



CMD 25-H116 - CNSC Staff Submission

Preliminary Decommissioning Plan and Financial Guarantee for TRIUMF Inc.

Classification	UNCLASSIFIED
Type of CMD	Original
CMD Number	25-H116
Reference CMD(s)	N/A
Type of audience	Hearing in writing based solely on written submissions
Public hearing date	September 2025
Word e-DOC #	7465699 – EN
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Attachments	Current licence PA1OL-01.01/2032
Summary	TRIUMF Inc. conducted its 5-year review and submitted a revised PDP with estimated decommissioning costs. TRIUMF Inc. is required to maintain in effect a financial guarantee for decommissioning that is acceptable to the Commission.
Actions required	CNSC staff request the Commission to render a decision on CNSC staff's recommendation for the proposed revision to TRIUMF Inc.'s financial guarantee.

CMD 25-H116 - Soumission du personnel de la CCSN

Plan préliminaire de déclasséement et garantie financière pour TRIUMF Inc.

Classification	NON CLASSIFIÉ
Type de CMD	Original
Numéro du CMD	25-H116
CMD de référence	S/O
Type d'audience	Audience par écrit fondée uniquement sur des mémoires
Date de l'audience	Septembre 2025
N° e-DOC Word	7465699 – EN
N° e-DOC PDF	7548647 – EN
Pièces jointes	Le permis actuel PA1OL-01.01/2032
Sommaire	TRIUMF Inc. a effectué son examen quinquennal et a soumis un PPD révisé avec une estimation des coûts de déclasséement. TRIUMF Inc. est tenue de maintenir en vigueur une garantie financière pour le déclasséement qui soit acceptable pour la Commission.
Actions requises	Le personnel de la CCSN demande à la Commission de rendre une décision sur sa recommandation concernant la révision proposée de la garantie financière de TRIUMF Inc.



CMD 25-H116

Preliminary Decommissioning Plan and Financial Guarantee for TRIUMF Inc.

Signed by:

X

Karen Owen-Whitred

Director General, Directorate of Nuclear Substance Regulation

Directrice générale de la Direction de la réglementation des substances
nucléaires

Preliminary Decommissioning Plan and Financial Guarantee for TRIUMF Inc.

Canadian Nuclear Safety Commission

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Land acknowledgement

The Canadian Nuclear Safety Commission acknowledges that TRIUMF Inc. is in the unceded territory of the Coast Salish Peoples, including the territories of the xʷməθkwəy̓əm (Musqueam), Skwxwú7mesh (Squamish), and Səlílwətaʔ/Selilwitulh (Tsleil-Waututh) Nations.

Plain language summary

In accordance with subsection 24(5) of the [Nuclear Safety and Control Act](#) (NSCA), a licence may contain a condition that the applicant provide a financial guarantee in a form that is acceptable to the Commission. TRIUMF Inc.'s licence has such a condition, and the financial guarantee is required to be reviewed and updated every 5 years, or when there are material changes to the licensee's operational activities as described in [REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities](#) and [REGDOC-2.11.2, Decommissioning](#).

TRIUMF Inc.'s current financial guarantee (FG) was submitted in 2021 as part of their licence renewal application (the FG was approved by the Commission in 2022). While a revised financial guarantee was not required until 2026, TRIUMF Inc. had to submit a revised preliminary decommissioning plan (PDP) by the end of 2023, as per the [REGDOC-2.11.2, Decommissioning](#). The increase in the estimated decommissioning costs necessitated a revision to TRIUMF Inc.'s current financial guarantee. Therefore, CNSC staff is requesting a decision from the Commission on whether to accept the proposed FG. The PDP does not require the Commission approval but is discussed in this CMD to provide context for the FG.

CNSC staff reviewed TRIUMF Inc.'s revised PDP and confirmed the decommissioning strategy and facility end-state remain the same as that proposed by TRIUMF Inc. Inc as part of its 2022 licence renewal. In addition, the revised PDP meets regulatory requirements as specified in [CSA N294:19, Decommissioning of facilities containing nuclear substances](#) and [REGDOC-2.11.2, Decommissioning](#).

CNSC staff recommend that the Commission accept the revised financial guarantee proposed by TRIUMF Inc. as its proposal meets the requirements specified in [REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities](#) for providing adequate funding towards decommissioning of its licensed facilities.

Referenced documents in this CMD are available to the public upon request, subject to confidentiality considerations.

1 Overview

1.1 Background

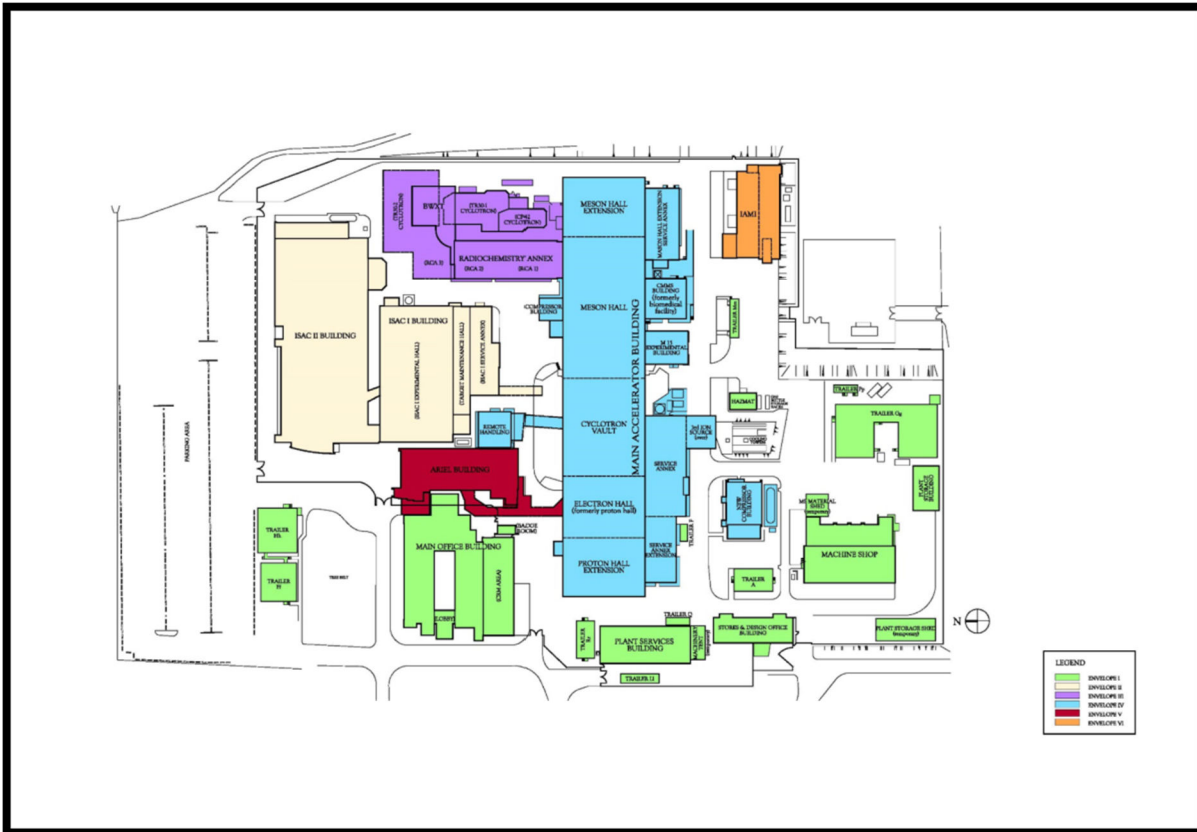
TRIUMF Inc. is Canada's particle accelerator centre and is located on the campus of the University of British Columbia. TRIUMF Inc. is owned and operated by a consortium consisting of 21 member universities from across Canada and is a not-for-profit corporation under the *Canada Not-for-profit Corporations Act*. Previously it was a joint venture known as TRIUMF Inc. Accelerators Inc. (TAI). During the 2022 licence renewal, the licence was transferred to the new entity and the name change took place. The current operating licence issued to TRIUMF Inc. is valid from July 1, 2022, until June 30, 2032. The record of [decision](#) for the renewal is Dec 22-H6 [1].

TRIUMF Inc. is licensed to operate a Class IB particle accelerator facility under licence PA1OL-01.01/2032 [2]. TRIUMF Inc. operates a Class 1B cyclotron, 4 Class II cyclotrons and 2 Class II linear accelerators.

