CNSC staff reviewed the revised ERA in 2018 and concluded that it is in compliance with CSA N288.6-12 and that the ERA conclusions regarding potential risk to human health and the environment at the TAI are valid: risks to human and ecological receptors attributable to current operations of the facility are very low.

In 2021, CNSC staff reviewed the 2020 annual compliance report for the TAI and found that no new risks have emerged since the 2018 and the facility currently has acceptable environmental programs in place to ensure protection of the public and the environment.

There are no open NNCs or compliance actions pertaining to this SCA.

3.6.3.2 Regulatory Focus

CNSC staff will continue to monitor performance in this area through regulatory oversight activities, inspections, and desktop reviews of TAI's compliance reporting and revisions to relevant program documentation pertaining to this SCA.

3.6.3.3 Proposed Improvements

There are no major changes anticipated in the near future for this SCA. CNSC staff expect that TAI will continually identify and implement improvements to its environmental protection program documents.

3.6.4 Conclusion

TAI has implemented and maintained an environmental protection program that adequately protects the environment and the public in accordance with regulatory requirements. CNSC staff expect no adverse effects on human health and the environment during the operation of the facility.

The environmental protection program at TAI continues to be effective in protecting the environment and minimizing adverse impacts to human health. TAI has and will continue to make adequate provision for the protection of the environment and the health and safety of persons.

3.6.5 Recommendation

CNSC staff recommend that the licence condition 9.1, 9.2, 9.3 and 9.4 associated with the Management System SCA be retained. CNSC staff recommend that the time to file a written report following an environmental action level exceedance be reduced from 30 working days to 21 days of becoming aware of the matter.

3.7 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 SCA also includes the requirement for TAI to have a comprehensive fire protection program to minimize the risk to the health and safety of persons and to the environment from fire; through appropriate fire protection system design, fire safety analysis, fire safe operation and fire prevention.

This SCA also includes any results of participation in exercises.

The specific areas that comprise this SCA at TRIUMF that are addressed individually in this document are:

- Conventional and Nuclear Emergency Preparedness and Response
- Fire Emergency Preparedness and Response

3.7.1 Trends

The following table indicates the overall rating trends for the emergency management and fire protection SCA over the current licensing period:

Table 3.14: Trends for Emergency Management and Fire Protection

Overall Compliance Ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA	SA

Comments
TAI has an acceptable emergency preparedness and response program that meets CNSC regulatory and performance requirements. TAI has a Fire Protection Program (FPP) in place to minimize both the probability of occurrence and the consequences of fire at the facility and the most recent Fire Hazard Analysis (FHA) indicates that the mitigation measures in place provide adequate life safety and environmental protection.

3.7.2 Discussion

Conventional and Nuclear Emergency Preparedness and Response

TAI has an Emergency Program consisting of an Emergency Preparedness Plan that outlines roles and responsibilities for implementing the overall program, and an Emergency Response Plan with a complete spectrum of graded emergencies and corresponding responses.

The Emergency Preparedness plan includes a "Vulnerability Analysis Chart" which identifies the potential natural and human initiated events that could cause damage or injury to TRIUMF facilities or personnel. Some of these vulnerabilities that have been identified include earthquakes, floods, fires, chemical spills, radioactive spills, personnel injuries and a number of other events.

The Emergency Response Plan details TRIUMF's response to these potentially dangerous natural and human initiated events.

The Emergency Preparedness program and all supporting documents were reviewed by TRIUMF and updated in 2019 to align with REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*.

Fire Emergency Preparedness and Response

TAI's FPP has been established to comply with the requirements of the *National Building Code of Canada (2015)*, the *National Fire Code of Canada (2015)* (*NFCC*) and *National Fire Protection Association NFPA-801(2014)*. TAI's FPP identifies the procedures, processes and supporting analyses necessary to demonstrate a planned, coordinated and controlled approach to fire protection at the facility.

In December 2019, TAI submitted the most recent version of the FHA for its facility, in accordance with CSA Standard N393-13, *Fire protection for facilities that process, handle, or store nuclear substances* (N393-13). The analysis was prepared by a third party fire safety consultant. It was conducted to ensure that the mitigation measures in place provide adequate life safety and environmental protection, and that the applicable fire code requirements were satisfied. CNSC staff has reviewed the report and found it to be acceptable.

In addition, TAI conducted a third party audit of the Fire Protection Program at TAI in 2019 intended to document the state of compliance of the Station with the

requirements of N393-13, the National Fire Code of Canada (NFCC-2015) and other applicable codes and standards. A number of findings were identified as part of the audit and TAI provided acceptable corrective action or disposition. CNSC staff continues to follow up through ongoing regulatory verification activities to ensure all corrective actions are adequately closed.

3.7.3 Summary

A summary of the licensee's past performance, challenges and proposed improvements are presented in the following subsections.

3.7.3.1 Past Performance

Conventional and Nuclear Emergency Preparedness and Response

Drills and Exercises

Emergency drills were conducted during the licensing period. These included site wide evacuation drills, fire drills, emergency rescue drills inside the facilities, first aid drills and chemical spill drills. Deficiencies and Opportunities for improvement were documented and a corrective action plan was implemented to address the deficiencies.

COVID-19 response

TAI struck a task force in 2020 to coordinate the site-wide COVID-19 pandemic response. A systematic approach was taken coordinated by the Chief Operating Officer with input from key stake holders. Policies were put in place to provide personnel with guidance on reporting absence due to COVID, managing the potential incidence on site and guidance for personnel on mitigation requirements. In addition, specific safe work procedures and facility controls were enacted to provide a safe work environment for personnel. As of September 3, 2021, there have been a total of 13 cases of COVID-19 amongst the workers, all coming from external sources (no on-site outbreaks or transmission).

Training

During the licensing period, TAI maintained annual refresher training. TAI hosted a third party Level I First Aid Attendant training course on site and an "on-line module" was developed for the Emergency Management Group and Emergency Advisors for their roles during an emergency.

Safety Fora

TAI hosted the 13th International Technical Safety Forum on September 18-22, 2017. This forum meets every 18 months and involves safety specialists from accelerator laboratories who gather to share expertise and lessons learned on technical safety and operational aspects of safety programs. CNSC staff were invited and participated in the forum.

Fire Emergency Preparedness and Response

TAI has contracted PLC Fire Safety Solutions to provide ongoing Third Party Fire Audits and provide training to TAI personnel to perform annual inspections during the intervening years.

There are no open NNCs or compliance actions pertaining to this SCA.

TAI performance is considered satisfactory as it continues to maintain a fire protection program in accordance with regulatory requirements.

CNSC staff concluded that TAI has implemented and maintains effective emergency preparedness and fire protection programs that meet regulatory requirements. CNSC staff rated TAI's overall performance for the Emergency Management and Fire Protection SCA as satisfactory during the current licence period.

3.7.3.2 Regulatory Focus

CNSC staff will continue to monitor TAI's performance in the Emergency Management and Fire Protection SCA through regulatory oversight activities including onsite inspections, desktop reviews of annual compliance reports, desktop reviews of third party reports, and desktop reviews of revisions to relevant program documentation pertaining to this SCA.

CNSC staff activities include a proposed emergency management and fire protection compliance inspection in October 2021.

3.7.3.3 Proposed Improvements

There are no proposed improvements for fire protection. TAI current fire protection program is considered satisfactory.

3.7.4 Conclusion

CNSC staff have assessed TAI's documentation and analyses under the Emergency Management and Fire Protection SCA and have found them to meet regulatory requirements.

TAI continues to maintain their emergency response capability and Fire Protection Program.

CNSC staff therefore conclude that the overall performance for the SCA is satisfactory and that TAI is qualified to carry out its authorized activities.

3.7.5 Recommendation

CNSC staff recommend that the licence conditions 10.1 and 10.2 associated with the Emergency Management and Fire Protection SCA be retained without change.

3.8 Waste Management

Waste Management 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 for storage, treatment, or disposal at another licensed location. This area also covers the planning for decommissioning.

This CMD covers the following specific areas of Waste Management:

- Waste Characterization
- Waste Minimization

- Waste Management Practices
- Decommissioning Plans

3.8.1 Trends

The following table indicates the overall rating trends for the waste management SCA over the current licensing period:

Table 3.15: Trends for Waste Management SCA

Overall Compliance Ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	BE	SA	SA	SA	SA
Comments								
TAI's waste management program met applicable CNSC regulatory and performance objectives. CNSC staff monitor TAI's implementation of this program through regular compliance verification activities. The grading of BE for 2016 is discussed in section 3.8.3.1 below.								

3.8.2 Discussion

TAI Inc. regularly assesses its waste management program and PDP to ensure the adequacy and effectiveness of its programs.

Based on CNSC staff's assessment of the licence renewal application, supporting documents and TAI's past performance in this SCA, CNSC staff conclude that TAI continues to maintain and implement a documented waste management program in accordance with CNSC regulatory requirements, and TAI has demonstrated satisfactory performance for this SCA.

3.8.3 Summary

A summary of TAI's past performance, challenges and proposed improvements are presented in the following subsections.

3.8.3.1 Past Performance

Waste Characterization, Minimization, and Management Practices

The majority of low-level radioactive waste generated at TAI originates from protective clothing used by personal. Other forms of radioactive waste are segregated into different streams, surveyed and usually allowed to decay due to the short half-lives, and then sent for disposal. High-level radioactive waste produced at TAI is in the form of beamline targets from the BL1A and ISAC lines. These targets are handled in hot cells following irradiation, with the waste then stored in a storage vault where it is allowed to decay for several years. Following this, the waste is transferred to the Canadian Nuclear Laboratories for further management.

During this licensing period, TAI was rated as BE in 2016 for this SCA. This was a result of a 2016 inspection which found deficiencies related to inventory and labelling of radioactive waste, as well as the absence of secondary containment of

some hazardous (non-radioactive) waste. A follow-up inspection in 2017 verified that TAI had implemented corrective actions, and CNSC staff closed out the actions related to these findings. Following 2016, the SCA of Waste Management was rated as SA for each year afterwards.

Decommissioning Plans

In December 2018, TAI Inc. submitted an updated PDP and cost estimate for the decommissioning of the TAI site.

Decommissioning must be conducted in a manner that ensures that the health, safety, and security of workers, the public, and the environment are protected. TAI Inc. has proposed a decommissioning plan to be conducted in 3 phases. Phase 1 would be initiated 2-3 years after shutdown, Phase 2 starting 25 years after shutdown, and finally, Phase 3 starting 45 years after shutdown. Phase 1 includes the decommissioning of ancillary buildings and the removal of radioactive material. Phase 2 includes the decommissioning of the ISAC-1, RadioChemistry Annex, and Main Accelerator Building. Finally, Phase 3 includes the decommissioning of the 520MeV Cyclotron Vault. TAI Inc.'s desired end-state for the decommissioning of their facility following all phases is a greenfield state, allowing for unrestricted use. All material resulting from decommissioning that is above clearance levels will be transferred to a CNSC licensed waste management facility, location or site.

The CNSC requires TAI to revise its PDP for their facility at a minimum every 5 years or when requested by the Commission or a person authorized by the Commission. CNSC staff have reviewed the updated PDP for TAI and found that it meets the applicable regulatory requirements and provides an acceptable basis for a decommissioning cost estimate.

There are no open NNCs or compliance actions pertaining to these SCA.

Additional details of the financial guarantee and its assessment are provided in Section 4.4 of this CMD.

3.8.3.2 Regulatory Focus

CNSC staff will continue to monitor and evaluate TAI's compliance with regulatory requirements through regulatory oversight activities including onsite inspections and reviews of compliance reports and revisions to relevant program documentation.

3.8.3.3 Proposed Improvements

TAI is working to implement CSA Group standard N292.0-19, *General principles for the management of radioactive waste*, and CSA N292.3-14, *Management of low and intermediate-level radioactive waste*, and expects to be in compliance within 1 year of this relicensing.

In January 2021, CNSC published REGDOC-2.11.1, *Waste Management, Volume I: Management of Radioactive Waste* and REGDOC-2.11.2, *Decommissioning*. CNSC staff expect that TAI will conduct a gap analysis to align their waste

management and planning for decommissioning programs with the new regulatory requirements outlined in these new REGDOCs, and create an implementation plan.

3.8.4 Conclusion

Based on the assessment of TAI's waste management program, CNSC staff conclude that CLSI has a waste management program in place that is satisfactory to CNSC staff.

Based on the assessment of TAI's revised PDP, CNSC staff conclude that the PDP meets the current licensing basis requirements described in CSA Group standard N294-09, *Decommissioning of facilities containing nuclear substances* and CNSC regulatory guide *G-219, Decommissioning Planning for Licensed Activities*.

3.8.5 Recommendation

CNSC staff recommend that the licence conditions 11.1 and 11.2 associated with the Waste Management SCA be retained without change.

3.9 Security

This 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.

The specific areas that comprise this SCA at TAI include:

- Facilities and Equipment
- Response Arrangements
- Security Practices

Although these 3 specific areas are applicable to the TAI site, they are not addressed individually in this CMD and are presented for the Security SCA as a whole.

3.9.1 Trends

The following table indicates the overall rating trends for the security SCA over the current licensing period:

Table 3.16: Trends for Security SCA

Overall Compliance Ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA	SA
Comments								
TAI has implemented and maintained a security program that meets regulatory requirements under the *GNSCR* to prevent the loss, unauthorized removal and sabotage of nuclear substances, nuclear materials, prescribed equipment or information.								

3.9.2 Discussion

Pursuant to the *NSCA* and its regulations, TAI is obligated to protect the environment, the health and safety of persons, and maintain security.

TAI submitted a revised Site Security Plan to the CNSC on May 17, 2021. The Site Security Plan was reviewed by CNSC staff and assessed as meeting applicable regulatory requirements.

TAI's application has identified that all technical and administrative security measures required by the CNSC have been implemented and maintained for TAI's site. Specific details on the measures implemented by TAI to meet regulatory requirements of the Security SCA are considered prescribed information pursuant to section 21 of the *GNSCR*. TAI has submitted program documentation with its licence renewal application that adequately identifies how it will meet regulatory expectations related to the Security SCA. This documentation has been reviewed by CNSC staff and has been accepted, as it satisfactorily meets the requirements of the *GNSCR*.

3.9.3 Summary

A summary of the licensee's performance, challenges and proposed improvements are presented in the following subsections.

3.9.3.1 Past Performance

The specific results of performance evaluations for security are identified as security sensitive information and have been designated as Confidential – Prescribed Information. This information is not available for public release.

TAI has maintained a security program that provides sufficient security systems and devices for the facility and the areas that involve the processing, use or storage of nuclear substances. Additionally, TAI has identified and implemented processes for the effective testing and maintenance of security-related devices and equipment.

Alarm detection and assessment systems are continually monitored and meet regulatory requirements. TAI has established and implemented response protocols to provide an adequate off-site response by both the RCMP and UBC Campus Patrol should a security-related incident occur. TAI also participates in monthly security awareness meetings with UBC.

TAI has provided training to its staff on security-related procedures, and has a program in place to provide refresher training at least every 5 years. TAI has also implemented measures for controlling access to both persons and vehicles to its facility. These measures were assessed as meeting regulatory requirements.

TAI has implemented a satisfactory trustworthiness and reliability verification process for staff who handle nuclear substances or other controlled goods in accordance with Public Services and Procurement Canada's Controlled Goods Program.

During the licensing period, CNSC staff conducted 2 security focused inspections at TAI. There are no open NNCs or compliance actions pertaining to this SCA.

3.9.3.2 Regulatory Focus

CNSC staff have not identified any challenges with respect to the Security SCA. TAI does not have any unresolved actions from inspections or technical assessments of the Security SCA conducted throughout the current licensing period.

3.9.3.3 Proposed Improvements

There are no specific proposed improvements for the TAI facility with specific focus on the Security SCA at this time.

3.9.4 Conclusion

CNSC staff confirm that TAI has met regulatory requirements for the Security SCA throughout the licensing period and rated the performance of this SCA as SA during oversight activities.

CNSC staff's expectations for TAI's compliance with the security SCA include ensuring adequate provisions for the security of nuclear substances, the implementation of measures to alert the licensee to the illegal use or removal of nuclear substances, or sabotage or attempted sabotage anywhere at the site, and that all workers will be instructed on the facility's security program and their obligations therein.

3.9.5 Recommendation

CNSC staff recommend that the licence condition 12.1 associated with the Security SCA be retained without change.

3.10 Safeguards and Non-Proliferation

The Safety and Control Area "Safeguards and Non-Proliferation" covers the programs and activities required for the successful implementation of the obligations arising from the Canada/International Atomic Energy Agency (IAEA) safeguards agreements, as well as all other measures arising from the Treaty on the Non-Proliferation of Nuclear Weapons.

This CMD covers the following specific areas of Safeguards and Non-Proliferation:

- Nuclear Material Accountancy and Control
- Access and Assistance to the IAEA
- Operational and Design Information
- Import and Export

3.10.1 Trends

The following table indicates the overall rating trends for the safeguards and non-proliferation SCA over the current licensing period:

Table 3.17: Trends for Safeguards and Non-Proliferation SCA

Overall Compliance Ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	FS	FS	FS	FS	FS	FS	SA

Comments

TAI continues to perform satisfactorily in this SCA. Overall, CNSC staff concludes TAI's safeguards and non-proliferation programs meet regulatory requirements.

Changes between FS and SA reflect changes in the CNSC's grading methodology and does not reflect an increase or decrease in TAI's performance. The change of rating in 2020 is to apply a consistent rating methodology with other licensees with safeguards requirements.

3.10.2 Discussion

Pursuant to the *Treaty on the Non-Proliferation of Nuclear Weapons*, Canada has entered into a Comprehensive Safeguards Agreement and an Additional Protocol with the IAEA (hereafter referred to as the safeguards agreements). The objective of the safeguards agreements is for the IAEA to provide annual assurance to Canada and to the international community that all declared nuclear material is in peaceful, non-explosive uses and that there is no indication of undeclared material.

The CNSC provides the mechanism, through the *NSCA*, regulations and licences, for the implementation of safeguards. Conditions for the application of safeguards are contained in CNSC facility operating licences and the criteria to meet those conditions are contained in the LCH and in regulatory document REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*. Compliance includes the timely provision of reports on the movement and location of nuclear material, provision of access and assistance to IAEA inspectors for safeguards activities, support for IAEA equipment, and the submission of annual operational information, additional protocol updates as well as accurate design information.

CNSC REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy* sets out requirements and guidance for safeguards programs for applicants and licensees who possess nuclear material, operate a uranium and/or thorium mine, carry out specified types of nuclear fuel-cycle related research and development work, and/or carry out specified types of nuclear-related manufacturing activities. The requirements and guidance in this document are essential to Canadian compliance with the safeguards agreements entered into with the IAEA, and are consistent with modern national and international practices.

The import and export of controlled nuclear substances, equipment and information identified in the *Nuclear Non-proliferation Import and Export Control Regulations* require separate authorization from the CNSC, consistent with subsection 3(2) of the *GNSCR*. CNSC REGDOC-2.13.2, *Import and Export* provides guidance on this type of authorization.

CNSC staff are satisfied that TAI's safeguards program meets the requirements set out in REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*. The program conforms to measures required by the CNSC to meet Canada's international safeguards obligations as well as other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*.

3.10.3 Summary

A summary of TAI's past performance, challenges and proposed improvements are presented in the following subsections.

3.10.3.1 Past Performance

CNSC staff are satisfied that an effective safeguards program has been implemented at the facility. Details pertaining to the specific areas within this SCA are presented in the following subsections.

Nuclear material accountancy and control

CNSC staff determined that the facility has complied with CNSC's regulatory requirements in accordance with REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*.

Access and Assistance to the IAEA

CNSC staff confirmed that the facility has granted adequate access and assistance to the IAEA for safeguards activities. During 2012-2020, the IAEA performed 2 Physical Inventory Verification (2016 and 2020) and 2 Complementary Accesses (2014 and 2019). In all cases, the facility provided the IAEA with the necessary access and assistance to perform the activities and complied with all regulatory requirements.

In all IAEA activities, the facility had no major issues and the IAEA's inspection results and conclusions were satisfactory.

Operational and Design Information

CNSC staff are satisfied that annual operational programs, annual updates to the additional protocol, design information questionnaires, and other required information have been submitted to the IAEA and the CNSC in a timely manner.

Import and Export

The scope of the non-proliferation program under TAI's licence is limited to the tracking and reporting of foreign obligations and origins of nuclear material. CNSC staff confirm that the CNSC's regulatory requirements in this respect have been met.

There are no open NNCs or compliance actions pertaining to this SCA.

TAI's program for safeguards and non-proliferation at the TAI site continues to meet CNSC requirements and expectations.

3.10.3.2 Regulatory Focus

CNSC staff will continue to monitor and evaluate TAI's performance through participation in IAEA inspections, CNSC evaluations, and ongoing assessments of compliance with reporting requirements.

3.10.3.3 Proposed Improvements

There are no proposed improvements or changes for this SCA.

3.10.4 Conclusion

Based on CNSC staff's assessment of TAI documentation and performance, CNSC staff conclude that TAI has appropriate measures and programs to meet CNSC expectations for the Safeguards and Non-Proliferation SCA. CNSC staff conclude that TAI overall performance for this SCA is satisfactory and that TAI is qualified to carry on the activities covered in this SCA.

3.10.5 Recommendation

CNSC staff recommend that the licence conditions 13.1 and 13.2 associated with the Safeguards SCA be retained without change.

3.11 Packaging and Transport

The Packaging and Transport SCA pertains to programs that cover the safe packaging and transport of nuclear substances to and from the licensed facility.

This CMD covers the following specific areas of packaging and transport:

- Package Design and Maintenance
- Packaging and Transport
- Registration for Use

Although these 3 specific areas are applicable to the TAI site, they are not addressed individually in this CMD and are presented for the Packaging and Transport SCA as a whole.

3.11.1 Trends

The following table indicates the overall rating trends for the packaging and transport SCA over the current licensing period:

Table 3.18: Trends for Packaging and Transport SCA

Overall Compliance Ratings								
2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SA	SA	SA	SA	SA	SA	SA	SA	SA
Comments								
TAI has a packaging and transport program that ensures compliance with the *PTNSR, 2015* and the *Transportation of Dangerous Goods Regulations* (*TDGR*). TAI continues to perform satisfactorily in this SCA. Overall, CNSC staff conclude that TAI's packaging and transport SCA meets regulatory requirements.								

3.11.2 Discussion

TAI has developed and implemented a packaging and transport program to ensure all shipments leaving their facility are in compliance with the *PTNSR, 2015* and the *TDGR*. TAI's packaging and transport program covers elements of package design and maintenance, and the registration for use of certified packages as required by the regulations.

The *PTNSR, 2015* apply to the packaging and transport of nuclear substances, including the design, production, use, inspection, maintenance and repair of packages, and the preparation, consigning, handling, loading, carriage and unloading of packages.

TAI is required to have appropriate training for personnel involved in the handling, offering for transport and transport of dangerous goods, and is required to issue a training certificate to those workers in accordance with the *TDGR*.

3.11.3 Summary

A summary of TAI's past performance, challenges and proposed improvements are presented in the following subsections.

3.11.3.1 Past Performance

There were 2 events reported under the *PTNSR, 2015* over the licensing period for consignments transported to or from the TAI facility. The events were of low safety significance. CNSC staff are satisfied with the corrective actions taken by TAI to ensure such events does not re-occur.

During the licencing period CNSC staff completed 4 Packaging and Transport inspections of TAI. CNSC staff classified all findings from these inspections as low safety significance and CNSC staff are satisfied with all corrective actions taken by TAI.

TAI has made adequate provision to demonstrate that they have a packaging and transport program covering all specific areas of this SCA and ensure compliance with the requirements specified in the *PTNSR, 2015* and *TDGR*.

There are no open NNCs or compliance actions pertaining to these SCA.

3.11.3.2 Regulatory Focus

CNSC staff will continue to ensure shipments transported to and from the TAI facility meet all regulatory requirements though the CNSC compliance program.

3.11.3.3 Proposed Improvements

Transport Canada have recently published a number of amendments to the *TDGR*. Although regulatory changes are minor, these revised regulations may have a small impact and TAI is required to review its packaging and transport program to ensure continued compliance with the revised regulations.

3.11.4 Conclusion

Based on CNSC staff assessments of TAI's licence application, supporting documents and past performance, TAI's implementation of the packaging and transport SCA has met and continues to meet all applicable regulatory requirements.

3.11.5 Recommendation

CNSC staff recommend that the licence condition 14.1 associated with the Packaging and Transport SCA be retained without change.

3.12 Indigenous Engagement

As an agent of the Government of Canada and as Canada's nuclear regulator, the CNSC recognizes and understands the importance of consulting and building relationships with Indigenous peoples in Canada.

The common-law duty to consult with Indigenous groups applies when the Crown contemplates actions that may adversely affect potential or established Indigenous and/or treaty rights. The CNSC ensures that all of its licence decisions under the *NSCA* uphold the honour of the Crown and consider Indigenous peoples' potential or established Indigenous and/or treaty rights pursuant to section 35 of the *Constitution Act, 1982*.

Based on the information provided in the application, TAI is a low risk research facility and the activities to be conducted under this decision do not involve any changes to the site and therefore will not cause any adverse impacts on potential or established Indigenous and/or treaty rights. The CNSC has not been made aware of any specific interest or concerns from Indigenous groups in relation to TAI licence renewal. However, CNSC staff are committed to providing any information and engaging Indigenous groups with regards to TAI licence renewal should interest be expressed.

4. OTHER MATTERS OF REGULATORY INTEREST

4.1 Public Engagement

As per its normal public notification process for Commission proceedings, CNSC staff informed the public via the CNSC's website, email subscription list, and social media channels of the public Commission hearing and availability of participant funding.

Part of CNSC's mission is to provide objective scientific and regulatory information to the public concerning nuclear activities. The availability and clarity of information pertaining to nuclear activities is essential to establishing an atmosphere of openness, transparency and trust between the licensee and the public. Licensees have an important role to inform the public about their nuclear facility and activities. Since 2012, the CNSC requires major licensees to develop and implement a public information program supported by a robust disclosure protocol that addresses local communities and stakeholders' needs.

CNSC staff report to the Commission and the public on the regulatory oversight of all Class IB facilities, including TAI. The list of regulatory oversight reports is presented in the references within this CMD and are also available on the CNSC's website. The public is provided the opportunity to review, question and comment on the regulatory oversight reports.

For TRIUMF's current licence renewal hearing, the CNSC made available up to $35,000 through its participant funding program to support the funding recipients in providing value-added information to the Commission through informed and topic-specific interventions. By the deadline of October 1, 2021 for submitting a participant funding application, none had been received.

The CNSC is committed to keeping interested communities informed of regulatory activities occurring at TAI and will continue to look for ways to enhance the involvement of interested groups.

4.2 Cost Recovery

It is a requirement of the *NSCA* under paragraph 24(2)(*c*), that the licence application is accompanied by the prescribed fee. The *Canadian Nuclear Safety Commission Cost Recovery Fees Regulations* (*CRFR*) set out the specific requirements based on the activities to be licensed. TAI is a not-for-profit organization and is exempt from the *CRFR* under section 2(b)

4.3 Financial Guarantees

The *NSCA* and its associated *GNSCR* require licensees to make adequate provision for the safe decommissioning of their facilities. Requirements and guidance for establishing a financial guarantee for decommissioning are provided CNSC regulatory guide G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*.

Under licence condition 15.2, a Financial Guarantee for decommissioning must be established to fund the activities described in a decommissioning plan. The financial guarantee must be accepted by the Commission. TAI currently maintains a financial guarantee for decommissioning of its facility as per licence condition 15.2 of its current licence.

4.3.1 Discussion

Under its existing licence, TAI currently maintains a financial guarantee of $12.21M (as of March 31, 2021) in an Escrow Fund for the decommissioning of TAI. TAI has committed to provide an updated PDP for CNSC staff review in 2023.

In December 2018, TAI submitted an updated PDP and cost estimate for decommissioning of the TAI site. CNSC staff reviewed the PDP and found that it meets the applicable regulatory requirements and provides an acceptable basis for a decommissioning cost estimate.

TAI has proposed a decommissioning plan to be conducted in 3 phases. Phase 1 would be initiated 2-3 years after shutdown, Phase 2 starting 25 years after

shutdown, and finally, Phase 3 starting 45 years after shutdown. According to the PDP, Phase 1 has a 15% contingency, while Phases 2 & 3 have 30% contingencies added to their value. Based on the most recent PDP, TAI has estimated the cost for decommissioning to be $69.87M (2022 Dollars).

CNSC staff have assessed the cost estimate against the criteria set out in the CNSC regulatory guide G-206: *Financial Guarantees for the Decommissioning of Licensed Activities* and consider the proposed amount to be adequate for decommissioning of the TAI site.

In May 2021, TAI submitted a revised financial guarantee instrument that reflects the transfer of TRIUMF joint venture to TRIUMF Inc., a not-for-profit corporation incorporated under the *Canada Not-for-profit Corporations Act*. It was determined to be necessary to ensure continuity of the financial instruments through this change. TAI proposed to continue to use an Escrow Agreement, a Contribution Gap Agreement, and Financial Security and Access Agreement to fund its financial guarantee. The Escrow Agreement is an acceptable financial instrument for the financial guarantees as identified in CNSC regulatory guide G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*. The Contribution Gap Agreement allows the licensee to demand funds from the member universities to cover costs related to decommissioning that exceed the remaining funds in the Escrow funds. This agreement is therefore necessary as there is a gap currently between the estimated cost of decommissioning ($69.87M) and the value of the Escrow Fund ($14.78M as of March 31, 2023). In May 2021, the Commission approved the revised financial guarantee instruments (CMD 21-H108).

CNSC staff reviewed the PDP and found that it meets the applicable regulatory requirements and provides an acceptable basis for a decommissioning cost estimate.

Regulatory Requirements

Regulatory guide G-206, *Financial Guarantees for the Decommissioning of Licensed Activities* was in effect during the review of TAI's financial guarantee.

In 2023, CNSC staff will assess the next full revision of TAI's financial guarantee against REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities.

4.3.2 Conclusion

CNSC staff conclude that TAI currently has in place a valid, in effect and acceptable to the Commission financial guarantee and recommend that the Commission accept the revised financial guarantee.

4.3.3 Recommendation

CNSC staff recommend that the Commission accept the revised financial guarantee in the form of an Escrow Agreement for an amount of $14.78M (as of March 31, 2023) and direct TRIUMF Inc. to provide the original instruments within 90 days from the issuance of a decision on this matter.

CNSC staff recommend that the licence condition 14.2 associated with the financial guarantee be retained without change.

4.4 Licensee Public Information Program

A Public Information and Disclosure Program (PIDP) is a regulatory requirement for licence applicants and licensees of Class I nuclear facilities, uranium mines and mills and certain Class II nuclear facilities. These requirements are found in REGDOC-3.2.1, *Public Information and Disclosure*.

The primary goal of the PIDP is to ensure that information related to the health, safety and security of persons and the environment, and other issues associated with the lifecycle of nuclear facilities are effectively communicated to the public.

The program must include a commitment to, and protocol for ongoing, timely communication of information related to the licensed facility during the course of the licence period.

CNSC's expectations of a licensee's public information program and disclosure protocol are commensurate with the level of risk of the facility, as well as the level of public interest in the licensed activities. The program and protocol may be further influenced by the complexity of the nuclear facility's lifecycle and activities, and the risks to public health and safety and the environment perceived to be associated with the facility and activities.

4.4.1 Discussion

TAI is a Class IB licensed particle accelerator facility and as such is required under its licence to maintain a PIDP as per REGDOC-3.2.1, *Public Information and Disclosure*.

Over the last 10 years, TAI has been successful in meeting its public disclosure and reporting obligations. It has made improvements to its website, adopted social media platforms and documented its areas of community engagement (tours, media, government and stakeholder relations, and community events).

As expected, the COVID-19 pandemic has provided challenges for TAI. However, they provided detailed information in their annual compliance reports about social media use and platforms, web site updates and public tours of the facility. Examples include increased social media use and online platforms, website updates, virtual town halls and meetings, and public video tours of the facility through new approaches. TAI detailed the publishing of annual reports and research articles, virtual events and an increase in social media storytelling.

CNSC staff have reviewed TAI's current PIDP and determined that it:

- Identifies clear goals and objectives in terms of dissemination of information to targeted audiences.
- Identifies multiple target audiences such as TAI staff, partners, facility visitors, local public within the university endowment lands, Musqueam First Nations, first responders and elected officials.

- Provides contact information for members of the public who want to obtain additional information.
- Provides key topics intended for sharing with target audience and/or other interested parties.
- Outlines communications tactics that TAI will deploy to reach target audiences (newsletters, email lists, website content, facility tours, social media, public meetings, public advertisements, volunteering, community investment and community relations activities).

CNSC staff will continue to monitor TAI's compliance with public information requirements and ongoing implementation of the PIDP.

4.4.2 Conclusion

CNSC staff conclude that TAI's current PIDP meets the regulatory requirements for public information and disclosure. CNSC staff continue to oversee TAI's implementation of the PIDP to ensure that it meets obligations regarding disseminating and notifying the public and Indigenous communities on its licensed activities.

CNSC staff also encourage TAI to refine and update its PIDP on a regular basis to meet the changing information needs of its target audiences. TAI has expressed a commitment to do this within their current PIPD.

4.4.3 Recommendation

Recognizing the limited interest in the facility, TAI is encouraged to continue exploring ways to augment their digital communications, both now and after the pandemic. This includes expanding virtual events/webinars and ensuring increased disclosure on social media (e.g. drawing better attention to its public disclosures when events are posted on its website).

CNSC staff recommend that the licence condition 14.1 associated with the Public Information and Disclosure be retained without change.

4.5 Proposed Licence Transfer

TRIUMF Joint Venture was a joint venture between several Canadian universities which owned and managed TAI until June 1, 2021.

On June 1, 2021, TRIUMF Joint Venture became TRIUMF Inc., a not-for-profit corporation incorporated under the *Canada Not-for-profit Corporation Act*. To reflect this change, TAI updated its financial guarantee instruments and submitted them to CNSC. The Commission approved the updated financial guarantee instruments in May 2021 (CMD 21-H108).

On November 23, 2021, CNSC received a request to transfer the licence from TAI to TRIUMF Inc. upon renewal. CNSC staff reviewed the request and is satisfied with the proposed licence transfer.

This licence transfer does not affect CNSC staff's assessment as covered in this CMD; Under TRIUMF Inc. the same staff will continue to operate the same facilities under the same programs with an oversight from the same member universities such as to continue to protect the environment and the health and safety of persons. Furthermore, TRIUMF Inc. is the signatory of the financial guarantee for TAI and is already assuming the risks under the current licence.

4.6 Licence Conditions Handbook

The LCH associated with the proposed particle accelerator operating licence provides compliance verification criteria used to determine whether the conditions listed in the licence have been met. The LCH sets out how CNSC staff will assess TRIUMF Inc.'s compliance with the licence. It provides details associated with each licence condition, such as:

- Applicable CSA Group standards and CNSC regulatory documents;
- Regulatory interpretation;
- Compliance verification criteria;
- Version-controlled documents; and
- Licensees' written notification documents and guidance.

This structure allows more freedom for the facility to evolve and update its documentation within the licensing basis.

4.7 Delegation of Authority

The Commission may include in a licence any condition it considers necessary for the purposes of the *NSCA*. The Commission may delegate authority to CNSC staff with respect to the administration of licence conditions, or portions thereof.

There are 3 proposed licence conditions in the proposed particle accelerator operating licence that contain the phrase "the Commission or a person authorized by the Commission":

• LC 1.3 Resolution of Conflict or Inconsistency;

• LC 8.2 Dose Action Levels; and

• LC 12.2 Planning for Decommissioning

CNSC staff recommend the Commission delegate its authority for the purposes described in the above licence conditions to the following staff:

• Director, Accelerators and Class II Facilities Division (ACFD);

• Director General, Directorate of Nuclear Substance Regulation (DNSR),

• Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch.

5. OVERALL CONCLUSIONS AND RECOMMENDATIONS

CNSC staff conclusions and recommendations consider an overall assessment of TAI's compliance with the *NSCA* and its regulations during the current licence period (2012 to 2021). TAI has programs, resources, and measures in place to ensure the health and safety of persons and the environment and of the measures related to security and Canada's international obligations during the proposed licence period.

5.1 Overall Conclusions

TAI has programs, resources, and measures in place to ensure the health and safety of persons and the environment and of the measures related to security and Canada's international obligations during the proposed licence period.

TAI's progress toward implementing N286.12 is below expectations; however, CNSC staff is of the opinion that the delay does not represent an immediate risk to health and safety nor an impediment to issuing the licence. CNSC staff conclude that TAI's performance in all other areas during the licensing term was satisfactory and met regulatory requirements.

CNSC staff conclude that TAI's proposed financial guarantee amounts and instruments are acceptable.

5.2 Overall Recommendations

CNSC staff recommend the following:

1. The Commission accept the conclusions of CNSC staff that TRIUMF Inc. is qualified to carry out the activities authorized by the particle accelerator operating licence;
2. The Commission renew particle accelerator licence PA1OL-01.00/2022 to operate the particle accelerators for a period of 10 years commencing on July 1, 2022, and ending on June 30, 2032;
3. The Commission accept the financial guarantee consisting of an Escrow Fund in the amount of $14.78M (as of March 31, 2023), a Contribution Gap Agreement, and a Financial Security and Access Agreement;
4. The Commission transfer particle accelerator licence PA1OL-01.00/2032 from TAI to TRIUMF Inc.;
5. The Commission delegate authority as set out in section 4.7 of this CMD.

GLOSSARY

For definitions of terms used in this document, see CNSC's REGDOC-3.6, *Glossary of CNSC Terminology*, which includes terms and definitions used in the *NSCA* and the regulations made under it, and in CNSC regulatory documents and other publications. REGDOC-3.6 is provided for reference and information.

ACRONYMS

Acronym	Term
ALARA	As Low As Reasonably Achievable
PDP	Preliminary Decommissioning Plan
BE	Below Expectations
CINFR	*Class I Nuclear Facilities Regulations*
CMD	Commission Member Document
CNSC	Canadian Nuclear Safety Commission
CRFR	*Canadian Nuclear Safety Commission Cost Recovery Fees Regulations*
CSA	CSA Group (formerly Canadian Standards Association)
CVC	Compliance Verification Criteria
DRD	Direct Reading Dosimeters
DRL	Derived Release Limit
EHS	Environment, Health and Safety
EMS	Environmental Management System
ERA	Environmental Risk Assessment
FHA	Fire Hazard Analysis
FPP	Fire Protection Program
FS	Fully Satisfactory
GNSCR	*General Nuclear Safety and Control Regulations*
IAEA	International Atomic Energy Agency
IEMP	Independent Environmental Monitoring Program
LCH	Licence Conditions Handbook
MeV	Megaelectronvolt
mSv	Millisievert
N286-12	CSA Standard N286-12, *Management System Requirements for Nuclear Facilities*
N393-13	CSA Standard N393-13, *Fire protection for facilities that process, handle, or store nuclear substances*
NEW	Nuclear Energy Worker

NNC	Notice of Non-Compliance
NSCA	*Nuclear Safety and Control Act*
nSv	Nanosievert
OHSR	*Occupational Health and Safety Regulation*
PDP	Preliminary Decommissioning Plan
PIDP	Public Information and Disclosure Program
PTNSR, 2015	*Packaging and Transport of Nuclear Substances Regulations, 2015*
QMS	Quality Management System
REGDOC	Regulatory Document
RP	Radiation Protection
RPR	*Radiation Protection Regulations*
SA	Satisfactory
SAT	Systematic Approach to Training
SCA	Safety and Control Area
TDGR	*Transportation of Dangerous Goods Regulations*
TSOP	TRIUMF Standard Operating Procedure
UA	Unacceptable
µSv	microsievert

A. RISK RANKING

The CNSC uses a risk-informed regulatory approach in the management and control of regulated facilities and activities. CNSC staff have therefore established an approach to identifying appropriate levels of regulatory monitoring and control for specific classes of licensed facilities and types of licensed activities based on risk ranking.