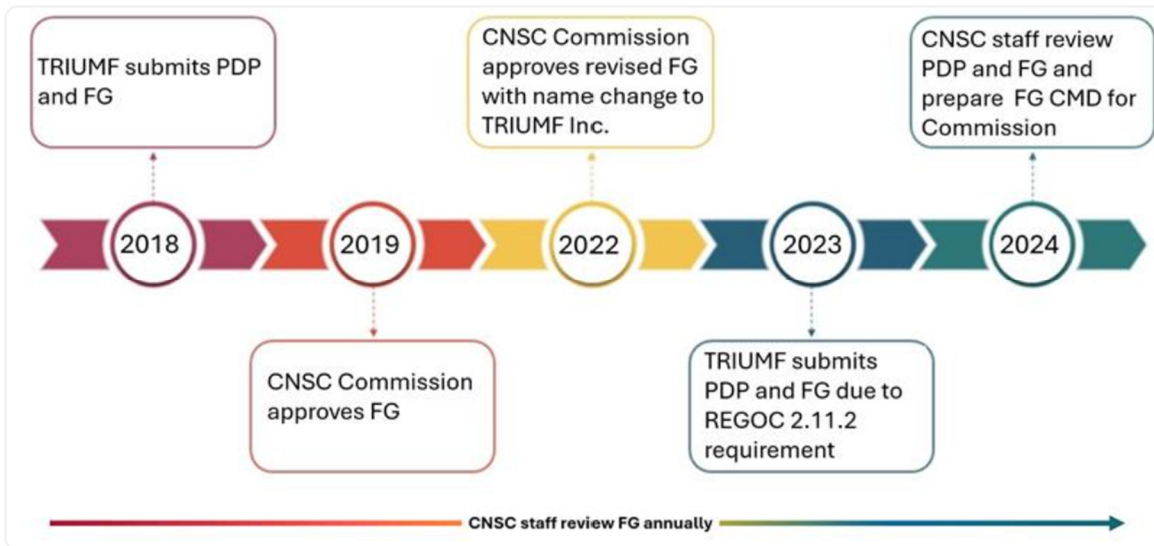
1.2 Highlights

- Decommissioning must be conducted in a manner that ensures that the health, safety, and security of workers, the public, and the environment are protected. TRIUMF Inc. has proposed a decommissioning plan to be conducted in 3 phases. Phase 1 would be initiated at shutdown, Phase 2 starting 25 years after shutdown, and finally, Phase 3 starting 45 years after shutdown.
- The overall decommissioning strategy for the TRIUMF Inc site involves the allocation of the various individual structures and components that comprise existing facility, into defined decommissioning planning envelopes:
 - Envelope I – Offices/Trailers and Support Facilities
 - Envelope II – ISAC-I and ISAC-II Facility
 - Envelope III – RCA and Production Cyclotron Facility
 - Envelope IV – Main Accelerator Building/Annexes and Remote Handling
 - Envelope V – ARIEL Facility
 - Envelope VI – IAMI Facility

DECOMMISSIONING PLANNING ENVELOPES



- The strategy considers 2 decommissioning end-state for each envelope. These end-states are A – returning a facility/structure to a state of re-use for the duration of its remaining anticipated life, or B – returning a facility/structure to a greenfield end-state.
- The proposed cost estimate to cover the decommissioning is C\$89.0 million. This is an increase from the estimate valued at C\$69.9 million provided in the 2021 licence renewal submission.
- The proposed financial instruments remain the same type as current, an Escrow Fund, a Contribution Gap Agreement [3], and the related *Amended and Restated CNSC Financial Security and Access Agreement* [4].
- Timeline of recent PDP & FG submissions:



1.3 Overall Conclusions

CNSC staff have concluded that:

- TRIUMF Inc.'s revised preliminary decommissioning plan [5] provides an acceptable strategy and credible cost estimate, and is consistent with CNSC [REGDOC-2.11.2, Decommissioning](#) and [CSA N294:19, Decommissioning of facilities containing nuclear substances](#).
- TRIUMF Inc.'s proposed financial guarantee is acceptable and adequate for future decommissioning of the facility and is consistent with CNSC [REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities](#).

1.4 Overall Recommendations

CNSC staff recommend:

That the Commission accept the proposed revision to TRIUMF Inc.'s financial guarantee to the current amount of C\$12.5 million in the form of an Escrow Fund and the C\$76.5 million in the form of a Contribution Gap Agreement. Both instruments collectively cover the estimated C\$89 million decommissioning costs, an increase from the previous value of C\$69.9 million.

2 Matters for Consideration

2.1 Preliminary Decommissioning Plan (PDP)

The PDP is intended to document the selected decommissioning strategy, the main decontamination, dismantling and/or clean-up activities and the end-state objectives. TRIUMF Inc. is required to review and revise their PDP every 5 years. The previous PDP was submitted in 2018. In 2023, TRIUMF Inc. submitted a revised PDP that included the additional decommissioning requirements related to the expanded ARIEL facility and the IAMI cyclotron facility and to also ensure compliance with REGDOC-2.11.2, Decommissioning. After exchanges between TRIUMF Inc. and CNSC staff, CNSC staff accepted TRIUMF Inc.'s revised PDP in January 2024. PDPs are accepted at the level of CNSC staff and do not require Commission approval.

TRIUMF Inc.'s decommissioning strategy consists of 6 planning envelopes, each with two end-states. End-state A may be chosen if there is a significant amount of serviceable life left in the buildings. It involves the cleanup and unrestricted use of portions of the buildings that can be returned to an appropriate state. This end-state only includes the cleaning of unrestricted areas and does not include any demolition costs, which are deferred until the structures reach the end of their life. End-state B involves the decommissioning of the entire site to a green field condition at the earliest opportunity. The total C\$89M cost estimate is based on end-state B for all envelopes, and is therefore, the most conservative estimation.

The decommissioning plan is separated into 6 envelopes. The first consists of offices, trailers, and general support areas where no radioactive materials are present. The second consists of the ISAC I&II facilities, where significant concrete and metal activation will require retention of materials for approximately 25 years before removal. Any remaining activated components above clearance levels will be moved to the 520 MeV vault for additional decay. The third envelope is the Radiochemistry Annex and Isotope Production Cyclotrons, where activated materials will be stored for approximately 25 years before removal. The fourth planning envelope consists of the main accelerator building and associated facilities. After 25 years all concrete and most metal components in the main accelerator building will have decayed below clearance levels. A total of 50 years will be required for the concrete in the 520 MeV cyclotron vault to decay below clearance levels. After 50 years, activated metals from the 520 MeV cyclotron and its beamlines will be in quantities greater than the clearance levels and will have to be shipped to a licensed radioactive waste facility. The fifth planning envelope is the ARIEL facility, it will be handled in a similar manner to the ISAC facilities (envelope 2). The sixth envelope is the IAMI Class II cyclotron facility, which is not yet fully constructed, where the demolition and removal of equipment is considered.

TRIUMF Inc.'s revised cost estimate for decommissioning of C\$89.0 million is an increase from the estimate of C\$69.9 million provided in the 2021 licence renewal submission. The increase is due to the inflation rate (2% per year), the addition of long-lived isotopes in the decommissioning plan and a higher percentage in the contingency dollars.

CNSC staff assessed and concluded that the submitted PDP meets the criteria and guidance set in CNSC REGDOC-2.11.2, Decommissioning and CSA N294:19, Decommissioning facilities of containing nuclear substances. The revised PDP provides a credible cost estimate for the future decommissioning of TRIUMF Inc.'s facility.

2.2 Financial Guarantee Proposal

Financial guarantees are intended to ensure that sufficient funding is available to cover the cost of decommissioning of nuclear facilities or termination of licensed activities authorized by the current licence as specified in REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities.

Financial guarantees must be sufficient to meet the decommissioning needs according to the most up-to-date decommissioning plan. Thus, a revised financial guarantee must be submitted following changes to the estimated decommissioning costs. Financial guarantees require approval by the Commission.

TRIUMF Inc.'s financial guarantee is funded by two instruments covering the total estimated decommissioning cost of C\$89 million (2024 CAD). C\$12.5 million (as of March 31, 2023) in an Escrow Fund, and C\$76.5 million Contribution Gap Agreement. An Escrow fund is an acceptable financial instrument that meets the requirements of certainty and adequacy of value, ease of liquidity, and continuity of protection. The Contribution Gap Agreement was last renewed in 2022 as part of the licence renewal and is currently valid. It allows TRIUMF Inc. and its 21 member universities to acknowledge that at any given time there may exist a difference between the total decommissioning cost and the fair market value of the Escrow Fund. It also confirms that the gap will be bridged by each of the Universities in accordance with the Contribution Gap Agreement. It is important to add that TRIUMF Inc.'s intent is that the Escrow fund will grow to sufficiently fund all decommissioning obligations, and therefore, gap funding should not be necessary. CNSC staff have no concerns with this approach.

It is also standard procedure to have an agreement between the licensee and the CNSC to provide assurance that the CNSC have access to the funds if needed (if, for example, the licensee goes bankrupt and cannot undertake decommissioning itself). In TRIUMF Inc.'s case the Amended and Restated CNSC Financial Security and Access Agreement that was last revised in 2022 and is currently valid, plays that role.

CNSC staff's review concluded the financial guarantee and the proposed financial instruments met the requirements of CNSC Regulatory Document, REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities.

3 Consultation and Engagement

3.1 Indigenous Consultation and Engagement

The common-law duty to consult with Indigenous Nations and communities applies when the Crown contemplates actions that may adversely affect potential or established Indigenous and/or treaty rights. The CNSC ensures 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 reviewed and received to date in relation to TRIUMF Inc.'s revised PDP and updated financial guarantee it is CNSC staff's assessment that the application is unlikely to result in new adverse impacts to Aboriginal and/or Treaty Rights. The proposed changes are administrative in nature and do not result in any changes to the facility's footprint or operations. CNSC staff encourages TRIUMF Inc. to continue conducting engagement and outreach activities to ensure that Indigenous Nations and communities that have indicated an interest in the TRIUMF Inc. facility are aware of the revised PDP and updated financial guarantee submission.

3.2 Public Consultation and Engagement

The NSCA mandates the CNSC to disseminate objective scientific, technical and regulatory information to the public concerning its activities and the activities it regulates. CNSC staff fulfill this mandate in a variety of ways, including hosting in-person and virtual information sessions and through annual regulatory reports. CNSC staff has made many attempts to reach out to interested parties. For example, in advance of the 2022 Independent Environmental Monitoring Program (IEMP) sampling campaign at TRIUMF Inc., notification emails were sent to Indigenous Nations and communities near the facility to notify them of the sampling campaign and to seek input on the sampling plan. Also, as part of the 2023 Regulatory Oversight Report (ROR) Commission meeting (CMD 25-M10), members of the public were invited to provide interventions. On both occasions, CNSC staff did not receive any comments from either Indigenous Nations and communities or members of the public. CNSC staff will continue to engage with Indigenous Nations and communities and members of the public to ensure that information in relation to TRIUMF Inc. is made available.

3.3 Participant Funding Program

The CNSC established the Participant Funding Program (PFP) in 2011 to:

1. enhance individual, not-for-profit organization and Indigenous Nations and Communities participation in the CNSC's environmental assessment (EA) and licensing processes for major nuclear facilities (e.g., uranium mines, nuclear power plants, nuclear substance processing, or nuclear waste facilities)
2. assist individuals, not-for-profit organizations and Indigenous Nations and Communities to bring value-added information to the Commission through informed and topic-specific interventions related to EAs and licensing (i.e., new, distinctive and relevant information that contributes to a better understanding of the anticipated effects of a project)

Since the proposed revision to TRIUMF Inc.'s financial guarantee is administrative in nature, and that no interventions were invited from the public, the CNSC did not offer participant funding for this matter.

4 Conclusions

CNSC staff have concluded that:

- TRIUMF Inc's revised preliminary decommissioning plan [5] provides an acceptable strategy and credible cost estimate and meets the requirements of [REGDOC-2.11.2, Decommissioning](#); and

TRIUMF Inc's proposed financial guarantee is acceptable and adequate for future decommissioning of the facility and meets the requirements of REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities..

5 Recommendations

CNSC staff recommend:

That the Commission accept the proposed revision to TRIUMF Inc.'s financial guarantee to the current amount of C\$12.5 million in the form of an Escrow Fund and the C\$76.5 million in the form of a Contribution Gap Agreement. Both instruments collectively cover the estimated C\$89 million decommissioning costs, an increase from the previous value of C\$69.9 million.

6 References

1. Record of Decision - TRIUMF - Licence Renewal and Transfer - CMD 22-H6 - Public Hearing of March 23, 2022. CNSC Document No. 6814893
2. Class IB Particle Accelerator Operating Licence, TRIUMF Inc., PA1OL-01.01/2032, valid from July 1, 2022, to June 30, 2032. CNSC Document No. 6697519
3. *Amended and Restated Fund Contribution Gap Agreement*. CNSC Document No. 6870333
4. *Amended and Restated CNSC Financial Security and Access Agreement*. CNSC Document No. 6870329
5. *Preliminary Decommissioning Plan (PDP)*, Document-8810, Release 7, January 02, 2024. CNSC Document No. 7202466

7 Glossary

For definitions of terms used in this document, see [REGDOC-3.6, Glossary of CNSC Terminology](#), which includes terms and definitions used in the [Nuclear Safety and Control Act](#) and the [Regulations](#) made under it, and in [CNSC regulatory documents](#) and other publications.

Glossary Term	Glossary Definition
C\$	Canadian dollars
CMD	Commission member document
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
NSCA	<i>Nuclear Safety and Control Act</i>
PDP	Preliminary decommissioning plan
REGDOC	Regulatory document

Appendix A: Basis for Recommendation(s)

A1: Regulatory Basis

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

Nuclear Safety and Control Act

Subsection 24(5) of the *Nuclear Safety and Control Act* provides that a licence may contain any term or condition that the Commission considers necessary for the purposes of the Act, including a condition that the applicant provide a financial guarantee in a form that is acceptable the Commission.

Subsection 24(6) of the *Nuclear Safety and Control Act* provides that the Commission may authorize the application of the proceeds of any financial guarantee referred to in subsection (5) in such manner as it considers appropriate for the purposes of this Act.

Subsection 24(7) of the *Nuclear Safety and Control Act* provides for the means by which a refund may be granted for any funds that have not been spent.

General Nuclear Safety and Control Regulations

The *General Nuclear Safety and Control Regulations* requires under paragraph 3(1)(l) that a licence application contains a description of any proposed financial guarantee relating to the activity to be licensed.

Class I Nuclear Facilities Regulations

Paragraph 3(k) of the *Class I Nuclear Facilities Regulations* required 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.

Licence Condition 11.2 of TRIUMF Inc. licence PA10L-01.01/2032

The licensee shall maintain a preliminary decommissioning plan.

Licence Condition 15.2 of TRIUMF Inc. licence PA10L-01.01/2032

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

A2: Technical Basis

The technical basis for the recommendations presented in this CMD is compared against the following:

- CNSC [REGDOC-2.11.2, Decommissioning](#)
- CNSC [REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities](#)
- [CSA N294:19, Decommissioning facilities of containing nuclear substances](#)



Record of Decision

DEC 22-H6

In the Matter of

Applicant TRIUMF Accelerators Inc.

Subject Application to Renew Particle Accelerator
Operating Licence and Transfer Licence to
TRIUMF Inc.

Public Hearing
Date March 23, 2022

Record of
Decision Date June 16, 2022

RECORD OF DECISION – DEC 22-H6

Applicant: TRIUMF Accelerators Inc.

Address/Location: 4004 Wesbrook Mall, Vancouver, BC, V6T 2A3

Purpose: Application to Renew Particle Accelerator Operating Licence and Transfer Licence to TRIUMF Inc.

Application received: March 19, 2021

Date of public hearing: March 23, 2022

Location: [Virtual Hearing](#)

Members present: R. Velshi, Chair
T. Berube
I. Maharaj

Registrar: D. Saumure

Recording Secretary: M. McMillan

Senior General Counsel: L. Thiele

Applicant Represented By		Document Number
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A. Levine	Team Leader, Indigenous Consultation and Participant Funding, Indigenous and Stakeholder Relations Division, Strategic Planning Directorate	
G. Steedman	Project Officer, Wastes and Decommissioning Division, Directorate of Nuclear Cycle and Facilities Regulation	
Intervenors		
See Appendix A		

Licence: Renewed and Transferred

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Appendix A – Intervenors		A

1.0 INTRODUCTION

1. TRIUMF Accelerators Inc. (TAI) has applied to the Canadian Nuclear Safety Commission¹ for the renewal of its Class IB particle accelerator operating licence. TAI's particle accelerator facilities are located on the campus of the University of British Columbia in Vancouver, British Columbia, and on the unceded territory of the Coast Salish Peoples, including the territories of the xʷməθkwəy̓əm (Musqueam), Skwxwú7mesh (Squamish), and Səlilwətaʔ/Selilwitulh (Tsleil-Waututh) Nations. The current operating licence, PA1OL-01.00/2022, expires on June 30, 2022. TAI requested a renewal of the licence for a period of 10 years.
2. TAI's particle accelerator facilities are a Class IB nuclear facility under the [Class I Nuclear Facilities Regulations](#).² TAI's current licence authorizes TAI to operate and service 7 particle accelerators including:
 - 1 520-MeV cyclotron;
 - 4 Class II cyclotrons; and
 - 2 Class II linear accelerators.

The licence also authorizes TAI to possess, transfer, use, and store nuclear substances arising from its operations. TAI did not request any new licensed activities in its licence renewal application.