Risk ranking is applied to each SCA, and is determined by considering the probability and consequence of adverse incidents associated with each SCA as it relates to the given facility and activity types.

The methodology used to determine risk ranking is based on Canadian Standards Association guideline CAN/CSA-Q850, *Risk Management: Guideline for Decision Makers*. This guideline provides a description of the major components of the risk management decision process and their relationship to each other, and describes a process for acquiring, analyzing, evaluating, and communicating information that is necessary for making decisions.

In section 2.2 of the CMD, in the Relevant Safety Control Areas table, the "Risk Ranking" column shows a high (H), moderate (M) or low (L) indicator for each SCA that is relevant to the current facility and activities being addressed in this CMD. The risk rankings are not static and will change over time for a given facility and activities (e.g., facilities age, facilities and equipment are upgraded, activities cease or begin, licensees change, technology and programs mature, knowledge and understanding of impacts and probabilities increase, etc.).

The following matrix provides a high-level overview of risk ranking, and the management and monitoring approach associated with the various degrees of risk.

APPROACH TO ASSESSING AND MANAGING POTENTIAL RISK			
CONSEQUENCE	**MANAGEMENT/MONITORING APPROACH**		
Significant Impact	Considerable management of risk is required	Must manage and monitor risk with occasional control	Extensive management is essential. Constant monitoring and control
Moderate Impact	Occasional monitoring	Management effort is recommended	Management effort and control is required
Low Impact	Random monitoring	Regular monitoring	Manage and monitor
Probability of Occurrence	Unlikely to Occur	Might Occur	Expected to Occur

RISK RANKING SCALE					
L	Low Risk	**M**	Moderate Risk	**H**	High Risk

On this basis, a high-risk SCA would be subject to increased regulatory scrutiny and control while a low-risk SCA would generally require minor verification and control.

B. RATING LEVELS

Fully Satisfactory (FS)

Safety and control measures implemented by the licensee are highly effective. In addition, compliance with regulatory requirements is fully satisfactory, and compliance within the safety and control area (SCA) or specific area exceeds requirements and CNSC expectations. Overall, compliance is stable or improving, and any problems or issues that arise are promptly addressed.

Satisfactory (SA)

Safety and control measures implemented by the licensee are sufficiently effective. In addition, compliance with regulatory requirements is satisfactory. Compliance within the SCA meets requirements and CNSC expectations. Any deviation is minor and any issues are considered to pose a low risk to the achievement of regulatory objectives and CNSC expectations. Appropriate improvements are planned.

Below Expectations (BE)

Safety and control measures implemented by the licensee are marginally ineffective. In addition, compliance with regulatory requirements falls below expectations. Compliance within the SCA deviates from requirements or CNSC expectations to the extent that there is a moderate risk of ultimate failure to comply. Improvements are required to address identified weaknesses. The licensee is taking appropriate corrective action.

Unacceptable (UA)

Safety and control measures implemented by the licensee are significantly ineffective. In addition, compliance with regulatory requirements is unacceptable and is seriously compromised. Compliance within the SCA is significantly below requirements or CNSC expectations, or there is evidence of overall non-compliance. Without corrective action, there is a high probability that the deficiencies will lead to unreasonable risk. Issues are not being addressed effectively, no appropriate corrective measures have been taken and no alternative plan of action has been provided. Immediate action is required.

C. BASIS FOR THE RECOMMENDATION(S)

C.1 Regulatory Basis

The recommendations presented in this CMD are based on compliance objectives and expectations associated with the relevant SCAs and other matters. The regulatory basis for the matters that are relevant to this CMD are as follows.

Management System

The regulatory foundation for the recommendation(s) associated with management system includes the following:

Paragraph 3(d) of the *CINFR* requires that a licence application contain "the proposed management system for the licensed activity, including measures to promote and support safety culture".

Paragraph 3(k) of the *GNSCR* requires that a licence application contain information related to the applicant's organizational management structure including the internal allocation of functions, responsibilities and authority.

Paragraph 4(d) of the *CINFR* requires that a licence application contain "the proposed quality assurance program for the licensed activity".

Human Performance Management

The regulatory foundation for the recommendation(s) associated with human performance management includes the following:

Paragraphs 12(1)(a) and 12(1)(b) of the *GNSCR* require that a licensee shall ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the Act, the regulations made under the Act and the licence; and shall train the workers to carry on the licensed activity in accordance with the Act, the regulations made under the Act and the licence.

Paragraph 3(d.1) of the *CINFR* requires that a licence application contain "the proposed human performance program for the licensed activity, including measures to ensure workers' fitness for duty".

Paragraphs 6(m) and 6(n) of the *CINFR* require that licence applications include the proposed responsibilities of and qualification requirements and training program for workers, including the procedures for the requalification of workers; and the results that have been achieved in implementing the program for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility. Subsection 14 (2) of the *CINFR* further requires *"every licensee to keep a record of the status of worker's qualifications, requalification and training, including the results of all tests and examinations"*.

Paragraph 14(2)(e) of the *CINFR* requires every licensee to keep a record of the status of each worker's qualifications, requalification and training, including the results of all tests and examinations completed in accordance with the licence.

Operating Performance

The regulatory foundation for the recommendation(s) associated with operating performance includes the following:

Paragraph 6(d) of the *CINFR* requires that a licence application contain *"the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility"*.

Paragraph 24(5) of the *NSCA* specifies that a licence may contain *"any term or condition that the Commission considers necessary for the purposes of this Act"*. Every facility operating licence includes the requirement to submit an "Annual Compliance Report". This report provides a summary of key facility operating performance parameters related to the safe operation of the facility and the safe conduct of the licensed activities.

Safety Analysis

The regulatory foundation for the recommendation(s) associated with safety analysis includes the following:

Paragraph 3(1)(i) of the *GNSCR* requires that a licence application contain "a description and the results of any test, analysis or calculation performed to substantiate the information included in the application".

Paragraphs 6(a), (c) and (d) of the *CINFR* require that a licence application contain: "a description of the structures, systems and equipment at the facility, including their design and their design operating conditions; a final safety analysis report demonstrating the adequacy of the design of the nuclear facility; and the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility".

Paragraph 3(1)(c) of the *GNSCR* requires that every licence application contain "the name, maximum quantity and form of any nuclear substance to be encompassed by the licence".

Paragraph 6(d) of the *CINFR* requires that a licence application contain "the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility".

Paragraph 12(1)(c), (d), and (f) of the *GNSCR* require that licensees take all reasonable precautions to protect the environment and the health and safety of persons and to maintain security; provide the devices required by the licence and maintain them; and take all reasonable precautions to control the release of radioactive nuclear substances or hazardous substances.

Physical Design

The regulatory foundation for the recommendation(s) associated with physical design includes the following:

Paragraphs 6(a), (b) and (d) of the *CINFR* require that a licence application contain: *"a description of the structures, systems and equipment at the facility, including their design and their design operating conditions; and the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility"*.

Fitness for Service

The regulatory foundation for the recommendation(s) associated with fitness for service includes the following:

Paragraph 6(d) of the *CINFR* requires that a licence application contain *"the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility"*.

Radiation Protection

The regulatory foundation for the recommendation(s) associated with radiation protection includes the following:

Subsection 3(1) of the *GNSCR* requires that a licence application contain the following information under paragraphs:

- 3(1)(e), the proposed measures to ensure compliance with the *RPR*.
- 3(1)(f), any proposed action level for the purpose of section 6 of the *RPR*.
- The *RPR* require, under sections 4 to 6, that the licensee implements a radiation protection program, ascertain and record doses, and take the required actions in the case that an action level has been reached.

The *CINFR* require that an application for a licence to operate a Class I nuclear facility contain:

- Under paragraph 6(e), the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances.
- Under paragraph 6(h), the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measure that will be taken to prevent or mitigate those effects.

Conventional Health and Safety

The regulatory foundation for the recommendation(s) associated with conventional health and safety includes the following:

Paragraph 3(f) of the *CINFR* requires that an application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain the proposed worker health and safety policies and procedures.

The *GNSCR* require, under paragraph 12(1)(c), that every licensee shall take all reasonable precautions to protect the environment and the health and safety of persons and to maintain the security of nuclear facilities and of nuclear substances.

The *GNSCR* require, under subsection 16(1), that every licensee shall make available to all workers the health and safety information with respect to their workplace that has been collected by the licensee in accordance with the Act, the regulations made under the Act and the licence.

It is a requirement of the *GNSCR* under section 17, that every worker shall:

- 17(a), use equipment, devices, facilities and clothing for protecting the environment or the health and safety of persons, or for determining doses of radiation, dose rates or

concentrations of radioactive nuclear substances, in a responsible and reasonable manner and in accordance with the Act, the regulations made under the Act and the licence.

- 17(b), comply with the measures established by the licensee to protect the environment and the health and safety of persons, maintain security, control the levels and doses of radiation, and control releases of radioactive nuclear substances and hazardous substances into the environment.
- 17(c)(i), promptly inform the licensee or the worker's supervisor of any situation in which the worker believes there may be a significant increase in the risk to the environment or the health and safety of persons.
- 17(e), take all reasonable precautions to ensure the worker's own safety, the safety of the other persons at the site of the licensed activity, the protection of the environment, the protection of the public and the maintenance of the security of nuclear facilities and of nuclear substances.

TAI's activities and operations must comply with WorkSafeBC's *OHSR*.

Environmental Protection

The regulatory foundation for the recommendation(s) associated with environmental protection includes the following:

Paragraphs 3 (g) and (h) of the *CINFR* require that an application for a licence to operate a Class I Nuclear Facility contain: the "proposed environmental protection policies and procedures" and "the proposed effluent and environmental monitoring programs". Paragraphs 6 (h), (i) and (j) of the same regulations further require that the licence application contain: "the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects", "the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics", and "the proposed measures to control releases of nuclear substances and hazardous substances into the environment", respectively.

Paragraph 12(1)(c) and (f) of the *GNSCR* require every licensee to take all reasonable precautions to protect the environment and to take all reasonable precautions to control the release of nuclear substances or hazardous substances.

Subsection 13(1) of the *RPR* prescribes the radiation dose limit for the general public of 1 mSv per calendar year.

Emergency Management and Fire Protection

The regulatory foundation for the recommendation(s) associated with emergency management and fire protection includes the following:

Paragraph 6(k) of the *CINFR* requires that a licence application contain information on the licensee's "*proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of security, including measures to:*

(i) *assist off-site authorities in planning and preparing to limit the effects of an accidental release;*
(ii) notify off-site authorities of an accidental release or the imminence of an accidental release;
(iii) report information to off-site authorities during and after an accidental release;,
(iv) assist off-site authorities in dealing with the effects of an accidental release; and
(v) test the implementation of the measures to prevent or mitigate the effects of an accidental release."

Paragraph 6(k) of the *CINFR* requires that a licence application contain information on the licensee's "*proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of security*". These measures must include the implementation of a fire protection program which complies with all applicable national codes and standards.

Waste Management

The regulatory foundation for the recommendation(s) associated with waste management includes the following:

Paragraph 3(1)(j) of the *GNSCR* requires that an application for a licence include the name, quantity, form and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed, or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste.

Security

The regulatory foundation for the recommendation(s) associated with security includes the following:

Paragraphs 3(1)(g) and 3(1)(h) of the *GNSCR* require that a licence application contain information related to site access control and measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information.

Paragraph 6(l) of the *CINFR* requires that a licence application contain "the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility".

Safeguards and Non-Proliferation

The regulatory foundation for the recommendation(s) associated with safeguards and non-proliferation includes the following:

Paragraph 12(1)(i) of the *GNSCR* requires that each licensee take all necessary measures to facilitate Canada's compliance with any applicable safeguards agreement.

Subsection 21(1) of the *GNSCR* requires that "*information that concerns any of the following, including a record of that information, is prescribed information for the purposes of the Act:*

- 21(1)(a) *a nuclear substance that is required for the design, production, use, operation or maintenance of a nuclear weapon or nuclear explosive device, including the properties of the nuclear substance.*
- 21(1)(b) *the design, production, use, operation or maintenance of a nuclear weapon or nuclear explosive device.*
- 21(1)(c) *the security arrangements, security equipment, security systems and security procedures established by a licensee in accordance with the Act, the regulations made under the Act or the licence, and any incident relating to security.*
- 21(1)(d) *the route or schedule for the transport of Category I, II or III nuclear material, as defined in section 1 of the Nuclear Security Regulations.*"

Subsection 30(1) of the *GNSCR* requires that "*every licensee who becomes aware of any of the following situations shall immediately make a preliminary report to the Commission of the situation and of any action that the licensee has taken or proposes to take with respect to it:*

- 30(1)(a) *interference with or an interruption in the operation of safeguards equipment or the alteration, defacement or breakage of a safeguards seal, other than in accordance with the safeguards agreement, the Act, the regulations made under the Act or the licence.*
- 30(1)(b) *the theft, loss or sabotage of safeguards equipment or samples collected for the purpose of a safeguards inspection, damage to such equipment or samples, or the illegal use, possession, operation or removal of such equipment or samples.*"

Subsection 30(2) of the *GNSCR* requires that "*every licensee who becomes aware of a situation referred to in subsection (1) shall file a full report of the situation with the Commission within 21 days after becoming aware of it, unless some other period is specified in the licence, and the report shall contain the following information:*

- 30(2)(a) *the date, time and location of becoming aware of the situation.*
- 30(2)(b) *a description of the situation and the circumstances.*
- 30(2)(c) *the probable cause of the situation.*
- 30(2)(d) *the adverse effects on the environment, the health and safety of persons and the maintenance of national and international security that have resulted or may result from the situation."*

The Agreement between the Government of Canada and the IAEA for the Application of Safeguards in connection with the *Treaty on the Non-Proliferation of Nuclear Weapons*.

The Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in connection with the *Treaty on the Non-Proliferation of Nuclear Weapons*.

Packaging and Transport

The regulatory foundation for the recommendation(s) associated with packaging and transport includes the following:

Paragraph 6(e) of the *CINFR* requires that an application for a licence to operate a Class I facility shall contain information on *"the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances"*. Every person

who transports radioactive material, or requires it to be transported, must act in accordance with the requirements of the *TDGR* and the *PTNSR, 2015*.

Decommissioning and Financial Guarantees

The regulatory foundation for the recommendation(s) associated with decommissioning and financial guarantees includes the following:

Paragraph 3(1)(1) of the *GNSCR* requires that a licence application contains a description of any proposed financial guarantee relating to the activity to be licensed.

Paragraph 3(k) of the *CINFR* requires that an application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain the proposed plan for the decommissioning of the nuclear facility or of the site.

Public Information and Disclosure Program

The regulatory foundation for the recommendation(s) associated with public information and disclosure program includes:

Paragraph 3(j) of the *CINFR* requires that a licence application contain the "the proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed".

C.2 Technical Basis

The technical basis for recommendations, including several guidance documents, national standards and regulatory documents has been presented in this CMD and is addressed in detail in the LCH.

D. SAFETY AND CONTROL AREA FRAMEWORK

D.1 Safety and Control Areas Defined

The safety and control areas identified in section 2.2, and discussed in summary in sections 3.1 through 3.11 are comprised of specific areas of regulatory interest which vary between facility types.

The following table provides a high-level definition of each SCA. The specific areas within each SCA are to be identified by the CMD preparation team in the respective areas within section 3 of this CMD.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
Management	Management System	Covers the framework which establishes the processes and programs required to ensure an organization achieves its safety objectives and continuously monitors its performance against these objectives and fostering a healthy safety culture.
	Human Performance Management	Covers activities that enable effective human performance through the development and implementation of processes that ensure that licensee staff is sufficient in number in all relevant job areas and that licensee staff have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.
	Operating Performance	This includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.
Facility and Equipment	Safety Analysis	Maintenance of the safety analysis that supports that 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 preventative measures and strategies in reducing the effects of such hazards.
	Physical Design	Relates to activities that impact on the ability of systems, components and structures to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.
	Fitness for Service	Covers activities that impact on the physical condition of systems, components and structures to ensure that they remain effective over time. This includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
Core Control Processes	Radiation Protection	Covers the implementation of a radiation protection program in accordance with the *RPR*. This program must ensure that contamination and radiation doses received are monitored and controlled.
	Conventional Health and Safety	Covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.
	Environmental Protection	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.
	Emergency Management and Fire Protection	Covers emergency plans and emergency preparedness programs which exist for emergencies and for non-routine conditions. This also includes any results of exercise participation.
	Waste Management	Covers internal waste-related programs which form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. Also covers the planning for decommissioning.
	Security	Covers the programs required to implement and support the security requirements stipulated in the regulations, in their licence, in orders, or in expectations for their facility or activity.
	Safeguards and Non-Proliferation	Covers the programs and activities required for the successful implementation of the obligations arising from the Canada/IAEA safeguards agreements as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*.
	Packaging and Transport	Programs that cover the safe packaging and transport of nuclear devices to and from the licensed facility.

D.2 Specific Areas for this Facility Type

The following table identifies the specific areas that comprise each SCA:

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Functional Area	**Safety and Control Area**	**Specific Areas**
Management	Management System	▪ Management System and Organization ▪ Performance Assessment, Improvement and Management Review ▪ Operating Experience (OPEX) ▪ Change Management, Configuration Management and Records Management ▪ Safety Culture ▪ Records Management ▪ Management of Contractors
	Human Performance Management	▪ Personnel Training ▪ Human Performance Management ▪ Human Performance Program ▪ Work Organization and Job Design ▪ Fitness for Duty
	Operating Performance	▪ Not addressed individually
Facility and Equipment	Safety Analysis	▪ Not addressed individually
	Physical Design	▪ Not addressed individually
	Fitness for Service	▪ Not addressed individually
Core Control Processes	Radiation Protection	▪ Application of ALARA ▪ Worker Dose Control ▪ Radiation Protection Program Performance ▪ Radiological Hazard Control
	Conventional Health and Safety	▪ Performance ▪ Practices
	Environmental Protection	▪ Effluent and Emissions Control (Releases) ▪ Environmental Management System (EMS) ▪ Assessment and Monitoring ▪ Protection of People ▪ Environmental Risk Assessment (ERA)
Core Control Processes (cont.)	Emergency Management and Fire Protection	▪ Conventional and Nuclear Emergency Preparedness and Response ▪ Fire Emergency Preparedness and Response

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Functional Area	**Safety and Control Area**	**Specific Areas**
	Waste Management	▪ Waste Characterization ▪ Waste Minimization ▪ Waste Management Practices ▪ Decommissioning Plans
	Security	▪ Not addressed individually
	Safeguards and Non-Proliferation	▪ Nuclear Material Accountancy and Control ▪ Access and Assistance to the IAEA ▪ Operational and Design Information ▪ Import and Export
	Packaging and Transport	▪ Not addressed individually

E. NEAR-MISS INCIDENT

In September 2014, TAI reported to CNSC a near-miss incident in which a worker in the new electron accelerator facility was not accounted for during a pre-lockup search of the electron hall. These searches are conducted in a systematic manner prior to securing the electron accelerator facility to ensure no one remains inside the room and be exposed to radiation before initiating operation for commissioning of the accelerator. Once the search and lockup is completed, there is a delay in which a pre-irradiation warning alarm is activated, after which power can be applied to begin conditioning and stabilizing the electron accelerator before actually injecting electrons to produce an accelerated beam.

The worker responded appropriately to the pre-irradiation warning alarm: he exited the area by opening the door, triggering the door interlock system, which aborted the initialization process before the power could be applied to the electron accelerator. The worker did not incur any radiation exposure as a result of this incident.

TAI's internal investigation of the incident identified multiple contributing factors, ranging from a failure to properly implement procedures and inadequate training to inadequacies in the location of the search switches, which otherwise might have ensured that the worker was detected during the search of the electron hall. TAI suspended all operations of the electron linear accelerator pending a full review of the safety systems and implementing updated procedures and training for all groups involved in the electron accelerator commissioning.

In December 2014, CNSC staff performed a follow-up inspection of this incident and issued 5 NNCs. In March 2015, CNSC staff perform another inspection around this incident, focusing this time on human and organizational factors, and the training program. CNSC staff issue 7 Recommendations and no additional NNCs.

In July 2015, TAI staff successfully addressed the findings of the internal investigation and the NNCs and submitted to CNSC major revisions of the electron accelerator safety analysis report and commissioning plan along with numerous supporting documents. CNSC staff assessed the information and CNSC authorized TAI to resume commissioning of the electron accelerator in August 2015, 11 months after the incident.

F. NOTICES OF NON-COMPLIANCE OF FEBRUARY 2021 MANAGEMENT SYSTEM INSPECTION

The table below lists the notices of non-compliance, required corrective action, safety significance, expected date of completion, and the status as of December 16, 2021. CNSC staff will perform one or more follow-up inspections in 2022 to verify the implementation of TAI's corrective action plan. CNSC staff will close the NNC only once CNSC staff are satisfied with the implementation of the corresponding corrective action plan.

Notice of Non-Compliance and required corrective action (paraphrased)	**Safety significance[2]**	**Expected Date of completion**	**Status as of Dec 16, 2021**
MS-TRIUMF-2021-NNC1 (RIB action #23013) Changes to the organizational structure are not clearly defined and communicated to workers in a timely manner. TRIUMF shall establish a process which ensures the organizational structure remains up to date and changes are communicated to staff in a timely manner. Compliance Verification Criteria (CVC): *CSA N286-12, Clause 4.4*	Low	Sep 17, 2021	Information received and under review at the time of writing this CMD
MS-TRIUMF-2021-NNC2 (RIB action #23014) Training records for maintenance and calibration technicians only list global training, nothing specific to maintenance or calibration. TRIUMF shall ensure records are kept for all training, not only for global training, but also for all job-specific training. CVC: *CSA N286-12, Clause 4.5.2*	Low	Jan 2, 2022	Open

[2] Even though the overall risk ranking for the Management System SCA is moderate, the risk significance is rated according to the risk of each NNC.

Notice of Non-Compliance and required corrective action (paraphrased)	Safety significance[2]	Expected Date of completion	Status as of Dec 16, 2021
MS-TRIUMF-2021-NNC3 (RIB action #23015) Some divisions have not been able to update their training program and training needs due to lack of resources. TRIUMF shall provide more resources to the line operation to maintain procedures and manage the training needs. CVC: *CSA N286-12, Clause 4.5.3*	Low	Oct 31, 2021	Information received and under review at the time of writing this CMD
MS-TRIUMF-2021-NNC4 (RIB action #23016) Not all workers are informed or cognizant of the requirements of N286-12 applicable to their functions. TRIUMF shall establish a process to assess the effectiveness of communication and the receipt of the message by workers. CVC: *CSA N286-12, Clauses 4.6 and 4.7.2*	Low	Jan 2, 2022	Open
MS-TRIUMF-2021-NNC5 (RIB action #23017) Workers who could be impacted by information updates are not always identified. TRIUMF shall implement a process to identify which workers need information, which information is needed, and ensure that the correct and current information is available to them on time when they need it. CVC: *CSA N286-12, Clause 4.7.2*	Low	Jul 26, 2021	Information received and under review at the time of writing this CMD

Notice of Non-Compliance and required corrective action (paraphrased)	Safety significance[2]	Expected Date of completion	Status as of Dec 16, 2021
MS-TRIUMF-2021-NNC6 (RIB action #23018) TRIUMF's management system documents are not always maintained to ensure they are current and valid. TRIUMF shall control and maintain all management system documents to ensure documents are current and valid. CVC: *CSA N286-12, Clause 4.7.1*	Low	Sep 17, 2021	Information received and under review at the time of writing this CMD
MS-TRIUMF-2021-NNC7 (RIB action #23019) Work activities are not always recorded. TRIUMF shall define policies and procedures to ensure that all records, which demonstrate completion, acceptance and verification of work performed, are produced and kept. CVC: *CSA N286-12, Clauses 4.7.4 and 4.8.1*	Low	Sep 17, 2021	Information received and under review at the time of writing this CMD
MS-TRIUMF-2021-NNC8 (RIB action #23020) Some records are not traceable to the original source (e.g. work permits do not trace back to their corrective action, TapRoot report or non-conformance report). TRIUMF shall ensure that records of the work activity are traceable back to their sources. CVC: *CSA N286-12, Clause 4.7.4*	Low	Sep 17, 2021	Information received and under review at the time of writing this CMD

Notice of Non-Compliance and required corrective action (paraphrased)	Safety significance[2]	Expected Date of completion	Status as of Dec 16, 2021
MS-TRIUMF-2021-NNC9 (RIB action #23021) Work is not controlled consistently across the organization. In some areas, the verification is performed by the persons who did the work. TRIUMF shall have a consistent process for planning, executing and verifying work across the organization. CVC: *CSA N286-12, Clause 4.8*	Low	Jan 2, 2021	Open
MS-TRIUMF-2021-NNC10 (RIB action #23022) Oversight of equipment maintenance is not consistent. Actions to address overdue equipment maintenance are not consistent. TRIUMF shall implement a consistent equipment calibration and maintenance process across the organization. CVC: *CSA N286-12, Clauses 4.8.2(d), 8.9.2(b), 8.9 and 8.9.4*	Low	Sep 17, 2021	Information received and under review at the time of writing this CMD

Notice of Non-Compliance and required corrective action (paraphrased)	Safety significance[2]	Expected Date of completion	Status as of Dec 16, 2021
MS-TRIUMF-2021-NNC11 (RIB action #23023) Non-conformance reports are not generated for overdue calibration and maintenance of equipment in the mechanical services, but only generated if further actions (e.g. repairs) are required. TRIUMF shall initiate non-conformance reports when calibration or maintenance of equipment is overdue. CVC: *CSA N286-12, Clause 4.9*	Low	Sep 17, 2021	Information received and under review at the time of writing this CMD
MS-TRIUMF-2021-NNC12 (RIB action #23024) TRIUMF supply chain process does not address all the requirements as defined in N26-12. TRIUMF shall implement a supply chain process that meets all the requirements of N286-12 Clause 8.5. CVC: *CSA N286-12, Clause 8.5*	Low	Jan 2, 2022	Open
MS-TRIUMF-2021-NNC13 (RIB action #23025) TRIUMF has not implemented any trend analysis for its non-conformances. TRIUMF shall conduct trend analysis of causes and problems as part of its continual improvement program. CVC: *CSA N286-12, Clause 4.13(a)*	Low	Jan 2, 2022	Open

Notice of Non-Compliance and required corrective action (paraphrased)	Safety significance[2]	Expected Date of completion	Status as of Dec 16, 2021
MS-TRIUMF-2021-NNC14 (RIB action #23026) Criteria for closing non-conformance reports are not defined. TRIUMF shall formally define criteria for closing non-conformance reports. CVC: *CSA N286-12, Clause 4.9*	Low	Jan 31, 2022	Open
MS-TRIUMF-2021-NNC15 (RIB action #23027) Actions taken to correct non-conformances are not reviewed for effectiveness. TRIUMF shall ensure that the problem identification and resolution process is implemented to verify and review the effectiveness of the corrective actions. CVC: *CSA N286-12, Clause 4.9*	Low	Sep 17, 2021	Information received and under review at the time of writing this CMD
MS-TRIUMF-2021-NNC16 (RIB action #23028) Corrective action reports are not always completed as agreed by the parties involved. Some actions are outstanding and overdue for more than a year. TRIUMF shall revisit its corrective action process to ensure all corrective actions are addressed and closed in a timely manner. CVC: *CSA N286-12, Clause 4.9*	Low	Jan 31, 2022	Open

Notice of Non-Compliance and required corrective action (paraphrased)	Safety significance[2]	Expected Date of completion	Status as of Dec 16, 2021
MS-TRIUMF-2021-NNC17 (RIB action #23029) There is no documented change control process that covers the scope of managing changes such as organizational changes, facility restructuring and enterprise asset management. TRIUMF shall implement a change control process that applies to all operational, organizational and improvement initiatives. CVC: *CSA N286-12, Clauses 4.7.1, 4.7.3(d), 4.8.2(a) and 4.10*	Low	Aug 13, 2021	Information received and under review at the time of writing this CMD
MS-TRIUMF-2021-NNC18 (RIB action #23030) Guidance and tools for conducting self-assessment are not defined and documented. There are no matrices to monitor compliance of the management system with N286-12. TRIUMF shall document and implement a self-assessment process to assess the effectiveness of the management system and its compliance to CSA N286-12 requirements. CVC: *CSA N286-12, Clause 4.11.1, 4.13(b)*	Low	Jan 31, 2022	Open

Notice of Non-Compliance and required corrective action (paraphrased)	Safety significance[2]	Expected Date of completion	Status as of Dec 16, 2021
MS-TRIUMF-2021-NNC19 (RIB action #23031) Independent assessments have not been conducted since 2018. TRIUMF shall conduct independent assessments at sufficient frequency to assess the effective implementation and maintenance of the management system. CVC: *CSA N286-12, Clause 4.11.2, 4.13(b)*	Low	Oct 31, 2021	Information received and under review at the time of writing this CMD
MS-TRIUMF-2021-NNC20 (RIB action #24365) Performance indicators presented to top management do not provide sufficient information to assess the effectiveness of the management system. TRIUMF shall provide sufficient information to enable top management to assess the effectiveness of the TRIUMF management system to achieve the planned results. CVC: *CSA N286-12, Clause 4.3(f), 4.7.1, 4.11.2 and 4.13(b)*	Low	Jan 31, 2022	Open

PART 2

Part 2 provides all relevant information pertaining directly to the licence, including:

1. current licence PA1OL-01.00/2022
2. current licence conditions handbook
3. proposed licence amendment
4. proposed licence PA1OL-01.00/2032
5. proposed licence PA1OL-01.01/2032 transferred to TRIUMF Inc.
6. draft licence conditions handbook

CURRENT LICENCE PA1OL-01.00/2022

e-Doc # 3870252 (Word)

e-Doc # 3960855 (PDF)

CLASS IB PARTICLE ACCELERATOR OPERATING LICENCE
TRIUMF ACCELERATORS INC.

I) LICENCE NUMBER: **PA1OL-01.00/2022**

II) LICENSEE: Pursuant to section 24 and subsection 37(2) of the *Nuclear Safety and Control Act*, this licence is issued to:

TRIUMF Accelerators Inc.
4004 Wesbrook Mall
Vancouver, British Columbia
V6T 2A3

III) LICENCE PERIOD: This licence is valid from **July 1, 2012**, to **June 30, 2022**, unless otherwise suspended, amended, revoked or replaced.

IV) LICENSED ACTIVITIES:

This licence authorizes the licensee to:

(i) Operate the following facilities:

a. Class I:

- a 500 MeV cyclotron and its associated beamlines and targets

b. Class II:

- CP42, a 42 MeV cyclotron
- TR30-1, a 30 MeV cyclotron
- TR30-2, a 30 MeV cyclotron
- TR13, a 13 MeV cyclotron
- ISAC I, a radioactive ion beam accelerator
- ISAC 2, a radioactive ion beam accelerator

(ii) Service the above facilities;

(iii) Produce, possess, process, transfer, use and store within the boundaries of the site any nuclear substance required for, associated with or incidental to the activity described in (i) above;

(iv) Produce, possess, process, transfer, use, import, export and store within the boundaries of the site any other nuclear substance, subject to condition 5.3.

V) EXPLANATORY NOTES:

(a) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and associated Regulations.

(b) The "*TRIUMF Licence Conditions Handbook (*LCH)" provides:

(i) compliance verification criteria in order to meet the conditions listed in the licence;

(ii) information regarding delegation of authority to CNSC staff; and

(iii) applicable versions of documents and a process for version control of codes, standards or other documents that are used as compliance verification criteria in order to meet the conditions listed in the licence.

VI) CONDITIONS:

1. General

1.1 ***Licensing Basis***

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

1.2 ***Changes to Documents***

(a) Changes to the safety and control measures described in the application and the documents needed to support that application are permitted provided that the objective of the licensing basis is met.

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

1.3 ***Resolution of Conflict or Inconsistency***

The licensee shall, in the event of any conflict or inconsistency between licence conditions, codes or standards or regulatory documents referenced in this licence, direct the conflict or inconsistency in writing to the Commission, or a person authorized by the Commission, for regulatory interpretation.

2. Management System

2.1 ***Management System***

The licensee shall implement and maintain a management system, including a written safety policy which places safety paramount within the management system, overriding all other demands, for activities carried out under this licence.

3. Human Performance Management

3.1 ***Human Performance Program***

The licensee shall implement and maintain a human performance program.

3.2 ***Training Program***

The licensee shall implement and maintain a training program.

4. Operating Performance

4.1 ***Operations Program***

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.

4.2 ***Reporting Requirements***

The licensee shall submit to the Commission each year a written annual compliance report that covers the previous year's operation.

5. Safety Analysis and Physical Design

5.1 ***Physical Design and Safety Analysis Program***

The licensee shall implement and maintain a facility design and safety analysis program.

5.2 ***Design and Safety Analysis Documents***

The licensee shall maintain an up to date set of documents and technical references comprising detailed technical descriptions and safety analyses specific to each major facility on-site.

5.3 ***Operational Specifications and Limits***

The licensee shall maintain an up to date set of operating limits for the facilities and activities authorized under the licence, including limits for the production, possession, processing, use, transfer, storage, import and export of nuclear substances and operational limits for accelerators, beam-lines and target assemblies.

6. Fitness for Service

6.1 ***Testing, Calibration and Maintenance Program***

The licensee shall implement and maintain a testing, calibration and maintenance program for the facility.

7. Radiation Protection

7.1 ***Radiation Protection Program***

The licensee shall implement and maintain a radiation protection program.

7.2 ***Dose Action Levels***

The licensee shall notify the Commission or a person authorized by the Commission within 24 hours of becoming aware that an action level has been

reached or exceeded and shall file a written report with the Commission within 30 working days of becoming aware of the matter.

8. Conventional Health and Safety

8.1 Conventional Health and Safety Program

The licensee shall implement and maintain a conventional health and safety program.

9. Environmental Protection

9.1 Environmental Protection Program

The licensee shall implement and maintain an environmental protection program for the facility.

9.2 Control and Monitoring of Nuclear Substance Releases

The licensee shall maintain an up to date set of nuclear substance release limits for the facility and shall control, monitor and record releases of nuclear substances to the environment from the facility such that the releases do not exceed these release limits.

9.3 Control and Monitoring of Hazardous Substance Releases

The licensee shall control, monitor and record the releases of hazardous substances.

9.4 Environmental Action Levels

The licensee shall notify the Commission or a person authorized by the Commission within 24 hours of becoming aware that an action level has been reached or exceeded and shall file a written report with the Commission within 30 working days of becoming aware of the matter.

10. Emergency Management and Fire Protection

10.1 Emergency Preparedness Program

The licensee shall implement and maintain a program for emergency preparedness to address on-site and off-site events which can affect the nuclear facilities.

10.2 Fire Protection Program

The licensee shall implement and maintain a fire protection program for the facility.

11. Waste Management

11.1 Waste Management Program

The licensee shall implement and maintain a program for waste management for the facility.

11.2 ***Preliminary Decommissioning Plan***

The licensee shall maintain a preliminary decommissioning plan (PDP) for decommissioning the facility. This PDP shall be reviewed every five years or when requested by the Commission, or a person authorized by the Commission.

12. Security

12.1 ***Security Program***

The licensee shall implement and maintain a security program.

13. Safeguards

13.1 ***Safeguards Program***

The licensee shall implement and maintain a safeguards program and undertake all measures required to ensure safeguards implementation at the nuclear facility.

13.2 ***Changes that Would Affect the Implementation of Safeguards Measures***

The licensee shall not, except with the prior approval of the Commission or a person authorized by the Commission, make changes to any aspect of the facility or its operation, equipment or procedures that would affect the implementation of safeguards measures.

14. Packaging and Transport

14.1 ***Packaging and Transport Program***

The licensee shall implement and maintain a packaging and transport program.

15. Site Specific

15.1 ***Public Information and Disclosure Program***

The licensee shall implement and maintain a public information program for the facility.

15.2 ***Financial Guarantees***

The licensee shall maintain in effect, a financial guarantee for decommissioning that is acceptable to the Commission.

SIGNED at OTTAWA this day of JUN 2 8 2012

M. Binder

Michael Binder, President,
on behalf of the Canadian Nuclear Safety Commission

CURRENT LICENCE CONDITIONS HANDBOOK

e-Doc # 6381008 (Word)

e-Doc # 6381009 (PDF)

Canada's Nuclear Regulator

E-DOCS #**6381008** (Word)
E-DOCS #**6381009** (PDF)

LICENCE CONDITIONS HANDBOOK

LCH-TRIUMF-R014
TRIUMF ACCELERATORS INC.
ACCELERATOR OPERATING LICENCE

PA1OL-01.00/2022

Revision 14

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

Licence Conditions Handbook
LCH-TRIUMF-R014
TRIUMF Accelerators Inc.
Accelerator Operating Licence
PA1OL-01.00/2022

Effective Date: October 5, 2020

SIGNED at Ottawa on October 5, 2020

Original signed by

_____

Mark Broeders
Director
Directorate of Nuclear Substance Regulation
CANADIAN NUCLEAR SAFETY COMMISSION

Revision History:

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
July 1, 2012	00	3962846	new	new	N/A
Sept 10, 2012	01	4003403	Doc. Ver. Cont. refs. under LCs 5.2 & 5.3 App. C and G	Replace BL2C4 STF SAR, rev 1, (rel 2) dated 2006-12-21 (TRIUMF doc 30071) with new rel 3, dated 2012/07/06. Includes increased beam current, energy and target thickness. Increase permissible beam current for Branch 2C4 in Section A, Table 3 of Appendix C from 80 µA to 100 µA	1363514
Jan 21, 2013	02	4079522	Doc. Ver. Cont. refs. under LC 11.1 & App. G	Replace Radioactive Waste Management for the TRIUMF Site (release 3) dated 2012/04/20 (TRIUMF doc 5330, edoc 3970384) with release 4, dated 2013/01/04 (edoc 4067587). This update allows ion exchange resins to be disposed of as low level, non-compactable waste in accordance with the previously accepted methods (CCL clearance) used for that waste stream.	4067581
Dec 18, 2013	03	4263102	Doc. Ver. Cont. refs. under LC 2.1 & App. G	Add TRIUMF TSOP-1 (593) and Document Manual (22284)	N/A
			Doc. Ver. Cont. refs. under LC 5.2, 5.3, & App. G	Update TRIUMF document 27099 re ISACII vault exclusion area to release 4. Updated document 561 ISACII SAR to release 4. Added docs 57727 re. e-Hall ASU and 93063 re. BL1A Shield Plug Modifications	4259681

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
			Doc. Ver. Cont. refs. under LC 14.1 & App. G	Add new Document Version Control section to LC14.1 re PTNS and add new TRIUMF procedures 62648 and 76036	N/A
			Doc. Ver. Cont. refs. under LC 11.2 & App. G	Update TRIUMF document 8810 PDP to release 4 (includes ARIEL)	4259725
			Doc. Ver. Cont. refs. under LC 11.2 & App. G	Updated TRIUMF TSOP-4 re Training to rel 4.	N/A
			All Doc. Ver Cont. sections and App. G	Reordered all TRIUMF document references. Updated all CNSC edoc references. Revised/corrected all TRIUMF document release numbers to match documents on file.	N/A
August 5, 2014	04	4482737	Doc. Ver. Cont. refs. under LC 5.2, 5.3, & App. G	Update TD9605 to release 7, encompassing new TRIUMF-CCM PET radiopharmaceutical pipeline	4482261

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
December 19, 2014	05	4602447	Doc. Ver. Cont. refs. under LC 6.1, App. G	Added effluent air monitor calibration procedure to controlled documents under Fitness for Service SCA, updated PTNS procedure 62648 to release 3,	4482952
			App C sections C and F, App E	Increased production limit for Tc-99m to 1400 GBq in App E Added Mo-100 target for Tc-99m production to App C section C. Amalgamated App C sections C and F (TR30-1 and TR30-1 targets and current limits) as they are identical.	4590088 4483467
			Doc. Ver. Cont. refs. under LC 5.2, 5.3 and App. G, App C section E	Added ThO target SAR addendum to Doc. Ver. Cont. for LC 5.2 and 5.3 to permit ThO test irradiation. Added ThO operating limits to App C section E.	4598439
			App F	Minor update to export limits in App F related to KCl target re-analysis	

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
November 3, 2016	06	5091678	Doc. Ver. Cont. refs. under multiple LC and App. G	Updated Document to latest releases per TRIUMF request. Added *Worst Case Emission Analysis Report* (Document-55017), *Accelerator Access Control Interlock Systems: Functional Requirements and Design of Area Safety Units and the Emergency Trip Pushbutton System for Primary Beam and ISAC Exclusion Areas* (Document-27775) and *520 MeV Accelerator Access Control Interlock Systems: Area Safety Units and the Emergency Trip Pushbutton System for Secondary Beam Exclusion Areas* (Document-27748) per TRIUMF request.	4983130
			Doc. Ver. Cont. refs. under 5.3, App. D and App. G	Added *End-Use Statement for dual-use goods: Deuterium oxide, deuterium and deuterated compound* and *Description of the use of up to 300kg of heavy water for the UCN project.* Added 300 kg of deuterium to App. D.	5093314 5093315
			App. D	Added Am-B source, 15 GBq.	5115937

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
			Sections 2.0, 3.2, 4.2, 9.1, 10.1 and 11.1	Section 2.0: Updated definition of Management Systems. Section 3.2: Updated to add reference to REGDOC-2.2.2. Section 4.2: DVC (2): Added bullet "A summary of the total volume and mass of any waste and by-product generated for each type of material" Section 9.1: Updated to add reference to REGDOC-2.9.1. Section 10.1: Updated to add reference to REGDOC-2.10.1. Section 11.1 DVC: Updated CSA N292.3-08 to CSA N292.3-14.	
November 21, 2016	07	5125676	Doc. Ver. Cont. refs under 5.2, 5.3, App. C and App. G	Added Document-136846, *BL1U Beam Commissioning Plan for up to 1μA Operation* and Document-136684, *Design Note TRI-DN-16-34, Safety Analysis for UCN Commissioning to 1 Microampere*. Added 1 μA for BL1U in App. C.	5122154 5109471
			Doc. Ver. Cont. refs under 4,1, 5.2, 5.3 and App. G	Updated Document-30071, *Beamline 2C4 Solid Target Facility Safety Report* and added ATG-PRO-OPR-STF-023, *Long Rb Prototype Target Irradiation Tests*.	5120321 5120322
November 16, 2017	08	5392069	Doc. Ver. Cont. refs under 5.2, 5.3, App. C (Section 2.(j)) and App. G	Updated Document-136684, *Design Note TRI-DN-16-34, Safety Analysis for UCN Commissioning to 1 Microampere* and Document-30071, *Beamline 2C4 Solid Target Facility Safety Report*. Added temporary BL1U operation to 10 μA until December 31, 2017 in App. C, Section 2.(j).	5235183 5392225 5393991

Revision History

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
			Doc. Ver. Cont. refs under 9.1, 9,2 and 9.3, and App. G	Updated Document-15678, *Environmental Management System.*	5391762
March 29, 2018	09	5492240	Doc. Ver. Cont. refs under 5.3, App. D and E	Updated Appendix D and Appendix E table.	N/A
			Doc. Ver. Cont. refs under 13.1	Updated to add reference to REGDOC-2.13.1.	
November 26, 2018	10	5704332	Doc. Ver. Cont. refs under 4.2	Updated to add reference to REGDOC-3.1.2.	N/A
			Section 10	Replaced “must” by “shall”.	
			Doc. Ver. Cont. refs under 15.1	Updated to add reference to REGDOC-3.2.1.	
			App. C	Updated App. C, Section E Actinide Target System, Depleted uranium targets.	
February 11, 2019	11	5760219	All	New CNSC LCH format	N/A
			Doc. Ver. Cont. refs under 2.1	Updated to add reference to REGDOC-2.1.2	
			App. D	Increased amount of deuterium to 110 kg (550 kg of heavy water) and 25 kg for other form.	5786562
			App. C	Removed temporary 10 µA operation on beam line 1U in 2017	5393991

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
			DVC of Sections 7.1, 9.1 and 9.2	Updated TSN 2.4, *Derived Release Limits for Radioactive Emissions from the TRIUMF Site* to latest release DU	5525656
			DVC of Section 13.1	Added Document-154117, *TRIUMF Safeguards Program*	5744915
September 18, 2019	12	5997277	App. D	Added TRIUMF address and shipping/receiving address	N/A
			App. E	App. Changed in Rev. 11 when LCH changed to new format. Reverting to content of Rev. 10.	N/A
March 20, 2020	13	6096926	DVC of Licence Conditions (LC) 5.2, 5.3, App. C (Table D) and App. G	Updated TRIUMF Document-5359, *TR13 Safety Report* to Release 6. Updated App. C to increase production to maximum saturation yield with the exception of ^{18}F (transferred to RCA) and Lithium.	6262648
			DVC of LCs 5.2 and 5.3, and App. G	Updated TRIUMF Document-9605, *TRIUMF to ACU, CCM, CBH Pipelines for PET Radiopharmaceuticals Safety Analysis Report* to Release 9	6266017
			DVC of LCs 7.1, 9.1 and 9.2, and App. G	Removed TSN 2.4.4 (TRIUMF Document-1606) since content is now cover under TRIUMF Document-8506, TSN 2.4, *Derived Release Limits for Radioactive Emissions form the TRIUMF Site*, and updated this latter document to Release 9	6262642

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
			DVC of LC 11.2 and App. G	Updated TRIUMF Document-8810, *Preliminary Decommissioning Plan* (PDP) to Release 5 and removed obsolete addendum to PDP R3 since it is now included in the PDP itself.	6265487
			DVC of LC 15.1 and App. G	Added TRIUMF Document-156040, *TRIUMF Public Information and Disclosure Program*	6265486
			App. D	Increased thorium possession limit to 10 MBq	6263151
			App. E	Corrected a typo for atomic number range.	
			PART I, Section 3.3	Changed ACR date from March 31 to June 30.	6032883
			DVC of LC 2.1, Guidance of LC 3.1 and App. G	Added N286-12 requirements for Licence Condition 2.1 and updated reference to N286-05 to N286-12 in the guidance section of Licence Condition 3.1.	N/A
			Various DVC and App. G	Updated controlled documents according to Table 5-1 of *TRIUMF Annual Compliance Report 2018*	5863670
September 18, 2020	14	6381009	App. C (Section A.2.(j))	Increased BL1U operation to 10 µA in App. C, Section A.2.(j).	N/A
			Doc. Ver. Cont. refs under 5.2, 5.3 and App. C (Section E)	Added TRIUMF Document-188621, Actinide SAR Addendum for a proton-to-neutron converter target at ISAC, Release 1	6389035

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
			Various DVC and App. G	Updated controlled documents according to 6385435	6393959 6393960 6393961 6393962 6393963 6393964 6393965 6393966 6393967 6393968 6393969 6393971 6393973 6393974 6393975 6393976

Table of Content

PART I - COMPLIANCE FRAMEWORK FOR EACH LICENCE CONDITION

1. INTRODUCTION

1.1 Licensing Overview

Class IB Particle Accelerator Operating Licence (PA1OL-01.00/2022) contains licence conditions, grouped by safety and control areas, that:

- identify programs that must be implemented and maintained by TRIUMF, based on information submitted in the licence application to demonstrate to the Canadian Nuclear Safety Commission that TRIUMF has adequate measures in place to fulfill all applicable licensing requirements pursuant to *Nuclear Safety and Control Act* 24(4)(*a*) and (*b*).

The licensing philosophy of the Canadian Nuclear Safety Commission (CNSC) is to support each Class IB Particle Accelerator Operating Licence with a Licence Conditions Handbook (LCH), which describes in detail the regulatory expectations associated with each condition in the licence. The LCH contains compliance criteria related to each licence condition, including:

- references to licensee's documentation with version control;
- reference to codes and standards;
- reference to CNSC regulatory documents; and
- specific operating limits and commitments made by TRIUMF to ensure compliance with CNSC expectations.

The LCH also defines the processes for making changes to the LCH and identifies the authorities delegated to CNSC staff with respect to approving changes.

1.2 Purpose of LCH

The objective of this document is to establish and consolidate into one document the compliance framework related to TRIUMF's particle accelerator operating licence
This includes:

- defining the licensing basis;
- explaining the regulatory context related to each licence condition; and
- identifying verification criteria for each licence condition.

The LCH is to be used by both TRIUMF and by CNSC staff as a tool to assist in ensuring TRIUMF continues to 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.

2. CNSC ADMINISTRATIVE CONTROL PROCESS

2.1 Change Control Process

A change control process is applied to the LCH to ensure that:

- preparation and use of this document is properly controlled;
- all referenced documents are correctly identified and maintained;
- changes are conducted in accordance with CNSC Regulatory Policy P-299, *Regulatory Fundamentals*; and
- procedures for modifying this document are clear.

Changes can be requested by either CNSC staff or TRIUMF. TRIUMF is to be consulted on any changes proposed by CNSC staff. Section 2.3 of this LCH identifies the persons authorized by the Commission to approve changes.

2.2 Change Control Procedure

A change request form is included in Appendix A of the LCH. The change will be assessed by CNSC staff. Provided the change is consistent with the conditions of the licence and the objectives of the licensing basis, a recommendation to proceed will be made to one of the authorized persons identified in section 2.3 of Part I of this LCH. TRIUMF will be consulted on any proposed change requested by CNSC staff. Once approved, the LCH will be updated and distributed in accordance with section 2.5 of this LCH.

2.3 Changes to LCH

The following CNSC staff may approve changes to this LCH:

- Director, Accelerators and Class II Facilities Division (ACFD);
- Director General, Directorate of Nuclear Substance Regulation (DNSR),
- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch.

2.4 Dispute Resolution Process

In the event of disagreement concerning the LCH, the following conflict resolution process will apply:

- The Project Officer handling the licence will arrange a meeting between the appropriate parties, including persons authorized by TRIUMF and the Director of the Accelerator and Class II Facilities Division of the CNSC.
- If a mutually acceptable decision is reached at this meeting, the rationale supporting the decision will be documented and referenced in the LCH.
- If a mutually agreeable decision is not reached, the disagreement will be brought to the next level of authority as defined in section 2.3 of Part I of this LCH.
- Any unresolved issue will be referred to the Commission.

2.5 Distribution

A copy of the updated version of the LCH will be provided to TRIUMF and made available to all relevant CNSC staff through the CNSC electronic document management system.

3. OVERVIEW OF THE OPERATING LICENCE

3.1 Section I - Licence Number

The alphanumeric expression PA1OL-01.00/2022 stems from a standard convention for identifying CNSC licences. The following table provides a description of each identifier used in the expression:

Identifier	Description
PA1OL	Class IB Particle Accelerator Facility Operating Licence
01	Identifier corresponding to TRIUMF Accelerators Inc.
00	Licence version number (00 = Initial licence)
2022	Expiration year

3.2 Section II - Licensee

This part of the licence provides the name and the address of the person or the corporate entity that holds the licence (hereinafter the “licensee”). In this case it is TRIUMF Accelerators Incorporated.

3.3 Licence Period

Identifies the duration for which the licence is valid, which for PA1OL-01.00/2022, is from 01 July 1, 2012 to June 30, 2022, unless suspended, amended, revoked, or replaced during the licensing period.

3.4 Section IV - Licensed Activities

This licence authorizes the licensee to:

(i) Operate the following facilities:

a. Class I:

- **a 500 MeV cyclotron and its associated beamlines and targets**

b. Class II:

- **CP42, a 42 MeV cyclotron**
- **TR30-1, a 30 MeV cyclotron**
- **TR30-2, a 30 MeV cyclotron**
- **TR13, a 13 MeV cyclotron**
- **ISAC I, a radioactive ion beam accelerator**
- **ISAC 2, a radioactive ion beam accelerator**

(ii) Service the above facilities;

(iii) Produce, possess, process, transfer, use and store within the boundaries of the site any nuclear substance required for, associated with or incidental to the activity described in (i) above;

(iv) Produce, possess, process, transfer, use, import, export and store within the boundaries of the site any other nuclear substance, subject to condition 5.3.

This part of the licence lists the activities that TRIUMF is authorized to conduct. They are derived from the list of activities described in section 26 of the *Nuclear Safety and Control Act* (hereinafter "NSCA").

The operation of the facility is subject to the *Nuclear Safety and Control Act*, its associated regulations and the licence conditions set out in the Class IB Particle Accelerator Facility Operating Licence (PA1OL).

3.5 Section V - Explanatory Notes

Part V of the licence clarifies the language used in the licence and introduces the Licence Conditions Handbook (LCH) as a licence compliance tool:

(a) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and associated Regulations.

(b) The "*TRIUMF Licence Conditions Handbook (*LCH)" provides:

(i) compliance verification criteria in order to meet the conditions listed in the licence;

(ii) information regarding delegation of authority to CNSC staff; and

(iii) applicable versions of documents and a process for version control of codes, standards or other documents that are used as compliance verification criteria in order to meet the conditions listed in the licence.

3.6 Section VI - Licence Conditions

This part of the licence lists the conditions with which the licensee must comply. For clarity, the licence conditions are grouped, to the extent possible, under the most appropriate safety and control area (SCA) relating to the licensed activities. Part II of the LCH provides compliance verification criteria and guidance for each licence condition.

PART II - COMPLIANCE FRAMEWORK FOR EACH LICENCE CONDITION

1. GENERAL

Licence Condition 1.1 – Licensing Basis

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

Preamble

The licensing basis for a regulated facility or activity is a set of requirements and documents comprising:

(i) the requirements set out in the applicable laws and regulations;
(ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence; and
(iii) the safety and control measures described in the licence application and the documents needed to support that licence application.

The licensing basis sets the boundary conditions for acceptable performance at a regulated facility or activity, thus establishing the basis for the CNSC's compliance program with respect to that regulated facility or activity.

Compliance Verification Criteria

TRIUMF shall operate its nuclear facilities in accordance with the licensing basis. This means that TRIUMF shall conduct the licensed activities in accordance with the laws, regulations, requirements and documents included in (i) through (iii) above.

The "documents needed to support the licence application" under item iii) above are referenced in this LCH. As improvements are made to TRIUMF's programs and documents throughout the licence period, provisions have been made under licence condition 1.2 to allow TRIUMF to make changes to these documents.

Guidance

None provided.

Licence Condition 1.2 – Changes to TRIUMF Documents

(a) Changes to the safety and control measures described in the application and the documents needed to support that application are permitted provided that the objective of the licensing basis is met.

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

Preamble

TRIUMF is encouraged to make continuous improvements to all aspects of its operations, but at all times must remain within the licensing basis authorized by the Commission. Consequently, if changes are made which improve safety and remain within the licensing basis, then TRIUMF does not need prior written approval of the Commission. However, TRIUMF is required to notify the CNSC staff when **any** changes are made to the core documents identified in each safety and control area. For these documents, the licensee must submit proposed changes sufficiently far in advance of the implementation date to enable CNSC staff to review the changes made and verify that all changes remain within the licensing basis **prior to implementation.**

Changes outside of the existing licensing basis require written approval of the Commission. Such changes will typically require the licensee to apply for a licence amendment to modify the scope of the licensing basis.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change: None.

TRIUMF shall not make any change that would result in an impact on the health and safety of persons, the environment, national security, or the control measures related to the international obligations to which Canada has agreed, that is different in nature or greater in magnitude or probability than that described in the licensing basis documents, without prior written approval of the Commission. All other changes are subject to the written approval of the persons designated under section 2.3 of Part I of this LCH.

The documents which must be submitted to obtain CNSC approval for changes must demonstrate that the change:

- has been thoroughly developed, designed, analyzed, reviewed and approved by the licensee, and
- is in compliance with all regulatory requirements.

The documents required to be submitted by criterion 1.2(1) must contain the complete set of information needed to enable CNSC staff to evaluate the proposed change and develop a

regulatory position for decision by the Commission, or a person authorized by the Commission as defined in section 2.3 of this LCH. Prior to submitting the request and documents related to the change approval, TRIUMF shall have assessed and approved the proposed change using TRIUMF's authorized change control process confirming the merit, validity and safety of the proposed change. The proposed change details shall have been developed and designed to the level which enables a sound and informed decision to be made. The proposed change must be supported by a corresponding safety analysis and TRIUMF must demonstrate that it complies with all regulatory and licensing requirements. The design, review, control and implementation of the change must be in accordance with the requirements of applicable standards and reference publications specified in the LCH, unless otherwise accepted in writing by CNSC staff.

The approval for changes may be granted by the Commission or by the CNSC staff identified in the introduction of this LCH, depending upon on its risk significance. CNSC staff will submit to the Commission for consideration any matter that in CNSC staff's opinion:

(a) may pose an unreasonable risk;
(b) is potentially of significant interest to the Commission; or
(c) has the potential to attract national or international public or media interest or concern.

If the written approval of the Commission is needed for a change to proceed, a determination of the applicability of the *Canadian Environmental Assessment Act* (CEAA) must be made by CNSC staff. An environmental assessment under CEAA may or may not be required.

Guidance

None provided.

Licence Condition 1.3 – Resolution of Conflict or Inconsistency

The licensee shall, in the event of any conflict or inconsistency, actual or potential, between licence conditions or codes, standards or regulatory documents referenced in this licence, direct the conflict or inconsistency in writing to the Commission, or a person authorized by the Commission, for resolution.

Preamble

This licence condition directs the licensee to seek CNSC resolution in the event that conflicts or inconsistencies are identified between the documents which form the licensing basis.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change: None.

The licensee shall formally seek CNSC resolution of any conflict or inconsistency.

In the event of any conflict or inconsistency between any CNSC requirement made pursuant to the *Nuclear Safety and Control Act* and its regulations, and the requirements of the licence, the licensee shall refer the matter to the Commission or a person authorized by the Commission for resolution.

Guidance

Any conflict or inconsistency identified should first be discussed between TRIUMF and CNSC Project Officer handling the licence. If the conflict or inconsistency cannot be resolved, the matter shall be referred to the dispute resolution process described in section 2.4 of Part I of this LCH.

The outcome will be documented to ensure a common understanding. CNSC staff will record all resolutions made pursuant to this licence condition in Appendix H of the LCH. This Appendix gives a description of the conflict or inconsistency and a reference to the CNSC electronic record (E-DOCS #) documenting the resolution.

If necessary, the LCH will be updated to reflect any changes required to resolve the conflict or inconsistency.

2. SCA – MANAGEMENT SYSTEM

The management system SCA covers the framework of processes, procedures and practices used to ensure an organization can fulfill all tasks required to achieve its objectives safely and consistently.

Performance Objective: Establishment and maintenance of a documented series of processes which ensure adequate management oversight and control over the operation of the facility and the conduct of licensed activities.

Licence Condition 2.1 – Management System

The licensee shall implement and maintain a management system, including a written safety policy which places safety paramount within the management system, overriding all other demands, for activities carried out under this licence.

Preamble

Paragraph 3(k) of the *General Nuclear Safety and Control Regulations* requires that a licence application contain information related to the applicant's organizational management structure including the internal allocation of functions, responsibilities and authority.

Paragraph 3(d) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain *"the proposed quality assurance program for the licensed activity"*.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CSA	*Management System Requirements for Nuclear Facilities*	N286-12		2012
CNSC	REGDOC-2.1.2, *Safety Culture*	REGDOC-2.1.2	1.0	2018/04

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.0, *TRIUMF Policy on Safety in the Workplace*	537	1.0.1	2001/07
TRIUMF	TSOP-01, *Documents and Records Management*	593	4	2018/09/11
TRIUMF	TSOP-07, *Experiment Management Science Division*	599	4	2015/10/02
TRIUMF	TSOP-09, *Quality Program Assessment*	607	6	2015/12/17
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04
TRIUMF	*TRIUMF Board of Management Safety & Security Committee Terms of Reference*	10610	1	2007/03
TRIUMF	*TRIUMF Organizational Chart*	18112	Oct 2018	2018/10/05
TRIUMF	*Joint Venture Agreement*	18114	Mar 2008	2008/03

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TAI Management Agreement*	18115	Mar 2008	2008/03
TRIUMF	*TRIUMF Joint Health & Safety Committee Terms of Reference*	18121	5	2017/10/23
TRIUMF	*Document Manual*	22284	5	2018/08/02
TRIUMF	*Safety and Quality Management Review Meeting - Terms of Reference*	24195	2	2018/01/15
TRIUMF	*TRIUMF Key Performance Indicators*	126719	2	2016/06/20

Guidance

None provided.

3. SCA – 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 the number of licensee staff is sufficient in all relevant job areas and that licensee staff have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.

Performance Objective: The number of licensee staff is sufficient in all relevant job areas and staff have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.

Licence Condition 3.1 – Human Performance Program

The licensee shall implement and maintain a human performance management program.

Preamble

Paragraphs 12(1)(a), (b), (e) and section 17 of the *General Nuclear Safety and Control Regulations* require different elements related to the human performance program.

CNSC Regulatory P-119, *Policy on Human Factors* requires that the CNSC take human factors issues into account in its regulatory activities.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	P-119, *Policy on Human Factors*	P-119		2000/10
CNSC	G-276, *Human Factors Engineering Program Plans*	G-276		2003/06
CNSC	G-278, *Human Factors Verification and Validation Plans*	G-278		2003/06

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.7, *Requirements for Reporting of Incidents*	529	draft	
TRIUMF	TSN 1.0, *TRIUMF Policy on Safety in the Workplace*	537	1.0.1	2001/07
TRIUMF	TSOP-09, *Quality Program Assessment*	607	6	2015/12/17
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04
TRIUMF	TSOP-11, *Operations Management*	5604	2	2008-10-15
TRIUMF	*TRIUMF Key Performance Indicators*	126719	2	2016/06/20

(1) The licensee shall implement a human performance program linking together the key elements important to human performance management. The program is expected to satisfy the requirements of:

- P-119, Policy on Human Factors;
- G-276, Human Factors Engineering Program Plans; and
- G-278, Human Factors Verification and Validation Plans.

(2) The licensee shall:

- define the expected personnel performance and behavior and communicate the expectations to personnel;
- define the expected results of personnel performance and communicate the expectations to personnel; and
- evaluate the personnel performance and compare it against expectations.

(3) The licensee shall ensure that work activities are authorized and carried out using approved documents (including those for software), materials, parts, tools, processes and practices.

(4) The licensee shall ensure that:

- verification activities are planned before starting the work;
- verification of work is performed to confirm that the work meets requirements; and
- verification is recorded.

(5) The licensee shall ensure that persons assigned to perform independent verification do not verify their own work; or work they have directly supervised.

(6) The licensee shall monitor and control the hours of work and shift schedules of personnel performing safety-related tasks or working on safety-related systems.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
USNRC	*Human Factors Engineering Program Review Model*	NUREG-0711	2	
CSA	*Management System Requirements for Nuclear Facilities*	N286-12		2012

A human performance management program is the overarching program that integrates all activities associated with human factors. Human performance is the outcome of human behaviors, functions and actions in a specified environment, reflecting the ability of workers and management to meet the management system's defined performance under the conditions in which the management system will be employed.

Human factors are factors that influence human performance as it relates to the safety of a nuclear facility or activity over all the phases, including design, operation, maintenance, and decommissioning. These factors may include the characteristics of the person, task, equipment, organization, environment, and training. The application of human factors to issues such as interface design, training, procedures, organization and job design may affect the reliability of humans performing tasks under various conditions.

The licensee may follow industry best practice in developing the elements of a human performance program. Additional details on human factors engineering programs can be found in NUREG-0711: *Human Factors Engineering Program Review Model*. Where applicable, the human performance program should reference governing documentation for the facility.

Independent Verification:
Clauses 5.4, 5.8 and 5.10 of CSA standard N286-12 define the generic requirements needed in order to ensure:

- personnel know what is expected of them;
- performance of work is controlled; and
- work is verified to confirm that it is correct.

The degree of independence and extent of verification can vary depending of the complexity of the work and the potential impact on safety.

Licence Condition 3.2 – Training Program

The licensee shall implement and maintain a training program.

Preamble

Paragraphs 12(1)(*a*) and 12(1)(*b*) of the *General Nuclear Safety and Control Regulations* require that a licensee shall ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the Act, the regulations made under the Act and the licence; and shall train the workers to carry on the licensed activity in accordance with the Act, the regulations made under the Act and the licence.

Paragraphs 6(*m*) and 6(*n*) of the *Class I Nuclear Facilities Regulations* require that licence applications include the proposed responsibilities of and qualification requirements and training program for workers, including the procedures for the requalification of workers; and the results that have been achieved in implementing the program for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility.

Paragraph 14(2)(e) of the *Class I Nuclear Facilities Regulations* requires every licensee to keep a record of the status of each worker's qualifications, requalification and training, including the results of all tests and examinations completed in accordance with the licence.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.2.2, *Personnel Training*	REGDOC-2.2.2	1.0	2014/08

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.1, *TRIUMF Radiation Protection Training Program*	538	5	2017/03/27
TRIUMF	TSOP-04, *The TRIUMF Training Program*	609	5	2019/04/01
TRIUMF	*TRIUMF Handbook of Occupational Health and Safety*	840	6	2017/09

The licensee shall implement and maintain training programs for workers in accordance with the requirements set out in REGDOC-2.2.2 *Personnel Training*.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	TPED-01, *Objectives and Criteria for Regulatory Evaluations of Nuclear Facility Training Programs*	TPED-01	4	2013/09

CNSC document TPED-01, *Objectives and Criteria for Regulatory Evaluation of Nuclear Facility Training Programs* sets out the compliance criteria to evaluate all training programs.

4. SCA – OPERATING PERFORMANCE

The Safety and Control Area "Operating Performance covers the overall program which establishes and maintains the operating policies and procedures which enable TRIUMF to safely conduct the activities authorized under the licence, as well as the processes used to periodically review performance to ensure TRIUMF continues to conduct the licensed activity in a safe and effective manner.

Performance Objective: The establishment and maintenance of a program which ensures the safe and secure operation of the facility, including adequate regard for health, safety, security, environmental protection and international obligations.

Licence Condition 4.1 – Operating Program

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.

Preamble

Paragraph 6(d) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.7, *Requirements for Reporting of Incidents*	529	draft	
TRIUMF	*TRIUMF Safety Report*	563	3	2005/09
TRIUMF	TSOP-09, *Quality Program Assessment*	607	6	2015/12/17
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04
TRIUMF	TSOP-11, *Operations Management*	5604	2	2008-10-15
TRIUMF	TSOP-12, *Configuration Management*	5605	3	2015/12/04
TRIUMF	TSOP-13, *Commissioning*	5708	2	2008/10/15
TRIUMF	*BL1U Beam Commissioning Plan for 1μA Operation*	136846	1	2016/11/08

(1) Operation of the facility shall be governed by formal developed and validated procedures which are reviewed and revised as necessary on a regular basis.

(2) The licensee shall use the safety analysis reports as a basis for continuous safe operation of its facilities and for assessing the safety implications of changes to the facility or to operating procedures.

(3) If operation outside permitted operating boundaries, limits and rules as defined in the facility safety analyses is discovered, the licensee shall take immediate action to return operations to within these limitations.

Guidance

The operating program defines the operating rules consistent with the safety analyses and other licensing support documentation within which the facility will be operated, maintained and modified, all of which should ensure nuclear safety. The program for operation must specify the authorities of facility staff positions to make decisions within the defined boundaries. The operations program establishes safe, uniform, and efficient operating practices within the nuclear facility.

The *TRIUMF Quality Manual* and facility Safety Analysis Reports define the specific requirements with respect to facility operations, configuration control and operating procedures related to TRIUMF's facilities. Compliance is verified by monitoring conformity with these documents and the supporting documents they reference.

Licence Condition 4.2 – Reporting Requirements

The licensee shall submit to the Commission each year a written annual compliance report that covers the previous year's operation.

Preamble

Paragraph 24(5) of the *Nuclear Safety and Control Act* specifies that a licence may contain "*any term or condition that the Commission considers necessary for the purposes of this Act"*. Every facility operating licence includes the requirement to submit an "Annual Compliance Report" (ACR). This report provides a summary of key facility operating performance parameters related to the safe operation of the facility and the safe conduct of the licensed activities.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change: None.

(1) TRIUMF shall submit a written Annual Compliance Report by June 30 of each year, unless otherwise directed or approved in writing by the Commission or a person authorized by the Commission.

(2) At a minimum, the ACR shall contain:

- A brief summary of operation during the year.
- A list of persons appointed by TRIUMF to be responsible for day-to-day operation of the facility.
- A list of the membership of the radiation safety committee (or equivalent) and any other committee having responsibility for oversight of the safe conduct of operations. Include a brief summary of any activities or decisions of these committees having a potentially significant impact upon the safe conduct of the licensed activities.
- A summary for the year of the status of any changes to the facility or operating procedures which might affect safety.
- A summary of the total volume and mass of any waste and by-product generated for each type of materials (both nuclear and/or hazardous).
- A summary and analysis of results of radiation safety measurements performed in the year (both routine and special measurements). Where potential annual doses are extrapolated from area monitoring results, provide a justification for any parameters used to perform the calculation.
- A summary of the results of routine and special tests performed on safety-related systems. Include the reasons for and nature of special tests. Include the required frequency for these tests which are specified as part of the facilities Maintenance, Testing and Calibration program. Provide an explanation for any tests which were not conducted, including the projected date for completing tests which have been delayed.

- A description of distribution of annual radiation exposures to personnel at the facility, including both Nuclear Energy Workers (NEWs) and non-NEWs. Include whole body effective doses, extremity equivalent doses, and the results of any neutron dosimetry or bioassays. Also include the methods used for personal dose monitoring.
- A summary of any unusual occurrences in which personnel or the public were, or could have been, exposed to radiological or other hazards. This should include a description of any corrective action taken as a result of the occurrences.
  NOTE: TRIUMF **must** report all such incidents immediately in accordance with sections 29 to 32 of the *General Nuclear Safety and Control Regulations*. Inclusion of a summary of these incidents in the ACR does **not** release TRIUMF from the any other reporting requirements specified in *NSC Act* or *Regulations.*
- The total number of hours of various operating modes during the year, including the energies and beam currents used in conjunction with the various accelerators, beam lines and targets.
- A current inventory of all nuclear substances (sealed and unsealed) and radiation devices.
- The activity, volume and composition of solid and liquid radioactive wastes generated during the year and the method employed for their disposal. Include the types of radioactive liquid and gaseous wastes released to the environment and total activities released during the year.
- A summary of any planned changes for which the Commission's approval will probably be requested during the next year.
- Any changes to the emergency procedures, or any other changes that could affect the facility's emergency response program. Include any training activities, drill and exercise activities, or unplanned events in which the facility's emergency response organization has been tested.
- A summary of the outcomes from the management reviews performed at the facility according to the TRIUMF Quality Assurance Manual.
- A brief report on the status of the preliminary decommissioning plan and decommissioning fund.
- The name and signature of the signing authority, certifying that the facility has been operated in compliance with the licence except where noted. Include the signatory's function, address and telephone number.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CNSC	REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills*	REGDOC-3.1.2	1.0	2018/01

Detailed guidance on preparing ACRs, licensee's report and notifications regarding situations is contained in the CNSC's REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills*.

5. SCA – SAFETY ANALYSIS AND PHYSICAL DESIGN

The SCA entitled "Safety Analysis" addresses the systematic evaluation of the potential hazards associated with the operation of the facility and the conduct of licensed activities; including the evaluation of the effectiveness of the preventative measures and strategies that have been implemented to mitigate these hazards.

The SCA entitled "Physical Design" relates to the ability of the facility's systems, components and structures to meet and maintain their design basis over the lifetime of the facility.

These SCAs are not readily separable in the context of TRIUMF. The physical design of each accelerator facility is described and assessed in the corresponding Safety Analysis Report (SAR) that supports the overall safety case for the various accelerators and associated sub-systems at TRIUMF.

Performance Objective: The protective measures incorporated into the design of the facility are established using a systematic safety analysis. The safety analysis addresses the potential exposure of personnel and the public to radiation and releases of radioactivity and hazardous substances to the environment, during both normal operation and "design basis events". The resulting design of the facility's systems, components and structures provide adequate protection from the potential hazards associated with the operation of the facility.

Licence Condition 5.1 – Design and Safety Analysis Program

The licensee shall implement and maintain a facility design and safety analysis program.

Preamble

Paragraph 3(1)(i) of the *General Nuclear Safety and Control Regulations* requires that a licence application contain a description and the results of any test, analysis or calculation performed to substantiate the information included in the application.

Paragraphs 6(a), (b), (c) and (d) of the *Class I Nuclear Facilities Regulations* require that a licence application contain: a description of the structures, systems and equipment at the facility, including their design and their design operating conditions; a final safety analysis report demonstrating the adequacy of the design of the nuclear facility; and the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	P-119, *Policy on Human Factors*	P-119		2000/10
CNSC	G-276, *Human Factors Engineering Program Plans*	G-276		2003/06
CNSC	G-278, *Human Factors Verification and Validation Plans*	G-278		2003/06
GOC	*National Building Code of Canada 2015*	N/A		2015
GOC	*National Fire Code of Canada 2015*	N/A		2015
NFPA	NFPA 801: S*tandard for Fire Protection for Facilities Handling Radioactive Materials*	NFPA 801		2014

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSOP-06, *Engineering Design, Manufacture and Assembly*	597	2	2008/10/15
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04
TRIUMF	TSOP-12, *Configuration Management*	5605	3	2015/12/04

TRIUMF	TSOP-15, *Project Governance*	22889	5	2019/03/26

(1) The design and safety analysis program shall include:

- processes to ensure that the design of any facility structure, system or component and any modifications comply with applicable codes, standards and regulations, including adequate consideration of human factors;
- provisions to ensure that design of any facility incorporates the shielding and safety systems necessary to keep radiological doses to workers and members of the public below regulatory limits and ALARA;
- provisions to ensure that design of any facility incorporates measures to keep releases of radioactive materials into the environment below regulatory limits and ALARA;
- provisions to ensure that systems and components important to safety are designed to be reliable, fail-safe and incorporate sufficient redundancy to ensure that the failure or the removal from service of a single component does not result in a loss of either the protection function or the minimum level of redundancy required;
- configuration management processes to ensure that the documented design basis for the facility is maintained up-to-date after design changes, and;
- processes to ensure that the impacts of design changes are fully assessed and accurately reflected in the safety analyses prior to implementation.

(2) Modifications to the facility shall be made in accordance with the *National Building Code of Canada 2015*, the *National Fire Code of Canada 2015*, and NFPA 801: S*tandard for Fire Protection for Facilities Handling Radioactive Materials*. TRIUMF shall, prior to implementation of any proposed modification of the facility with the potential to impact protection from fire:

- submit the proposed modification for third-party review for compliance with the above fire protection codes and standards;
- have the review carried out by one or more independent external reviewers having specific expertise with such reviews; and
- submit in writing the results of the review to the Commission, or a person authorized by the Commission.

(3) As a minimum, facility safety analyses shall include a description and analysis of:

- the design of the facility;
- the normal operating conditions and parameters for the facility;
- the radiological hazards related to the operation of the facility and the measures implemented to ensure that radiological doses to workers and members of the public are below regulatory limits and ALARA;
- the measures implemented to ensure that releases of radioactive materials into the environment are below regulatory limits and ALARA;
- all safety systems and their design basis;
- the potential accident scenarios caused by process deviations, events internal to the facility, and credible external events including natural phenomena, and;
- the radiological consequences should such an accident occur.

Guidance

The *TRIUMF Quality Manual* defines the specific requirements needed to adequately conduct the design of structures, systems and components, including control system software. TRIUMF Standard Operating Procedures (TSOP) TSOP-02, *Nonconformity Reporting & Resolution*, TSOP-06, *Engineering design, Manufacture and Assembly*, TSOP-12, *Configuration Management*, and TSOP-15, Project Management describe processes and procedures applicable to the design and safety analysis of TRIUMF's facilities. Compliance is verified by monitoring conformity with these policies and procedures and the supporting documents referenced in these documents.

The criteria set out in CNSC regulatory documents G-276, *Human Factors Engineering Program Plans* and G-278, *Human Factors Verification and Validation Plans* should be included as part of TRIUMF's design program.

When the safety analysis methodology is modified as a result of improved knowledge, or to address emerging issues, TRIUMF is expected to assess the impact of such a modification on the operating limits, as well as procedural and administrative rules. TRIUMF cannot credit results obtained with a modified safety analysis methodology to relax operating limits, or procedural and administrative rules, without the consent of the CNSC authorized person.

Licence Condition 5.2 – Design and Safety Analysis Documents

The licensee shall maintain an up to date set of documents and technical references comprising detailed technical descriptions and safety analyses specific to each major facility on-site.

Preamble

Paragraph 3(1)(i) of the *General Nuclear Safety and Control Regulations* requires that a licence application contain a description and the results of any test, analysis or calculation performed to substantiate the information included in the application.

Paragraphs 6(a), (b), (c) and (d) of the *Class I Nuclear Facilities Regulations* require that a licence application contain: a description of the structures, systems and equipment at the facility, including their design and their design operating conditions; a final safety analysis report demonstrating the adequacy of the design of the nuclear facility; and the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*ISAC II Safety Report*	561	4	2013/07/22
TRIUMF	*TRIUMF TR30-2 Safety Report*	562	1.7	2003/03
TRIUMF	*TRIUMF Safety Report*	563	3	2005/09
TRIUMF	*ISAC I Safety Analysis Report*	565	1	2000/10
TRIUMF	*TRIUMF TR30-1 Safety Analysis Report*	3794	0	2005/03
TRIUMF	*TR13 Safety Report*	5359	6	2020/01/17
TRIUMF	*CP-42 Safety Analysis Report*	7114	2.2	2006/08
TRIUMF	*TRIUMF - ISAC II Safety Report Supplementary Information*	8913	1	2006/12/08
TRIUMF	*Proton Therapy Safety Analysis Report*	9408	3	2011/12/01
TRIUMF	*TRIUMF to ACU, CCM, CBH Pipelines for PET Radiopharmaceuticals Safety Analysis Report*	9605	9	2019/11/
TRIUMF	*Actinide Target Safety Analysis Report*	12972	2	2011/09/28
TRIUMF	*Proposal to Modify ISAC II Vault Exclusion Area Boundary*	27099	4	2013/03/15

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*520 MeV Accelerator Access Control Interlock Systems: Area Safety Units and the Emergency Trip Pushbutton System for Secondary Beam Exclusion Areas*	27748	7	2015/10/01
TRIUMF	*Accelerator Access Control Interlock Systems: Functional Requirements and Design of Area Safety Units and the Emergency Trip Pushbutton System for Primary Beam and ISAC Exclusion Areas*	27775	7	2015/10/01
TRIUMF	*Beamline 2C4 Solid Target Facility Safety Report*	30071	5	2017/08/21
TRIUMF	*Worst Case Emissions Analysis Report*	55017	1	2015/01/31
TRIUMF	*Functional Requirements and Design of the e-Hall Maze Area Safety Unit*	57727	1	2013/01/31
TRIUMF	*Design Note TRI-DN-13-17 BL1A Shield Plug Modifications for UCN*	93063	2	2013/10/28
TRIUMF	*Actinide Target SAR Addendum for Thorium Oxide*	110961	1	2014/07/30
TRIUMF	Design Note TRI-DN-16-34, *Safety Analysis for UCN Commissioning to 1 Microampere*	136684	2	2017/04/24
TRIUMF	*BL1U Beam Commissioning Plan for 1μA Operation*	136846	1	2016/11/08
TRIUMF	*Actinide SAR Addendum for a proton-to-neutron converter target at ISAC*	188621	1	2020/09/28

(1) TRIUMF shall maintain an up to date set of design documents, technical references and safety analysis reports for the nuclear facility. These must include all accelerators, beam-lines, target system, beam dumps and associated safety interlocks systems.