3. TAI requested that the licence, if renewed, be transferred to TRIUMF Inc., a not-for-profit corporation. TRIUMF Inc. currently has a management agreement with TAI to operate the particle accelerators under licence PA1OL-01.00/2022. TAI indicated that, if the Commission authorizes the transfer of the licence, TAI intends to amalgamate with TRIUMF Inc. when the renewed licence term begins on July 1, 2022.
4. The Commission is also being asked to accept TAI's revised financial guarantee consisting of an Escrow Fund in the amount of \$14.78M (as of March 31, 2023) and a Contribution Gap Agreement and a Financial Security and Access Agreement.

Issues

5. The Commission is required to determine whether and what requirements the [Impact Assessment Act](#)³ (IAA) imposes in relation to the activities sought to be authorized in TAI's application to renew and transfer its Class IB particle accelerator operating licence. Satisfying any such requirements can be a prerequisite to licensing.

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

² SOR/2000-204

³ S.C. 2019, c. 28, s. 1

6. Pursuant to paragraph 24(4)(a) and (b) of the [Nuclear Safety and Control Act](#)⁴ (NSCA), to renew the licence, the Commission must be satisfied that:
 - a) TAI is qualified to carry on the activity that the licence would authorize; and
 - b) in carrying on that activity, TAI would make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.
7. Similarly, pursuant to paragraph 24(4)(a) and (b) of the NSCA, the Commission must be satisfied of the following prior to authorizing the transfer of the licence:
 - a) TRIUMF Inc. is qualified to carry on the activity that the licence would authorize; and
 - b) in carrying on that activity, TRIUMF Inc. would make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.
8. As an agent of the Crown, the Commission recognizes its role in fulfilling the Crown's constitutional obligations, along with advancing reconciliation with Canada's Indigenous peoples. The Commission's responsibilities include the duty to consult and, where appropriate, accommodate Indigenous interests where the Crown contemplates conduct which may adversely impact potential or established Indigenous or treaty rights⁵. As such, the Commission must determine what engagement and consultation steps and accommodation measures are called for, respecting Indigenous interests.

Public Hearing

9. On August 3, 2021, a [Notice of Public Hearing and Participant Funding](#) was published for this matter.
10. Pursuant to section 22 of the NSCA, the President of the Commission established a Panel of the Commission over which she would preside, including Commission Members Dr. T. Berube and Ms. I. Maharaj. The Commission, in making its decision, considered information presented for a public hearing held virtually on March 23, 2022. The public hearing was conducted in accordance with the [Canadian Nuclear Safety Commission Rules of Procedure](#)⁶ (the Rules). During the public hearing, the

⁴ S.C. 1997, c. 9

⁵ *Haida Nation v. British Columbia (Minister of Forests)*, 2004 SCC 73; *Taku River Tlingit First Nation v. British Columbia (Project Assessment Director)*, 2004 SCC 74

⁶ Statutory Orders and Regulations (SOR)/2000-211.

Commission considered written submissions and heard oral presentations from TAI ([CMD 22-H6.1](#), [CMD 22-H6.1A](#), and [CMD 22-H6.1B](#)) and CNSC staff ([CMD 22-H6](#) and [CMD 22-H6.A](#)). The Commission also considered oral and written submissions from 7 intervenors (see Appendix A for a list of interventions). All interventions received were in support of TAI's application. The hearing was webcast live via the CNSC website, and [video archives](#) are available on the CNSC's website.

Participant Funding Program

11. Pursuant to paragraph 21(1)(b.1) of the NSCA, the Commission has established a [Participant Funding Program](#) (PFP) to facilitate the participation of Indigenous Nations and communities, members of the public and stakeholders in Commission proceedings. In [August 2021](#), up to \$35,000 in funding to was made available through the CNSC's PFP to review TAI's licence renewal application and associated documents, and to provide the Commission with value-added information through topic-specific interventions. No PFP applications were received for this proceeding.

2.0 DECISION

12. Based on its consideration of the matter, and as described in more detail in the following sections of this *Record of Decision*, the Commission is satisfied that:
 - no requirements under the *Impact Assessment Act* (IAA) are imposed in relation to this matter
 - the Commission's responsibility to uphold the honour of the Crown and its constitutional obligations with regard to engagement and consultation respecting Indigenous interests has been satisfied
 - TAI is qualified to carry on the activity that the licence will authorize
 - TAI, in carrying on these activities, will 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

Therefore,

the Commission, pursuant to section 24 of the *Nuclear Safety and Control Act*, renews the Class IB particle accelerator operating licence issued to TRIUMF Accelerators Inc. for its particle accelerator facilities located in Vancouver, British Columbia. The renewed licence, PA1OL-01.00/2023, is valid from July 1, 2022 until June 30, 2032.

13. Given that the amalgamation of TAI to TRIUMF Inc. would have no substantive impact on the operation of the particle accelerator facilities, and that the facilities will be operated by TRIUMF Inc, with the same staff and under the same programs as TAI, the Commission concludes the following:

- TRIUMF Inc. is qualified to carry on the activity that the licence will authorize
- TRIUMF Inc, in carrying on these activities, will 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

Therefore,

the Commission, pursuant to section 24 of the *Nuclear Safety and Control Act*, transfers the renewed licence, PA1OL-01.00/2023, from TRIUMF Accelerators Inc. to TRIUMF Inc.

14. The Commission includes in the licence the conditions as recommended by CNSC staff in CMD 22-H6, with changes to reflect the most recent standardized conditions. The Commission is imposing the licence conditions that are in the licence that goes with this record of decision, which is not as was drafted in CNSC staff's CMD but which reflects updated conditions as discussed in the hearing. The Commission also delegates authority for the purposes of licence conditions G.3, 7.2, 9.4, and 13.2, as recommended by CNSC staff. Licence conditions and delegation of authority are further discussed in section 4.5 of this Record of Decision.
15. The Commission finds the proposed financial guarantee amount of C\$14.78 million (as of March 31, 2023) to be acceptable, and the proposed financial guarantee instruments of an Escrow Fund with a Contribution Gap agreement and the related *CNSC Financial Security and Access Agreement*, to be appropriate. Any administrative changes to the instruments to reflect TRIUMF Inc. as the licensee rather than TAI will be in conformity with this Commission decision, so long as no substantive change is made. The Commission directs the licensee to provide original financial guarantee instrument documentation that conforms with [G-206 Financial Guarantees for the Decommissioning of Licensed Activities](#), within 90 days of the issuance of this decision.
16. With this decision, the Commission directs CNSC staff to report on TRIUMF Inc.'s performance as part of the periodic [Regulatory Oversight Report](#) for Class IB particle accelerators. CNSC staff shall present this report at a public proceeding of the Commission. The Commission also directs CNSC staff to inform the Commission, as part of the *Regulatory Oversight Report*, of any changes made to the Licence Conditions Handbook (LCH). CNSC staff may bring any matter to the Commission's attention as required.

3.0 APPLICABILITY OF THE *IMPACT ASSESSMENT ACT*

17. In coming to its decision, the Commission was first required to determine whether any requirement under the IAA applied to the licence renewal application. Pursuant to the

IAA and the [Physical Activities Regulations](#) made under it, impact assessments are to be conducted in respect of projects identified as having the greatest potential for adverse environmental effects in areas of federal jurisdiction. Neither licence renewal nor transfer is a project designated under the *Physical Activities Regulations*.

18. The Commission is satisfied there is no requirement under the IAA for an impact assessment to be completed. The Commission is also satisfied that there are no other applicable requirements of the IAA to be addressed in this matter.⁷ The Commission notes that the NSCA provides a strong regulatory framework for environmental protection and the health and safety of persons. Environmental protection is further discussed in section 4.2.9 of this decision.

4.0 ISSUES AND COMMISSION FINDINGS

19. In making its licensing decision, the Commission considered a number of issues and submissions relating to TAI's qualification to carry out the licensed activities. The Commission also considered the adequacy of the proposed measures for protecting the environment, the health and safety of persons, national security and international obligations to which Canada has agreed.
20. This decision focuses on the issues relevant for this application, specifically:
- completeness of the licence application
 - TAI's performance in the 14 safety and control areas
 - Indigenous engagement and consultation
 - other matters of regulatory importance, including the financial guarantee
 - licence length and conditions, and delegation of authority
 - licence transfer

4.1 Completeness of Licence Application

21. TAI submitted a licence renewal application on [March 19, 2021](#) and a request for licence transfer on [November 22, 2021](#). In its consideration of this matter, the Commission examined the completeness of the application and the adequacy of the information submitted by the TAI, as required by the NSCA, the [General Nuclear Safety and Control Regulations](#)⁸ (GNSCR), the [Class I Nuclear Facilities Regulations](#)⁹, and other applicable regulations made under the NSCA, including the [Nuclear Security Regulations](#)¹⁰ and the [Radiation Protection Regulations](#)¹¹.

⁷ The IAA can impose other requirements on federal authorities in respect of authorizing projects that are not designated as requiring an impact assessment, including projects that are to be carried out on federal lands, or projects outside of Canada. This licence renewal does not engage any such applicable IAA requirements

⁸ SOR/2000-202.