The list of controlled Safety Analysis Reports pertaining to this requirement is included under the Document Control Section for this licence condition.

Guidance

Major new facilities or systems being constructed on TRIUMF's the site will typically require the issuance of licences to construct and commission the new facilities and are subject to the normal licensing processes as specified under the *NSC Act* and *Regulations.* The list of approved safety analysis reports will be updated to include such new facilities once they achieve routine operating status and are incorporated under the operating licence.

While TRIUMF is expected to review and if necessary, to revise and reissue the Safety Analysis periodically, **revisions to the reports must be submitted to the CNSC for review and are subject to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).**

Licence Condition 5.3 – Operational Specifications and Limits

The licensee shall maintain an up to date set of operating limits for the facilities and activities authorized under the licence, including limits for the production, possession, processing, use, transfer, storage, import and export of nuclear substances and operational limits for accelerators, beam-lines and target assemblies.

Preamble

Paragraph 3(1)(c) of the *General Nuclear Safety and Control Regulations* requires that every licence application contain the name, maximum quantity and form of any nuclear substance to be encompassed by the licence.

Paragraph 6(d) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Paragraphs 12(1)(c), (d) and (f) of the *General Nuclear Safety and Control Regulations* require that licensees take all reasonable precautions to protect the environment and the health and safety of persons and to maintain security; provide the devices required by the licence and maintain them; and take all reasonable precautions to control the release of radioactive nuclear substances or hazardous substances. Paragraph 12(1)(e) of the *General Nuclear Safety and Control Regulations* further requires that every person at the site of the licensed activity use equipment, devices, clothing and procedures in accordance with the Act, the regulations made under the Act and the licence.

Parameters such as beam energy and current limits for accelerators, beam lines, targets and beam dumps, define the safe operating envelope for the facility.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*ISAC II Safety Report*	561	4	2013/07/22
TRIUMF	*TRIUMF TR30-2 Safety Report*	562	1.7	2003/03
TRIUMF	*TRIUMF Safety Report*	563	3	2005/09
TRIUMF	*ISAC I Safety Analysis Report*	565	1	2000/10
TRIUMF	*TRIUMF TR30-1 Safety Analysis Report*	3794	0	2005/03
TRIUMF	*TR13 Safety Report*	5359	6	2020/01/17
TRIUMF	*CP-42 Safety Analysis Report*	7114	2.2	2006/08

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF - ISAC II Safety Report Supplementary Information*	8913	1	2006/12/08
TRIUMF	*Proton Therapy Safety Analysis Report*	9408	3	2011/12/01
TRIUMF	*TRIUMF to ACU, CCM, CBH Pipelines for PET Radiopharmaceuticals Safety Analysis Report*	9605	9	2019/11/
TRIUMF	*Actinide Target Safety Analysis Report*	12972	2	2011/09/28
TRIUMF	*Proposal to Modify ISAC II Vault Exclusion Area Boundary*	27099	4	2013/03/15
TRIUMF	*Beamline 2C4 Solid Target Facility Safety Report*	30071	5	2017/08/21
TRIUMF	*Functional Requirements and Design of the e-Hall Maze Area Safety Unit*	57727	1	2013/01/31
TRIUMF	*Design Note TRI-DN-13-17 BL1A Shield Plug Modifications for UCN*	93063	2	2013/10/28
TRIUMF	*Actinide Target SAR Addendum for Thorium Oxide*	110961	1	2014/07/30
TRIUMF	Design Note TRI-DN-16-34, *Safety Analysis for UCN Commissioning to 1 Microampere*	136684	2	2017/04/24
TRIUMF	*Actinide SAR Addendum for a proton-to-neutron converter target at ISAC*	188621	1	2020/09/28
TRIUMF	*Long Rb Prototype Target Irradiation Tests*	ATG-PRO-OPR-STF-023	A	2016/10/31
TRIUMF	*End-Use Statement for dual-use goods: Deuterium oxide, deuterium and deuterated compound*			2016/08/10
TRIUMF	*Description of the use of up to 300kg of heavy water for the UCN project*			2016/09/29

(1) TRIUMF shall operate its facilities in accordance with the operating limits and specifications listed in "APPENDIX C – FACILITY OPERATIONAL LIMITS" in this LCH. Changes to the operating limits and specifications require written approval from the Commission or a person authorized by the Commission, prior to implementation.

(2) Except for nuclear substances listed in paragraph IV iii) of the licence, for Sealed and Unsealed Sources, TRIUMF shall possess, import, use, transfer and store within the boundaries of the site only those nuclear substances which are identified under

"APPENDIX D: SOURCE - LIMITS FOR POSSESSION, IMPORT, USE, TRANSFER AND STORAGE" in this LCH.

(3) Except for nuclear substances listed in paragraph IV iii) of the licence, for isotopes collected at the ISAC Collection Station or produced at TRIUMF Class IB and II facilities, TRIUMF shall produce and process only those nuclear substances identified in "APPENDIX E: NUCLEAR SUBSTANCES - ISAC COLLECTION STATION AND ISOTOPE PRODUCTION, FACILITY LIMITS FOR PRODUCTION AND PROCESSING" in this LCH.

(4) TRIUMF shall export only those nuclear substances identified in "APPENDIX F: NUCLEAR SUBSTANCES - LIMITS FOR EXPORT" in this LCH.

Guidance

Note that this exempts any activated components or by-products which result from normal operation of TRIUMF's various accelerator facilities. It also does not apply to radioactive ion beams produced by ISAC targets. It is intended to apply only to sealed and open radioactive sources used on the site or deliberately produced for sale or transfer to another licensed facility.

Also note that the licence condition does not authorize TRIUMF to import or export any "controlled nuclear substances" as defined in the *Nuclear Non-proliferation Import and Export Control Regulations*.

6. SCA – FITNESS FOR SERVICE

The Safety and Control Area "Fitness for Service" covers the testing, calibration and maintenance programs and activities that ensure the systems, components and structures at TRIUMF continue to effectively fulfill their intended purpose.

Performance Objective: Those structures, systems, and components which affect safe operation and security of the facility remain available, reliable and effective and continue to function in a manner which is consistent with their design.

Licence Condition 6.1 – Testing, Calibration and Maintenance Program

The licensee shall implement and maintain a testing, calibration and maintenance program for the facility.

Preamble

Paragraph 6(d) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
GOC	*National Fire Code of Canada 2015*	N/A		2015
NFPA	NFPA 801: S*tandard for Fire Protection for Facilities Handling Radioactive Materials*	NFPA 801		2014

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.3, *TRIUMF Lockout Policy and Procedures*	539	6	2018/06/14
TRIUMF	TSN 1.5, *Policy and Procedures for the Implementation of Interlocks Defeats and Device Disables*	541	3	2018/11/23
TRIUMF	TSN 1.6, *Availability Requirements for TRIUMF Radiation Safety Systems*	542	1	2006/01
TRIUMF	TSOP-08, *Calibration and Inspection*	595	4	2016/12/12
TRIUMF	TSOP-06, *Engineering Design, Manufacture and Assembly*	597	2	2008/10/15
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-12, *Configuration Management*	5605	3	2015/12/04
TRIUMF	*Verification of Effluent Air Monitor Calibration*	109449	1	2014/05/20

(1) TRIUMF shall determine the extent and frequency of preventive maintenance, testing, surveillance, and inspection of structures, systems and components through a systematic approach, following operating experience and best industry practices. As a minimum, for each structure, system or component, this shall take into account:

- their importance to safety;

- their inherent reliability;
- their potential for degradation (based on operational and other relevant experience, research and vendor recommendations); and
- the consequences of failure.

(2) TRIUMF shall document the frequency that the various maintenance, inspection and testing tasks are performed.

(3) Following any abnormal event which may have an impact upon the safety functions and functional integrity of any structure, system or component TRIUMF shall identify and revalidate the safety functions and carry out any necessary remedial actions, including inspection, testing, maintenance, and repair, as appropriate.

(4) TRIUMF shall record the results of all maintenance, testing, and surveillance of structures, systems and components. The results of TRIUMF's testing, maintenance and calibration program must be reviewed at least annually as part of TRIUMF's internal Quality Assurance Program to look for evidence of incipient and recurring failures and shall initiate corrective actions accordingly.

(5) A description of the results of TRIUMF's testing, maintenance and calibration program as it relates to critical safety systems and device must be submitted to the CNSC annually as part of the Annual Compliance Report required under Licence Condition 4.2.

(6) TRIUMF shall operate, maintain, test, and inspect the facility in accordance with the *National Fire Code of Canada 2015* and NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials*. To demonstrate compliance with the applicable codes and standards TRIUMF shall:

- arrange for a third party review of compliance with the requirements of the *National Fire Code of Canada2015* and NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials* biennially;
- have the review carried out by one or more independent external agencies having specific expertise with such reviews, and;
- submit the results of the review in writing to the CNSC.

Guidance

The intent of a maintenance program is to ensure that systems important to safety remain capable of maintaining their intended design function. An effective maintenance program consists of an organized set of administrative and technical activities designed to keep systems, structures and components in good operating condition, and to verify that they continue function as designed.

TRIUMF's testing, maintenance and calibration program is governed by the general provisions of the following *TRIUMF Standard Operating Procedures* (TSOP):

- TSOP 06, *Engineering Design, Manufacture and Assembly*

- TSOP-08, *Calibration & Inspection*
- TSOP-12, *Configuration Management*

Theses TSOPs reference detailed procedures for performing specific activities within the overall maintenance and calibration program including the frequency at which the various maintenance, inspection and testing tasks are performed. Compliance is verified by monitoring conformity with these policies, procedures and supporting documents.

7. SCA – RADIATION PROTECTION

The Safety and Control Area "Radiation Protection" covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. This program must ensure that radiation doses received by both facility staff and the general public, as well as levels of radioactive contamination, are monitored and controlled.

Performance Objective: Radiation doses received by both facility staff and the general public, as well as levels of radioactive contamination, are maintained As Low As Reasonably Achievable (ALARA).

Licence Condition 7.1 – Radiation Protection Program

The licensee shall implement and maintain a radiation protection program.

Preamble

The *Radiation Protection Regulations* require that the licensee implement a radiation protection program and also ascertain and record doses for each person who performs any duties in connection with any activity that is authorized by the *Nuclear Safety and Control Act* or is present at a place where that activity is carried out. This program must ensure that doses to workers do not exceed prescribed dose limits and are kept as low as reasonably achievable (the ALARA principle).

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Doc
TRIUMF	TSN 1.1, *TRIUMF Radiation Protection Training Program*	538	5	2017/03/27
TRIUMF	TSN 1.8, *Policy for Maximum Allowable Dose in Accessible Areas at TRIUMF*	544	2	2012/04/13
TRIUMF	TSN 1.2, *Policy on Radiation Exposure*	545	3	2010/01/25
TRIUMF	*TRIUMF Safety Report* (sections 1.6 to 1.9 and section 4)	563	3	2005/09
TRIUMF	*TRIUMF Handbook of Occupational Health and Safety*	840	6	2017/09
TRIUMF	TSN 3.6, *Designation of Nuclear Energy Workers at TRIUMF*	850	2	2012/12/05
TRIUMF	TSN 2.4, *Derived Release Limits for Radioactive Emissions from the TRIUMF Site*	8506	9	2019/04/12

(1) The licensee shall implement and maintain a radiation protection program that ensures radiation doses received by individuals and contamination are monitored, controlled and kept ALARA.

(2) The licensee shall review and revise the provisions of the radiation protection program as necessary to reflect changes in facility design and operations.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Doc
CNSC	G-129, *Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"*	G-129	1	2000/06

CNSC regulatory document G-129, *Keeping Radiation Exposures and Doses 'As Low As Reasonably Achievable (ALARA)* provides guidance on developing and implementing radiation protection programs

TRIUMF's radiation protection program is described in detail in the *TRIUMF Safety Report* and the various documents referenced in that report. A concise summary of the main radiation safety related policies and procedures is also contained in the *TRIUMF Occupational Health & Safety Handbook.* Compliance is verified by monitoring conformity with the policies, procedures and supporting documents included in the radiation program descriptions contained in these documents.

While TRIUMF is expected to review and if necessary, to revise the radiation protection program periodically, **revisions must be submitted to the CNSC for review and are subject to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).**

Licence Condition 7.2 – Dose Action Levels

The licensee shall notify the Commission or a person authorized by the Commission within 24 hours of becoming aware that an action level has been reached or exceeded and shall file a written report within 30 working days of becoming aware of the matter.

Preamble

Section 6 of the *Radiation Protection Regulations* specifies the requirements related to action levels. This licence condition is required to provide the notification timeframe.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev #	Rev. Date
TRIUMF	*TRIUMF Safety Report*	563	3	2005/09

(1) For the purpose of this licence condition, "a person authorized by the Commission" includes the Project Officer responsible for licensing and compliance issues related to TRIUMF and the persons identified under Part 1, section 2.3 of this LCH.

(2) If any radiation exposure action level is exceeded, TRIUMF shall notify the Commission as required by licence condition 7.2.

(3) TRIUMF shall conduct a documented review of dose action levels at least once every five years in order to validate their effectiveness, and shall revise action levels as necessary to reflect changes in facility operations.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CNSC	G-228, *Developing and Using Action Levels*	G-228		2001/03

For the purpose of this licence condition, the "***action levels***" are TRIUMF's Dose Action Levels as documented in *TRIUMF Safety Report* section 4.4.10.1. The current Action Levels for TRIUMF workers are given in the TRIUMF Safety Report and repeated here for reference:

Category of Worker	**Action Level**
Nuclear Energy Workers (NEWs)	15 mSv/year
Non-NEWs	0.5 mSv /quarter

Dose action levels are used as indicators to identify abnormal doses to staff, including both Nuclear Energy Workers (NEWs) and non-NEWs, during normal operation of the licensed facility. They are precautionary levels and as such, should be set well below regulatory limits. If the dose action levels are exceeded, they may indicate a potential loss of control of the radiation protection program.

CNSC guidance document G-228, *Developing and Using Action Levels* provides detailed guidance on establishing and using action levels.

While TRIUMF is expected to review and if necessary, to revise and reissue the dose action levels periodically, **revisions to the action levels must be submitted to the CNSC for review and are subject to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).**

8. SCA – CONVENTIONAL HEALTH AND SAFETY

The Safety and Control Area "Conventional Health and Safety" covers the implementation of a program to manage workplace safety hazards.

Performance Objective: Conventional health and safety work practices and conditions achieve a high degree of personnel safety and compliance with the applicable Labour Codes.

Licence Condition 9.1 – Occupational Health and Safety Program

The licensee shall implement and maintain a conventional health and safety program.

Preamble

Paragraph 3(f) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed worker health and safety policies and procedures.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev #	Rev. Date
WorkSafeBC	*Occupational Health and Safety Regulation*			

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Section 4.3)	563	3	2005/09
TRIUMF	*TRIUMF Handbook of Occupational Health and Safety*	840	6	2017/09

TRIUMF shall comply with all applicable federal and provincial conventional health & safety legislation.

Guidance

None provided.

9. SCA – ENVIRONMENTAL PROTECTION

The safety and control area "Environmental Protection" requires the licensee to have a program in place to identify, control and monitor all releases of radioactive and hazardous substances from the facility. The potential effect of these releases on the public and the environment must be assessed as part of the program.

Performance Objective: The protection of the environment and the health and safety of persons by taking all reasonable precautions to control the release of radioactive substances and hazardous substances to the environment.

Licence Condition 9.1 – Environmental Protection Program

The licensee shall implement and maintain an environmental protection program for the facility.

Preamble

Paragraphs 3 (g) and (h) of the *Class I Nuclear Facilities Regulations*, require that an application for a licence to operate a Class I Nuclear Facility contain: the *"proposed environmental protection policies and procedures"* and *"the proposed effluent and environmental monitoring programs"*. Paragraphs 6 (h), (i) and (j) of the same regulations further require that the licence application contain: *"the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects"*, *"the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics"*, and *"the proposed measures to control releases of nuclear substances and hazardous substances into the environment"*, respectively.

Paragraph 12(1)(c) and (f) of the *General Nuclear Safety and Control Regulations* require every licensee to take all reasonable precautions to protect the environment and to take all reasonable precautions to control the release of nuclear substances or hazardous substances.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Amending Bylaw No. 244, 2008*	244		2008
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007*	299		2007
Metro Vancouver	*Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008*	1082		2008
BC Environmental Management Act	*Waste Discharge Regulation*			

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Sections 1.8 and 4.4.10)	563	3	2005/09
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	*Monitoring of Emissions from the TRIUMF site (EHS-RPG-04-10)*	5328	3	2015/11/27
TRIUMF	*Environmental Monitoring Program for the TRIUMF site (EHS-RPG-07-10)*	5329	3	2015/11/27
TRIUMF	TSN 2.4, *Derived Release Limits for Radioactive Emissions from the TRIUMF Site*	8506	9	2019/04/12
TRIUMF	*Environmental Management System*	15678	2	2016/12/14

The licensee shall implement an environmental protection program for the facility. This program shall cover the control of releases to the environment and the assessment of the potential impacts of those releases.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.9.1, *Environmental Protection: Policies, Programs and Procedures*	REGDOC-2.9.1	1.0	2013/09
CNSC	P-223, *Protection of the Environment*	P-223		2001/02

Guiding principles and factors for environmental protection are given in CNSC Regulatory Policy P-223, *Protection of the Environment*. CNSC regulatory document REGDOC-2.9.1, *Environmental Protection: Policies, Programs and Procedures*, provides detailed guidance on the development, implementation and maintenance of environmental protection programs.

Licence Condition 9.2 – Control and Monitoring of Nuclear Substance Releases

The licensee shall control, monitor and record releases of nuclear substances to the environment from the facility such that the releases do not exceed the release limits specified in the Licence Condition Handbook.

Preamble

Paragraph 3 (h) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence to operate a Class I Nuclear Facility contain *"the proposed effluent and environmental monitoring programs"*. Paragraphs 6 (i) and (j) of the same regulations further require that the licence application contain: *"the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics"*, and *"the proposed measures to control releases of nuclear substances and hazardous substances into the environment"*, respectively.

Paragraph 12(1)(c) and (f) of the *General Nuclear Safety and Control Regulations* require every licensee to take all reasonable precautions to protect the environment and to take all reasonable precautions to control the release of nuclear substances or hazardous substances.

Subsection 13(1) of the *Radiation Protection Regulations* prescribes the radiation dose limit for the general public of 1 mSv per calendar year.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CSA	*Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*	N288.1-14		2014
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Amending Bylaw No. 244, 2008*	244		2008
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007*	299		2007
Metro Vancouver	*Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008*	1082		2008

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Sections 1.8 and 4.4.10)	563	3	2005/09
TRIUMF	*Monitoring of Emissions from the TRIUMF site (EHS-RPG-04-10)*	5328	3	2015/11/27
TRIUMF	*Environmental Monitoring Program for the TRIUMF site (EHS-RPG-07-10)*	5329	3	2015/11/27
TRIUMF	TSN 2.4, *Derived Release Limits for Radioactive Emissions from the TRIUMF Site*	8506	9	2019/04/12
TRIUMF	*Environmental Management System*	15678	2	2016/12/14

(1) TRIUMF shall establish and maintain Derived Release Limits (DRL) in accordance with CSA standard N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*, and shall monitor and control radiological emissions to ensure they remain ALARA with respect to these DRLs.

(2) TRIUMF shall periodically review the facility DRLs to ensure they address all emissions from the facility and to ensure that they remain up to date and consistent with applicable standards.

Guidance

The DRL for a given radionuclide is the release rate of that radionuclide to air or surface water, during normal operation of a nuclear facility over the period of one calendar year, that would cause an individual in the most highly exposed group to receive a committed dose equal to the regulatory annual dose limit for the general public as specified in section 13 of the *Radiation Protection Regulations*. The DRL is derived using mathematical equations that describe the transfer of radioactive materials through the environment to humans

For the purpose of this licence condition, the "***release limits specified in the Licence Condition Handbook*"** are specified in:

- TRIUMF Safety Note 2.4 *Part I Exposures to the Public and Environment: Derived Release Limits for the TRIUMF Site*, and;
- TRIUMF Safety Note 2.4 *Part II: Results and Tables of Values;*

While TRIUMF is expected to review and if necessary, to revise and reissue the DRLs periodically, **revisions to DRLs must be submitted to the CNSC for review and are subject**

to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).

Licence Condition 9.3 – Control and Monitoring of Hazardous Substance Releases

The licensee shall control, monitor and record the releases of hazardous substances.

Preamble

Paragraph 3 (h) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence to operate a Class I Nuclear Facility contain *"the proposed effluent and environmental monitoring programs"*. Paragraphs 6 (i) and (j) of the same regulations further require that the licence application contain: *"the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics"*, and *"the proposed measures to control releases of nuclear substances and hazardous substances into the environment"*, respectively.

Paragraph 12(1)(c) and (f) of the *General Nuclear Safety and Control Regulations* require every licensee to take all reasonable precautions to protect the environment and to take all reasonable precautions to control the release of nuclear substances or hazardous substances.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Amending Bylaw No. 244, 2008*	244		2008
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007*	299		2007
Metro Vancouver	*Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008*	1082		2008

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*Environmental Management System*	15678	2	2016/12/14

TRIUMF shall comply with all applicable federal, provincial and municipal legislation relating to the handling and release of hazardous substances.

Guidance

None provided.

Licence Condition 9.4 – Environmental Action Levels

The licensee shall notify the Commission or a person authorized by the Commission within 24 hours of becoming aware that an action level has been reached or exceeded and shall file a written report within 30 working days of becoming aware of the matter.

Preamble

Section 6 of the *Radiation Protection Regulations* specifies the requirements related to action levels. This licence condition is required to provide the notification timeframe.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Section 4.4.10)	563	3	2005/09

(1) For the purpose of this licence condition, "a person authorized by the Commission" includes the Project Officer responsible for licensing and compliance issues related to TRIUMF and the persons identified under Part 1, section 2.3 of this LCH.

(2) If any environmental action level is exceeded, TRIUMF shall notify the Commission as required by licence condition 9.4

(3) TRIUMF shall conduct a review of environmental action levels at least annually as part of the management review of operations and shall revise action levels as necessary to reflect changes in facility operations.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CNSC	G-228, *Developing and Using Action Levels*	G-228		2001/03

Environmental Action Levels are used as indicators identify abnormal releases of radionuclides into the environment during normal operation of the licensed facility. They are precautionary levels and as should be set well below regulatory limits. If the environmental action levels are exceeded, they may indicate a potential loss of control of the environmental protection program.

For the purpose of this licence condition, the "***action level***" is TRIUMF's Environmental Action Level of 5% of the corresponding DRL (see licence condition 9.2 above) as documented in *TRIUMF Safety Report* section 4.4.10.2.

CNSC guidance document G-228 "Developing and Using Action Levels" provides detailed guidance on establishing and using action levels.

While TRIUMF is expected to review and if necessary, to revise and reissue the environmental action levels periodically, **revisions to action levels must be submitted to the CNSC for review and are subject to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).**

10. SCA – EMERGENCY MANAGEMENT AND FIRE PROTECTION

The Safety and Control Area "Emergency Management and Fire Protection" covers emergency plans and emergency preparedness programs which exist for emergencies and for non-routine conditions. It also includes the results of participation in any emergency exercises. This includes:

- Nuclear emergency management;
- Conventional emergency response, and;
- Fire protection and response.

Performance Objective: The implementation of programs which ensure the licensee's capability to respond appropriately to emergencies and non-routine conditions and to mitigate the potential effects to the health and safety of persons and the environment and to national security.

Licence Condition 10.1 – Emergency Preparedness Program

The licensee shall implement and maintain a program for emergency preparedness to address on-site and off-site events which can affect the nuclear facility.

Preamble

Paragraph 6(k) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain information on the licensee's *"proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of security, including measures to:*

(i) assist off-site authorities in planning and preparing to limit the effects of an accidental release;
(ii) notify off-site authorities of an accidental release or the imminence of an accidental release;
(iii) report information to off-site authorities during and after an accidental release;,
(iv) assist off-site authorities in dealing with the effects of an accidental release; and
(v) test the implementation of the measures to prevent or mitigate the effects of an accidental release."

This licence condition ensures appropriate regulatory oversight of the implementation by the licensee of the emergency preparedness program.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*	REGDOC-2.10.1	2.0	2016/02

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 2.1, *TRIUMF First Aid Program*	857	3	2013/12/02
TRIUMF	*TRIUMF Emergency Preparedness Plan*	4952	6	2019/11/28
TRIUMF	*TRIUMF Emergency Response Plan*	5856	6	2019/11/29

(1) TRIUMF shall have an emergency preparedness plan which satisfies the criteria set out in CNSC regulatory document REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*.

(2) TRIUMF shall implement an emergency response program in accordance with the criteria set out in the regulatory document REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*. The program shall address the following areas:

- Mitigation,
- Protection of Facility Personnel,
- Protection of the Public and the Environment,
- Termination of the Emergency, and
- Adequacy of Conduct of Exercises.

(3) An evacuation drill and/or exercise is required at least annually. Drills shall be conducted in coordination with appropriate Federal, Provincial, and local agencies.

Guidance

Emergency Management is governed by TRIUMF's "Emergency Preparedness Plan" (TRI-EHS-05-05) and TRIUMF's Emergency Response Plan (TRI-EHS-05-06). TRIUMF's Emergency Preparedness Plan ensures that the resources of TRIUMF are prepared to respond to any emergency outside of the laboratory's normal operation.

The plan's objectives are:

- Protection of TRIUMF employees, public health and security, and the environment.
- Minimizing the effects of an emergency or disaster.
- Ensuring rapid organized response to an emergency or disaster.
- Protection and preservation of TRIUMF critical infrastructure and facilities.
- Timely release of factual information on the status of an incident or emergency.
- Restoration of normal operations in a timely manner.

The Emergency Preparedness Plan identifies the roles and responsibilities of emergency responders, and provides broad guidance for responding effectively to emergencies. TRIUMF's Emergency Response Plan provides the response procedures for emergencies identified in the TRIUMF Emergency Preparedness Plan. Drills are the responsibility of Environment Health and Safety Group.

TRIUMF may revise their emergency plans to take into account relevant factors, such as operating experience or changed needs or circumstances, subject to the approval process described in section 2 of this LCH.

Licence Condition 10.2 – Fire Protection Program

The licensee shall implement and maintain a fire protection program for the facility.

Preamble

Paragraph 6(k) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain information on the licensee's "*proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of security"*. These measures must include the implementation of a fire protection program which complies with all applicable national codes and standards.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
GOC	*National Building Code of Canada 2015*	N/A		2015
GOC	*National Fire Code of Canada 2015*	N/A		2015
NFPA	NFPA 801: S*tandard for Fire Protection for Facilities Handling Radioactive Materials*	NFPA801		2014

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 5.9, *Fire Protection and Prevention at TRIUMF*	868	3	2010/09/03
TRIUMF	*TRIUMF Fire Protection Program*	29313	2	2010/10/12

TRIUMF's fire protection program shall clearly demonstrate compliance with the requirements of:

- the *National Building Code of Canada 2015*;
- the *National Fire Code of Canada 2015*, and;
- NFPA 801: S*tandard for Fire Protection for Facilities Handling Radioactive Materials*;

and that these requirements have been implemented into the facilities operations in a controlled, consistent and coordinated manner.

Guidance

Fire Safety requirements relating to the design and modification of facilities and to testing and maintenance of fire safety equipment can be found in sections 5.1 Design and Safety Analysis Program and 6.1 Testing, Calibration and Maintenance Program of Part II of this LCH.

11. SCA – WASTE MANAGEMENT

The safety and control area "waste management" covers internal waste-related programs which form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. It also covers the planning for decommissioning.

Performance Objective: An acceptable waste management program will be facility and waste stream specific. It is expected that licensees will develop, implement, audit and update their waste management programs and preliminary decommissioning plans and will include waste management as a key component of their corporate and safety culture.

Licence Condition 11.1 – Waste Management Program

The licensee shall implement and maintain a program for waste management for the facility.

Preamble

The *General Nuclear Safety and Control Regulations* require that a licence application contain information related to the management of radioactive waste or hazardous waste resulting from the licensed activities. Paragraph 3(1)(j) of the *General Nuclear Safety and Control Regulations* stipulates that an application for a licence shall contain, in addition to other information, *"the name, quantity, form, origin and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste"*.

Paragraph 6(e) of the *Class I Nuclear Facilities Regulations* require that a licence application contain the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*Radioactive Waste Management for the TRIUMF site (EHS-RPG-06-10)*	5330	5	2016/12/23
TRIUMF	*Characterization of Radioactive Waste (EHS-RPG-06-04)*	5815	1	2012/03/29
TRIUMF	*Sorting Radioactive Waste at the Source (EHS-RPG-06-01)*	5816	2	2012/03/23
TRIUMF	*Assaying Pump Oil Samples (EHS-RPG-06-03)*	5817	2	2016/09/01
TRIUMF	*Assaying Radioactive Waste (EHS-RPG-06-02)*	8000	2	2012/03/23

The waste management program for TRIUMF shall include provisions for waste minimization, waste segregation and characterization, waste storage, processing and disposal.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CSA	*Management of low and intermediate-level radioactive waste*	N292.3-14		2014

CSA standard N292.3-14, *Management of low and intermediate-level radioactive waste* provides detailed guidance for the development and implementation of a suitable waste management program.

Licence Condition 11.2 – Preliminary Decommissioning Plan

The licensee shall maintain a preliminary decommissioning plan (PDP) for decommissioning the facility. This PDP shall be reviewed every five years or when requested by the Commission, or a person authorized by the Commission.

Preamble

Paragraph 3(k) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed plan for decommissioning of the nuclear facility. The preliminary decommissioning plan includes strategies for the management of low and intermediate level waste and waste storage facility decommissioning.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	*G-219, Decommissioning Planning for Licensed Activities*	G-219		2000/06
CSA	*Decommissioning of Facilities Containing Nuclear Substance*	N294-09		2014

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*Preliminary Decommissioning Plan*	8810	5	2019/05/17

(1) The *Preliminary Decommissioning Plan* shall conform with the requirements of *CNSC Regulatory Guide, G-219: Decommissioning Planning for Licensed Activities* and the CSA Standard N294-09, *Decommissioning of Facilities Containing Nuclear Substance*. Following the acceptance of the plan by CNSC staff, this plan must be reviewed and revised every five years.

(2) TRIUMF shall notify the CNSC in writing of any changes to the *TRIUMF Preliminary Decommissioning Plan* prior to implementation.

(3) For the purpose of this licence condition, "a person authorized by the Commission" includes the persons identified under Part 1, section 2.3 of this LCH.

Guidance

None provided.

12. SCA – SECURITY

The Safety and Control Area "Security" covers the programs required to implement and support the security requirements stipulated in the Act, the regulations, and the licence.

Performance Objective: The implementation of a security program which provides the required level of security for the facility and its operations.

Licence Condition 12.1 – Security Program

The licensee shall implement and maintain a security program.

Preamble

Paragraphs 3(1)(g) and 3(1)(h) of the *General Nuclear Safety and Control Regulations* require that a licence application contain information related to site access control and measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information.

Paragraph 6(l) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility.

The overall objective of a nuclear security program is to protect persons, property, society, and the environment from malicious acts involving nuclear material or other radioactive material that could cause unacceptable radiological consequences.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Section 4.1)	563	3	2005/09
TRIUMF	TSOP-10, *Access to TRIUMF*	1733	4	2018/05/14
TRIUMF	*TRIUMF Accelerator Inc. Security Plan* **(Confidential – Prescribed Information)**	29843	5	2015/08/15

(1) TRIUMF shall maintain the operation, design and analysis provisions specified in the Security Plan and required to ensure adequate engineered safety barriers for the protection against malevolent acts.

(2) TRIUMF shall take all reasonable precautions to protect the environment and the health and safety of persons and to maintain security in accordance with paragraph 12 (1) (c) of the *General Nuclear Safety and Control Regulations*.

(3) TRIUMF shall implement measures for alerting TRIUMF to the illegal use or removal of a nuclear substance, prescribed equipment or prescribed information, or the illegal use of

a nuclear facility in accordance with paragraph 12 (1) (g) of the *General Nuclear Safety and Control Regulations*.

(4) Technical and administrative security measures shall be documented by TRIUMF in a site Security Plan which is appropriately designated in accordance with paragraph 12(j) and sections 21 to 23 of the *General Nuclear Safety and Control Regulations*, and shall be clearly labelled as "CONFIDENTIAL – Prescribed Information" in the top right hand corner of every page. Such information may be distributed only in hard copy. The site Security Plan must be updated and verified by TRIUMF at least once a year, to address any changes within the licensed facility or to address an increased threat level.

(5) The site Security Plan shall be updated on a regular basis and submitted to the CNSC.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
IAEA	*Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control*	Nuclear Security Series No. 15		2011

13. SCA – SAFEGUARDS

The Safety and Control Area "Safeguards" covers the programs required for the successful implementation of the obligations arising from the Canada/IAEA Safeguards Agreement.

Performance Objective: Conformity with measures required by the facility to meet Canada's international safeguards obligations through:

- timely provision of accurate reports and information;
- provision of access and assistance to IAEA inspectors for verification activities;
- submission of annual operational information and accurate design information of plant structures, processes and procedures;
- development and satisfactory implementation of appropriate facility safeguards procedures; and
- demonstration of capability, as confirmed through CNSC onsite evaluations, to meet all requirements in support of physical inventory verifications of nuclear material by the IAEA.

Licence Condition 13.1 – Safeguards Program

The licensee shall implement and maintain a safeguards program and undertake all measures required to ensure safeguards implementation at the facility.

Preamble

Safeguards is a system of inspection and other verification activities undertaken by the International Atomic Energy Agency (IAEA) in order to evaluate a Member State's compliance with its obligations pursuant to its safeguards agreements with the IAEA.

The *General Nuclear Safety and Control Regulations* require the licensee to take all necessary measures to facilitate Canada's compliance with any applicable safeguards agreement, and define reporting requirements for safeguards events.

The *Class I Nuclear Facilities Regulations* require that a licence application contain information on the licensee's proposed measures to facilitate Canada's compliance with any applicable safeguards agreement.

Compliance Verification Criteria

Licensing Basis Publications: None.

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*	REGDOC-2.9.1	1.0	2018/02

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Safeguards Program*	154117	1	2018/12/17

The CNSC regulatory document REGDOC-2.13.1, Safeguards and Nuclear Material Accountancy sets out requirements and guidance for safeguards programs, including information on nuclear material accounting reports and request forms and detailed instructions on how to complete them.

(1) TRIUMF shall provide the International Atomic Energy Agency (IAEA), an IAEA inspector, or a person acting on behalf of the IAEA, with such reasonable services and assistance as are required to enable the IAEA to carry out its duties and functions pursuant to a safeguards agreement.

(2) TRIUMF shall grant prompt access at all reasonable times to all locations at the facility to an IAEA inspector, or to a person acting on behalf of the IAEA, where such access is

required for the purposes of carrying on an activity pursuant to a safeguards agreement. In granting access, TRIUMF shall provide health and safety services and escorts as required in order to facilitate activities pursuant to a safeguards agreement.

(3) TRIUMF shall disclose to the Commission, to the IAEA, or to an IAEA inspector, any records that are required to be kept or any reports that are required to be made under a safeguards agreement.

(4) TRIUMF shall provide such reasonable assistance to an IAEA inspector, or a person acting on behalf of the IAEA, as is required to enable sampling and removal or shipment of samples required pursuant to a safeguards agreement.

(5) TRIUMF shall provide such reasonable assistance to an IAEA inspector, or a person acting on behalf of the IAEA, as is required to enable measurements, tests and removal or shipment of equipment required pursuant to a safeguards agreement.

(6) TRIUMF shall not alter, deface or break a safeguards seal, except pursuant to a safeguards agreement.

(7) TRIUMF shall implement measures to prevent damage to or the theft, loss or sabotage of safeguards equipment or samples collected pursuant to a safeguards agreement or the illegal use, possession, operation or removal of such equipment or samples.

(8) TRIUMF shall make such reports and provide such information to the Commission, as are required to facilitate Canada's compliance with any applicable safeguards agreement.

(9) TRIUMF shall make and submit reports to the Commission on the inventory and transfer of fissionable and fertile substances in accordance with the regulatory document REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*, or as otherwise stipulated in any regulatory document that replaces REGDOC-2.13.1.

Guidance

None provided.

Licence Condition 13.2 – Changes that Would Affect the Implementation of Safeguards Measures

The licensee shall not, except with the prior approval of the Commission or a person authorized by the Commission, make changes to any aspect of the facility or its operation, equipment or procedures that would affect the implementation of safeguards measures.

Preamble

This licence condition provides regulatory control over the changes requested by the licensee to its operation, equipment or procedures not previously agreed to by the CNSC that would affect the implementation of safeguards measures.

With respect to the implementation of safeguards measures, changes made by the licensee to operation, equipment or procedures as of the result of agreement between the licensee, the CNSC, and the IAEA are considered routine.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF				

(1) TRIUMF shall obtain prior written approval of the Commission, or a person authorized by the Commission, for any changes to operation, equipment or procedures requested by TRIUMF that would affect the implementation of safeguards measures.

(2) Delegation of approval by the Commission, to give consent, applies to the following staff with respect to this licence condition only:

- Director, International Safeguards Division
- Director General, Directorate of Security and Safeguards, and
- Vice-President, Technical Support Branch

(3) TRIUMF shall provide such reasonable assistance to an IAEA inspector, or a person acting on behalf of the IAEA, as is required to enable sampling and removal or shipment of samples required pursuant to a safeguards agreement.

(4) If TRIUMF's requested changes to the operation, equipment or procedures do not adversely impact the requirements set out in the Preamble of licence condition 13.1, the CNSC authorized person has the authority to give the consent to TRIUMF to proceed with the proposed changes and the LCH will be revised as required.

(5) If TRIUMF's requested changes to the operation, equipment or procedures do adversely impact on the requirements set out in the Preamble of licence condition 13.1, the CNSC authorized person does not have the authority to give the consent, as this would violate the obligations arising from the Canada-IAEA safeguards agreement.

Guidance

None provided.

14. SCA – PACKAGING AND TRANSPORT

The SCA entitled "Packaging and Transport" covers the programs that ensure the safe packaging and transport of nuclear substances and radiation devices to and from the licensed facility.

Performance Objective: Compliance with the CNSC *Packaging and Transport of Nuclear Substances Regulations, 2015* and Transport Canada *Transportation of Dangerous Goods Regulations*.

Licence Condition 14.1 – Packaging and Transport

The licensee shall implement and maintain a packaging and transport program.

Preamble

Paragraph 6(e) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence to operate a Class I facility shall contain information on the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances. Every person who transports, or causes to be transported, nuclear substances shall comply with the *Transportation of Dangerous Goods Regulations* set out by Transport Canada and the *Packaging and Transport of Nuclear Substances Regulations, 2015*.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*Package Handling and Transport Protocols for Radioactive Shipments*	62648	5	2019/10/21
TRIUMF	*Procurement and Shipping of Radioactive Materials Procedure*	76036	3	2017/02/09

TRIUMF shall implement and maintain a 'Packaging and Transport" program which complies with all the regulatory requirements set out in:

- Transport Canada's *Transportation of Dangerous Goods Regulations*; and
- the CNSC *Packaging and Transport of Nuclear Substances Regulations, 2015*.