⁹ SOR/2000-204.

¹⁰ SOR/2000-209.

22. The GNSCR call on an applicant for a licence renewal to provide information regarding any changes in information to the CNSC as part of its application. Section 5 provides:
- An application for the renewal of a licence shall contain
- (a) the information required to be contained in an application for that licence by the applicable regulations made under the Act; and
- (b) a statement identifying the changes in the information that was previously submitted.
23. TAI's application and supplemental submissions included reasoning for its application, information on the operation of its particle accelerator facilities since issuance of the current licence, information on the measures implemented by TAI to satisfy the requirements of its current licence, and information on how those measures would continue to be implemented under a future licence, if granted. TAI also provided detailed information of the proposed transfer of the licence to TRIUMF Inc. CNSC staff reviewed TAI's application and determined that the information submitted by TAI is complete and satisfies CNSC regulatory requirements, including the NSCA, and associated regulations.
24. The Commission concludes that TAI's licence renewal application is complete and complies with the regulatory requirements respecting an application for licence renewal. The Commission notes that TAI's application is for the renewal of an existing licence to continue operating a Class IB facility, with no substantive changes to the licensing basis, and that section 7 of the GNSCR provides that "An application ...for the renewal... of a licence may incorporate by reference any information that is included in a valid, expired or revoked licence."

4.2 TAI's Performance in the Safety and Control Areas

25. The Commission examined CNSC staff's assessment of TAI's performance in all 14 [safety and control areas](#) (SCAs) for the purpose of evaluating this application. Throughout the current licence period, CNSC staff rated TAI's performance in all SCAs as "satisfactory" or "fully satisfactory"¹², with the exception of four "below expectations" ratings, which are discussed in sections 4.2.1 Management System, 4.2.2 Human Performance Management, 4.2.6 Fitness for Service, and 4.2.11 Waste Management.

¹¹ SOR/2000-203.

¹² Changes between "satisfactory" and "fully satisfactory" reflect changes in the CNSC's rating methodology and do not necessarily reflect a significant change in TAI's performance.

4.2.1 Management System

26. The Commission examined TAI's management system, which covers the framework that establishes the processes and programs required to ensure that the TAI achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture.
27. TAI provided information on its management system, including its governing documentation, its organizational structure and recent organizational changes, and its recent safety culture assessment. TAI also provided information on its ongoing improvement initiatives including improvements to its work control, document management and safety management processes.
28. CNSC staff provided information concerning its evaluation of TAI's performance over the licence period. From 2012 to 2017, CNSC staff rated TAI's performance in the management system SCA as "satisfactory", with the exception of 2014. In 2014, CNSC staff rated TAI's performance as "below expectations" due to an incident where an employee was missed during a pre-lockup search of the electron accelerator facility. This incident is discussed further in section 4.2.2 of this Record of Decision.
29. CNSC staff submitted that, in 2016, TAI committed to implement CSA Group standard N286-12, *Management system requirements for nuclear facilities*,^{13,14} by 2018. TAI did not meet this implementation deadline and consequently CNSC staff graded TAI's management system SCA performance as "below expectations" from 2018-2020. Despite the incomplete implementation of some clauses of CSA N286-12, CNSC staff's position is that TAI has a management system in place that is sufficient to allow TAI to perform its licensed activities safely.
30. In February 2021, CNSC staff performed an inspection of TAI's progress towards full implementation of CSA N286-12 and issued 20 notices of non-compliance (NNCs), all of which were of low safety significance. CNSC staff reported that TAI implemented an acceptable action plan to address the NNCs. As of March 11, 2022, CNSC staff reported that 16 of the 20 NNCs are closed, with two more targeted for closure before the end of the current licence term. CNSC staff expect the licensee to complete the implementation of CSA N286-12 in the first quarter of 2023 and committed to continue to monitor the licensee's progress through increased regulatory oversight.
31. The Commission asked for the reasoning behind TAI's delayed implementation of CSA N286-12. TAI described that it had taken time to complete a thorough gap analysis of the standard's requirements and implement the necessary organizational changes. The Commission acknowledges the effort required by TAI to implement the full requirements CSA N286-12 but emphasizes the importance of timely compliance with the standard.

¹³ The CSA Group makes its nuclear series standards freely viewable to members of the public on its [website](#) by means of a guest account.

¹⁴ CSA N286-12 *Management system requirements for nuclear facilities*, CSA Group, 2012.

32. On the topic of increased regulatory oversight of TAI's management system, CNSC staff explained that its increased oversight activities began with mandatory monthly progress reports from TAI and have moved to weekly progress meetings with TAI. Next, CNSC staff will be entering a phase of more frequent inspections, with the next inspection planned in May 2022. CNSC staff will continue to assess TAI's compliance with N286-12 through regular updates, document reviews and inspections throughout the proposed licensing period. The Commission is satisfied that TAI has an appropriate plan in place to fully implement CSA N286-12 and that CNSC staff will verify, through regulatory oversight activities, that the licensee continues to ensure that the risk to the public and the environment from its operations remains low.
33. The Commission asked why CNSC staff considered the management SCA to be of "moderate risk" per Table 2.1 in CMD 22-H6. CNSC staff explained that SCA risk rankings are relative across different licensed facilities. CNSC staff rank SCAs based on the likelihood and magnitude of potential harm associated with each SCA and then use that ranking to inform how CNSC staff expend resources for compliance inspections. The Commission is satisfied with the information provided by CNSC staff regarding SCA risk rankings.
34. On safety culture, TAI submitted that it underwent an independent safety culture assessment from 2017-2018. TAI stated that it received positive feedback on safety culture from its staff. In response to the assessment findings, TAI created a plan to bolster identified strengths and make changes where areas for improvement were identified, such as conventional health and safety. TAI also hired a new Chief Safety Officer to prioritize implementation of the safety culture improvement plan. The Commission is satisfied with the measures taken by TAI to strengthen its existing safety culture.
35. The Commission finds that TAI has appropriate organization and management structures in place to carry on the licensed activities and acceptable programs in place to foster a healthy safety culture. The Commission is satisfied that the outstanding management system deficiencies are of low safety significance and do not pose an unreasonable risk to safe operation of the facility, or to the safety and security of the public and the environment. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's assessment that, despite TAI's incomplete implementation of CSA N286-12, TAI has an adequate management system in place to operate the facility
 - the Commission agrees with CNSC staff's assessment that TAI has an action plan in place to fully implement CSA N286-12 by 2023
 - CNSC staff will conduct increased oversight activities to verify TAI's timely implementation of N286-12
 - the Commission is satisfied that the evidence presented by TAI demonstrates that TAI has an acceptable safety culture and has implemented a sufficient plan to further improve

The Commission highlights the importance of compliance with CSA N286-12 and expects TAI to meet the requirements of the standard in a timely manner. The Commission expects to be informed of the licensee's progress to fully implement CSA N286-12 through the *Regulatory Oversight Report*, or through other means, as appropriate.

4.2.2 Human Performance Management

36. The Commission assessed TAI's human performance management program. Human performance management encompasses activities that ensure that TAI staff are sufficient in number in all relevant job areas and have the necessary knowledge, skills, procedures, and tools in place to safely carry out their duties.
37. Regarding personnel training, TAI submitted that it has three major training areas consisting of safety training, operator training, and group/task specific training. TAI explained that it develops all training courses according to the systematic approach to training (SAT) framework, and has instated an inter-department training implementation panel to oversee training programs site-wide. TAI added that it audits all training plans at least every 5 years. CNSC staff reported that it conducted 4 inspections and numerous document reviews of TAI's training program over the current licence term. CNSC staff found that TAI has implemented a training program in compliance with [REGDOC 2.2.2 Personnel Training](#). The Commission is satisfied that TAI has a personnel training program in place that meets regulatory requirements.
38. Asked about how operators are trained as new accelerator facilities come online, a TAI representative explained that operators for new accelerators receive a significant amount of on-the-job training. The TAI representative described TAI's process for commissioning new equipment, and noted that the commissioning team develops training plans that are used to train operators on the new equipment. The Commission is satisfied that TAI has implemented training programs for new accelerator facilities.
39. Regarding staffing levels at TAI, CNSC staff confirmed that TAI met the requirements for minimum staff complement over the current licensing period. CNSC staff noted that, during the licence period, TAI added new personnel for core safety-related programs in the areas of environment, health and safety, quality management, training, and computing, to correct an identified lack of resources. The Commission is satisfied that TAI has a sufficient number of staff in all relevant job areas.
40. In 2014, CNSC staff rated TAI's performance in both the management system and human performance management SCAs as "below expectations" following a near-miss event in which a worker was missed during the pre-lockup search executed prior to electron accelerator operation. The worker exited the area when the pre-irradiation warning alarm sounded and did not incur any radiation exposure. Following an event root cause analysis, TAI undertook corrective actions which included a training improvement plan. CNSC staff conducted an inspection and numerous reviews to

ensure the effectiveness of the corrective actions. CNSC staff reported that all corrective actions were implemented in a timely manner. The Commission is satisfied that TAI implemented adequate corrective actions in response to the near-miss event.

41. The Commission concludes that TAI's employees are appropriately trained and qualified and that TAI has appropriate human performance management programs in place for the conduct of the requested licensed activities. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's assessment that TAI has a sufficient number of staff in all relevant job areas
 - the Commission agrees with CNSC staff's assessment that TAI has a SAT-based training program in place that meets regulatory requirements
 - the Commission agrees with CNSC staff's assessment that TAI has implemented adequate corrective actions in response to the 2014 near-miss event

4.2.3 Operating Performance

42. The Commission examined TAI's operating performance, which includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.
43. TAI provided information on its operations and configuration management programs, its process for tracking faults and non-conformities, as well as its key operating performance indicators. TAI noted that it submits annual compliance reports to the CNSC that include a summary of its yearly licensed activities.
44. CNSC staff assessed TAI's operating performance over the current licence term through desktop reviews of program documents and event reports, as well as through 2 SCA-specific inspections. CNSC staff confirmed that TAI's operating procedures meet regulatory requirements and adequately describe TAI's operations. CNSC staff further confirmed that TAI operated in accordance with its procedures throughout the current licence period. The Commission is satisfied that TAI has operated in accordance with regulatory requirements over the current licence period and that its operating programs meets regulatory requirements.
45. The Commission concludes that TAI remains qualified to carry out the activities under the proposed licence. The Commission is satisfied that TAI has operated in accordance with regulatory requirements over the current licence period and that TAI has adequate operation performance-related programs in place to provide for the protection of the health and safety of persons and the environment over the proposed licence term. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's assessment that TAI meets the regulatory requirements of the operating performance SCA

- the Commission agrees with CNSC staff's assessment that TAI operated in accordance with regulatory requirements over the current licence period

4.2.4 *Safety Analysis*

46. The Commission assessed TAI's safety analysis, which is a systematic evaluation of the potential hazards associated with the conduct of the licensed activity or the operation of a facility and considers the effectiveness of preventive measures and strategies in reducing the effects of such hazards. TAI submitted that it maintains safety analysis reports (SARs) for all TAI facilities to document hazard analyses and hazard mitigation measures. TAI explained that it revises its SARs whenever a facility is modified or undergoes significant changes in its operating regime.
47. CNSC staff reported that TAI's SARs are comprehensive, and that TAI meets regulatory requirements for the safety analysis SCA. CNSC staff verified TAI's performance in the safety analysis SCA through oversight activities including desktop reviews and a safety analysis-focused inspection conducted in 2017.
48. The Commission is satisfied that TAI's safety analysis program meets regulatory requirements, and that TAI has SARs in place that demonstrate the adequacy of the design of its facilities. The Commission concludes that TAI has systematically evaluated potential hazards and adequately prepared for reducing the effects of such hazards for the operation of the facility under the proposed license. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's assessment that TAI's safety analysis reports are adequate
 - the Commission agrees with CNSC staff's assessment that TAI meets the regulatory requirements for the safety analysis SCA

4.2.5 *Physical Design*

49. The Commission examined the physical design of TAI's particle accelerator facilities. Physical design relates to activities that impact the ability of structures, systems, and components to meet and maintain their design basis, given new information or activities arising over time and taking changes in the external environment into account.
50. TAI submitted information on the safety-related systems incorporated in the design of its particle accelerator facilities, including shielding, radiation monitors, and access control systems. TAI also described improvements made to its radiation monitoring, access control, and oxygen deficiency monitoring systems over the current licence term. TAI explained that it manages the implementation of design changes under its engineering design, manufacture, and assembly process.

51. CNSC assessed TAI's performance in the physical design SCA through a variety of means including desktop reviews, and an SCA-specific inspection in 2017. CNSC staff submitted that TAI's physical design program meets regulatory requirements.
52. The Commission concludes that TAI has implemented an effective design program and that the design of TAI's facilities is adequate. The Commission comes to this conclusion on the basis that:
 - the Commission is satisfied that the evidence presented by TAI demonstrates that TAI has an adequate process in place to safely manage and implement design changes that are within the licensing basis
 - the Commission agrees with CNSC staff's assessment that TAI's physical design program meets regulatory requirements

4.2.6 Fitness for Service

53. The Commission considered the measures in place to maintain the fitness for service of TAI's particle accelerator facilities. Fitness for service covers activities that are performed to ensure that systems, structures, and components continue to effectively fulfill their purpose.
54. TAI provided information pertaining to its calibration, inspection, and testing regimes which ensure the fitness for service of its safety systems, radiation monitors, and fire prevention systems. TAI also reported that it has similar calibration, inspection, and testing regimes in place for its oxygen deficiency monitors, flammable gas monitors, differential pressure gauges, and HEPA and charcoal filters.
55. CNSC staff submitted that it verified TAI's implementation of its fitness for service program through oversight activities including a focused inspection conducted in 2017. CNSC staff found that TAI currently meets the regulatory requirements related to the fitness for service SCA.
56. CNSC staff rated TAI's performance related to the fitness for service SCA as "satisfactory" across the current licence period, with the exceptions of one "below expectations" rating in 2013. In 2013, TAI reported 2 events related to the malfunction of safety related systems. Neither event had adverse radiological impact on workers, the public, or the environment. CNSC staff found that TAI implemented adequate corrective actions following these events. The Commission is satisfied with TAI's implementation of corrective actions in response to these 2 events.
57. The Commission is satisfied that TAI has appropriate programs in place to ensure that the equipment at its facilities will remain fit for service throughout the proposed licence period. The Commission comes to this conclusion on the basis that:
 - the Commission agrees with CNSC staff's assessment that TAI's fitness for service program meets regulatory requirements

- the Commission is satisfied that TAI has implemented adequate corrective actions in response to the 2 safety related system events in 2013

4.2.7 Radiation Protection

58. As part of its evaluation of the adequacy of the measures for protecting the health and safety of persons, the Commission considered TAI's past performance in radiation protection. The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*¹⁵ (RPR).
59. TAI submitted that the primary radiation hazard present at its facilities is associated with the prompt radiation¹⁶ fields present outside of shielding during accelerator operation. A lesser radiation hazard is also posed by residual radiation fields from activated components inside shielding when the accelerator is offline for personnel access. TAI specified that most radiation doses received by TAI workers are the result of exposure to residual radiation fields when performing maintenance activities on activated components.
60. CNSC staff verified the compliance of TAI's radiation protection program over the current licence term through 3 focused inspections, as well as other inspections. CNSC staff reported that TAI has adequately addressed all action items raised during radiation protection inspections over the current licence period and that TAI's radiation protection program meets the requirements of the RPR.
61. The Commission considered whether TAI's radiation protection program ensures that contamination and radiation doses to persons are monitored, controlled, and kept as low as reasonably achievable (ALARA), with social and economic factors taken into consideration. TAI submitted that it controls radiation hazards and keeps doses ALARA using shielding, administrative controls, personnel access control systems, and radiation monitoring systems. CNSC staff reported that TAI's application of the ALARA principle has been demonstrated through TAI's implementation of a policy on personnel radiation exposure. The Commission is satisfied with TAI's application of the ALARA principle.
62. In its submission, TAI included detailed personnel dose information for the Commission's consideration. CNSC staff reported that no worker at TAI received a radiation dose in excess of CNSC regulatory limits¹⁷ during the current licence period. The maximum effective doses received by a nuclear energy worker (NEW) and a non-NEW at TAI over the current licence term were 9.18 millisievert (mSv) and 0.67 mSv,

¹⁵ SOR/200-203.

¹⁶ Gamma rays and neutrons produced by the interactions of the beam of protons hitting targets and appearing less than a second after the interaction.

¹⁷ The regulatory effective dose limit for a nuclear energy worker is 50 mSv per year, and 100 mSv over a 5-year period. The regulatory dose limit for a non-nuclear energy worker is 1 mSv per year.

respectively. The maximum equivalent doses to the skin and to the extremities received by a NEW at TAI over the current licence term were 9.37 mSv/year and 59.8 mSv/year, respectively. CNSC staff informed the Commission that there were two radiological action level¹⁸ exceedances during the licence term and that TAI had investigated both events and implemented corrective actions where required. Based on the dose information provided, the Commission is satisfied that effective and equivalent doses to NEWs and non-NEWs at TAI are being controlled below CNSC regulatory dose limits.