Guidance

None provided.

15. SCA – SITE SPECIFIC

This section covers licence conditions which are not associated with a specific Safety and Control Area.

Performance Objective: Compliance with regulatory expectations for the implementation of a Public Information Program and an appropriate Financial Guarantee for the eventual decommissioning of the licensee's facilities.

Licence Condition 15.1 – Public Information and Disclosure

The licensee shall implement and maintain a public information program for the facility.

Preamble

Paragraph 3(j) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the *"the proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed"*.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CNSC	REGDOC-3.2.1, *Public Information and Disclosure*	REGDOC-3.2.1	1.0	2018/05

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Public Information and Disclosure Program*	156040	3	2020/02/20

The licensee shall implement and maintain a public information program for the facility. The public information program shall comply with the requirements set out in CNSC regulatory document REGDOC-3.2.1, *Public Information and Disclosure*.

Guidance

None provided.

Licence Condition 15.2 – Financial Guarantee

The licensee shall maintain, in effect, a financial guarantee for decommissioning of the facility that is acceptable to the Commission.

Preamble

Paragraph 3(k) of the *Class I Nuclear Facilities Regulations* stipulates that that an application for any licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain, in addition to other information, the *"proposed plan for decommissioning of the nuclear facility or of the site."*

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev #	Rev. Date
TRIUMF	*CNSC Financial Security and Access Agreement*	30101	Jan 2008	2008/01/07
TRIUMF	*Fund Contribution Gap Agreement*	30102	Jan 2008	2008/01/07
TRIUMF	*Escrow Agreement*	30103	Jan 2008	2008/01/07

TRIUMF shall maintain the financial guarantee, to ensure it remains valid and in effect and adequate to fund the preliminary decommissioning plan. If the preliminary decommissioning plan is revised, the expectation is that the financial guarantee is revised and submitted to the Commission for acceptance.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CSA	*Decommissioning of Facilities Containing Nuclear Substance*	N294-09		2014
CNSC	*G-219, Decommissioning Planning for Licensed Activities*	G-219		2000/06
CNSC	G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*	G-206		2000/06

The criteria outlined in CNSC guidance document G-206, "Financial Guarantees for the Decommissioning of Licensed Activities" provides guidance when reviewing the financial guarantees for decommissioning.

CSA standard N294-09, *Decommissioning of Facilities Containing Nuclear Substance* provides direction on the decommissioning of licensed facilities and specifies requirements for the planning, preparation, execution and completion of decommissioning. It incorporates current best practices and existing regulatory requirements. CSA N294-09 references CNSC regulatory guidance document G-219, *Decommissioning Planning for Licensed Activities* that provides guidance regarding the preparation of decommissioning plans for CNSC licensed activities.

APPENDIX A: LCH CHANGE CONTROL PROCESS AND LCH CHANGE REQUEST FORM

Licensee Requests

1. Authorized licensee representative submits the request to the CNSC Project Officer using the Licensee LCH Change Request Form in this Appendix.

2. Assessment of the change request by CNSC Project Officer:
   - Determine if the requested change is in line with the LCH change control process.
   - Determine whether the change is substantial enough to warrant an update to the LCH.
   - Refer for review by Specialist Divisions as appropriate.
   - Draft the changes to the LCH and a recommendation for approval, including any Specialist recommendations as appropriate.
   - Submit recommendations and the draft LCH to the person authorized to approve the changes in accordance with section 2.3 of Part I of this LCH*.

3. Approval:
   - The change may be referred to a higher level of authority in accordance with section 2.3 of Part I of this LCH*.
   - In the event that the change is not approved, the licensee may refer the issue to the dispute resolution process in section 2.4 of Part I of this LCH.

4. Notification of Changes:
   - Once approved, the Project Officer will update the LCH to reflect the changes.
   - Formal notification will be sent to the licensee along with the updated LCH.

* *NOTE: for changes to operation, equipment or procedures that would affect the implementation of safeguards measures, the Project Officer shall refer the matter to the International Safeguards Division for review. Recommendations and LCH revisions shall be referred to the Director, International Safeguards Division for approval. The hierarchy of approval for safeguards related issues is provided in section 13.2 of Part II of this LCH.*

CNSC Staff Requests

1. Staff member submits the request to the CNSC Project Officer using the CNSC Staff LCH Change Request Form in this Appendix. For requests originating from Specialist Divisions, include any analysis or justification necessary to assess the nature and scope of the request.

2. Assessment of the change request by CNSC Project Officer:

   - Determine if the requested change is in line with the LCH change control process.
   - Determine whether the change is substantial enough to warrant an update to the LCH.
   - Refer for review by other Specialist Divisions if required.
   - Consult with licensee regarding the proposed change and obtain authorization from licensee.
     a. In the event the licensee is not in agreement with the proposed change, the Project Officer shall refer the issue to the dispute resolution process in section 2.4 of Part 1 of this LCH.
   - Draft changes to LCH and recommendation for approval, including Specialist recommendations and the licensee's written concurrence with the proposed change.
   - Submit recommendations and the draft LCH to the person authorized to approve the changes in accordance with section 2.3 of Part I of this LCH*.

3. Approval:
   - The change may be referred to a higher level of authority in accordance with section 2.3 of Part I of this LCH*.

4. Notification of Changes:
   - Once approved, the Project Officer will update the LCH to reflect the changes.
   - Formal notification will be sent to the licensee along with the updated LCH.

* *NOTE: for changes to operation, equipment or procedures that would affect the implementation of safeguards measures, the Project Officer shall refer the matter to the International Safeguards Division for review. Recommendations and LCH revisions shall be referred to the Director, International Safeguards Division for approval. The hierarchy of approval for safeguards related issues is provided in section 13.2 of Part II of this LCH.*

Licensee LCH Change Request Form

TRIUMF - Licence Conditions Handbook Change Request				
Current LCH	Version Date			
	CNSD Document #			
	Revision #			
Requestor Information	Date of Request			
	Name			
	Title			
	Signature			
Description of Changes	Overview of Changes Requested			
	Affected Sections of LCH			
New or Amended TRIUMF Documents	Title(s)			
	Document #(s)			
	Revision #(s)			
	Revision Date(s)			
CNSC staff use only				
Assessment	List each specialist Division consulted and the date(s) of referral			
	List the edoc # and date(s) of response for each specialist report			
	Project Officer summary and recommendation			
Approval	Title:	Director	Director General	Vice President
	Div/Dir/Branch			
	Name:			
	Signature:			
	Indicate approved, rejected or referred to next level of authority			
Referred to Dispute Resolution	Provide edocs#			

CNSC Staff LCH Change Request Form

CNSC Staff - Licence Conditions Handbook Change Request for TRIUMF				
Current LCH	Version Date			
	CNSD Document #			
	Revision #			
Requestor Information	Date of Request			
	Name			
	Title			
	Division			
	Directorate			
	Signature			
Line Manager Approval	Name			
	Title			
	Signature			
Description of Changes	Overview of Changes Requested			
	Affected Sections of LCH			
New/Changed Documents	Title(s)			
	Document #(s)			
	Revision #(s)			
	Revision Date(s)			
Assessment	List each specialist Division consulted and the date(s) of referral			
	List the edoc # and date(s) of response for each specialist report			
	List the edoc # and date for the licensee's acceptance of the change			
	Project Officer summary and recommendation			
Approval	Title:	Director	Director General	Vice President
	Div/Dir/Branch			
	Name:			
	Signature:			
	Indicate approved, rejected or referred to next level of authority			
Referred to Dispute Resolution	Provide edocs#			

APPENDIX A: LCH CHANGE CONTROL PROCESS AND LCH CHANGE REQUEST FORM

APPENDIX B: DEFINITIONS

The following is a list of definitions of words or expressions used in the LCH that may need clarification. Unless a reference source is provided in parenthesis, the words or expressions have been defined for the purpose of the LCH.

Accept/Accepted/Acceptable/Acceptance
Meet regulatory requirements, which mean it is in compliance with regulatory documents or technical standards referenced in the licence.

Approval
1) Commission's permission to proceed, for situations or changes where the licensee would be:

- not compliant with a regulatory requirements set out in applicable laws and regulations; or
- not compliant with a licence condition; or
- not in the safe direction but the objective of the licensing basis is met.

2) Written permission to proceed, given by CNSC delegated authority, for situations or changes where the licensee would:

- comply with a regulatory requirements set out in applicable laws and regulations;
- comply with a licence condition; and
- not adversely impact the licensing basis.

Boundary conditions
Procedural, administrative rules and operating limits for ensuring safe operation of the facility based on safety analysis. It also includes any applicable regulatory requirements.

Compliance verification criteria
Measures of conformity to the regulatory requirements. CNSC staff use these criteria to confirm that the licensee is meeting the corresponding provisions from the *Nuclear Safety and Control Act*, the regulations and the licence conditions.

Defense-in-depth
The provision of multiple, redundant, nuclear safety provisions to protect workers, the public and the environment from radiological hazards of a nuclear facility.

Design basis
The range of conditions and events taken into account in the design of the facility, according to established criteria, such that the facility can withstand them without exceeding authorized limits for the planned operation of safety systems.

Design basis accident
Accident conditions against which a facility is designed according to established design criteria, and for which the damage and the release of radioactive material are kept within authorized limits.

Extent of condition
Means an evaluation to determine if an issue has potential or actual applicability to other activities, processes, equipment, programs, facilities, operations or organizations.

Graduated enforcement
A process for escalating enforcement action. If initial enforcement action does not result in timely compliance, gradually more severe enforcement actions may need to be used. It takes into account such things as:

- the risk significance of the non-compliance with respect to health, safety, security, the environment and international obligations;
- the circumstances that lead to the non-compliance (including acts of willfulness);
- previous compliance record; and
- operational and legal constraints (for example, Directive on the Health of Canadians)
- industry specific strategies.

Human factors engineering
Is the application of knowledge about human capabilities and limitations to plant or facility, system, and equipment design. Human factors engineering ensures that the plant or facility, system, or equipment design, human tasks, and work environment, are compatible with the sensory, perceptual, cognitive, and physical attributes of the personnel who operate, maintain, and support it.
[CNSC regulatory document G-276: "Human Factors Engineering Program Plans"]

Important to safety
Items important to safety include, but are not limited to:

- Structures, Systems or Components (SSC) whose malfunction or failure could lead to undue radiation exposure of the facility/site personnel, or members of the public;
- SSCs that prevent anticipated operational occurrences from leading to accident conditions;
- SSCs that protect the environment;
- those features that are provided to mitigate the consequences of malfunctions or failures of SSCs; and
- tasks, duties, activities, aging mechanisms, findings, or any work that improperly performed could lead to radiation exposure of, or other harm to, the facility/site personnel, or members of the public.

Licensee-produced licensing documents
Documents containing the safety and control measures described in the licence application and the documents needed to support that licence application.

Licensee documents requiring notification of change
As determined by CNSC staff, these are documents needed to support the licence application which contain the necessary safety and control measures. Depending on the risk significance of the document, changes may require either a "notification" or a "notification prior to implementation"

Program(s)
A documented group of planned activities, procedures, processes, standards and instructions coordinated to meet a specific purpose.

Programmatic failure
A programmatic failure (or programmatic non-compliance), arises under one or more of the following circumstances:

- Failure to establish a required program or program element.
- Failure of a program or program element to meet a mandated standard.
- Failure to comply with a specific, objective provision of a program.
- Aggravated or systemic failure(s) to adhere to applicable procedures.

Regulatory undertakings
Refers to high level commitments that ensure safety, not component work orders or regulatory predefined maintenance tasks.

Safe direction
Means changes in facility safety levels which would not result in:

- a reduction in safety margins,
- a breakdown of barrier,
- an increase (in certain parameters) above accepted limits,
- an increase in risk,
- impairment(s) of safety systems,
- an increase in the risk of radioactive releases or spills of hazardous substances,
- injuries to workers or members of the public,
- introduction of a new hazard,
- reduction of defense-in-depth provisions,
- causing hazards or risks different in nature or greater in probability or magnitude than those stated in the safety analysis of the nuclear facility.

Safety and control measures
The subset of measures described at a program level put in place by the applicant to protect the environment and the health and safety of persons at the nuclear facility which satisfy the regulatory requirements for safely carrying out the licensed activities.

Safety-related system(s)
Those systems, and the components and structures thereof, which, by virtue of failure to perform in accordance with the design intent, have the potential to impact on the radiological safety of the public or facility personnel from the operation of the nuclear facility. Those systems, and components and structures thereof, are associated with:

(i) control of the facility;
(ii) limiting the release of radioactive material and the exposure of facility personnel and/or the public to meet the criteria established by the licensing authority with respect to radiation exposure during and following normal, anticipated transient conditions and accident conditions.

Safety significance
Refers to the significance of a discovery/issue with respect to the impact on meeting the fundamental nuclear safety objectives as defined by the IAEA.

In general, a discovery/event has safety significance if it denotes a deviation away from the safety case accepted in the licence, in the direction detrimental to safety, such as:

- Reducing margins to, or exceeding the accepted limits;
- Increasing risk;
- Impairments (various degrees) of the safety systems or of the safety functions for accident mitigation;
- Human factor issues; and
- Events causing radioactive releases and spills of hazardous substances, injuries to workers, public, etc.

Shall
Is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard.

Version-controlled documents
Refers to documents which require CNSC control and are captured in this LCH. Such documents include regulatory/industry standards as referenced in the licence (may include regulatory/industry standards which require transition); and licensee documents defining the licensing basis.

Written notification
A physical or electronic communication between a CNSC delegated authority and a person authorized to act on behalf of the licensee.

APPENDIX C: FACILITY OPERATIONAL LIMITS

A. 520 MeV Cyclotron Facility Operating Specifications

1. Proton Beam Energy Limitations

The proton energy shall not exceed 525 MeV.

2. Proton Beam Current Limitations

The proton beam currents shall not exceed

(a) 320 µA total circulating current for proton energies up to 480 MeV, or;
250 µA total circulating current for proton energies greater than 480 MeV;
(b) 200 µA into the BL1A beam dump;
(c) 250 µA into beam line 1A;
(d) 1 µA into beam line 4B2;
(e) 0.02 µA into beam line 1B;
(f) 10 µA into beam line 4A3;
(g) 0.5 µA into beam dump 4A2;
(h) 0.5 µA into beam dump 4B3; and
(i) 100 µA into beam line 2A; and
(j) 10 µA into beam line 1U.

3. Beam Energy and Current Limitations for Beam Line 2C Targets

The proton beam current at energies between 65 and 120 MeV on the targets in beam line 2C shall be limited to the values below.

Branch	Target	Maximum Current	Product / Purpose
2C1:	Biological phantoms Patients	0.01 µA	Proton therapy Proton therapy studies
2C4:	Rb	100 µA	^{82}Sr
2C5:	Cs	50 µA	^{127}Xe
2C7:	Faraday cup	10 µA	Calibration

4. Permissible target materials for the Proton Irradiation Facility:

Molybdenum

B. 42 MeV Cyclotron Facility Operating Specifications

Targets	Maximum Energy	Maximum Current
Solid: ^{203}Tl, ^{68}Zn, ^{112}Cd	30 MeV	0.25 mA
Solid: ^{58}Ni	24 MeV	0.32 mA
Solid: Ga_nNi	30 MeV	0.20 mA
Gas to produce: ^{123}I	30 MeV	0.15 mA
Gas to produce: ^{11}C, ^{15}O	30 MeV	0.05 mA
Gas to produce: ^{18}F	42 MeV	0.02 mA
Water to produce: ^{18}F, ^{13}N	30 MeV	0.02 mA

C. TR30-1 and TR30-2 Cyclotron Facility Operating Specifications

Targets	Maximum Energy	Maximum Current
^{203}Tl, ^{68}Zn, ^{112}Cd	30 MeV	0.35 mA
Ga, Ni	30 MeV	0.20 mA
^{58}Ni	24 MeV	0.32 mA
Gas to produce: ^{123}I	30 MeV	0.15 mA
Solid to produce: ^{103}Pd	30 MeV	0.65 mA
^{100}Mo	24 MeV	0.50 mA

D. 13 MeV Cyclotron Facility Operating Specifications

Target Material	Reaction	Max. Current (μA)	Max. Energy (MeV)	Maximum Yield @ EOB (GBq)
$^{14}N_2$, 1% O_2 (Gas)	$^{14}N(p,\alpha)^{11}C$	40	13	160
H_2O<1% ethanol (Liquid) or $H_2{}^{16}O$ (Liquid)	$^{16}O(p,\alpha)^{13}N$	20	13	15
^{15}N-N_2, 1% O_2 (Gas)	$^{15}N(p,n)^{15}O$	30	13	104
$H_2{}^{18}O$ (Liquid) transferred to TR13 hotcell	$^{18}O(p,n)^{18}F$	20	13	189
$H_2{}^{18}O$ (Liquid) transferred to RCA	$^{18}O(p,n)^{18}F$	20	13	37*
$^{18}O_2$<1% F_2 (Gas)	$^{18}O(p,n)^{18}F$	30	13	285
Li	$^{7}Li(p,n)^{7}Be$	50	13	37*

* Operating limit instead of maximum saturation yield due to ALARA considerations when using the transfer lines to RCA (^{18}F) or manual removal of the target (Li).

E. ISAC Facility Operating Limitations

Maximum heavy ion beam activity: 37 GBq.

Conventional targets:
Maximum target material atomic number - 82

Actinide Target System:

Uranium carbide UCx targets subject to the following conditions:
Maximum proton beam current - 100 μA
Maximum integrated beam current per irradiation - 300,000 μA·h·g/cm^2
Maximum number of irradiations per year - no restriction

Uranium carbide P2N targets subject to the following conditions:
Maximum proton beam current:
- 80 μA with FWHM of 4 mm or
- 100 μA with FWHM of 7 mm

Maximum integrated charge on target: 16,000 μA-hours
Maximum number of irradiations per year – no restriction

Thorium Oxide target **ONE ONLY** subject to the following conditions:
Maximum proton beam current - 10 μA
Maximum integrated charge on target – 2400 μA-hours
Maximum target density - 11 g/cm^2

APPENDIX D: SOURCE - LIMITS FOR POSSESSION, IMPORT, USE, TRANSFER AND STORAGE

Location for possession, import, use, transfer and storage:

TRIUMF
4004 Wesbrook Mall
Vancouver BC V6T 2A3

Shipping address:

TRIUMF
6095 Nurseries Road
Vancouver BC V6T 2A3

Material	Maximum Total Quantity on Site for Unsealed Sources[1]		Maximum Activity per Sealed Source[2]	Comments
	(kg)	(GBq)	(GBq)	
Thorium	200	10		Importing these Controlled Nuclear Substances requires a separate licence under the *Nuclear Non-proliferation Import and Export Control Regulations.*
Depleted Uranium <0.6% U-235 by weight	600	14.0		
Natural Uranium	200	5.23		
Plutonium	0.002	4		
Enriched Uranium (Limit of only one sealed source)	0.100		0.000740	
Heavy water (Deuterium)	550 (110)			
Deuterium (other form than heavy water)	25			
Tritium		10,000		
Atomic numbers 2-89 (a) Tc-99m only (b) all other isotopes		1400 400		
Atomic numbers 2-89			100	
Americium 241 / Beryllium			55	
Americium 241 / Boron			15	
Americium 241			14	
Curium 244			1	
Californium 252			0.001	

[1] The limit refers to the sum of all activity for sources of a given isotope on site. It includes the processed activity from isotope production facilities (Appendix E). Once the processed activity is captured in a vial it becomes an unsealed source, and the limit applies to the sum of unsealed sources of that isotope.

[2] The limit refers to a per source activity and only applies to sources that exceed the exemption quantity.

APPENDIX E: NUCLEAR SUBSTANCES - ISAC COLLECTION STATION AND ISOTOPE PRODUCTION, FACILITY LIMITS FOR PRODUCTION AND PROCESSING

Material	Maximum Activity at the ISAC Collection Station[3]	Maximum Activity for Isotope Production[4]
	(GBq)	(GBq)
Atomic numbers 2-89 (except Tc-99m)	400	400
Tc-99m		1400

[3] The limit refers to the activity per isotope in a collection sample and only applies to quantities that exceed the exemption quantity.

[4] The limit refers to the activity per isotope produced for one irradiation and only applies to quantities that exceed the exemption quantity.

APPENDIX F: NUCLEAR SUBSTANCES - LIMITS FOR EXPORT

Nuclear Substance	Maximum Activity per Shipment (GBq)
Beryllium-7	81.0
Sodium-22	26.0
Silicon-32	0.053
Phosphorus-32	26.0
Phosphorus-33	35.0
Sulphur-35	160.0
Argon-37	270.0
Argon-39	1.0
Argon-42	0.010
Titanium-44	1.0
Calcium-45	1.0
Scandium-46	7.2
Vanadium-48	5.2
Vanadium-49	47.0
Chromium-51	29.0
Manganese-54	26.0
Iron-55	36.0
Cobalt-56	73.0
Nickel-56	0.011
Cobalt-57	120.0
Cobalt-58	21.0
Cobalt-60	0.59
Zinc-65	0.047
Strontium-90	0.001
Tin-113	0.001
Iodine-125	0.20
Cadmium-109	0.001
Barium-133	0.001
Cesium-137	0.001
Gadolinium-148	0.001
Europium-152	0.001
Lutetium-177m	0.001
Bismuth-207	0.001
Americium-241	0.010

APPENDIX G : DOCUMENTS VERSION CONTROL

Table G-1: Licensee Documents that are subject to LCH Document Control

Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
3.1 4.1	TSN 1.7, *Requirements for Reporting of Incidents* (Revised draft version, new document TD535)	529	draft		3970354
2.1 3.1	TSN 1.0, *TRIUMF Policy on Safety in the Workplace*	537	1.0.1	2001/07	3970355
3.2 7.1	TSN 1.1, *TRIUMF Radiation Protection Training Program*	538	5	2017/03/27	6393959
6.1	TSN 1.3, *TRIUMF Lockout Policy and Procedures*	539	6	2018/06/14	6262637
6.1	TSN 1.5, *Policy and Procedures for the Implementation of Interlocks Defeats and Device Disables*	541	3	2018/11/23	6262638
6.1	TSN 1.6, *Availability Requirements for TRIUMF Radiation Safety Systems*	542	1	2006/01	3970359
7.1	TSN 1.8, *Policy for Maximum Allowable Dose in Accessible Areas at TRIUMF*	544	2	2012/04/13	3970360
7.1	TSN 1.2, *Policy on Radiation Exposure*	545	3	2010/01/25	3970361
5.2 5.3	*ISAC II Safety Report*	561	4	2013/07/22	4181458
5.2 5.3	*TRIUMF TR30-2 Safety Report*	562	1.7	2003/03	3970363
4.1 5.2 5.3 7.1 7.2 8.1 9.1 9.2 9.4 12.1	*TRIUMF Safety Report*	563	3	2005/09	3970364
5.2 5.3	*ISAC I Safety Analysis Report*	565	1	2000/10	3970365
2.1	TSOP-01, *Documents and Records Management*	593	4	2018/09/11	6262639
6.1	TSOP-08, *Calibration and Inspection*	595	4	2016/12/12	6393960
5.1 6.1	TSOP-06, *Engineering Design, Manufacture and Assembly*	597	2	2008/10/15	3970367

Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
2.1	TSOP-07, *Experiment Management Science Division*	599	4	2015/10/02	5093978
2.1 3.1 4.1	TSOP-09, *Quality Program Assessment*	607	6	2015/12/17	5093983
3.2	TSOP-04, *The TRIUMF Training Program*	609	5	2019/04/01	F
2.1 3.1 4.1 5.1 6.1 9.1	*TRIUMF Quality Manual*	611	7	2020/06/09	6393962
3.2 7.1 8.1	*TRIUMF Handbook of Occupational Health and Safety*	840	6	2017/09/07	6393963
7.1	TSN 3.6, *Designation of Nuclear Energy Workers at TRIUMF*	850	2	2012/12/05	6393964
10.1	TSN 2.1, *TRIUMF First Aid Program*	857	3	2013/12/02	5094229
10.2	TSN 5.9, *Fire Protection and Prevention at TRIUMF*	868	3	2010/09/03	3970376
12.1	TSOP-10, *Access to TRIUMF*	1733	6	2018/05/14	6262641
5.2 5.3	*TRIUMF TR30-1 Safety Analysis Report*	3794	0	2005/03	3970379
2.1 3.1 4.1 5.1	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04	5093991
10.1	*TRIUMF Emergency Preparedness Plan*	4952	6	2019/11/28	6393965
9.1 9.2	*Monitoring of Emissions from the TRIUMF site (EHS-RPG-04-10)*	5328	3	2015/11/27	4980368
9.1 9.2	*Environmental Monitoring Program for the TRIUMF site (EHS-RPG-07-10)*	5329	3	2015/11/27	4980371
11.1	*Radioactive Waste Management for the TRIUMF site (EHS-RPG-06-10)*	5330	5	2016/12/23	6393966

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Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
5.2 5.3	*TR13 Safety Report*	5359	6	2020/01/17	6262648
3.1 4.1	TSOP-11, *Operations Management*	5604	2	2008-10-15	3970386
4.1 5.1 6.1	TSOP-12, *Configuration Management*	5605	3	2015/12/04	5094030
4.1	TSOP-13, Commissioning	5708	2	2008/10/15	3692689
11.1	*Characterization of Radioactive Waste (EHS-RPG-06-04)*	5815	1	2012/03/29	3970388
11.1	*Sorting Radioactive Waste at the Source (EHS-RPG-06-01)*	5816	2	2012/03/23	6393967
11.1	*Assaying Pump Oil Samples (EHS-RPG-06-03)*	5817	2	2016/09/01	6393968
10.1	*TRIUMF Emergency Response Plan*	5856	6	2019/11/29	6393969
5.2 5.3	*CP-42 Safety Analysis Report*	7114	2.2	2006/08	3970393
11.1	*Assaying Radioactive Waste (EHS-RPG-06-02)*	8000	2	2012/03/23	3970394
7.1 9.1 9.2	TSN 2.4, *Derived Release Limits for Radioactive Emissions from the TRIUMF Site*	8506	9	2019/04/12	6262642
11.2	*Preliminary Decommissioning Plan*	8810	5	2019/05/17	6265487
5.2 5.3	*TRIUMF - ISAC II Safety Report Supplementary Information*	8913	1	2006/12/08	3970396
5.2 5.3	*Proton Therapy Safety Analysis Report*	9408	3	2011/12/01	3970398

Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
5.2 5.3	*TRIUMF to ACU, CCM, CBH Pipelines for PET Radiopharmaceuticals Safety Analysis Report*	9605	9	2019/11/12	6266017
2.1	*TRIUMF Board of Management Safety & Security Committee Terms of Reference*	10610	1	2007/03	3970401
5.2 5.3	*Actinide Target Safety Analysis Report*	12972	2	2011/09/28	3970402
9.1 9.2 9.3	*Environmental Management System*	15678	2	2016/12/14	5378135
2.1	*TRIUMF Organizational Chart*	18112	Oct 2018	2018/10/05	6262643
2.1	*Joint Venture Agreement*	18114	Mar 2008	2008/03	3970407
2.1	*TAI Management Agreement*	18115	Mar 2008	2008/03	3970408
2.1	*TRIUMF Joint Health & Safety Committee Terms of Reference*	18121	5	2017/10/23	6393971
2.1	*Document Manual*	22284	5	2018/08/02	6262644
5.1	TSOP-15, *Project Governance*	22889	5	2019/03/26	6262645
2.1	*Safety and Quality Management Review Meeting - Terms of Reference*	24195	2	2018/01/15	6262646
5.2 5.3	*Proposal to Modify ISAC II Vault Exclusion Area Boundary*	27099	4	2013/03/15	4259681
5.2	*520 MeV Accelerator Access Control Interlock Systems: Area Safety Units and the Emergency Trip Pushbutton System for Secondary Beam Exclusion Areas*	27748	7	2015/10/01	5094131
5.2	*Accelerator Access Control Interlock Systems: Functional Requirements and Design of Area Safety Units and the Emergency Trip Pushbutton System for Primary Beam and ISAC Exclusion Areas*	27775	7	2015/10/01	5094124
10.2	*TRIUMF Fire Protection Program*	29313	2	2010/10/12	6393973
12.1	*TRIUMF Accelerator Inc. Security Plan* **(Confidential – Prescribed Information)**	29843	5	2015/08/15	3772037
5.2 5.3	*Beamline 2C4 Solid Target Facility Safety Report*	30071	5	2017/08/21	5392225
15.2	*CNSC Financial Security and Access Agreement*	30101	Jan 2008	2008/01/07	3970415

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Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
15.2	*Fund Contribution Gap Agreement*	30102	Jan 2008	2008/01/07	3970416
15.2	*Escrow Agreement*	30103	Jan 2008	2008/01/07	3970353
5.2	*Worst Case Emissions Analysis Report*	55017	1	2015/01/31	5094111
5.2 5.3	*Functional Requirements and Design of the e-Hall Maze Area Safety Unit*	57727	1	2013/01/31	4247010
14.1	*Package Handling and Transport Protocols for Radioactive Shipments*	62648	5	2019/10/21	6393974
14.1	*Procurement and Shipping of Radioactive Materials Procedure*	76036	3	2017/02/09	6393975
5.2 5.3	*Design Note TRI-DN-13-17 BL1A Shield Plug Modifications for UCN*	93063	2	2013/10/28	4227189
6.1	*Verification of Effluent Air Monitor Calibration*	109449	1	2014/05/20	4482952
5.2 5.3	*Actinide Target SAR Addendum for Thorium Oxide*	110961	1	2014/07/30	4496082
2.1 3.1	*TRIUMF Key Performance Indicators*	126719	2	2016/06/20	6393976
5.2 5.3	Design Note TRI-DN-16-34, *Safety Analysis for UCN Commissioning to 1 Microampere*	136684	2	2017/04/24	5235183
4.1 5.2	*BL1U Beam Commissioning Plan for 1μA Operation*	136846	1	2016/11/08	5122154
13.1	*TRIUMF Safeguards Program*	154117	1	2018/12/17	5744915
15.1	*TRIUMF Public Information and Disclosure Program*	156040	3	2020/02/20	6265486
5.2 5.3	*Actinide SAR Addendum for a proton-to-neutron converter target at ISAC*	188621	1	2020/09/28	6389035
5.3	*Long Rb Prototype Target Irradiation Tests*	ATG-PRO-OPR-STF-023	A	2016/10/31	5120322
5.3	*End-Use Statement for dual-use goods: Deuterium oxide, deuterium and deuterated compound*			2016/08/10	5093314
5.3	*Description of the use of up to 300kg of heavy water for the UCN project*			2016/09/29	5093315

Table G-2: Standards and Other Documents

Lic. Cond.	Source	Document Number	Title	Year	E-DOCS #
2.1 3.1	CSA	N286-12	*Management System Requirements for Nuclear Facilities*	2012	
9.2	CSA	N288.1-14	*Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*	2014	3469661
11.1	CSA	N292.3-14	*Management of low and intermediate-level radioactive waste*	2014	
11.2 15.2	CSA	N294-09	*Decommissioning of Facilities Containing Nuclear Substance*	2014	3661579
12.1	IAEA	Nuclear Security Series No. 15	*Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control*	2011	
8.1	WorkSafeBC		*Occupational Health and Safety Regulation*		
9.1 9.2 9.3	Metro Vancouver	244	*Greater Vancouver Sewerage and Drainage District Amending Bylaw No. 244, 2008*	2008	
9.1 9.2 9.3	Metro Vancouver	299	*Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007*	2007	
9.1 9.2 9.3	Metro Vancouver	1082	*Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008*	2008	

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Lic. Cond.	Source	Document Number	Title	Year	E-DOCS #
9.1 9.2 9.3	BC Environmental Management Act	N/A	*Waste Discharge Regulation*		
3.1	USNRC	NUREG-0711, Revision 3	*Human Factors Engineering Program Review Model*	2012	
5.1 10.2	GOC	N/A	*National Building Code of Canada 2015*	2015	
5.1 6.1 10.2	GOC	N/A	*National Fire Code of Canada 2015*	2015	
5.1 6.1 10.2	National Fire Protection Association	NFPA 801	NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials*	2014	

Table G-3: CNSC Documents

Lic. Cond.	Title	Document Number	Rev. #	Rev. Date	E-DOCS #
7.1	G-129, *Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"*	G-129	1	2004/10	
15.2	G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*	G-206		2000/06	
11.2 15.2	*G-219, Decommissioning Planning for Licensed Activities*	G-219		2000/06	
7.2 9.4	G-228, *Developing and Using Action Levels*	G-228		2001/03	
3.1 5.1	G-276, *Human Factors Engineering Program Plans*	G-276		2003/06	
3.1 5.1	G-278, *Human Factors Verification and Validation Plans*	G-278		2003/06	
3.1 5.1	P-119, *Policy on Human Factors*	P-119		2000/10	

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Lic. Cond.	Title	Document Number	Rev. #	Rev. Date	E-DOCS #
9.1	P-223, *Protection of the Environment*	P-223		2001/02	
2.1	REGDOC-2.1.2, *Safety Culture*	REGDOC-2.1.2	1.0	2018/04	
3.2	REGDOC-2.2.2, *Personnel Training*	REGDOC-2.2.2	1.0	2014/08	
9.1	REGDOC-2.9.1, *Environmental Protection: Policies, Programs and Procedures*	REGDOC-2.9.1	1.0	2013/09	
10.1	REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*	REGDOC-2.10.1	2.0	2016/02	
13.1	REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*	REGDOC 2.13.1	1.0	2018/02	
4.2	REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills*	REGDOC-3.1.2	1.0	2018/01	
15.1	REGDOC-3.2.1, *Public Information and Disclosure*	REGDOC-3.2.1	1.0	2018/05	
3.2	TPED-01, *Objectives and Criteria for Regulatory Evaluations of Nuclear Facility Training Programs*	TPED-01	4	2013/09	4148739
4.2	*Annual Compliance Monitoring and Operational Performance Reporting Requirements for Class I A & B Nuclear Facilities*			2011/03	3471152

APPENDIX H – RESOLUTION OF INCONSISTENCIES

Identifier	LC	Subject of Conflict or Inconsistency	E-DOCS #	Date of Resolution

PROPOSED LICENCE CHANGES

Overview

There are no changes to the licence conditions or format. The licence term recommended is for a 10-year period.

Licence Format

No new changes to the licence format for this CMD.

Licence Conditions

The changes to the existing licence conditions are the following:

- Separate the section for Safety Analysis SCA and Physical Design SCA to be consistent with other CNSC's LCHs.
- Change the period for filing a written report for dose action levels and environmental action levels exceedances from 30 working days to 21 days.

Licence Period

TAI has submitted an application with a request to renew its CNSC-issued operating licence for a period of 10 years.

TAI's performance over the last licensing period has been satisfactory for all SCAs, except for the following BE ratings:

- 2013, Fitness for Service SCA: 2 events related to the malfunction of safety related systems (rupture of xenon-123 gas target and under reporting of airborne emissions from 2009 to 2012 due to malfunction of stack monitoring);
- 2014, Management System and Human Performance Management SCAs: electron accelerator lockup incident (details in Appendix E);
- 2016, Waste Management Compliance SCA: CNSC staff downgraded this SCA to a rating of BE following a compliance verification inspection
- 2018-2020, Management System SCA: due to lack of progress towards compliance to N286-12.

For the first 3 BE ratings above, TAI addressed the issues within the year and brought back their performance to SA the following year. For the continuing BE rating related to compliance to N286-12 for the management system, TAI has submitted an Action Plan to address these NNC with associated milestones. Some of the actions have already been addressed based on the milestones and submitted documents. CNSC staff continue to monitor the progress and completion of the action plan and follow-up with inspections in the future to verify compliance, and has access to enforcement tools that will bring TAI

to compliance with N286-12 if their Action Plan is not completed by first calendar quarter of 2022.

In conclusion, TAI's performance has been consistent and adequate over the past licence period and reporting processes are in place to monitor performance over the proposed licensing period. Therefore, CNSC staff recommend that the Commission accept TAI's request for a 10-year licence period.

PROPOSED LICENCE PA1OL-01.00/2032

e-Doc# 6678553 (Word)

e-Doc# 6680370 (PDF)

CLASS IB PARTICLE ACCELERATOR OPERATING LICENCE

TRIUMF Accelerators INC.

I) **LICENCE NUMBER: PA1OL-01.00/2032**

II) **LICENSEE:**

Pursuant to section 24 of the *Nuclear Safety and Control Act*, this licence is issued to:

TRIUMF Accelerators Inc. (hereinafter "TRIUMF").
4004 Wesbrook Mall
Vancouver, British Columbia
V6T 2A3

III) **LICENCE PERIOD:**

This licence is valid from **July 1, 2022**, to **June 30, 2032**, unless otherwise suspended, amended, revoked or replaced.

IV) **LICENSED ACTIVITIES:**

This licence authorizes the licensee to:

a) Operate the following facilities at the location referred to in Part II of this licence:

   i) Class I:
      - a 500 MeV cyclotron and its associated beamlines and targets

   ii) Class II:
      - CP42, a 42 MeV cyclotron
      - TR30-1, a 30 MeV cyclotron
      - TR30-2, a 30 MeV cyclotron
      - TR13, a 13 MeV cyclotron
      - ISAC I, a radioactive ion beam accelerator
      - ISAC 2, a radioactive ion beam accelerator

b) Service the above facilities;

c) Produce, possess, process, transfer, use and store within the boundaries of the site any nuclear substance required for, associated with or incidental to the activity described in a) above;

d) Produce, possess, process, transfer, use, import, export and store within the boundaries of the site any other nuclear substance, subject to condition 5.3.

V) EXPLANATORY NOTES:

a) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the Nuclear Safety and Control Act and associated Regulations.

b) The "*TRIUMF Licence Conditions Handbook (*LCH*)*" provides:

i) compliance verification criteria in order to meet the conditions listed in the licence;

ii) information regarding delegation of authority to CNSC staff; and

iii) applicable versions of documents and a process for version control of codes, standards or other documents that are used as compliance verification criteria in order to meet the conditions listed in the licence.

VI) CONDITIONS:

G. GENERAL

G.1 Licensing Basis

The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) the regulatory requirements set out in the applicable laws and regulations;

(ii) the conditions and safety and control measures described in the facility's licence and the documents directly referenced in that licence;

(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (CNSC, hereinafter, "the Commission").

G.2 Changes to TRIUMF Documents

(i) Changes to the safety and control measures described in the application and the documents needed to support that application are permitted provided that the objective of the licensing basis is met.

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

G.3 Resolution of Conflict or Inconsistency

The licensee shall, in the event of any conflict or inconsistency, actual or potential, between licence conditions or codes, standards or regulatory documents referenced in this licence, direct the conflict or inconsistency in writing to the Commission or a person authorized by the Commission, for resolution.

1. MANAGEMENT SYSTEM

1.1 Management System

The licensee shall implement and maintain a management system, including a written safety policy which places safety paramount within the management system, overriding all other demands, for activities carried out under this licence.

2. HUMAN PERFORMANCE MANAGEMENT

2.1 Human Performance Program

The licensee shall implement and maintain a human performance program.

2.2 Training Program

The licensee shall implement and maintain a training program.

3. OPERATING PERFORMANCE

3.1 Operations Program

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.

3.2 Reporting Requirements

The licensee shall submit to the Commission each year a written annual compliance report that covers the previous year's operation.

4. SAFETY ANALYSIS

4.1 Safety Analysis Program

The licensee shall implement and maintain a safety analysis program.