63. The Commission is satisfied that TAI has an adequate radiation protection program in place to protect workers, the public and the environment from radiation hazards associated with TAI's particle accelerator facilities. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's assessment that TAI has implemented a radiation protection program that meets the requirements of the RPR
 - the Commission is satisfied that personnel dose information confirms that radiation doses to workers at TAI were well below CNSC regulatory limits during the current licence term
 - the Commission agrees with CNSC staff's assessment that TAI has adequately applied the ALARA principle over the current licence period
 - the Commission is satisfied that TAI implemented adequate corrective actions in response to the 2 radiation protection-related action level exceedances over the current licence period

4.2.8 Conventional Health and Safety

64. The Commission examined TAI's implementation of a conventional health and safety program, which covers the management of conventional (non-radiological) hazards in the workplace. TAI's conventional health and safety program must meet the requirements of British Columbia provincial authority WorkSafeBC's [*Occupational Health and Safety Regulations*](#) (OHSR).
65. TAI provided the Commission with information on its conventional health and safety program, reporting that it complies with the mandates of WorkSafeBC. TAI explained that it documents conventional safety hazards in its facility Safety Reports and that it has a Joint Health and Safety Committee in place which conducts regular safety inspections across TAI's site.

¹⁸ Per the RPR, an action level is a specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee's radiation protection program and triggers a requirement for specific action to be taken.

66. CNSC staff verified the compliance of TAI's conventional health and safety program with regulatory requirements through several means over the current licence term, including desktop reviews and 4 conventional health and safety related inspections. CNSC staff reported that TAI adequately addressed all findings identified during these inspections and that TAI's conventional health and safety program meets applicable regulatory requirements. The Commission is satisfied that TAI has a conventional health and safety program in place that meets regulatory requirements.
67. TAI reported that, in 2018, the possible uptake of lead by a worker triggered a site-wide investigation for the prevalence of lead. TAI confirmed via bioassays that workers whose job duties may have exposed them to lead did not indicate any uptake, however, TAI found that the areal densities of lead on some surfaces in its experimental halls were above the regulatory threshold. TAI implemented a remedial program which was completed in 2020 when the surfaces in question were found to be below threshold. For ongoing lead hazard mitigation, TAI implemented a lead exposure control plan which was accepted by WorkSafeBC. The Commission is satisfied that TAI has the ongoing monitoring and mitigation measures in place to control potential lead hazards to its workers.
68. On lost-time injuries (LTI) throughout the licence term, TAI submitted that its LTI rates per 100 person-years of employment ranged between 0 and 0.65 (between 0 to 4 LTIs in a given year), which were below or comparable to the yearly average for similar facilities regulated by WorkSafeBC. TAI stated that the most common injuries experienced at its facility were hand injuries and muscle strains. In response, TAI implemented enhanced work instructions and safety sessions to minimize injuries. The Commission encourages TAI to compare its LTI statistics against industry-leading facilities to benchmark performance.
69. The Commission is satisfied that TAI adequately protected the health and safety of workers and the public during the current licence period and that the health and safety of persons will continue to be adequately protected during throughout the proposed licence period. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's assessment that TAI's conventional health and safety program meets regulatory requirements
 - the Commission is satisfied that TAI has adequately addressed inspection findings over the current licence term
 - the Commission is satisfied that the evidence presented by TAI demonstrates that TAI has monitoring and mitigation measures in place to control potential lead hazards

4.2.9 Environmental Protection

70. The Commission examined TAI's performance related to the environmental protection SCA. The environmental protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances, and aim to minimize the

effects on the environment which may result from licensed activities. Such programs and measures include effluent and emissions control, environmental management system (EMS), environmental assessment and monitoring, public dose, and environmental risk assessment.

71. TAI submitted information on its environmental management system, environmental monitoring program, emissions and effluent data, predicted public dose, and environmental risk assessment. TAI reported that it has an established environmental protection program that it developed to be consistent with regulatory requirements, and that its emissions are well below regulatory limits.
72. Over the current licence term, CNSC staff verified TAI's performance with respect to the environmental protection SCA through compliance oversight activities which included 2 focused environmental protection inspections. CNSC staff informed the Commission that all inspection findings were of low safety significance and all enforcement actions associated with these inspections have been closed.
73. CNSC staff submitted that TAI has an EMS in place per the requirements of [REGDOC-2.9.1 Environmental Protection: Policies, Programs, and Procedures](#). TAI's EMS describes the programs and practices that TAI has implemented to protect the environment. The Commission is satisfied that TAI has an EMS which meets regulatory requirements.
74. With respect to air emissions and liquid effluent releases, TAI submitted that its principal air emissions are short-lived positron (β^+) emitting radionuclides and Argon-41. These emissions are produced from the neutron activation of air in the immediate vicinity of TAI's accelerators and production targets. CNSC staff explained that TAI's primary source of liquid effluent is tritiated cooling water from its 520 MeV cyclotron. CNSC staff provided detailed monitoring data for TAI's air emissions and liquid effluent releases in Tables 3.10, 3.11, and 3.12 of CMD 22-H6. The monitoring data demonstrates that TAI's total annual air emissions and liquid effluent releases over the current licence term were each less than 1.4% of their respective derived release limits (DRLs)¹⁹ and that no environmental action levels were exceeded. CNSC staff confirmed that TAI maintained releases to the environment below release limits over the current licence period, and that TAI has calculated its DRLs 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*.²⁰ Based on the reported release data, the Commission is satisfied that TAI has maintained releases to the environment well below regulatory limits.

¹⁹ A derived release limit is defined as the release rate that would cause an individual of the most highly exposed group to receive, and be committed to, a dose equal to the regulatory annual dose limit due to release of a given radionuclide to air or surface water during normal operation of a nuclear facility over the period of a calendar year.

²⁰ CSA N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*, CSA Group, 2014.

75. On environmental monitoring, CNSC staff submitted that TAI has an environmental monitoring program in place that focuses on the monitoring of storm sewer water, radio-assays of building drains and vegetation samples, as well as gamma/beta measurements at the site boundary. CNSC staff provided details on the results of TAI's environmental monitoring activities over the current licence term, including the following:

- water samples taken during the licensing period detected only natural background radioactive isotopes
- vegetation sampling measured Beryllium-7 activity levels similar to background levels
- gamma/beta radiation effective dose rates at TAI's fence line were below TAI's maximum dose rate of 150 nanosieverts (nSv) per hour

CNSC staff reviewed TAI's environmental monitoring results and confirmed that no adverse effects on human health or the environment are expected from the operation of TAI's facilities. The Commission is satisfied that TAI has an environmental monitoring program in place that meets regulatory requirements and finds that TAI's environmental monitoring results indicate that human health and the environment remain protected.

76. TAI submitted that estimated dose to the public from its facility was well below the regulatory public dose limit of 1 mSv per year over the current licence term. The maximum estimated dose to the public calculated by TAI over the current licence period was 0.0120 mSv/year. TAI uses data collected by a Health Canada detector located near TAI's most active stack to verify its estimated public dose. TAI submitted that data from the Health Canada detector has shown TAI's estimated public dose calculation to be conservative. The Commission is satisfied that TAI has maintained public dose below regulatory requirements and that TAI has effective radiation protection measures in place to protect public health.

77. In its application, TAI explained that it revised its screening level environmental risk assessment (ERA) in 2017 to identify and quantify contaminants and physical stressors associated with TAI's operations that may pose a risk to the environment. CNSC staff reviewed TAI's revised ERA in 2018 and determined that it met the specifications of CSA N288.6-12 *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*.²¹ In 2021, CNSC staff confirmed that the conclusions of TAI's ERA remain valid and that no new risks have emerged. The Commission is satisfied that TAI has a valid ERA in place that meets regulatory requirements.

²¹ CSA N288.6-12 *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*, CSA Group, 2012.

78. CNSC staff submitted information on its [Independent Environmental Monitoring Program](#) (IEMP) around TAI's facilities. CNSC staff completed IEMP sampling campaigns in publicly accessible areas near the TAI site in 2016 and 2019. The IEMP results indicate that the public and the environment in the vicinity of the TAI site are protected, with no expected health impacts. The Commission is satisfied that the results of the CNSC's IEMP campaigns support its conclusion that the health of persons and the environment around the TAI site remain protected.
79. The Commission concludes that TAI has implemented an environmental protection program that will provide adequate protection to the health and safety of persons and the environment throughout the proposed licence period. The Commission comes to this conclusion on the basis that:
- TAI has addressed all enforcement actions associated with CNSC staff's environmental protection SCA inspections to CNSC staff's satisfaction
 - TAI has maintained an environmental management system in compliance with REGDOC-2.9.1
 - TAI's air emissions and liquid effluent releases over the current licence term remained well below TAI's derived release limits
 - CNSC staff has confirmed, through regulatory oversight activities, that TAI's environmental monitoring program meets regulatory requirements
 - environmental monitoring data has shown that public dose remained well below the regulatory limit throughout the current licence period
 - TAI has a valid ERA in place that meets regulatory requirements
 - IEMP results have indicated that the health of persons and the environment around the TAI facility remain protected

4.2.10 Emergency Management and Fire Protection

80. The Commission considered TAI's emergency management program which covers the measures for preparedness and response capabilities implemented by TAI in the event of emergencies and non-routine conditions at the TAI facility.
81. TAI submitted that it maintains mature emergency preparedness and response plans and that it coordinates regular emergency exercises and drills at its facilities. Over the current licence term, TAI executed emergency response exercises including radiation protection and first aid exercises, chemical spill drills, as well as a site-wide emergency evacuation drill. TAI reported that some exercises included external response services such as Vancouver Fire and Rescue Services and BC Ambulance Service.
82. CNSC staff submitted that it assessed TAI's emergency response program through regulatory oversight activities including onsite inspections and desktop documentation reviews. CNSC staff confirmed that TAI's emergency preparedness program, which was updated in 2019, complies with [REGDOC-2.10.1, Nuclear Emergency](#)

[Preparedness and Response, Version 2](#). The Commission is satisfied that TAI maintains an effective emergency management program that meets regulatory requirements.