4.2 Documentation

The licensee shall maintain a current set of documents and technical references comprising detailed technical descriptions and safety analyses specific to each major facility on-site.

4.3 Operational Specifications and Limits

The licensee shall maintain an up to date set of operating limits for the facilities and activities authorized under the licence, including limits for the production, possession, processing, use, transfer, storage, import and export of nuclear substances and operational limits for accelerators, beam-lines and target assemblies.

5. PHYSICAL DESIGN

5.1 Design Program

The licensee shall implement and maintain a design program.

6. FITNESS FOR SERVICE

6.1 Testing, Calibration and Maintenance Program

The licensee shall implement and maintain a testing, calibration and maintenance program for the facility.

7. RADIATION PROTECTION

7.1 Radiation Protection Program

The licensee shall implement and maintain a radiation protection program.

7.2 Dose Action Levels

The licensee shall notify the Commission or a person authorized by the Commission within 24 hours of becoming aware that a dose action level has been reached or exceeded and shall file a written report within 21 days of becoming aware of the matter.

8. CONVENTIONAL HEALTH AND SAFETY

8.1 Conventional Health and Safety Program

The licensee shall implement and maintain a conventional health and safety program.

9. ENVIRONMENTAL PROTECTION

9.1 Conventional Health and Safety Program

The licensee shall implement and maintain an environmental protection program for the facility.

9.2 Control and Monitoring of Nuclear Substance Releases

The licensee shall maintain an up to date set of nuclear substance release limits for the facility and shall control, monitor and record releases of nuclear substances to the environment from the facility such that the releases do not exceed these release limits.

9.3 Control and Monitoring of Hazardous Substance Releases

The licensee shall control, monitor and record the releases of hazardous substances.

9.4 Environmental Action Levels

The licensee shall notify the Commission or a person authorized by the Commission within 24 hours of becoming aware that an environmental action level has been reached or exceeded and shall file a written report within 21 days of becoming aware of the matter.

10. EMERGENCY MANAGEMENT AND FIRE PROTECTION

10.1 Emergency Preparedness Program

The licensee shall implement and maintain a program for emergency preparedness to address on-site and off-site events which can affect the nuclear facilities.

10.2 Fire Protection Program

The licensee shall implement and maintain a fire protection program for the facility.

11. WASTE MANAGEMENT

11.1 Waste Management Program

The licensee shall implement and maintain a program for waste management for the facility.

11.2 Preliminary Decommissioning Plan

The licensee shall maintain a preliminary decommissioning plan (PDP) for decommissioning the facility. This PDP shall be reviewed every five years or when requested by the Commission, or a person authorized by the Commission.

12. SECURITY

12.1 Security Program

The licensee shall implement and maintain a security program.

13. SAFEGUARDS

13.1 Safeguards Program

The licensee shall implement and maintain a safeguards program and undertake all measures required to ensure safeguards implementation at the nuclear facility.

13.2 Changes that Would Affect the Implementation of Safeguards Measures

The licensee shall not, except with the prior approval of the Commission or a person authorized by the Commission, make changes to any aspect of the facility or its operation, equipment or procedures that would affect the implementation of safeguards measures.

14. PACKAGING AND TRANSPORT

14.1 Packaging and Transport Program

The licensee shall implement and maintain a packaging and transport program of nuclear substances.

15. SITE SPECIFIC

15.1 Public Information and Disclosure Program

The licensee shall implement and maintain a public information program for the facility.

15.2 Financial Guarantees

The licensee shall maintain, in effect, a financial guarantee for decommissioning that is acceptable to the Commission.

SIGNED at OTTAWA, this _____day of _____, 2022.

_____

Rumina Velshi, President
on behalf of the Canadian Nuclear Safety Commission

PROPOSED LICENCE PA1OL-01.01/2032 TRANSFERRED TO TRIUMF INC.

e-Doc # 6697514 (Word)

e-Doc # 6697519 (PDF)

CLASS IB PARTICLE ACCELERATOR OPERATING LICENCE

TRIUMF INC.

I) **LICENCE NUMBER: PA1OL-01.01/2032**

II) **LICENSEE:**

Pursuant to section 24 of the *Nuclear Safety and Control Act*, this licence is issued to:

TRIUMF Inc. (hereinafter "TRIUMF").
4004 Wesbrook Mall
Vancouver, British Columbia
V6T 2A3

III) **LICENCE PERIOD:**

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IV) **LICENSED ACTIVITIES:**

This licence authorizes the licensee to:

a) Operate the following facilities at the location referred to in Part II of this licence:

   i) Class I:
      - a 500 MeV cyclotron and its associated beamlines and targets

   ii) Class II:
      - CP42, a 42 MeV cyclotron
      - TR30-1, a 30 MeV cyclotron
      - TR30-2, a 30 MeV cyclotron
      - TR13, a 13 MeV cyclotron
      - ISAC I, a radioactive ion beam accelerator
      - ISAC 2, a radioactive ion beam accelerator

b) Service the above facilities;

c) Produce, possess, process, transfer, use and store within the boundaries of the site any nuclear substance required for, associated with or incidental to the activity described in a) above;

d) Produce, possess, process, transfer, use, import, export and store within the boundaries of the site any other nuclear substance, subject to condition 5.3.

V) EXPLANATORY NOTES:

a) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the Nuclear Safety and Control Act and associated Regulations.

b) The "*TRIUMF Licence Conditions Handbook (*LCH)" provides:

i) compliance verification criteria in order to meet the conditions listed in the licence;

ii) information regarding delegation of authority to CNSC staff; and

iii) applicable versions of documents and a process for version control of codes, standards or other documents that are used as compliance verification criteria in order to meet the conditions listed in the licence.

VI) CONDITIONS:

G. GENERAL

G.1 Licensing Basis

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(i) the regulatory requirements set out in the applicable laws and regulations;

(ii) the conditions and safety and control measures described in the facility's licence and the documents directly referenced in that licence;

(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (CNSC, hereinafter, "the Commission").

G.2 Changes to TRIUMF Documents

(i) Changes to the safety and control measures described in the application and the documents needed to support that application are permitted provided that the objective of the licensing basis is met.

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

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The licensee shall, in the event of any conflict or inconsistency, actual or potential, between licence conditions or codes, standards or regulatory documents referenced in this licence, direct the conflict or inconsistency in writing to the Commission or a person authorized by the Commission, for resolution.

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The licensee shall implement and maintain a training program.

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3.1 Operations Program

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.

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The licensee shall submit to the Commission each year a written annual compliance report that covers the previous year's operation.

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4.1 Safety Analysis Program

The licensee shall implement and maintain a safety analysis program.

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The licensee shall maintain a current set of documents and technical references comprising detailed technical descriptions and safety analyses specific to each major facility on-site.

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The licensee shall control, monitor and record the releases of hazardous substances.

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The licensee shall implement and maintain a safeguards program and undertake all measures required to ensure safeguards implementation at the nuclear facility.

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14.1 Packaging and Transport Program

The licensee shall implement and maintain a packaging and transport program of nuclear substances.

15. SITE SPECIFIC

15.1 Public Information and Disclosure Program

The licensee shall implement and maintain a public information program for the facility.

15.2 Financial Guarantees

The licensee shall maintain, in effect, a financial guarantee for decommissioning that is acceptable to the Commission.

SIGNED at OTTAWA, this _____day of _____, 2022.

_____

Rumina Velshi, President
on behalf of the Canadian Nuclear Safety Commission

PROPOSED LICENCE CONDITIONS HANDBOOK

e-Doc # 6686519 (Word)

e-Doc # 6686526 (PDF)

Canada's Nuclear Regulator

E-DOCS #**6686519** (Word)
E-DOCS #**6686526** (PDF)

LICENCE CONDITIONS HANDBOOK

LCH-TRIUMF-R000
TRIUMF INC.
ACCELERATOR OPERATING LICENCE

PA1OL-01.01/2032

Revision 0

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

Licence Conditions Handbook
LCH-TRIUMF-R0000
TRIUMF Inc.
Accelerator Operating Licence
PA1OL-01.01/2032

Effective Date: July 1, 2022

SIGNED at Ottawa on July 1, 2022

_____

Mark Broeders
Director
Directorate of Nuclear Substance Regulation
CANADIAN NUCLEAR SAFETY COMMISSION

Revision History:

Effective Date	Rev #	LCH E-DOCS #	Section(s) changed	Description of the Changes	DCR List E-DOCS #
July 1, 2022	00	6686526	All	New	N/A

Table of Content

PART I - COMPLIANCE FRAMEWORK FOR EACH LICENCE CONDITION

1. INTRODUCTION

1.1 Licensing Overview

Class IB Particle Accelerator Operating Licence (PA1OL-01.01/2032) contains licence conditions, grouped by safety and control areas, that:

- identify programs that must be implemented and maintained by TRIUMF, based on information submitted in the licence application to demonstrate to the Canadian Nuclear Safety Commission that TRIUMF has adequate measures in place to fulfill all applicable licensing requirements pursuant to *Nuclear Safety and Control Act* 24(4)(*a*) and (*b*).

The licensing philosophy of the Canadian Nuclear Safety Commission (CNSC) is to support each Class IB Particle Accelerator Operating Licence with a Licence Conditions Handbook (LCH), which describes in detail the regulatory expectations associated with each condition in the licence. The LCH contains compliance criteria related to each licence condition, including:

- references to licensee's documentation with version control;
- reference to codes and standards;
- reference to CNSC regulatory documents; and
- specific operating limits and commitments made by TRIUMF to ensure compliance with CNSC expectations.

The LCH also defines the processes for making changes to the LCH and identifies the authorities delegated to CNSC staff with respect to approving changes.

1.2 Purpose of LCH

The objective of this document is to establish and consolidate into one document the compliance framework related to TRIUMF's particle accelerator operating licence
This includes:

- defining the licensing basis;
- explaining the regulatory context related to each licence condition; and
- identifying verification criteria for each licence condition.

The LCH is to be used by both TRIUMF and by CNSC staff as a tool to assist in ensuring TRIUMF continues to 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.

2. CNSC ADMINISTRATIVE CONTROL PROCESS

2.1 Change Control Process

A change control process is applied to the LCH to ensure that:

- preparation and use of this document is properly controlled;
- all referenced documents are correctly identified and maintained;
- changes are conducted in accordance with CNSC Regulatory Policy P-299, *Regulatory Fundamentals*; and
- procedures for modifying this document are clear.

Changes can be requested by either CNSC staff or TRIUMF. TRIUMF is to be consulted on any changes proposed by CNSC staff. Section 2.3 of this LCH identifies the persons authorized by the Commission to approve changes.

2.2 Change Control Procedure

A change request form is included in Appendix A of the LCH. The change will be assessed by CNSC staff. Provided the change is consistent with the conditions of the licence and the objectives of the licensing basis, a recommendation to proceed will be made to one of the authorized persons identified in section 2.3 of Part I of this LCH. TRIUMF will be consulted on any proposed change requested by CNSC staff. Once approved, the LCH will be updated and distributed in accordance with section 2.5 of this LCH.

2.3 Changes to LCH

The following CNSC staff may approve changes to this LCH:

- Director, Accelerators and Class II Facilities Division (ACFD);
- Director General, Directorate of Nuclear Substance Regulation (DNSR),
- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch.

2.4 Dispute Resolution Process

In the event of disagreement concerning the LCH, the following conflict resolution process will apply:

- The Project Officer handling the licence will arrange a meeting between the appropriate parties, including persons authorized by TRIUMF and the Director of the Accelerator and Class II Facilities Division of the CNSC.
- If a mutually acceptable decision is reached at this meeting, the rationale supporting the decision will be documented and referenced in the LCH.
- If a mutually agreeable decision is not reached, the disagreement will be brought to the next level of authority as defined in section 2.3 of Part I of this LCH.
- Any unresolved issue will be referred to the Commission.

2.5 Distribution

A copy of the updated version of the LCH will be provided to TRIUMF and made available to all relevant CNSC staff through the CNSC electronic document management system.

3. OVERVIEW OF THE OPERATING LICENCE

3.1 Section I - Licence Number

The alphanumeric expression PA1OL-01.01/2032 stems from a standard convention for identifying CNSC licences. The following table provides a description of each identifier used in the expression:

Identifier	Description
PA1OL	Class IB Particle Accelerator Facility Operating Licence
01	Identifier corresponding to TRIUMF Inc.
00	Licence version number (00 = Initial licence)
2022	Expiration year

3.2 Section II - Licensee

This part of the licence provides the name and the address of the person or the corporate entity that holds the licence (hereinafter the “licensee”). In this case it is TRIUMF Incorporated.

3.3 Licence Period

Identifies the duration for which the licence is valid, which for PA1OL-01.01/2032, is from 01 July 1, 2022 to June 30, 2032, unless suspended, amended, revoked, or replaced during the licensing period.

3.4 Section IV - Licensed Activities

This licence authorizes the licensee to:

(i) Operate the following facilities:

a. Class I:

- **a 500 MeV cyclotron and its associated beamlines and targets**

b. Class II:

- **CP42, a 42 MeV cyclotron**
- **TR30-1, a 30 MeV cyclotron**
- **TR30-2, a 30 MeV cyclotron**
- **TR13, a 13 MeV cyclotron**
- **ISAC I, a radioactive ion beam accelerator**
- **ISAC 2, a radioactive ion beam accelerator**

(ii) Service the above facilities;

(iii) Produce, possess, process, transfer, use and store within the boundaries of the site any nuclear substance required for, associated with or incidental to the activity described in (i) above;

(iv) Produce, possess, process, transfer, use, import, export and store within the boundaries of the site any other nuclear substance, subject to condition 5.3.

This part of the licence lists the activities that TRIUMF is authorized to conduct. They are derived from the list of activities described in section 26 of the *Nuclear Safety and Control Act* (hereinafter "NSCA").

The operation of the facility is subject to the *Nuclear Safety and Control Act*, its associated regulations and the licence conditions set out in the Class IB Particle Accelerator Facility Operating Licence (PA1OL).

3.5 Section V - Explanatory Notes

Part V of the licence clarifies the language used in the licence and introduces the Licence Conditions Handbook (LCH) as a licence compliance tool:

(a) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and associated Regulations.

(b) The "*TRIUMF Licence Conditions Handbook (*LCH)" provides:

(i) compliance verification criteria in order to meet the conditions listed in the licence;

(ii) information regarding delegation of authority to CNSC staff; and

(iii) applicable versions of documents and a process for version control of codes, standards or other documents that are used as compliance verification criteria in order to meet the conditions listed in the licence.

3.6 Section VI - Licence Conditions

This part of the licence lists the conditions with which the licensee must comply. For clarity, the licence conditions are grouped, to the extent possible, under the most appropriate safety and control area (SCA) relating to the licensed activities. Part II of the LCH provides compliance verification criteria and guidance for each licence condition.

PART II - COMPLIANCE FRAMEWORK FOR EACH LICENCE CONDITION

G. GENERAL

Licence Condition G.1 – Licensing Basis

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

Preamble

The licensing basis for a regulated facility or activity is a set of requirements and documents comprising:

(i) the regulatory requirements set out in the applicable laws and regulations;
(ii) the conditions and safety and control measures described in the facility's licence and the documents directly referenced in that licence; and
(iii) the safety and control measures described in the licence application and the documents needed to support that licence application.

The licensing basis sets the boundary conditions for acceptable performance at a regulated facility or activity, thus establishing the basis for the CNSC's compliance program with respect to that regulated facility or activity.

Compliance Verification Criteria

TRIUMF shall operate its nuclear facilities in accordance with the licensing basis. This means that TRIUMF shall conduct the licensed activities in accordance with the laws, regulations, requirements and documents included in (i) through (iii) above.

The "documents needed to support the licence application" under item iii) above are referenced in this LCH. As improvements are made to TRIUMF's programs and documents throughout the licence period, provisions have been made under licence condition 1.2 to allow TRIUMF to make changes to these documents.

Guidance

None provided.

Licence Condition G.2 – Changes to TRIUMF Documents

(a) Changes to the safety and control measures described in the application and the documents needed to support that application are permitted provided that the objective of the licensing basis is met.

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

Preamble

TRIUMF is encouraged to make continuous improvements to all aspects of its operations, but at all times must remain within the licensing basis authorized by the Commission. Consequently, if changes are made which improve safety and remain within the licensing basis, then TRIUMF does not need prior written approval of the Commission. However, TRIUMF is required to notify the CNSC staff when **any** changes are made to the core documents identified in each safety and control area. For these documents, the licensee must submit proposed changes sufficiently far in advance of the implementation date to enable CNSC staff to review the changes made and verify that all changes remain within the licensing basis **prior to implementation.**

Changes outside of the existing licensing basis require written approval of the Commission. Such changes will typically require the licensee to apply for a licence amendment to modify the scope of the licensing basis.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change: None.

TRIUMF shall not make any change that would result in an impact on the health and safety of persons, the environment, national security, or the control measures related to the international obligations to which Canada has agreed, that is different in nature or greater in magnitude or probability than that described in the licensing basis documents, without prior written approval of the Commission. All other changes are subject to the written approval of the persons designated under section 2.3 of Part I of this LCH.

The documents which must be submitted to obtain CNSC approval for changes must demonstrate that the change:

- has been thoroughly developed, designed, analyzed, reviewed and approved by the licensee, and
- is in compliance with all regulatory requirements.

The documents required to be submitted by criterion 1.2(1) must contain the complete set of information needed to enable CNSC staff to evaluate the proposed change and develop a

regulatory position for decision by the Commission, or a person authorized by the Commission as defined in section 2.3 of this LCH. Prior to submitting the request and documents related to the change approval, TRIUMF shall have assessed and approved the proposed change using TRIUMF's authorized change control process confirming the merit, validity and safety of the proposed change. The proposed change details shall have been developed and designed to the level which enables a sound and informed decision to be made. The proposed change must be supported by a corresponding safety analysis and TRIUMF must demonstrate that it complies with all regulatory and licensing requirements. The design, review, control and implementation of the change must be in accordance with the requirements of applicable standards and reference publications specified in the LCH, unless otherwise accepted in writing by CNSC staff.

The approval for changes may be granted by the Commission or by the CNSC staff identified in the introduction of this LCH, depending upon on its risk significance. CNSC staff will submit to the Commission for consideration any matter that in CNSC staff's opinion:

(a) may pose an unreasonable risk;
(b) is potentially of significant interest to the Commission; or
(c) has the potential to attract national or international public or media interest or concern.

If the written approval of the Commission is needed for a change to proceed, a determination of the applicability of the *Canadian Environmental Assessment Act* (CEAA) must be made by CNSC staff. An environmental assessment under CEAA may or may not be required.

Guidance

None provided.

Licence Condition G.3 – Resolution of Conflict or Inconsistency

The licensee shall, in the event of any conflict or inconsistency, actual or potential, between licence conditions or codes, standards or regulatory documents referenced in this licence, direct the conflict or inconsistency in writing to the Commission, or a person authorized by the Commission, for resolution.

Preamble

This licence condition directs the licensee to seek CNSC resolution in the event that conflicts or inconsistencies are identified between the documents which form the licensing basis.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change: None.

The licensee shall formally seek CNSC resolution of any conflict or inconsistency.

In the event of any conflict or inconsistency between any CNSC requirement made pursuant to the *Nuclear Safety and Control Act* and its regulations, and the requirements of the licence, the licensee shall refer the matter to the Commission or a person authorized by the Commission for resolution.

Guidance

Any conflict or inconsistency identified should first be discussed between TRIUMF and CNSC Project Officer handling the licence. If the conflict or inconsistency cannot be resolved, the matter shall be referred to the dispute resolution process described in section 2.4 of Part I of this LCH.

The outcome will be documented to ensure a common understanding. CNSC staff will record all resolutions made pursuant to this licence condition in Appendix H of the LCH. This Appendix gives a description of the conflict or inconsistency and a reference to the CNSC electronic record (E-DOCS #) documenting the resolution.

If necessary, the LCH will be updated to reflect any changes required to resolve the conflict or inconsistency.

1. SCA – MANAGEMENT SYSTEM

The management system SCA covers the framework of processes, procedures and practices used to ensure an organization can fulfill all tasks required to achieve its objectives safely and consistently.

Performance Objective: Establishment and maintenance of a documented series of processes which ensure adequate management oversight and control over the operation of the facility and the conduct of licensed activities.

Licence Condition 1.1 – Management System

The licensee shall implement and maintain a management system, including a written safety policy which places safety paramount within the management system, overriding all other demands, for activities carried out under this licence.

Preamble

Paragraph 3(k) of the *General Nuclear Safety and Control Regulations* requires that a licence application contain information related to the applicant's organizational management structure including the internal allocation of functions, responsibilities and authority.

Paragraph 3(d) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain *"the proposed quality assurance program for the licensed activity"*.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CSA	*Management System Requirements for Nuclear Facilities*	N286-12		2012
CNSC	REGDOC-2.1.2, *Safety Culture*	REGDOC-2.1.2	1.0	2018/04

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.0, *TRIUMF Policy on Safety in the Workplace*	537	1.0.1	2001/07
TRIUMF	TSOP-01, *Documents and Records Management*	593	4	2018/09/11
TRIUMF	TSOP-07, *Experiment Management Science Division*	599	4	2015/10/02
TRIUMF	TSOP-09, *Quality Program Assessment*	607	6	2015/12/17
TRIUMF	*TRIUMF Quality Manual*	611	**7**	2020/06/09
TRIUMF	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04
TRIUMF	*TRIUMF Board of Management Safety & Security Committee Terms of Reference*	10610	1	2007/03
TRIUMF	*TRIUMF Organizational Chart*	18112	Oct 2018	2018/10/05
TRIUMF	*Joint Venture Agreement*	18114	Mar 2008	2008/03

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TAI Management Agreement*	18115	Mar 2008	2008/03
TRIUMF	*TRIUMF Joint Health & Safety Committee Terms of Reference*	18121	5	2017/10/23
TRIUMF	*Document Manual*	22284	5	2018/08/02
TRIUMF	*Safety and Quality Management Review Meeting - Terms of Reference*	24195	2	2018/01/15
TRIUMF	*TRIUMF Key Performance Indicators*	126719	2	2016/06/20

Guidance

None provided.

2. SCA – 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 the number of licensee staff is sufficient in all relevant job areas and that licensee staff have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.

Performance Objective: The number of licensee staff is sufficient in all relevant job areas and staff have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.

Licence Condition 2.1 – Human Performance Program

The licensee shall implement and maintain a human performance management program.

Preamble

Paragraphs 12(1)(a), (b), (e) and section 17 of the *General Nuclear Safety and Control Regulations* require different elements related to the human performance program.

CNSC Regulatory P-119, *Policy on Human Factors* requires that the CNSC take human factors issues into account in its regulatory activities.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.2.1, *Human Factors*	REGDOC-2.2.1		2019/03

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.7, *Requirements for Reporting of Incidents*	529	draft	
TRIUMF	TSN 1.0, *TRIUMF Policy on Safety in the Workplace*	537	1.0.1	2001/07
TRIUMF	TSOP-09, *Quality Program Assessment*	607	6	2015/12/17
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04
TRIUMF	TSOP-11, *Operations Management*	5604	2	2008-10-15
TRIUMF	*TRIUMF Key Performance Indicators*	126719	2	2016/06/20

(1) The licensee shall implement a human performance program linking together the key elements important to human performance management. The program is expected to satisfy the requirements of:

- REGDOC-2.2.1, *Human Factors*.

(2) The licensee shall:

- define the expected personnel performance and behavior and communicate the expectations to personnel;
- define the expected results of personnel performance and communicate the expectations to personnel; and
- evaluate the personnel performance and compare it against expectations.

(3) The licensee shall ensure that work activities are authorized and carried out using approved documents (including those for software), materials, parts, tools, processes and practices.

(4) The licensee shall ensure that:

- verification activities are planned before starting the work;
- verification of work is performed to confirm that the work meets requirements; and
- verification is recorded.

(5) The licensee shall ensure that persons assigned to perform independent verification do not verify their own work; or work they have directly supervised.

(6) The licensee shall monitor and control the hours of work and shift schedules of personnel performing safety-related tasks or working on safety-related systems.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
USNRC	*Human Factors Engineering Program Review Model*	NUREG-0711	2	
CSA	*Management System Requirements for Nuclear Facilities*	N286-12		2012

A human performance management program is the overarching program that integrates all activities associated with human factors. Human performance is the outcome of human behaviors, functions and actions in a specified environment, reflecting the ability of workers and management to meet the management system's defined performance under the conditions in which the management system will be employed.

Human factors are factors that influence human performance as it relates to the safety of a nuclear facility or activity over all the phases, including design, operation, maintenance, and decommissioning. These factors may include the characteristics of the person, task, equipment, organization, environment, and training. The application of human factors to issues such as interface design, training, procedures, organization and job design may affect the reliability of humans performing tasks under various conditions.

The licensee may follow industry best practice in developing the elements of a human performance program. Additional details on human factors engineering programs can be found in NUREG-0711: *Human Factors Engineering Program Review Model*. Where applicable, the human performance program should reference governing documentation for the facility.

Independent Verification:
Clauses 5.4, 5.8 and 5.10 of CSA standard N286-12 define the generic requirements needed in order to ensure:

- personnel know what is expected of them;
- performance of work is controlled; and
- work is verified to confirm that it is correct.

The degree of independence and extent of verification can vary depending of the complexity of the work and the potential impact on safety.

Licence Condition 2.2 – Training Program

The licensee shall implement and maintain a training program.

Preamble

Paragraphs 12(1)(*a*) and 12(1)(*b*) of the *General Nuclear Safety and Control Regulations* require that a licensee shall ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the Act, the regulations made under the Act and the licence; and shall train the workers to carry on the licensed activity in accordance with the Act, the regulations made under the Act and the licence.

Paragraphs 6(*m*) and 6(*n*) of the *Class I Nuclear Facilities Regulations* require that licence applications include the proposed responsibilities of and qualification requirements and training program for workers, including the procedures for the requalification of workers; and the results that have been achieved in implementing the program for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility.

Paragraph 14(2)(e) of the *Class I Nuclear Facilities Regulations* requires every licensee to keep a record of the status of each worker's qualifications, requalification and training, including the results of all tests and examinations completed in accordance with the licence.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.2.2, *Personnel Training*	REGDOC-2.2.2	1.0	2014/08

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.1, *TRIUMF Radiation Protection Training Program*	538	5	2017/03/27
TRIUMF	TSOP-04, *The TRIUMF Training Program*	609	5	2019/04/0
TRIUMF	*TRIUMF Handbook of Occupational Health and Safety*	840	6	2017/09

The licensee shall implement and maintain training programs for workers in accordance with the requirements set out in REGDOC-2.2.2 *Personnel Training*.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	TPED-01, *Objectives and Criteria for Regulatory Evaluations of Nuclear Facility Training Programs*	TPED-01	4	2013/09

CNSC document TPED-01, *Objectives and Criteria for Regulatory Evaluation of Nuclear Facility Training Programs* sets out the compliance criteria to evaluate all training programs.

3. SCA – OPERATING PERFORMANCE

The Safety and Control Area "Operating Performance covers the overall program which establishes and maintains the operating policies and procedures which enable TRIUMF to safely conduct the activities authorized under the licence, as well as the processes used to periodically review performance to ensure TRIUMF continues to conduct the licensed activity in a safe and effective manner.

Performance Objective: The establishment and maintenance of a program which ensures the safe and secure operation of the facility, including adequate regard for health, safety, security, environmental protection and international obligations.

Licence Condition 3.1 – Operating Program

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.

Preamble

Paragraph 6(d) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.7, *Requirements for Reporting of Incidents*	529	draft	
TRIUMF	*TRIUMF Safety Report*	563	3	2005/09
TRIUMF	TSOP-09, *Quality Program Assessment*	607	6	2015/12/17
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04
TRIUMF	TSOP-11, *Operations Management*	5604	2	2008-10-15
TRIUMF	TSOP-12, *Configuration Management*	5605	3	2015/12/04
TRIUMF	TSOP-13, *Commissioning*	5708	2	2008/10/15
TRIUMF	*BL1U Beam Commissioning Plan for 1μA Operation*	136846	1	2016/11/08

(1) Operation of the facility shall be governed by formal developed and validated procedures which are reviewed and revised as necessary on a regular basis.

(2) The licensee shall use the safety analysis reports as a basis for continuous safe operation of its facilities and for assessing the safety implications of changes to the facility or to operating procedures.

(3) If operation outside permitted operating boundaries, limits and rules as defined in the facility safety analyses is discovered, the licensee shall take immediate action to return operations to within these limitations.

Guidance

The operating program defines the operating rules consistent with the safety analyses and other licensing support documentation within which the facility will be operated, maintained and modified, all of which should ensure nuclear safety. The program for operation must specify the authorities of facility staff positions to make decisions within the defined boundaries. The operations program establishes safe, uniform, and efficient operating practices within the nuclear facility.

The *TRIUMF Quality Manual* and facility Safety Analysis Reports define the specific requirements with respect to facility operations, configuration control and operating procedures related to TRIUMF's facilities. Compliance is verified by monitoring conformity with these documents and the supporting documents they reference.

Licence Condition 3.2 – Reporting Requirements

The licensee shall submit to the Commission each year a written annual compliance report that covers the previous year's operation.

Preamble

Paragraph 24(5) of the *Nuclear Safety and Control Act* specifies that a licence may contain "*any term or condition that the Commission considers necessary for the purposes of this Act"*. Every facility operating licence includes the requirement to submit an "Annual Compliance Report" (ACR). This report provides a summary of key facility operating performance parameters related to the safe operation of the facility and the safe conduct of the licensed activities.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change: None.

(1) TRIUMF shall submit a written Annual Compliance Report by June 30 of each year, unless otherwise directed or approved in writing by the Commission or a person authorized by the Commission.

(2) At a minimum, the ACR shall contain:

- A brief summary of operation during the year.
- A list of persons appointed by TRIUMF to be responsible for day-to-day operation of the facility.
- A list of the membership of the radiation safety committee (or equivalent) and any other committee having responsibility for oversight of the safe conduct of operations. Include a brief summary of any activities or decisions of these committees having a potentially significant impact upon the safe conduct of the licensed activities.
- A summary for the year of the status of any changes to the facility or operating procedures which might affect safety.
- A summary of the total volume and mass of any waste and by-product generated for each type of materials (both nuclear and/or hazardous).
- A summary and analysis of results of radiation safety measurements performed in the year (both routine and special measurements). Where potential annual doses are extrapolated from area monitoring results, provide a justification for any parameters used to perform the calculation.
- A summary of the results of routine and special tests performed on safety-related systems. Include the reasons for and nature of special tests. Include the required frequency for these tests which are specified as part of the facilities Maintenance, Testing and Calibration program. Provide an explanation for any tests which were not conducted, including the projected date for completing tests which have been delayed.

- A description of distribution of annual radiation exposures to personnel at the facility, including both Nuclear Energy Workers (NEWs) and non-NEWs. Include whole body effective doses, extremity equivalent doses, and the results of any neutron dosimetry or bioassays. Also include the methods used for personal dose monitoring.
- A summary of any unusual occurrences in which personnel or the public were, or could have been, exposed to radiological or other hazards. This should include a description of any corrective action taken as a result of the occurrences.
  NOTE: TRIUMF **must** report all such incidents immediately in accordance with sections 29 to 32 of the *General Nuclear Safety and Control Regulations*. Inclusion of a summary of these incidents in the ACR does **not** release TRIUMF from the any other reporting requirements specified in *NSC Act* or *Regulations.*
- The total number of hours of various operating modes during the year, including the energies and beam currents used in conjunction with the various accelerators, beam lines and targets.
- A current inventory of all nuclear substances (sealed and unsealed) and radiation devices.
- The activity, volume and composition of solid and liquid radioactive wastes generated during the year and the method employed for their disposal. Include the types of radioactive liquid and gaseous wastes released to the environment and total activities released during the year.
- A summary of any planned changes for which the Commission's approval will probably be requested during the next year.
- Any changes to the emergency procedures, or any other changes that could affect the facility's emergency response program. Include any training activities, drill and exercise activities, or unplanned events in which the facility's emergency response organization has been tested.
- A summary of the outcomes from the management reviews performed at the facility according to the TRIUMF Quality Assurance Manual.
- A brief report on the status of the preliminary decommissioning plan and decommissioning fund.
- The name and signature of the signing authority, certifying that the facility has been operated in compliance with the licence except where noted. Include the signatory's function, address and telephone number.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CNSC	REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills*	REGDOC-3.1.2	1.0	2018/01

Detailed guidance on preparing ACRs, licensee's report and notifications regarding situations is contained in the CNSC's REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills*.

4. SCA – SAFETY ANALYSIS

The Safety and Control Area "Safety Analysis" addresses the systematic evaluation of the potential hazards associated with the operation of the facility and the conduct of licensed activities; including the evaluation of the effectiveness of the preventative measures and strategies that have been implemented to mitigate these hazards.

Performance Objective: The safety analysis addresses the potential exposure of personnel and the public to radiation and releases of radioactivity and hazardous substances to the environment, during both normal operation and "design basis events".

Licence Condition 4.1 – Safety Analysis Program

The licensee shall implement and maintain a safety analysis program.

Preamble

Paragraph 3(1)(i) of the *General Nuclear Safety and Control Regulations* requires that a licence application contain a description and the results of any test, analysis or calculation performed to substantiate the information included in the application.

Paragraphs 6(a), (b), (c) and (d) of the *Class I Nuclear Facilities Regulations* require that a licence application contain: a description of the structures, systems and equipment at the facility, including their design and their design operating conditions; a final safety analysis report demonstrating the adequacy of the design of the nuclear facility; and the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.2.1, *Human Factors*	REGDOC-2.2.1		2019/03
GOC	*National Building Code of Canada 2015*	N/A		2015
GOC	*National Fire Code of Canada 2015*	N/A		2015
NFPA	NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials*	NFPA 801		2014

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSOP-06, *Engineering Design, Manufacture and Assembly*	597	2	2008/10/15
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04
TRIUMF	TSOP-12, *Configuration Management*	5605	3	2015/12/04
TRIUMF	TSOP-15, *Project Governance*	22889	5	2019/03/26

(1) The safety analysis program shall include:

- processes to ensure that the design of any facility structure, system or component and any modifications comply with applicable codes, standards and regulations, including adequate consideration of human factors;
- provisions to ensure that design of any facility incorporates the shielding and safety systems necessary to keep radiological doses to workers and members of the public below regulatory limits and ALARA;
- provisions to ensure that design of any facility incorporates measures to keep releases of radioactive materials into the environment below regulatory limits and ALARA;
- provisions to ensure that systems and components important to safety are designed to be reliable, fail-safe and incorporate sufficient redundancy to ensure that the failure or the removal from service of a single component does not result in a loss of either the protection function or the minimum level of redundancy required;
- configuration management processes to ensure that the documented design basis for the facility is maintained up-to-date after design changes, and;
- processes to ensure that the impacts of design changes are fully assessed and accurately reflected in the safety analyses prior to implementation.

(2) Modifications to the facility shall be made in accordance with the *National Building Code of Canada 2015*, the *National Fire Code of Canada 2015*, and NFPA 801: S*tandard for Fire Protection for Facilities Handling Radioactive Materials*. TRIUMF shall, prior to implementation of any proposed modification of the facility with the potential to impact protection from fire:

- submit the proposed modification for third-party review for compliance with the above fire protection codes and standards;
- have the review carried out by one or more independent external reviewers having specific expertise with such reviews; and
- submit in writing the results of the review to the Commission, or a person authorized by the Commission.

(3) As a minimum, facility safety analyses shall include a description and analysis of:

- the design of the facility;
- the normal operating conditions and parameters for the facility;
- the radiological hazards related to the operation of the facility and the measures implemented to ensure that radiological doses to workers and members of the public are below regulatory limits and ALARA;
- the measures implemented to ensure that releases of radioactive materials into the environment are below regulatory limits and ALARA;
- all safety systems and their design basis;
- the potential accident scenarios caused by process deviations, events internal to the facility, and credible external events including natural phenomena, and;
- the radiological consequences should such an accident occur.

Guidance

The *TRIUMF Quality Manual* defines the specific requirements needed to adequately conduct the design of structures, systems and components, including control system software. TRIUMF Standard Operating Procedures (TSOP) TSOP-02, *Nonconformity Reporting & Resolution*, TSOP-06, *Engineering design, Manufacture and Assembly*, TSOP-12, *Configuration Management,* and TSOP-15, Project Management describe processes and procedures applicable to the design and safety analysis of TRIUMF's facilities. Compliance is verified by monitoring conformity with these policies and procedures and the supporting documents referenced in these documents.

Licence Condition 4.2 – Documentation

The licensee shall maintain an up to date set of documents and technical references comprising detailed technical descriptions and safety analyses specific to each major facility on-site.

Preamble

Paragraph 3(1)(i) of the *General Nuclear Safety and Control Regulations* requires that a licence application contain a description and the results of any test, analysis or calculation performed to substantiate the information included in the application.

Paragraphs 6(a), (b), (c) and (d) of the *Class I Nuclear Facilities Regulations* require that a licence application contain: a description of the structures, systems and equipment at the facility, including their design and their design operating conditions; a final safety analysis report demonstrating the adequacy of the design of the nuclear facility; and the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*ISAC II Safety Report*	561	4	2013/07/22
TRIUMF	*TRIUMF TR30-2 Safety Report*	562	1.7	2003/03
TRIUMF	*TRIUMF Safety Report*	563	3	2005/09
TRIUMF	*ISAC I Safety Analysis Report*	565	1	2000/10
TRIUMF	*TRIUMF TR30-1 Safety Analysis Report*	3794	0	2005/03
TRIUMF	*TR13 Safety Report*	5359	6	2020/01/17
TRIUMF	*CP-42 Safety Analysis Report*	7114	2.2	2006/08
TRIUMF	*TRIUMF - ISAC II Safety Report Supplementary Information*	8913	1	2006/12/08
TRIUMF	*Proton Therapy Safety Analysis Report*	9408	3	2011/12/01
TRIUMF	*TRIUMF to ACU, CCM, CBH Pipelines for PET Radiopharmaceuticals Safety Analysis Report*	9605	9	2019/11/
TRIUMF	*Actinide Target Safety Analysis Report*	12972	2	2011/09/28
TRIUMF	*Proposal to Modify ISAC II Vault Exclusion Area Boundary*	27099	4	2013/03/15

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*520 MeV Accelerator Access Control Interlock Systems: Area Safety Units and the Emergency Trip Pushbutton System for Secondary Beam Exclusion Areas*	27748	7	2015/10/01
TRIUMF	*Accelerator Access Control Interlock Systems: Functional Requirements and Design of Area Safety Units and the Emergency Trip Pushbutton System for Primary Beam and ISAC Exclusion Areas*	27775	7	2015/10/01
TRIUMF	*Beamline 2C4 Solid Target Facility Safety Report*	30071	5	2017/08/21
TRIUMF	*Worst Case Emissions Analysis Report*	55017	1	2015/01/31
TRIUMF	*Functional Requirements and Design of the e-Hall Maze Area Safety Unit*	57727	1	2013/01/31
TRIUMF	*Design Note TRI-DN-13-17 BL1A Shield Plug Modifications for UCN*	93063	2	2013/10/28
TRIUMF	*Actinide Target SAR Addendum for Thorium Oxide*	110961	1	2014/07/30
TRIUMF	Design Note TRI-DN-16-34, *Safety Analysis for UCN Commissioning to 1 Microampere*	136684	2	2017/04/24
TRIUMF	*BL1U Beam Commissioning Plan for 1μA Operation*	136846	1	2016/11/08
TRIUMF	*Actinide SAR Addendum for a proton-to-neutron converter target at ISAC*	188621	1	2020/09/28

(1) TRIUMF shall maintain an up to date set of design documents, technical references and safety analysis reports for the nuclear facility. These must include all accelerators, beam-lines, target system, beam dumps and associated safety interlocks systems.

The list of controlled Safety Analysis Reports pertaining to this requirement is included under the Document Control Section for this licence condition.

Guidance

Major new facilities or systems being constructed on TRIUMF's the site will typically require the issuance of licences to construct and commission the new facilities and are subject to the normal licensing processes as specified under the *NSC Act* and *Regulations.* The list of approved safety analysis reports will be updated to include such new facilities once they achieve routine operating status and are incorporated under the operating licence.

SAFETY ANALYSIS

While TRIUMF is expected to review and if necessary, to revise and reissue the Safety Analysis periodically, **revisions to the reports must be submitted to the CNSC for review and are subject to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).**

Licence Condition 4.3 – Operational Specifications and Limits

The licensee shall maintain an up to date set of operating limits for the facilities and activities authorized under the licence, including limits for the production, possession, processing, use, transfer, storage, import and export of nuclear substances and operational limits for accelerators, beam-lines and target assemblies.

Preamble

Paragraph 3(1)(c) of the *General Nuclear Safety and Control Regulations* requires that every licence application contain the name, maximum quantity and form of any nuclear substance to be encompassed by the licence.

Paragraph 6(d) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Paragraphs 12(1)(c), (d) and (f) of the *General Nuclear Safety and Control Regulations* require that licensees take all reasonable precautions to protect the environment and the health and safety of persons and to maintain security; provide the devices required by the licence and maintain them; and take all reasonable precautions to control the release of radioactive nuclear substances or hazardous substances. Paragraph 12(1)(e) of the *General Nuclear Safety and Control Regulations* further requires that every person at the site of the licensed activity use equipment, devices, clothing and procedures in accordance with the Act, the regulations made under the Act and the licence.

Parameters such as beam energy and current limits for accelerators, beam lines, targets and beam dumps, define the safe operating envelope for the facility.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*ISAC II Safety Report*	561	4	2013/07/22
TRIUMF	*TRIUMF TR30-2 Safety Report*	562	1.7	2003/03
TRIUMF	*TRIUMF Safety Report*	563	3	2005/09
TRIUMF	*ISAC I Safety Analysis Report*	565	1	2000/10
TRIUMF	*TRIUMF TR30-1 Safety Analysis Report*	3794	0	2005/03
TRIUMF	*TR13 Safety Report*	5359	6	2020/01/17
TRIUMF	*CP-42 Safety Analysis Report*	7114	2.2	2006/08

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF - ISAC II Safety Report Supplementary Information*	8913	1	2006/12/08
TRIUMF	*Proton Therapy Safety Analysis Report*	9408	3	2011/12/01
TRIUMF	*TRIUMF to ACU, CCM, CBH Pipelines for PET Radiopharmaceuticals Safety Analysis Report*	9605	9	2019/11/
TRIUMF	*Actinide Target Safety Analysis Report*	12972	2	2011/09/28
TRIUMF	*Proposal to Modify ISAC II Vault Exclusion Area Boundary*	27099	4	2013/03/15
TRIUMF	*Beamline 2C4 Solid Target Facility Safety Report*	30071	5	2017/08/21
TRIUMF	*Functional Requirements and Design of the e-Hall Maze Area Safety Unit*	57727	1	2013/01/31
TRIUMF	*Design Note TRI-DN-13-17 BL1A Shield Plug Modifications for UCN*	93063	2	2013/10/28
TRIUMF	*Actinide Target SAR Addendum for Thorium Oxide*	110961	1	2014/07/30
TRIUMF	Design Note TRI-DN-16-34, *Safety Analysis for UCN Commissioning to 1 Microampere*	136684	2	2017/04/24
TRIUMF	*Actinide SAR Addendum for a proton-to-neutron converter target at ISAC*	188621	1	2020/09/28
TRIUMF	*Long Rb Prototype Target Irradiation Tests*	ATG-PRO-OPR-STF-023	A	2016/10/31
TRIUMF	*End-Use Statement for dual-use goods: Deuterium oxide, deuterium and deuterated compound*			2016/08/10
TRIUMF	*Description of the use of up to 300kg of heavy water for the UCN project*			2016/09/29

(1) TRIUMF shall operate its facilities in accordance with the operating limits and specifications listed in "APPENDIX C – FACILITY OPERATIONAL LIMITS" in this LCH. Changes to the operating limits and specifications require written approval from the Commission or a person authorized by the Commission, prior to implementation.

(2) Except for nuclear substances listed in paragraph IV iii) of the licence, for Sealed and Unsealed Sources, TRIUMF shall possess, import, use, transfer and store within the boundaries of the site only those nuclear substances which are identified under

"APPENDIX D: SOURCE - LIMITS FOR POSSESSION, IMPORT, USE, TRANSFER AND STORAGE" in this LCH.

(3) Except for nuclear substances listed in paragraph IV iii) of the licence, for isotopes collected at the ISAC Collection Station or produced at TRIUMF Class IB and II facilities, TRIUMF shall produce and process only those nuclear substances identified in "APPENDIX E: NUCLEAR SUBSTANCES - ISAC COLLECTION STATION AND ISOTOPE PRODUCTION, FACILITY LIMITS FOR PRODUCTION AND PROCESSING" in this LCH.

(4) TRIUMF shall export only those nuclear substances identified in "APPENDIX F: NUCLEAR SUBSTANCES - LIMITS FOR EXPORT" in this LCH.

Guidance

Note that this exempts any activated components or by-products which result from normal operation of TRIUMF's various accelerator facilities. It also does not apply to radioactive ion beams produced by ISAC targets. It is intended to apply only to sealed and open radioactive sources used on the site or deliberately produced for sale or transfer to another licensed facility.

Also note that the licence condition does not authorize TRIUMF to import or export any "controlled nuclear substances" as defined in the *Nuclear Non-proliferation Import and Export Control Regulations*.

5. SCA – PHYSICAL DESIGN

The SCA entitled "Physical Design" relates to the ability of the facility's systems, components and structures to meet and maintain their design basis over the lifetime of the facility.

This SCAs are not readily separable in the context of TRIUMF. The physical design of each accelerator facility is described and assessed in the corresponding Safety Analysis Report (SAR) that supports the overall safety case for the various accelerators and associated sub-systems at TRIUMF.

Performance Objective: The protective measures incorporated into the design of the facility are established using a systematic safety analysis. The safety analysis addresses the potential exposure of personnel and the public to radiation and releases of radioactivity and hazardous substances to the environment, during both normal operation and "design basis events". The resulting design of the facility's systems, components and structures provide adequate protection from the potential hazards associated with the operation of the facility.

Licence Condition 5.1 – Design Program

The licensee shall implement and maintain a design program.

Preamble

Paragraphs 6(a), (b) and (d) of the *Class I Nuclear Facilities Regulations* require that a licence application contain: a description of the structures, systems and equipment at the facility, including their design and their design operating conditions; and the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.2.1, *Human Factors*	REGDOC 2.2.1		2019/03
GOC	*National Building Code of Canada 2015*	N/A		2015
GOC	*National Fire Code of Canada 2015*	N/A		2015
NFPA	NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials*	NFPA 801		2014

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSOP-06, *Engineering Design, Manufacture and Assembly*	597	2	2008/10/15
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04
TRIUMF	TSOP-12, *Configuration Management*	5605	3	2015/12/04
TRIUMF	TSOP-15, *Project Governance*	22889	5	2019/03/26

(1) The design and safety analysis program shall include:

- processes to ensure that the design of any facility structure, system or component and any modifications comply with applicable codes, standards and regulations, including adequate consideration of human factors;
- provisions to ensure that design of any facility incorporates the shielding and safety systems necessary to keep radiological doses to workers and members of the public below regulatory limits and ALARA;

- provisions to ensure that design of any facility incorporates measures to keep releases of radioactive materials into the environment below regulatory limits and ALARA;
- provisions to ensure that systems and components important to safety are designed to be reliable, fail-safe and incorporate sufficient redundancy to ensure that the failure or the removal from service of a single component does not result in a loss of either the protection function or the minimum level of redundancy required;
- configuration management processes to ensure that the documented design basis for the facility is maintained up-to-date after design changes, and;
- processes to ensure that the impacts of design changes are fully assessed and accurately reflected in the safety analyses prior to implementation.

(2) Modifications to the facility shall be made in accordance with the *National Building Code of Canada 2015*, the *National Fire Code of Canada 2015*, and NFPA 801: S*tandard for Fire Protection for Facilities Handling Radioactive Materials*. TRIUMF shall, prior to implementation of any proposed modification of the facility with the potential to impact protection from fire:

- submit the proposed modification for third-party review for compliance with the above fire protection codes and standards;
- have the review carried out by one or more independent external reviewers having specific expertise with such reviews; and
- submit in writing the results of the review to the Commission, or a person authorized by the Commission.

Guidance

The *TRIUMF Quality Manual* defines the specific requirements needed to adequately conduct the design of structures, systems and components, including control system software. TRIUMF Standard Operating Procedures (TSOP) TSOP-02, *Nonconformity Reporting & Resolution*, TSOP-06, *Engineering design, Manufacture and Assembly*, TSOP-12, *Configuration Management*, and TSOP-15, Project Management describe processes and procedures applicable to the design and safety analysis of TRIUMF's facilities. Compliance is verified by monitoring conformity with these policies and procedures and the supporting documents referenced in these documents.

Human Factors in Design

Human factors in design (also called Human Factors Engineering) is a part of the design program. Human factors in design is a systematic design approach, which applies knowledge of human characteristics, OPEX, design standards, guidelines and methods to optimize human and system performance, including for safety. Its application and scope are generally based on risk and safety considerations, as well as to improve productivity. Safe and reliable human performance plays a major role in overall system safety and human factors in design aims to minimize human error and undesirable performance outcomes. The goal is for the design of the facility, system or equipment, including the work tasks and the working environment, to be compatible with the characteristics of the people who manage, operate, maintain and support it, to achieve optimal human and organizational performance.

The approach considers factors that influence human performance, such as characteristics of the workers, tasks, equipment, technology, procedures, organization, supervision and management practices, working environment, and training. Human factors in design work activities are usually integrated with engineering design, and extend to consider practical operational outcomes, such as workload, operability, maintainability, effectiveness and safety. These outcomes are evaluated through empirical verification and validation processes, to determine if the system or equipment has been designed as specified in the system requirements and standards, and to evaluate the degree to which the designed system achieves its safety and performance goals when used by people in the work environment.

Analyses related to people performing work and the equipment and processes that they use may be conducted in a variety of SCAs e.g., hazard analysis, training needs analysis, procedure verification and validation. Such analyses may trigger design projects, where they become important inputs to the human factors in design project activities.

Source	Title	Document Number
ISO	Ergonomics of human-system interaction Part 210 Human-centred design for interactive systems, 2019	ISO 9421-210
ISO	Ergonomic Principles in the design of work systems	ISO 6385

6. SCA – FITNESS FOR SERVICE

The Safety and Control Area "Fitness for Service" covers the testing, calibration and maintenance programs and activities that ensure the systems, components and structures at TRIUMF continue to effectively fulfill their intended purpose.

Performance Objective: Those structures, systems, and components which affect safe operation and security of the facility remain available, reliable and effective and continue to function in a manner which is consistent with their design.

Licence Condition 6.1 – Testing, Calibration and Maintenance Program

The licensee shall implement and maintain a testing, calibration and maintenance program for the facility.

Preamble

Paragraph 6(d) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
GOC	*National Fire Code of Canada 2015*	N/A		2015
NFPA	NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials*	NFPA 801		2014

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 1.3, *TRIUMF Lockout Policy and Procedures*	539	6	2018/06/14
TRIUMF	TSN 1.5, *Policy and Procedures for the Implementation of Interlocks Defeats and Device Disables*	541	3	2018/11/23
TRIUMF	TSN 1.6, *Availability Requirements for TRIUMF Radiation Safety Systems*	542	1	2006/01
TRIUMF	TSOP-08, *Calibration and Inspection*	595	4	2016/12/12
TRIUMF	TSOP-06, *Engineering Design, Manufacture and Assembly*	597	2	2008/10/15
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	TSOP-12, *Configuration Management*	5605	3	2015/12/04
TRIUMF	*Verification of Effluent Air Monitor Calibration*	109449	1	2014/05/20

(1) TRIUMF shall determine the extent and frequency of preventive maintenance, testing, surveillance, and inspection of structures, systems and components through a systematic approach, following operating experience and best industry practices. As a minimum, for each structure, system or component, this shall take into account:

- their importance to safety;

- their inherent reliability;
- their potential for degradation (based on operational and other relevant experience, research and vendor recommendations); and
- the consequences of failure.

(2) TRIUMF shall document the frequency that the various maintenance, inspection and testing tasks are performed.

(3) Following any abnormal event which may have an impact upon the safety functions and functional integrity of any structure, system or component TRIUMF shall identify and revalidate the safety functions and carry out any necessary remedial actions, including inspection, testing, maintenance, and repair, as appropriate.

(4) TRIUMF shall record the results of all maintenance, testing, and surveillance of structures, systems and components. The results of TRIUMF's testing, maintenance and calibration program must be reviewed at least annually as part of TRIUMF's internal Quality Assurance Program to look for evidence of incipient and recurring failures and shall initiate corrective actions accordingly.

(5) A description of the results of TRIUMF's testing, maintenance and calibration program as it relates to critical safety systems and device must be submitted to the CNSC annually as part of the Annual Compliance Report required under Licence Condition 4.2.

(6) TRIUMF shall operate, maintain, test, and inspect the facility in accordance with the *National Fire Code of Canada 2015* and NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials*. To demonstrate compliance with the applicable codes and standards TRIUMF shall:

- arrange for a third party review of compliance with the requirements of the *National Fire Code of Canada2015* and NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials* biennially;
- have the review carried out by one or more independent external agencies having specific expertise with such reviews, and;
- submit the results of the review in writing to the CNSC.

Guidance

The intent of a maintenance program is to ensure that systems important to safety remain capable of maintaining their intended design function. An effective maintenance program consists of an organized set of administrative and technical activities designed to keep systems, structures and components in good operating condition, and to verify that they continue function as designed.

TRIUMF's testing, maintenance and calibration program is governed by the general provisions of the following *TRIUMF Standard Operating Procedures* (TSOP):

- TSOP 06, *Engineering Design, Manufacture and Assembly*

- TSOP-08, *Calibration & Inspection*
- TSOP-12, *Configuration Management*

Theses TSOPs reference detailed procedures for performing specific activities within the overall maintenance and calibration program including the frequency at which the various maintenance, inspection and testing tasks are performed. Compliance is verified by monitoring conformity with these policies, procedures and supporting documents.

7. SCA – RADIATION PROTECTION

The Safety and Control Area "Radiation Protection" covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. This program must ensure that radiation doses received by both facility staff and the general public, as well as levels of radioactive contamination, are monitored and controlled.

Performance Objective: Radiation doses received by both facility staff and the general public, as well as levels of radioactive contamination, are maintained As Low As Reasonably Achievable (ALARA).

Licence Condition 7.1 – Radiation Protection Program

The licensee shall implement and maintain a radiation protection program.

Preamble

The *Radiation Protection Regulations* require that the licensee implement a radiation protection program and also ascertain and record doses for each person who performs any duties in connection with any activity that is authorized by the *Nuclear Safety and Control Act* or is present at a place where that activity is carried out. This program must ensure that doses to workers do not exceed prescribed dose limits and are kept as low as reasonably achievable (the ALARA principle).

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Doc
TRIUMF	TSN 1.1, *TRIUMF Radiation Protection Training Program*	538	5	2017/03/27
TRIUMF	TSN 1.8, *Policy for Maximum Allowable Dose in Accessible Areas at TRIUMF*	544	2	2012/04/13
TRIUMF	TSN 1.2, *Policy on Radiation Exposure*	545	3	2010/01/25
TRIUMF	*TRIUMF Safety Report* (sections 1.6 to 1.9 and section 4)	563	3	2005/09
TRIUMF	*TRIUMF Handbook of Occupational Health and Safety*	840	6	2017/09
TRIUMF	TSN 3.6, *Designation of Nuclear Energy Workers at TRIUMF*	850	2	2012/12/05
TRIUMF	TSN 2.4, *Derived Release Limits for Radioactive Emissions from the TRIUMF Site*	8506	9	2019/04/12

(1) The licensee shall implement and maintain a radiation protection program that ensures radiation doses received by individuals and contamination are monitored, controlled and kept ALARA.

(2) The licensee shall review and revise the provisions of the radiation protection program as necessary to reflect changes in facility design and operations.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Doc
CNSC	G-129, *Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"*	G-129	1	2000/06

CNSC regulatory document G-129, *Keeping Radiation Exposures and Doses 'As Low As Reasonably Achievable (ALARA)* provides guidance on developing and implementing radiation protection programs

TRIUMF's radiation protection program is described in detail in the *TRIUMF Safety Report* and the various documents referenced in that report. A concise summary of the main radiation safety related policies and procedures is also contained in the *TRIUMF Occupational Health & Safety Handbook.* Compliance is verified by monitoring conformity with the policies, procedures and supporting documents included in the radiation program descriptions contained in these documents.

While TRIUMF is expected to review and if necessary, to revise the radiation protection program periodically, **revisions must be submitted to the CNSC for review and are subject to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).**

Licence Condition 7.2 – Dose Action Levels

The licensee shall notify the Commission or a person authorized by the Commission within 24 hours of becoming aware that an action level has been reached or exceeded and shall file a written report within 30 working days of becoming aware of the matter.

Preamble

Section 6 of the *Radiation Protection Regulations* specifies the requirements related to action levels. This licence condition is required to provide the notification timeframe.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev #	Rev. Date
TRIUMF	*TRIUMF Safety Report*	563	3	2005/09

(1) For the purpose of this licence condition, "a person authorized by the Commission" includes the Project Officer responsible for licensing and compliance issues related to TRIUMF and the persons identified under Part 1, section 2.3 of this LCH.

(2) If any radiation exposure action level is exceeded, TRIUMF shall notify the Commission as required by licence condition 7.2.

(3) TRIUMF shall conduct a documented review of dose action levels at least once every five years in order to validate their effectiveness, and shall revise action levels as necessary to reflect changes in facility operations.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CNSC	G-228, *Developing and Using Action Levels*	G-228		2001/03

For the purpose of this licence condition, the "***action levels***" are TRIUMF's Dose Action Levels as documented in *TRIUMF Safety Report* section 4.4.10.1. The current Action Levels for TRIUMF workers are given in the TRIUMF Safety Report and repeated here for reference:

Category of Worker	Action Level
Nuclear Energy Workers (NEWs)	15 mSv/year
Non-NEWs	0.5 mSv /quarter

Dose action levels are used as indicators to identify abnormal doses to staff, including both Nuclear Energy Workers (NEWs) and non-NEWs, during normal operation of the licensed facility. They are precautionary levels and as such, should be set well below regulatory limits. If the dose action levels are exceeded, they may indicate a potential loss of control of the radiation protection program.

CNSC guidance document G-228, *Developing and Using Action Levels* provides detailed guidance on establishing and using action levels.

While TRIUMF is expected to review and if necessary, to revise and reissue the dose action levels periodically, **revisions to the action levels must be submitted to the CNSC for review and are subject to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).**

8. SCA – CONVENTIONAL HEALTH AND SAFETY

The Safety and Control Area "Conventional Health and Safety" covers the implementation of a program to manage workplace safety hazards.

Performance Objective: Conventional health and safety work practices and conditions achieve a high degree of personnel safety and compliance with the applicable Labour Codes.

Licence Condition 9.1 – Occupational Health and Safety Program

The licensee shall implement and maintain a conventional health and safety program.

Preamble

Paragraph 3(f) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed worker health and safety policies and procedures.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev #	Rev. Date
WorkSafeBC	*Occupational Health and Safety Regulation*			

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Section 4.3)	563	3	2005/09
TRIUMF	*TRIUMF Handbook of Occupational Health and Safety*	840	6	2017/09

TRIUMF shall comply with all applicable federal and provincial conventional health & safety legislation.

Guidance

None provided.

9. SCA – ENVIRONMENTAL PROTECTION

The safety and control area "Environmental Protection" requires the licensee to have a program in place to identify, control and monitor all releases of radioactive and hazardous substances from the facility. The potential effect of these releases on the public and the environment must be assessed as part of the program.

Performance Objective: The protection of the environment and the health and safety of persons by taking all reasonable precautions to control the release of radioactive substances and hazardous substances to the environment.

Licence Condition 9.1 – Environmental Protection Program

The licensee shall implement and maintain an environmental protection program for the facility.

Preamble

Paragraphs 3 (g) and (h) of the *Class I Nuclear Facilities Regulations*, require that an application for a licence to operate a Class I Nuclear Facility contain: the *"proposed environmental protection policies and procedures"* and *"the proposed effluent and environmental monitoring programs"*. Paragraphs 6 (h), (i) and (j) of the same regulations further require that the licence application contain: *"the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects"*, *"the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics"*, and *"the proposed measures to control releases of nuclear substances and hazardous substances into the environment"*, respectively.

Paragraph 12(1)(c) and (f) of the *General Nuclear Safety and Control Regulations* require every licensee to take all reasonable precautions to protect the environment and to take all reasonable precautions to control the release of nuclear substances or hazardous substances.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Amending Bylaw No. 244, 2008*	244		2008
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007*	299		2007
Metro Vancouver	*Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008*	1082		2008
BC Environmental Management Act	*Waste Discharge Regulation*			

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Sections 1.8 and 4.4.10)	563	3	2005/09
TRIUMF	*TRIUMF Quality Manual*	611	7	2020/06/09
TRIUMF	*Monitoring of Emissions from the TRIUMF site (EHS-RPG-04-10)*	5328	3	2015/11/27
TRIUMF	*Environmental Monitoring Program for the TRIUMF site (EHS-RPG-07-10)*	5329	3	2015/11/27
TRIUMF	TSN 2.4, *Derived Release Limits for Radioactive Emissions from the TRIUMF Site*	8506	9	2019/04/12
TRIUMF	*Environmental Management System*	15678	2	2016/12/14

The licensee shall implement an environmental protection program for the facility. This program shall cover the control of releases to the environment and the assessment of the potential impacts of those releases.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.9.1, *Environmental Protection: Policies, Programs and Procedures*	REGDOC-2.9.1	1.0	2013/09
CNSC	P-223, *Protection of the Environment*	P-223		2001/02

Guiding principles and factors for environmental protection are given in CNSC Regulatory Policy P-223, *Protection of the Environment*. CNSC regulatory document REGDOC-2.9.1, *Environmental Protection: Policies, Programs and Procedures*, provides detailed guidance on the development, implementation and maintenance of environmental protection programs.

Licence Condition 9.2 – Control and Monitoring of Nuclear Substance Releases

The licensee shall control, monitor and record releases of nuclear substances to the environment from the facility such that the releases do not exceed the release limits specified in the Licence Condition Handbook.

Preamble

Paragraph 3 (h) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence to operate a Class I Nuclear Facility contain *"the proposed effluent and environmental monitoring programs"*. Paragraphs 6 (i) and (j) of the same regulations further require that the licence application contain: *"the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics"*, and *"the proposed measures to control releases of nuclear substances and hazardous substances into the environment"*, respectively.

Paragraph 12(1)(c) and (f) of the *General Nuclear Safety and Control Regulations* require every licensee to take all reasonable precautions to protect the environment and to take all reasonable precautions to control the release of nuclear substances or hazardous substances.

Subsection 13(1) of the *Radiation Protection Regulations* prescribes the radiation dose limit for the general public of 1 mSv per calendar year.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CSA	*Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*	N288.1-14		2014
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Amending Bylaw No. 244, 2008*	244		2008
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007*	299		2007
Metro Vancouver	*Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008*	1082		2008

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Sections 1.8 and 4.4.10)	563	3	2005/09
TRIUMF	*Monitoring of Emissions from the TRIUMF site (EHS-RPG-04-10)*	5328	3	2015/11/27
TRIUMF	*Environmental Monitoring Program for the TRIUMF site (EHS-RPG-07-10)*	5329	3	2015/11/27
TRIUMF	TSN 2.4, *Derived Release Limits for Radioactive Emissions from the TRIUMF Site*	8506	9	2019/04/12
TRIUMF	*Environmental Management System*	15678	2	2016/12/14

(1) TRIUMF shall establish and maintain Derived Release Limits (DRL) in accordance with CSA standard N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*, and shall monitor and control radiological emissions to ensure they remain ALARA with respect to these DRLs.

(2) TRIUMF shall periodically review the facility DRLs to ensure they address all emissions from the facility and to ensure that they remain up to date and consistent with applicable standards.

Guidance

The DRL for a given radionuclide is the release rate of that radionuclide to air or surface water, during normal operation of a nuclear facility over the period of one calendar year, that would cause an individual in the most highly exposed group to receive a committed dose equal to the regulatory annual dose limit for the general public as specified in section 13 of the *Radiation Protection Regulations*. The DRL is derived using mathematical equations that describe the transfer of radioactive materials through the environment to humans

For the purpose of this licence condition, the "***release limits specified in the Licence Condition Handbook***" are specified in:

- TRIUMF Safety Note 2.4 *Part I Exposures to the Public and Environment: Derived Release Limits for the TRIUMF Site*, and;
- TRIUMF Safety Note 2.4 *Part II: Results and Tables of Values;*

While TRIUMF is expected to review and if necessary, to revise and reissue the DRLs periodically, **revisions to DRLs must be submitted to the CNSC for review and are subject**

to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).

Licence Condition 9.3 – Control and Monitoring of Hazardous Substance Releases

The licensee shall control, monitor and record the releases of hazardous substances.

Preamble

Paragraph 3 (h) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence to operate a Class I Nuclear Facility contain *"the proposed effluent and environmental monitoring programs"*. Paragraphs 6 (i) and (j) of the same regulations further require that the licence application contain: *"the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics"*, and *"the proposed measures to control releases of nuclear substances and hazardous substances into the environment"*, respectively.

Paragraph 12(1)(c) and (f) of the *General Nuclear Safety and Control Regulations* require every licensee to take all reasonable precautions to protect the environment and to take all reasonable precautions to control the release of nuclear substances or hazardous substances.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Amending Bylaw No. 244, 2008*	244		2008
Metro Vancouver	*Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007*	299		2007
Metro Vancouver	*Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008*	1082		2008

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*Environmental Management System*	15678	2	2016/12/14

TRIUMF shall comply with all applicable federal, provincial and municipal legislation relating to the handling and release of hazardous substances.

Guidance

None provided.

Licence Condition 9.4 – Environmental Action Levels

The licensee shall notify the Commission or a person authorized by the Commission within 24 hours of becoming aware that an action level has been reached or exceeded and shall file a written report within 30 working days of becoming aware of the matter.

Preamble

Section 6 of the *Radiation Protection Regulations* specifies the requirements related to action levels. This licence condition is required to provide the notification timeframe.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Section 4.4.10)	563	3	2005/09

(1) For the purpose of this licence condition, "a person authorized by the Commission" includes the Project Officer responsible for licensing and compliance issues related to TRIUMF and the persons identified under Part 1, section 2.3 of this LCH.

(2) If any environmental action level is exceeded, TRIUMF shall notify the Commission as required by licence condition 9.4

(3) TRIUMF shall conduct a review of environmental action levels at least annually as part of the management review of operations and shall revise action levels as necessary to reflect changes in facility operations.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CNSC	G-228, *Developing and Using Action Levels*	G-228		2001/03

Environmental Action Levels are used as indicators identify abnormal releases of radionuclides into the environment during normal operation of the licensed facility. They are precautionary levels and as should be set well below regulatory limits. If the environmental action levels are exceeded, they may indicate a potential loss of control of the environmental protection program.

For the purpose of this licence condition, the "***action level***" is TRIUMF's Environmental Action Level of 5% of the corresponding DRL (see licence condition 9.2 above) as documented in *TRIUMF Safety Report* section 4.4.10.2.

CNSC guidance document G-228 "Developing and Using Action Levels" provides detailed guidance on establishing and using action levels.

While TRIUMF is expected to review and if necessary, to revise and reissue the environmental action levels periodically, **revisions to action levels must be submitted to the CNSC for review and are subject to the normal assessment and approval processes as determined by the scope and nature of the changes proposed (see licence condition 1.2).**

10. SCA – EMERGENCY MANAGEMENT AND FIRE PROTECTION

The Safety and Control Area "Emergency Management and Fire Protection" covers emergency plans and emergency preparedness programs which exist for emergencies and for non-routine conditions. It also includes the results of participation in any emergency exercises. This includes:

- Nuclear emergency management;
- Conventional emergency response, and;
- Fire protection and response.

Performance Objective: The implementation of programs which ensure the licensee's capability to respond appropriately to emergencies and non-routine conditions and to mitigate the potential effects to the health and safety of persons and the environment and to national security.

Licence Condition 10.1 – Emergency Preparedness Program

The licensee shall implement and maintain a program for emergency preparedness to address on-site and off-site events which can affect the nuclear facility.

Preamble

Paragraph 6(k) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain information on the licensee's *"proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of security, including measures to:*

(i) assist off-site authorities in planning and preparing to limit the effects of an accidental release;
(ii) notify off-site authorities of an accidental release or the imminence of an accidental release;
(iii) report information to off-site authorities during and after an accidental release;,
(iv) assist off-site authorities in dealing with the effects of an accidental release; and
(v) test the implementation of the measures to prevent or mitigate the effects of an accidental release."

This licence condition ensures appropriate regulatory oversight of the implementation by the licensee of the emergency preparedness program.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*	REGDOC-2.10.1	2.0	2016/02

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 2.1, *TRIUMF First Aid Program*	857	3	2013/12/02
TRIUMF	*TRIUMF Emergency Preparedness Plan*	4952	6	2019/11/28
TRIUMF	*TRIUMF Emergency Response Plan*	5856	6	2019/11/29

(1) TRIUMF shall have an emergency preparedness plan which satisfies the criteria set out in CNSC regulatory document REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*.

(2) TRIUMF shall implement an emergency response program in accordance with the criteria set out in the regulatory document REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*. The program shall address the following areas:

- Mitigation,
- Protection of Facility Personnel,
- Protection of the Public and the Environment,
- Termination of the Emergency, and
- Adequacy of Conduct of Exercises.

(3) An evacuation drill and/or exercise is required at least annually. Drills shall be conducted in coordination with appropriate Federal, Provincial, and local agencies.

Guidance

Emergency Management is governed by TRIUMF's "Emergency Preparedness Plan" (TRI-EHS-05-05) and TRIUMF's Emergency Response Plan (TRI-EHS-05-06). TRIUMF's Emergency Preparedness Plan ensures that the resources of TRIUMF are prepared to respond to any emergency outside of the laboratory's normal operation.

The plan's objectives are:

- Protection of TRIUMF employees, public health and security, and the environment.
- Minimizing the effects of an emergency or disaster.
- Ensuring rapid organized response to an emergency or disaster.
- Protection and preservation of TRIUMF critical infrastructure and facilities.
- Timely release of factual information on the status of an incident or emergency.
- Restoration of normal operations in a timely manner.

The Emergency Preparedness Plan identifies the roles and responsibilities of emergency responders, and provides broad guidance for responding effectively to emergencies. TRIUMF's Emergency Response Plan provides the response procedures for emergencies identified in the TRIUMF Emergency Preparedness Plan. Drills are the responsibility of Environment Health and Safety Group.

TRIUMF may revise their emergency plans to take into account relevant factors, such as operating experience or changed needs or circumstances, subject to the approval process described in section 2 of this LCH.

Licence Condition 10.2 – Fire Protection Program

The licensee shall implement and maintain a fire protection program for the facility.

Preamble

Paragraph 6(k) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain information on the licensee's "*proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of security"*. These measures must include the implementation of a fire protection program which complies with all applicable national codes and standards.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
GOC	*National Building Code of Canada 2015*	N/A		2015
GOC	*National Fire Code of Canada 2015*	N/A		2015
NFPA	NFPA 801: S*tandard for Fire Protection for Facilities Handling Radioactive Materials*	NFPA801		2014

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	TSN 5.9, *Fire Protection and Prevention at TRIUMF*	868	3	2010/09/03
TRIUMF	*TRIUMF Fire Protection Program*	29313	2	2010/10/12

TRIUMF's fire protection program shall clearly demonstrate compliance with the requirements of:

- the *National Building Code of Canada 2015*;
- the *National Fire Code of Canada 2015*, and;
- NFPA 801: S*tandard for Fire Protection for Facilities Handling Radioactive Materials*;

and that these requirements have been implemented into the facilities operations in a controlled, consistent and coordinated manner.

Guidance

Fire Safety requirements relating to the design and modification of facilities and to testing and maintenance of fire safety equipment can be found in sections 5.1 Design and Safety Analysis Program and 6.1 Testing, Calibration and Maintenance Program of Part II of this LCH.

11. SCA – WASTE MANAGEMENT

The safety and control area "waste management" covers internal waste-related programs which form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. It also covers the planning for decommissioning.

Performance Objective: An acceptable waste management program will be facility and waste stream specific. It is expected that licensees will develop, implement, audit and update their waste management programs and preliminary decommissioning plans and will include waste management as a key component of their corporate and safety culture.

Licence Condition 11.1 – Waste Management Program

The licensee shall implement and maintain a program for waste management for the facility.

Preamble

The *General Nuclear Safety and Control Regulations* require that a licence application contain information related to the management of radioactive waste or hazardous waste resulting from the licensed activities. Paragraph 3(1)(j) of the *General Nuclear Safety and Control Regulations* stipulates that an application for a licence shall contain, in addition to other information, *"the name, quantity, form, origin and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste"*.

Paragraph 6(e) of the *Class I Nuclear Facilities Regulations* require that a licence application contain the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*Radioactive Waste Management for the TRIUMF site (EHS-RPG-06-10)*	5330	5	2016/12/23
TRIUMF	*Characterization of Radioactive Waste (EHS-RPG-06-04)*	5815	1	2012/03/29
TRIUMF	*Sorting Radioactive Waste at the Source (EHS-RPG-06-01)*	5816	2	2012/03/23
TRIUMF	*Assaying Pump Oil Samples (EHS-RPG-06-03)*	5817	2	2016/09/01
TRIUMF	*Assaying Radioactive Waste (EHS-RPG-06-02)*	8000	2	2012/03/23

The waste management program for TRIUMF shall include provisions for waste minimization, waste segregation and characterization, waste storage, processing and disposal.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CSA	*Management of low and intermediate-level radioactive waste*	N292.3-14		2014

CSA standard N292.3-14, *Management of low and intermediate-level radioactive waste* provides detailed guidance for the development and implementation of a suitable waste management program.

Licence Condition 11.2 – Preliminary Decommissioning Plan

The licensee shall maintain a preliminary decommissioning plan (PDP) for decommissioning the facility. This PDP shall be reviewed every five years or when requested by the Commission, or a person authorized by the Commission.

Preamble

Paragraph 3(k) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed plan for decommissioning of the nuclear facility. The preliminary decommissioning plan includes strategies for the management of low and intermediate level waste and waste storage facility decommissioning.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	*G-219, Decommissioning Planning for Licensed Activities*	G-219		2000/06
CSA	*Decommissioning of Facilities Containing Nuclear Substance*	N294-09		2014

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*Preliminary Decommissioning Plan*	8810	5	2019/05/17

(1) The *Preliminary Decommissioning Plan* shall conform with the requirements of *CNSC Regulatory Guide, G-219: Decommissioning Planning for Licensed Activities* and the CSA Standard N294-09, *Decommissioning of Facilities Containing Nuclear Substance*. Following the acceptance of the plan by CNSC staff, this plan must be reviewed and revised every five years.

(2) TRIUMF shall notify the CNSC in writing of any changes to the *TRIUMF Preliminary Decommissioning Plan* prior to implementation.

(3) For the purpose of this licence condition, "a person authorized by the Commission" includes the persons identified under Part 1, section 2.3 of this LCH.

Guidance

None provided.

12. SCA – SECURITY

The Safety and Control Area "Security" covers the programs required to implement and support the security requirements stipulated in the Act, the regulations, and the licence.

Performance Objective: The implementation of a security program which provides the required level of security for the facility and its operations.

Licence Condition 12.1 – Security Program

The licensee shall implement and maintain a security program.

Preamble

Paragraphs 3(1)(g) and 3(1)(h) of the *General Nuclear Safety and Control Regulations* require that a licence application contain information related to site access control and measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information.

Paragraph 6(l) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility.

The overall objective of a nuclear security program is to protect persons, property, society, and the environment from malicious acts involving nuclear material or other radioactive material that could cause unacceptable radiological consequences.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Safety Report* (Section 4.1)	563	3	2005/09
TRIUMF	TSOP-10, *Access to TRIUMF*	1733	4	2018/05/14
TRIUMF	*TRIUMF Accelerator Inc. Security Plan* **(Confidential – Prescribed Information)**	29843	5	2015/08/15

(1) TRIUMF shall maintain the operation, design and analysis provisions specified in the Security Plan and required to ensure adequate engineered safety barriers for the protection against malevolent acts.

(2) TRIUMF shall take all reasonable precautions to protect the environment and the health and safety of persons and to maintain security in accordance with paragraph 12 (1) (c) of the *General Nuclear Safety and Control Regulations*.

(3) TRIUMF shall implement measures for alerting TRIUMF to the illegal use or removal of a nuclear substance, prescribed equipment or prescribed information, or the illegal use of

a nuclear facility in accordance with paragraph 12 (1) (g) of the *General Nuclear Safety and Control Regulations*.

(4) Technical and administrative security measures shall be documented by TRIUMF in a site Security Plan which is appropriately designated in accordance with paragraph 12(j) and sections 21 to 23 of the *General Nuclear Safety and Control Regulations*, and shall be clearly labelled as "CONFIDENTIAL – Prescribed Information" in the top right hand corner of every page. Such information may be distributed only in hard copy. The site Security Plan must be updated and verified by TRIUMF at least once a year, to address any changes within the licensed facility or to address an increased threat level.

(5) The site Security Plan shall be updated on a regular basis and submitted to the CNSC.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev. #	Rev. Date
IAEA	*Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control*	Nuclear Security Series No. 15		2011

13. SCA – SAFEGUARDS

The Safety and Control Area "Safeguards" covers the programs required for the successful implementation of the obligations arising from the Canada/IAEA Safeguards Agreement.

Performance Objective: Conformity with measures required by the facility to meet Canada's international safeguards obligations through:

- timely provision of accurate reports and information;
- provision of access and assistance to IAEA inspectors for verification activities;
- submission of annual operational information and accurate design information of plant structures, processes and procedures;
- development and satisfactory implementation of appropriate facility safeguards procedures; and
- demonstration of capability, as confirmed through CNSC onsite evaluations, to meet all requirements in support of physical inventory verifications of nuclear material by the IAEA.

Licence Condition 13.1 – Safeguards Program

The licensee shall implement and maintain a safeguards program and undertake all measures required to ensure safeguards implementation at the facility.

Preamble

Safeguards is a system of inspection and other verification activities undertaken by the International Atomic Energy Agency (IAEA) in order to evaluate a Member State's compliance with its obligations pursuant to its safeguards agreements with the IAEA.

The *General Nuclear Safety and Control Regulations* require the licensee to take all necessary measures to facilitate Canada's compliance with any applicable safeguards agreement, and define reporting requirements for safeguards events.

The *Class I Nuclear Facilities Regulations* require that a licence application contain information on the licensee's proposed measures to facilitate Canada's compliance with any applicable safeguards agreement.

Compliance Verification Criteria

Licensing Basis Publications: None.

Source	Document Title	Document Number	Rev. #	Rev. Date
CNSC	REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*	REGDOC-2.9.1	1.0	2018/02

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Safeguards Program*	154117	1	2018/12/17

The CNSC regulatory document REGDOC-2.13.1, Safeguards and Nuclear Material Accountancy sets out requirements and guidance for safeguards programs, including information on nuclear material accounting reports and request forms and detailed instructions on how to complete them.

(1) TRIUMF shall provide the International Atomic Energy Agency (IAEA), an IAEA inspector, or a person acting on behalf of the IAEA, with such reasonable services and assistance as are required to enable the IAEA to carry out its duties and functions pursuant to a safeguards agreement.

(2) TRIUMF shall grant prompt access at all reasonable times to all locations at the facility to an IAEA inspector, or to a person acting on behalf of the IAEA, where such access is

required for the purposes of carrying on an activity pursuant to a safeguards agreement. In granting access, TRIUMF shall provide health and safety services and escorts as required in order to facilitate activities pursuant to a safeguards agreement.

(3) TRIUMF shall disclose to the Commission, to the IAEA, or to an IAEA inspector, any records that are required to be kept or any reports that are required to be made under a safeguards agreement.

(4) TRIUMF shall provide such reasonable assistance to an IAEA inspector, or a person acting on behalf of the IAEA, as is required to enable sampling and removal or shipment of samples required pursuant to a safeguards agreement.

(5) TRIUMF shall provide such reasonable assistance to an IAEA inspector, or a person acting on behalf of the IAEA, as is required to enable measurements, tests and removal or shipment of equipment required pursuant to a safeguards agreement.

(6) TRIUMF shall not alter, deface or break a safeguards seal, except pursuant to a safeguards agreement.

(7) TRIUMF shall implement measures to prevent damage to or the theft, loss or sabotage of safeguards equipment or samples collected pursuant to a safeguards agreement or the illegal use, possession, operation or removal of such equipment or samples.

(8) TRIUMF shall make such reports and provide such information to the Commission, as are required to facilitate Canada's compliance with any applicable safeguards agreement.

(9) TRIUMF shall make and submit reports to the Commission on the inventory and transfer of fissionable and fertile substances in accordance with the regulatory document REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*, or as otherwise stipulated in any regulatory document that replaces REGDOC-2.13.1.

Guidance

None provided.

Licence Condition 13.2 – Changes that Would Affect the Implementation of Safeguards Measures

The licensee shall not, except with the prior approval of the Commission or a person authorized by the Commission, make changes to any aspect of the facility or its operation, equipment or procedures that would affect the implementation of safeguards measures.

Preamble

This licence condition provides regulatory control over the changes requested by the licensee to its operation, equipment or procedures not previously agreed to by the CNSC that would affect the implementation of safeguards measures.

With respect to the implementation of safeguards measures, changes made by the licensee to operation, equipment or procedures as of the result of agreement between the licensee, the CNSC, and the IAEA are considered routine.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF				

(1) TRIUMF shall obtain prior written approval of the Commission, or a person authorized by the Commission, for any changes to operation, equipment or procedures requested by TRIUMF that would affect the implementation of safeguards measures.

(2) Delegation of approval by the Commission, to give consent, applies to the following staff with respect to this licence condition only:

- Director, International Safeguards Division
- Director General, Directorate of Security and Safeguards, and
- Vice-President, Technical Support Branch

(3) TRIUMF shall provide such reasonable assistance to an IAEA inspector, or a person acting on behalf of the IAEA, as is required to enable sampling and removal or shipment of samples required pursuant to a safeguards agreement.

(4) If TRIUMF's requested changes to the operation, equipment or procedures do not adversely impact the requirements set out in the Preamble of licence condition 13.1, the CNSC authorized person has the authority to give the consent to TRIUMF to proceed with the proposed changes and the LCH will be revised as required.

(5) If TRIUMF's requested changes to the operation, equipment or procedures do adversely impact on the requirements set out in the Preamble of licence condition 13.1, the CNSC authorized person does not have the authority to give the consent, as this would violate the obligations arising from the Canada-IAEA safeguards agreement.

Guidance

None provided.

14. SCA – PACKAGING AND TRANSPORT

The SCA entitled "Packaging and Transport" covers the programs that ensure the safe packaging and transport of nuclear substances and radiation devices to and from the licensed facility.

Performance Objective: Compliance with the CNSC *Packaging and Transport of Nuclear Substances Regulations, 2015* and Transport Canada *Transportation of Dangerous Goods Regulations*.

Licence Condition 14.1 – Packaging and Transport

The licensee shall implement and maintain a packaging and transport program.

Preamble

Paragraph 6(e) of the *Class I Nuclear Facilities Regulations* requires that an application for a licence to operate a Class I facility shall contain information on the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances. Every person who transports, or causes to be transported, nuclear substances shall comply with the *Transportation of Dangerous Goods Regulations* set out by Transport Canada and the *Packaging and Transport of Nuclear Substances Regulations, 2015*.

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*Package Handling and Transport Protocols for Radioactive Shipments*	62648	5	2019/10/21
TRIUMF	*Procurement and Shipping of Radioactive Materials Procedure*	76036	3	2017/02/09

TRIUMF shall implement and maintain a 'Packaging and Transport" program which complies with all the regulatory requirements set out in:

- Transport Canada's *Transportation of Dangerous Goods Regulations*; and
- the CNSC *Packaging and Transport of Nuclear Substances Regulations, 2015*.

Guidance

None provided.

15. SCA – SITE SPECIFIC

This section covers licence conditions which are not associated with a specific Safety and Control Area.

Performance Objective: Compliance with regulatory expectations for the implementation of a Public Information Program and an appropriate Financial Guarantee for the eventual decommissioning of the licensee's facilities.

Licence Condition 15.1 – Public Information and Disclosure

The licensee shall implement and maintain a public information program for the facility.

Preamble

Paragraph 3(j) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the *"the proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed"*.

Compliance Verification Criteria

Licensing Basis Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CNSC	REGDOC-3.2.1, *Public Information and Disclosure*	REGDOC-3.2.1	1.0	2018/05

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev. #	Rev. Date
TRIUMF	*TRIUMF Public Information and Disclosure Program*	156040	3	2020/02/20

The licensee shall implement and maintain a public information program for the facility. The public information program shall comply with the requirements set out in CNSC regulatory document REGDOC-3.2.1, *Public Information and Disclosure*.

Guidance

None provided.

Licence Condition 15.2 – Financial Guarantee

The licensee shall maintain, in effect, a financial guarantee for decommissioning of the facility that is acceptable to the Commission.

Preamble

Paragraph 3(k) of the *Class I Nuclear Facilities Regulations* stipulates that that an application for any licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain, in addition to other information, the *"proposed plan for decommissioning of the nuclear facility or of the site."*

Compliance Verification Criteria

Licensing Basis Publications: None.

Licensee Documents that Require Notification of Change

Source	Document Title	Document Number	Rev #	Rev. Date
TRIUMF	*CNSC Financial Security and Access Agreement*	30101	Jan 2008	2008/01/07
TRIUMF	*Fund Contribution Gap Agreement*	30102	Jan 2008	2008/01/07
TRIUMF	*Escrow Agreement*	30103	Jan 2008	2008/01/07

TRIUMF shall maintain the financial guarantee, to ensure it remains valid and in effect and adequate to fund the preliminary decommissioning plan. If the preliminary decommissioning plan is revised, the expectation is that the financial guarantee is revised and submitted to the Commission for acceptance.

Guidance

Guidance Publications

Source	Document Title	Document Number	Rev #	Rev. Date
CSA	*Decommissioning of Facilities Containing Nuclear Substance*	N294-09		2014
CNSC	*G-219, Decommissioning Planning for Licensed Activities*	G-219		2000/06
CNSC	G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*	G-206		2000/06

The criteria outlined in CNSC guidance document G-206, "Financial Guarantees for the Decommissioning of Licensed Activities" provides guidance when reviewing the financial guarantees for decommissioning.

CSA standard N294-09, *Decommissioning of Facilities Containing Nuclear Substance* provides direction on the decommissioning of licensed facilities and specifies requirements for the planning, preparation, execution and completion of decommissioning. It incorporates current best practices and existing regulatory requirements. CSA N294-09 references CNSC regulatory guidance document G-219, *Decommissioning Planning for Licensed Activities* that provides guidance regarding the preparation of decommissioning plans for CNSC licensed activities.

APPENDIX A: LCH CHANGE CONTROL PROCESS AND LCH CHANGE REQUEST FORM

Licensee Requests

1. Authorized licensee representative submits the request to the CNSC Project Officer using the Licensee LCH Change Request Form in this Appendix.

2. Assessment of the change request by CNSC Project Officer:
   - Determine if the requested change is in line with the LCH change control process.
   - Determine whether the change is substantial enough to warrant an update to the LCH.
   - Refer for review by Specialist Divisions as appropriate.
   - Draft the changes to the LCH and a recommendation for approval, including any Specialist recommendations as appropriate.
   - Submit recommendations and the draft LCH to the person authorized to approve the changes in accordance with section 2.3 of Part I of this LCH*.

3. Approval:
   - The change may be referred to a higher level of authority in accordance with section 2.3 of Part I of this LCH*.
   - In the event that the change is not approved, the licensee may refer the issue to the dispute resolution process in section 2.4 of Part I of this LCH.

4. Notification of Changes:
   - Once approved, the Project Officer will update the LCH to reflect the changes.
   - Formal notification will be sent to the licensee along with the updated LCH.

* *NOTE: for changes to operation, equipment or procedures that would affect the implementation of safeguards measures, the Project Officer shall refer the matter to the International Safeguards Division for review. Recommendations and LCH revisions shall be referred to the Director, International Safeguards Division for approval. The hierarchy of approval for safeguards related issues is provided in section 13.2 of Part II of this LCH.*

CNSC Staff Requests

1. Staff member submits the request to the CNSC Project Officer using the CNSC Staff LCH Change Request Form in this Appendix. For requests originating from Specialist Divisions, include any analysis or justification necessary to assess the nature and scope of the request.

2. Assessment of the change request by CNSC Project Officer:

   - Determine if the requested change is in line with the LCH change control process.
   - Determine whether the change is substantial enough to warrant an update to the LCH.
   - Refer for review by other Specialist Divisions if required.
   - Consult with licensee regarding the proposed change and obtain authorization from licensee.
     a. In the event the licensee is not in agreement with the proposed change, the Project Officer shall refer the issue to the dispute resolution process in section 2.4 of Part 1 of this LCH.
   - Draft changes to LCH and recommendation for approval, including Specialist recommendations and the licensee's written concurrence with the proposed change.
   - Submit recommendations and the draft LCH to the person authorized to approve the changes in accordance with section 2.3 of Part I of this LCH*.

3. Approval:
   - The change may be referred to a higher level of authority in accordance with section 2.3 of Part I of this LCH*.

4. Notification of Changes:
   - Once approved, the Project Officer will update the LCH to reflect the changes.
   - Formal notification will be sent to the licensee along with the updated LCH.

* *NOTE: for changes to operation, equipment or procedures that would affect the implementation of safeguards measures, the Project Officer shall refer the matter to the International Safeguards Division for review. Recommendations and LCH revisions shall be referred to the Director, International Safeguards Division for approval. The hierarchy of approval for safeguards related issues is provided in section 13.2 of Part II of this LCH.*

Licensee LCH Change Request Form

TRIUMF - Licence Conditions Handbook Change Request				
Current LCH	Version Date			
	CNSD Document #			
	Revision #			
Requestor Information	Date of Request			
	Name			
	Title			
	Signature			
Description of Changes	Overview of Changes Requested			
	Affected Sections of LCH			
New or Amended TRIUMF Documents	Title(s)			
	Document #(s)			
	Revision #(s)			
	Revision Date(s)			
CNSC staff use only				
Assessment	List each specialist Division consulted and the date(s) of referral			
	List the edoc # and date(s) of response for each specialist report			
	Project Officer summary and recommendation			
Approval	Title:	Director	Director General	Vice President
	Div/Dir/Branch			
	Name:			
	Signature:			
	Indicate approved, rejected or referred to next level of authority			
Referred to Dispute Resolution	Provide edocs#			

APPENDIX A: LCH CHANGE CONTROL PROCESS AND LCH CHANGE REQUEST FORM

CNSC Staff LCH Change Request Form

CNSC Staff - Licence Conditions Handbook Change Request for TRIUMF				
Current LCH	Version Date			
	CNSD Document #			
	Revision #			
Requestor Information	Date of Request			
	Name			
	Title			
	Division			
	Directorate			
	Signature			
Line Manager Approval	Name			
	Title			
	Signature			
Description of Changes	Overview of Changes Requested			
	Affected Sections of LCH			
New/Changed Documents	Title(s)			
	Document #(s)			
	Revision #(s)			
	Revision Date(s)			
Assessment	List each specialist Division consulted and the date(s) of referral			
	List the edoc # and date(s) of response for each specialist report			
	List the edoc # and date for the licensee's acceptance of the change			
	Project Officer summary and recommendation			
Approval	Title:	Director	Director General	Vice President
	Div/Dir/Branch			
	Name:			
	Signature:			
	Indicate approved, rejected or referred to next level of authority			
Referred to Dispute Resolution	Provide edocs#			

APPENDIX B: DEFINITIONS

The following is a list of definitions of words or expressions used in the LCH that may need clarification. Unless a reference source is provided in parenthesis, the words or expressions have been defined for the purpose of the LCH.

Accept/Accepted/Acceptable/Acceptance
Meet regulatory requirements, which mean it is in compliance with regulatory documents or technical standards referenced in the licence.

Approval
1) Commission's permission to proceed, for situations or changes where the licensee would be:

- not compliant with a regulatory requirements set out in applicable laws and regulations; or
- not compliant with a licence condition; or
- not in the safe direction but the objective of the licensing basis is met.

2) Written permission to proceed, given by CNSC delegated authority, for situations or changes where the licensee would:

- comply with a regulatory requirements set out in applicable laws and regulations;
- comply with a licence condition; and
- not adversely impact the licensing basis.

Boundary conditions
Procedural, administrative rules and operating limits for ensuring safe operation of the facility based on safety analysis. It also includes any applicable regulatory requirements.

Compliance verification criteria
Measures of conformity to the regulatory requirements. CNSC staff use these criteria to confirm that the licensee is meeting the corresponding provisions from the *Nuclear Safety and Control Act*, the regulations and the licence conditions.

Defense-in-depth
The provision of multiple, redundant, nuclear safety provisions to protect workers, the public and the environment from radiological hazards of a nuclear facility.

Design basis
The range of conditions and events taken into account in the design of the facility, according to established criteria, such that the facility can withstand them without exceeding authorized limits for the planned operation of safety systems.

Design basis accident
Accident conditions against which a facility is designed according to established design criteria, and for which the damage and the release of radioactive material are kept within authorized limits.

Extent of condition
Means an evaluation to determine if an issue has potential or actual applicability to other activities, processes, equipment, programs, facilities, operations or organizations.

Graduated enforcement
A process for escalating enforcement action. If initial enforcement action does not result in timely compliance, gradually more severe enforcement actions may need to be used. It takes into account such things as:

- the risk significance of the non-compliance with respect to health, safety, security, the environment and international obligations;
- the circumstances that lead to the non-compliance (including acts of willfulness);
- previous compliance record; and
- operational and legal constraints (for example, Directive on the Health of Canadians)
- industry specific strategies.

Human factors engineering
Is the application of knowledge about human capabilities and limitations to plant or facility, system, and equipment design. Human factors engineering ensures that the plant or facility, system, or equipment design, human tasks, and work environment, are compatible with the sensory, perceptual, cognitive, and physical attributes of the personnel who operate, maintain, and support it.
[CNSC regulatory document G-276: "Human Factors Engineering Program Plans"]

Important to safety
Items important to safety include, but are not limited to:

- Structures, Systems or Components (SSC) whose malfunction or failure could lead to undue radiation exposure of the facility/site personnel, or members of the public;
- SSCs that prevent anticipated operational occurrences from leading to accident conditions;
- SSCs that protect the environment;
- those features that are provided to mitigate the consequences of malfunctions or failures of SSCs; and
- tasks, duties, activities, aging mechanisms, findings, or any work that improperly performed could lead to radiation exposure of, or other harm to, the facility/site personnel, or members of the public.

Licensee-produced licensing documents
Documents containing the safety and control measures described in the licence application and the documents needed to support that licence application.

Licensee documents requiring notification of change
As determined by CNSC staff, these are documents needed to support the licence application which contain the necessary safety and control measures. Depending on the risk significance of the document, changes may require either a "notification" or a "notification prior to implementation"

Program(s)
A documented group of planned activities, procedures, processes, standards and instructions coordinated to meet a specific purpose.

Programmatic failure
A programmatic failure (or programmatic non-compliance), arises under one or more of the following circumstances:

- Failure to establish a required program or program element.
- Failure of a program or program element to meet a mandated standard.
- Failure to comply with a specific, objective provision of a program.
- Aggravated or systemic failure(s) to adhere to applicable procedures.

Regulatory undertakings
Refers to high level commitments that ensure safety, not component work orders or regulatory predefined maintenance tasks.

Safe direction
Means changes in facility safety levels which would not result in:

- a reduction in safety margins,
- a breakdown of barrier,
- an increase (in certain parameters) above accepted limits,
- an increase in risk,
- impairment(s) of safety systems,
- an increase in the risk of radioactive releases or spills of hazardous substances,
- injuries to workers or members of the public,
- introduction of a new hazard,
- reduction of defense-in-depth provisions,
- causing hazards or risks different in nature or greater in probability or magnitude than those stated in the safety analysis of the nuclear facility.

Safety and control measures
The subset of measures described at a program level put in place by the applicant to protect the environment and the health and safety of persons at the nuclear facility which satisfy the regulatory requirements for safely carrying out the licensed activities.

Safety-related system(s)
Those systems, and the components and structures thereof, which, by virtue of failure to perform in accordance with the design intent, have the potential to impact on the radiological safety of the public or facility personnel from the operation of the nuclear facility. Those systems, and components and structures thereof, are associated with:

(i) control of the facility;
(ii) limiting the release of radioactive material and the exposure of facility personnel and/or the public to meet the criteria established by the licensing authority with respect to radiation exposure during and following normal, anticipated transient conditions and accident conditions.

Safety significance
Refers to the significance of a discovery/issue with respect to the impact on meeting the fundamental nuclear safety objectives as defined by the IAEA.

In general, a discovery/event has safety significance if it denotes a deviation away from the safety case accepted in the licence, in the direction detrimental to safety, such as:

- Reducing margins to, or exceeding the accepted limits;
- Increasing risk;
- Impairments (various degrees) of the safety systems or of the safety functions for accident mitigation;
- Human factor issues; and
- Events causing radioactive releases and spills of hazardous substances, injuries to workers, public, etc.

Shall
Is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard.

Version-controlled documents
Refers to documents which require CNSC control and are captured in this LCH. Such documents include regulatory/industry standards as referenced in the licence (may include regulatory/industry standards which require transition); and licensee documents defining the licensing basis.

Written notification
A physical or electronic communication between a CNSC delegated authority and a person authorized to act on behalf of the licensee.

APPENDIX C: FACILITY OPERATIONAL LIMITS

A. 520 MeV Cyclotron Facility Operating Specifications

1. Proton Beam Energy Limitations

The proton energy shall not exceed 525 MeV.

2. Proton Beam Current Limitations

The proton beam currents shall not exceed

(a) 320 µA total circulating current for proton energies up to 480 MeV, or;
250 µA total circulating current for proton energies greater than 480 MeV;
(b) 200 µA into the BL1A beam dump;
(c) 250 µA into beam line 1A;
(d) 1 µA into beam line 4B2;
(e) 0.02 µA into beam line 1B;
(f) 10 µA into beam line 4A3;
(g) 0.5 µA into beam dump 4A2;
(h) 0.5 µA into beam dump 4B3; and
(i) 100 µA into beam line 2A; and
(j) 10 µA into beam line 1U.

3. Beam Energy and Current Limitations for Beam Line 2C Targets

The proton beam current at energies between 65 and 120 MeV on the targets in beam line 2C shall be limited to the values below.

Branch	Target	Maximum Current	Product / Purpose
2C1:	Biological phantoms Patients	0.01 µA	Proton therapy Proton therapy studies
2C4:	Rb	100 µA	^{82}Sr
2C5:	Cs	50 µA	^{127}Xe
2C7:	Faraday cup	10 µA	Calibration

4. Permissible target materials for the Proton Irradiation Facility:

Molybdenum

B. 42 MeV Cyclotron Facility Operating Specifications

Targets	Maximum Energy	Maximum Current
Solid: ^{203}Tl, ^{68}Zn, ^{112}Cd	30 MeV	0.25 mA
Solid: ^{58}Ni	24 MeV	0.32 mA
Solid: Ga_nNi	30 MeV	0.20 mA
Gas to produce: ^{123}I	30 MeV	0.15 mA
Gas to produce: ^{11}C, ^{15}O	30 MeV	0.05 mA
Gas to produce: ^{18}F	42 MeV	0.02 mA
Water to produce: ^{18}F, ^{13}N	30 MeV	0.02 mA

C. TR30-1 and TR30-2 Cyclotron Facility Operating Specifications

Targets	Maximum Energy	Maximum Current
^{203}Tl, ^{68}Zn, ^{112}Cd	30 MeV	0.35 mA
Ga, Ni	30 MeV	0.20 mA
^{58}Ni	24 MeV	0.32 mA
Gas to produce: ^{123}I	30 MeV	0.15 mA
Solid to produce: ^{103}Pd	30 MeV	0.65 mA
^{100}Mo	24 MeV	0.50 mA

D. 13 MeV Cyclotron Facility Operating Specifications

Target Material	Reaction	Max. Current (µA)	Max. Energy (MeV)	Maximum Yield @ EOB (GBq)
$^{14}N_2$, 1% O_2 (Gas)	$^{14}N(p,\alpha)^{11}C$	40	13	160
H_2O<1% ethanol (Liquid) or $H_2{}^{16}O$ (Liquid)	$^{16}O(p,\alpha)^{13}N$	20	13	15
^{15}N-N_2, 1% O_2 (Gas)	$^{15}N(p,n)^{15}O$	30	13	104
$H_2{}^{18}O$ (Liquid) transferred to TR13 hotcell	$^{18}O(p,n)^{18}F$	20	13	189
$H_2{}^{18}O$ (Liquid) transferred to RCA	$^{18}O(p,n)^{18}F$	20	13	37*
$^{18}O_2$<1% F_2 (Gas)	$^{18}O(p,n)^{18}F$	30	13	285
Li	$^{7}Li(p,n)^{7}Be$	50	13	37*

* Operating limit instead of maximum saturation yield due to ALARA considerations when using the transfer lines to RCA (^{18}F) or manual removal of the target (Li).

E. ISAC Facility Operating Limitations

Maximum heavy ion beam activity: 37 GBq.

Conventional targets:
Maximum target material atomic number - 82

Actinide Target System:

Uranium carbide UCx targets subject to the following conditions:
Maximum proton beam current - 100 µA
Maximum integrated beam current per irradiation - 300,000 µA·h·g/cm^2
Maximum number of irradiations per year - no restriction

Uranium carbide P2N targets subject to the following conditions:
Maximum proton beam current:
- 80 µA with FWHM of 4 mm or
- 100 µA with FWHM of 7 mm

Maximum integrated charge on target: 16,000 µA-hours
Maximum number of irradiations per year – no restriction

Thorium Oxide target **ONE ONLY** subject to the following conditions:
Maximum proton beam current - 10 µA
Maximum integrated charge on target – 2400 µA-hours
Maximum target density - 11 g/cm^2

APPENDIX D: SOURCE - LIMITS FOR POSSESSION, IMPORT, USE, TRANSFER AND STORAGE

Location for possession, import, use, transfer and storage:

TRIUMF
4004 Wesbrook Mall
Vancouver BC V6T 2A3

Shipping address:

TRIUMF
6095 Nurseries Road
Vancouver BC V6T 2A3

Material	Maximum Total Quantity on Site for Unsealed Sources[1]		Maximum Activity per Sealed Source[2]	Comments
	(kg)	(GBq)	(GBq)	
Thorium	200	10		Importing these Controlled Nuclear Substances requires a separate licence under the *Nuclear Non-proliferation Import and Export Control Regulations.*
Depleted Uranium <0.6% U-235 by weight	600	14.0		
Natural Uranium	200	5.23		
Plutonium	0.002	4		
Enriched Uranium (Limit of only one sealed source)	0.100		0.000740	
Heavy water (Deuterium)	550 (110)			
Deuterium (other form than heavy water)	25			
Tritium		10,000		
Atomic numbers 2-89 (a) Tc-99m only (b) all other isotopes		1400 400		
Atomic numbers 2-89			100	
Americium 241 / Beryllium			55	
Americium 241 / Boron			15	
Americium 241			14	
Curium 244			1	
Californium 252			0.001	

[1] The limit refers to the sum of all activity for sources of a given isotope on site. It includes the processed activity from isotope production facilities (Appendix E). Once the processed activity is captured in a vial it becomes an unsealed source, and the limit applies to the sum of unsealed sources of that isotope.

[2] The limit refers to a per source activity and only applies to sources that exceed the exemption quantity.

APPENDIX E: NUCLEAR SUBSTANCES - ISAC COLLECTION STATION AND ISOTOPE PRODUCTION, FACILITY LIMITS FOR PRODUCTION AND PROCESSING

Material	Maximum Activity at the ISAC Collection Station[3]	Maximum Activity for Isotope Production[4]
	(GBq)	(GBq)
Atomic numbers 2-89 (except Tc-99m)	400	400
Tc-99m		1400

[3] The limit refers to the activity per isotope in a collection sample and only applies to quantities that exceed the exemption quantity.

[4] The limit refers to the activity per isotope produced for one irradiation and only applies to quantities that exceed the exemption quantity.

APPENDIX F: NUCLEAR SUBSTANCES - LIMITS FOR EXPORT

Nuclear Substance	Maximum Activity per Shipment (GBq)
Beryllium-7	81.0
Sodium-22	26.0
Silicon-32	0.053
Phosphorus-32	26.0
Phosphorus-33	35.0
Sulphur-35	160.0
Argon-37	270.0
Argon-39	1.0
Argon-42	0.010
Titanium-44	1.0
Calcium-45	1.0
Scandium-46	7.2
Vanadium-48	5.2
Vanadium-49	47.0
Chromium-51	29.0
Manganese-54	26.0
Iron-55	36.0
Cobalt-56	73.0
Nickel-56	0.011
Cobalt-57	120.0
Cobalt-58	21.0
Cobalt-60	0.59
Zinc-65	0.047
Strontium-90	0.001
Tin-113	0.001
Iodine-125	0.20
Cadmium-109	0.001
Barium-133	0.001
Cesium-137	0.001
Gadolinium-148	0.001
Europium-152	0.001
Lutetium-177m	0.001
Bismuth-207	0.001
Americium-241	0.010

APPENDIX G : DOCUMENTS VERSION CONTROL

Table G-1: Licensee Documents that are subject to LCH Document Control

Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
3.1 4.1	TSN 1.7, *Requirements for Reporting of Incidents* (Revised draft version, new document TD535)	529	draft		3970354
2.1 3.1	TSN 1.0, *TRIUMF Policy on Safety in the Workplace*	537	1.0.1	2001/07	3970355
3.2 7.1	TSN 1.1, *TRIUMF Radiation Protection Training Program*	538	5	2017/03/27	6393959
6.1	TSN 1.3, *TRIUMF Lockout Policy and Procedures*	539	6	2018/06/14	6262637
6.1	TSN 1.5, *Policy and Procedures for the Implementation of Interlocks Defeats and Device Disables*	541	3	2018/11/23	6262638
6.1	TSN 1.6, *Availability Requirements for TRIUMF Radiation Safety Systems*	542	1	2006/01	3970359
7.1	TSN 1.8, *Policy for Maximum Allowable Dose in Accessible Areas at TRIUMF*	544	2	2012/04/13	3970360
7.1	TSN 1.2, *Policy on Radiation Exposure*	545	3	2010/01/25	3970361
5.2 5.3	*ISAC II Safety Report*	561	4	2013/07/22	4181458
5.2 5.3	*TRIUMF TR30-2 Safety Report*	562	1.7	2003/03	3970363
4.1 5.2 5.3 7.1 7.2 8.1 9.1 9.2 9.4 12.1	*TRIUMF Safety Report*	563	3	2005/09	3970364
5.2 5.3	*ISAC I Safety Analysis Report*	565	1	2000/10	3970365
2.1	TSOP-01, *Documents and Records Management*	593	4	2018/09/11	6262639
6.1	TSOP-08, *Calibration and Inspection*	595	4	2016/12/12	6393960
5.1 6.1	TSOP-06, *Engineering Design, Manufacture and Assembly*	597	2	2008/10/15	3970367

Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
2.1	TSOP-07, *Experiment Management Science Division*	599	4	2015/10/02	5093978
2.1 3.1 4.1	TSOP-09, *Quality Program Assessment*	607	6	2015/12/17	5093983
3.2	TSOP-04, *The TRIUMF Training Program*	609	5	2019/04/01	6393961
2.1 3.1 4.1 5.1 6.1 9.1	*TRIUMF Quality Manual*	611	7	2020/06/09	6393962
3.2 7.1 8.1	*TRIUMF Handbook of Occupational Health and Safety*	840	6	2017/09/07	6393963
7.1	TSN 3.6, *Designation of Nuclear Energy Workers at TRIUMF*	850	2	2012/12/05	6393964
10.1	TSN 2.1, *TRIUMF First Aid Program*	857	3	2013/12/02	5094229
10.2	TSN 5.9, *Fire Protection and Prevention at TRIUMF*	868	3	2010/09/03	3970376
12.1	TSOP-10, *Access to TRIUMF*	1733	6	2018/05/14	6262641
5.2 5.3	*TRIUMF TR30-1 Safety Analysis Report*	3794	0	2005/03	3970379
2.1 3.1 4.1 5.1	TSOP-02, *Nonconformity Reporting and Resolution*	4758	6	2015/12/04	5093991
10.1	*TRIUMF Emergency Preparedness Plan*	4952	6	2019/11/28	6393965
9.1 9.2	*Monitoring of Emissions from the TRIUMF site (EHS-RPG-04-10)*	5328	3	2015/11/27	4980368
9.1 9.2	*Environmental Monitoring Program for the TRIUMF site (EHS-RPG-07-10)*	5329	3	2015/11/27	4980371
11.1	*Radioactive Waste Management for the TRIUMF site (EHS-RPG-06-10)*	5330	5	2016/12/23	6393966

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Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
5.2 5.3	*TR13 Safety Report*	5359	6	2020/01/17	6262648
3.1 4.1	TSOP-11, *Operations Management*	5604	2	2008-10-15	3970386
4.1 5.1 6.1	TSOP-12, *Configuration Management*	5605	3	2015/12/04	5094030
4.1	TSOP-13, Commissioning	5708	2	2008/10/15	3692689
11.1	*Characterization of Radioactive Waste (EHS-RPG-06-04)*	5815	1	2012/03/29	3970388
11.1	*Sorting Radioactive Waste at the Source (EHS-RPG-06-01)*	5816	2	2012/03/23	6393967
11.1	*Assaying Pump Oil Samples (EHS-RPG-06-03)*	5817	2	2016/09/01	6393968
10.1	*TRIUMF Emergency Response Plan*	5856	6	2019/11/29	6393969
5.2 5.3	*CP-42 Safety Analysis Report*	7114	2.2	2006/08	3970393
11.1	*Assaying Radioactive Waste (EHS-RPG-06-02)*	8000	2	2012/03/23	3970394
7.1 9.1 9.2	TSN 2.4, *Derived Release Limits for Radioactive Emissions from the TRIUMF Site*	8506	9	2019/04/12	6262642
11.2	*Preliminary Decommissioning Plan*	8810	5	2019/05/17	6265487
5.2 5.3	*TRIUMF - ISAC II Safety Report Supplementary Information*	8913	1	2006/12/08	3970396
5.2 5.3	*Proton Therapy Safety Analysis Report*	9408	3	2011/12/01	3970398

Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
5.2 5.3	*TRIUMF to ACU, CCM, CBH Pipelines for PET Radiopharmaceuticals Safety Analysis Report*	9605	9	2019/11/12	6266017
2.1	*TRIUMF Board of Management Safety & Security Committee Terms of Reference*	10610	1	2007/03	3970401
5.2 5.3	*Actinide Target Safety Analysis Report*	12972	2	2011/09/28	3970402
9.1 9.2 9.3	*Environmental Management System*	15678	2	2016/12/14	5378135
2.1	*TRIUMF Organizational Chart*	18112	Oct 2018	2018/10/05	6262643
2.1	*Joint Venture Agreement*	18114	Mar 2008	2008/03	3970407
2.1	*TAI Management Agreement*	18115	Mar 2008	2008/03	3970408
2.1	*TRIUMF Joint Health & Safety Committee Terms of Reference*	18121	5	2017/10/23	6393971
2.1	*Document Manual*	22284	5	2018/08/02	6262644
5.1	TSOP-15, *Project Governance*	22889	5	2019/03/26	6262645
2.1	*Safety and Quality Management Review Meeting - Terms of Reference*	24195	2	2018/01/15	6262646
5.2 5.3	*Proposal to Modify ISAC II Vault Exclusion Area Boundary*	27099	4	2013/03/15	4259681
5.2	*520 MeV Accelerator Access Control Interlock Systems: Area Safety Units and the Emergency Trip Pushbutton System for Secondary Beam Exclusion Areas*	27748	7	2015/10/01	5094131
5.2	*Accelerator Access Control Interlock Systems: Functional Requirements and Design of Area Safety Units and the Emergency Trip Pushbutton System for Primary Beam and ISAC Exclusion Areas*	27775	7	2015/10/01	5094124
10.2	*TRIUMF Fire Protection Program*	29313	2	2010/10/12	6393973
12.1	*TRIUMF Accelerator Inc. Security Plan* **(Confidential – Prescribed Information)**	29843	5	2015/08/15	3772037
5.2 5.3	*Beamline 2C4 Solid Target Facility Safety Report*	30071	5	2017/08/21	5392225
15.2	*CNSC Financial Security and Access Agreement*	30101	Jan 2008	2008/01/07	3970415

Lic. Cond.	Title	Doc. #	Rev. #	Rev. Date	E-DOCS #
15.2	*Fund Contribution Gap Agreement*	30102	Jan 2008	2008/01/07	3970416
15.2	*Escrow Agreement*	30103	Jan 2008	2008/01/07	3970353
5.2	*Worst Case Emissions Analysis Report*	55017	1	2015/01/31	5094111
5.2 5.3	*Functional Requirements and Design of the e-Hall Maze Area Safety Unit*	57727	1	2013/01/31	4247010
14.1	*Package Handling and Transport Protocols for Radioactive Shipments*	62648	5	2019/10/21	6393974
14.1	*Procurement and Shipping of Radioactive Materials Procedure*	76036	3	2017/02/09	6393975
5.2 5.3	*Design Note TRI-DN-13-17 BL1A Shield Plug Modifications for UCN*	93063	2	2013/10/28	4227189
6.1	*Verification of Effluent Air Monitor Calibration*	109449	1	2014/05/20	4482952
5.2 5.3	*Actinide Target SAR Addendum for Thorium Oxide*	110961	1	2014/07/30	4496082
2.1 3.1	*TRIUMF Key Performance Indicators*	126719	2	2016/06/20	6393976
5.2 5.3	Design Note TRI-DN-16-34, *Safety Analysis for UCN Commissioning to 1 Microampere*	136684	2	2017/04/24	5235183
4.1 5.2	*BL1U Beam Commissioning Plan for 1μA Operation*	136846	1	2016/11/08	5122154
13.1	*TRIUMF Safeguards Program*	154117	1	2018/12/17	5744915
15.1	*TRIUMF Public Information and Disclosure Program*	156040	3	2020/02/20	6265486
5.2 5.3	*Actinide SAR Addendum for a proton-to-neutron converter target at ISAC*	188621	1	2020/09/28	6389035
5.3	*Long Rb Prototype Target Irradiation Tests*	ATG-PRO-OPR-STF-023	A	2016/10/31	5120322
5.3	*End-Use Statement for dual-use goods: Deuterium oxide, deuterium and deuterated compound*			2016/08/10	5093314
5.3	*Description of the use of up to 300kg of heavy water for the UCN project*			2016/09/29	5093315

Table G-2: Standards and Other Documents

Lic. Cond.	Source	Document Number	Title	Year	E-DOCS #
2.1 3.1	CSA	N286-12	*Management System Requirements for Nuclear Facilities*	2012	
9.2	CSA	N288.1-14	*Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*	2014	3469661
11.1	CSA	N292.3-14	*Management of low and intermediate-level radioactive waste*	2014	
11.2 15.2	CSA	N294-09	*Decommissioning of Facilities Containing Nuclear Substance*	2014	3661579
12.1	IAEA	Nuclear Security Series No. 15	*Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control*	2011	
8.1	WorkSafeBC		*Occupational Health and Safety Regulation*		
9.1 9.2 9.3	Metro Vancouver	244	*Greater Vancouver Sewerage and Drainage District Amending Bylaw No. 244, 2008*	2008	
9.1 9.2 9.3	Metro Vancouver	299	*Greater Vancouver Sewerage and Drainage District Sewer Use Bylaw No. 299, 2007*	2007	
9.1 9.2 9.3	Metro Vancouver	1082	*Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008*	2008	

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Lic. Cond.	Source	Document Number	Title	Year	E-DOCS #
9.1 9.2 9.3	BC Environmental Management Act	N/A	*Waste Discharge Regulation*		
3.1	USNRC	NUREG-0711, Revision 3	*Human Factors Engineering Program Review Model*	2012	
5.1 10.2	GOC	N/A	*National Building Code of Canada 2015*	2015	
5.1 6.1 10.2	GOC	N/A	*National Fire Code of Canada 2015*	2015	
5.1 6.1 10.2	National Fire Protection Association	NFPA 801	NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials*	2014	

Table G-3: CNSC Documents

Lic. Cond.	Title	Document Number	Rev. #	Rev. Date	E-DOCS #
7.1	G-129, *Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"*	G-129	1	2004/10	
15.2	G-206, *Financial Guarantees for the Decommissioning of Licensed Activities*	G-206		2000/06	
11.2 15.2	*G-219, Decommissioning Planning for Licensed Activities*	G-219		2000/06	
7.2 9.4	G-228, *Developing and Using Action Levels*	G-228		2001/03	
3.1 5.1	P-119, *Policy on Human Factors*	P-119		2000/10	
9.1	P-223, *Protection of the Environment*	P-223		2001/02	
2.1	REGDOC-2.1.2, *Safety Culture*	REGDOC-2.1.2	1.0	2018/04	

Lic. Cond.	Title	Document Number	Rev. #	Rev. Date	E-DOCS #
2.1 4.1 5.1	*REGDOC-2.2.1, Human Factors*	REGDOC-2.2.1	1.0	2019/03	
3.2	REGDOC-2.2.2, *Personnel Training*	REGDOC-2.2.2	1.0	2014/08	
9.1	REGDOC-2.9.1, *Environmental Protection: Policies, Programs and Procedures*	REGDOC-2.9.1	1.0	2013/09	
10.1	REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*	REGDOC-2.10.1	2.0	2016/02	
13.1	REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*	REGDOC 2.13.1	1.0	2018/02	
4.2	REGDOC-3.1.2, *Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills*	REGDOC-3.1.2	1.0	2018/01	
15.1	REGDOC-3.2.1, *Public Information and Disclosure*	REGDOC-3.2.1	1.0	2018/05	
3.2	TPED-01, *Objectives and Criteria for Regulatory Evaluations of Nuclear Facility Training Programs*	TPED-01	4	2013/09	4148739
4.2	*Annual Compliance Monitoring and Operational Performance Reporting Requirements for Class I A & B Nuclear Facilities*			2011/03	3471152

APPENDIX H – RESOLUTION OF INCONSISTENCIES

Identifier	LC	Subject of Conflict or Inconsistency	E-DOCS #	Date of Resolution