83. The Commission examined the adequacy of TAI's fire protection program, including TAI's fire prevention measures, preparedness, and fire response capabilities. In its application, TAI provided information on the compliance of its fire protection program with the National Fire Protection Association's *NFPA-801: Standard for Fire Protection for Facilities Handling Radioactive Materials*.²² TAI also reported that, over the current licence term, it had completed significant fire prevention system improvements, executed fire drills, and underwent multiple third-party fire protection reviews. CNSC staff assessed TAI's fire protection program through inspections and desktop documentation reviews and found it to be in compliance with the [National Fire Code of Canada, 2015](#)²³, the [National Building Code of Canada, 2015](#)²⁴, and NFPA-801. The Commission is satisfied that TAI maintains an effective fire protection program that meets regulatory requirements.
84. TAI submitted that its most recent fire hazards analysis (2019) confirms that the mitigation measures in place at the facility provide adequate protection of the public and the environment. CNSC staff found TAI's analysis to be acceptable. The Commission is satisfied that the evidence provided shows that TAI maintains an acceptable fire hazards analysis, and that TAI has implemented adequate fire mitigation measures.
85. The Commission is satisfied that TAI has acceptable emergency management and fire protection programs in place to protect the health and safety of persons and the environment throughout the proposed licence period. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's assessment that TAI's emergency preparedness program meets regulatory requirements
 - the Commission agrees with CNSC staff's assessment that TAI's fire protection program meets regulatory requirements
 - the Commission agrees with CNSC staff's assessment that TAI's fire hazards analysis is acceptable and that TAI has implemented adequate fire mitigation measures

4.2.11 Waste Management

86. The Commission assessed TAI's waste management program. Waste management covers waste-related programs that form part of TAI's operations up to the point where the waste is removed from the licensed site for storage, treatment, or disposal at

²² NFPA 801: *Standard for Fire Protection for Facilities Handling Radioactive Materials*, National Fire Protection Association, 2014.

²³ *National Fire Code of Canada 2015*, National Research Council Canada, 2015.

²⁴ *National Building Code of Canada 2015*, National Research Council Canada, 2015.

another licensed location, and includes waste minimization, segregation, characterization, and storage programs. The waste management SCA also covers planning for decommissioning, however, TAI's decommissioning plans are discussed in section 4.4.2 of this Record of Decision.

87. TAI submitted that it has a waste management program in effect that meets its licensing requirements. TAI's waste classification scheme includes categories for high-level radioactive waste (e.g., irradiated beamline targets), low-level radioactive waste (e.g., used personal protective equipment), and hazardous (non-radioactive) waste. TAI submitted descriptions of the disposal processes for each waste category. TAI explained that it stores high-level waste in the Spent Target Storage Facility where it decays for 2-3 years before being transported to Canadian Nuclear Laboratories in Chalk River, Ontario, for storage. TAI sorts and segregates low-level waste to allow for optimum decay and eventual landfill disposal when radioactivity levels drop below the clearance level. TAI stores hazardous waste in the Hazardous Materials Building for eventual offsite disposal with a third-party facility.
88. CNSC staff reported that it assessed TAI's waste management program over the current licence term through regulatory oversight activities including onsite inspections, program documentation reviews and compliance report reviews. With the exception of inspection findings in 2016, discussed below, CNSC staff found TAI's waste management program to be effective and consistent with regulatory expectations, as described in the Licence Conditions Handbook.
89. CNSC staff reported that, during a 2016 waste management inspection, it identified deficiencies related to TAI's inventory and labelling of radioactive waste, as well as the absence of secondary containment of some hazardous non-radioactive waste. As a result, CNSC staff rated TAI's waste management SCA performance as "below expectations" for the 2016 reporting period. CNSC staff confirmed that TAI had implemented adequate corrective actions during a follow-up inspection in 2017. The Commission is satisfied that TAI adequately addressed the deficiencies identified in its waste management program, and that TAI currently has a satisfactory waste management program in place.
90. The Commission concludes that TAI has adequate measures in place to safely manage its waste. The Commission comes to this conclusion on the basis that:
 - the Commission agrees with CNSC staff's assessment that TAI has implemented a waste management program that meets regulatory requirements
 - the Commission agrees with CNSC staff's assessment that TAI implemented appropriate corrective actions after CNSC staff rated TAI's performance in the waste management SCA as "below expectations" in 2016

4.2.12 Security

91. The Commission examined TAI's security program, which covers the programs required to implement and support the security requirements described in the applicable provisions of the GNSCR and the *Nuclear Security Regulations* (NSR).²⁵ In May 2021, TAI provided the CNSC with its revised Site Security Plan, which identifies the security measures implemented by TAI. CNSC staff reviewed TAI's Site Security Plan and determined that it meets applicable regulatory requirements. CNSC staff also conducted 2 security focused inspections at TAI during the current licence period and confirmed that TAI has implemented and maintained all required technical and administrative security measure. The Commission is satisfied that TAI has implemented a security program that meets regulatory requirements.
92. The Commission agrees with CNSC staff's assessment that TAI's Site Security Plan and security program meet regulatory requirements. The Commission is satisfied that TAI has adequate programs and measures in place to provide for the physical security of the TAI facility during the proposed licence period.

4.2.13 Safeguards and Non-Proliferation

93. The Commission examined the adequacy of TAI's safeguards program. The CNSC's regulatory mandate includes ensuring conformity with measures required to implement Canada's international obligations under the [*Treaty on the Non-Proliferation of Nuclear Weapons*](#) (NPT). Pursuant to the NPT, Canada has entered into a [*Comprehensive Safeguards Agreement*](#) and an [*Additional Protocol*](#) (safeguards agreements) with the IAEA. The objective of these safeguards agreements is for the IAEA to provide credible assurance on an annual basis to Canada and to the international community that all declared nuclear material is in peaceful, non-explosive uses and that there is no undeclared nuclear material or activity in this country.
94. TAI submitted that its safeguards program complies with CNSC [REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*](#), and that it continues to file all required submissions for the inventory of nuclear material. Based on its assessment of TAI's safeguards related documentation and performance, CNSC staff confirmed that TAI's safeguards program meets the requirements set out in REGDOC-2.13.1 and conforms to measures required by the CNSC to meet Canada's international safeguards obligations as well as other measures arising from the NPT. The Commission is satisfied that TAI has a safeguards program in place that meets international and national regulatory requirements.

²⁵ SOR/2000-209.

95. CNSC staff reported that the IAEA performed 2 Physical Inventory Verifications and 2 Complementary Accesses at the TAI site during the current licence term, and that the IAEA's inspection results were satisfactory. CNSC staff confirmed that in all cases TAI granted adequate access and assistance to the IAEA. The Commission is satisfied that TAI adequately supported the IAEA's safeguards activities throughout the current licence period.
96. The Commission is satisfied that TAI has adequate programs in place to provide for the implementation of measures in the area of safeguards and non-proliferation and is of the opinion that TAI will continue to do so during the proposed licence period. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's assessment that TAI's safeguards program meets the requirements of REGDOC 2.13.1
 - the Commission agrees with CNSC staff's assessment that TAI has implemented the measures that are necessary for maintaining national security, and for implementing the international agreements to which Canada has agreed
 - the Commission is satisfied that TAI granted adequate access and assistance to the IAEA for safeguards activities during the current licence period, as required

4.2.14 Packaging and Transport

97. The Commission examined TAI's packaging and transport program. The packaging and transport SCA covers the safe packaging and transport of nuclear substances and radiation devices to and from the TAI site. TAI must adhere to the [*Packaging and Transport of Nuclear Substances Regulations, 2015*](#)²⁶ (PTNSR, 2015) and Transport Canada's [*Transportation of Dangerous Goods Regulations*](#)²⁷ (TDGR) for all shipments.
98. TAI provided information on its packaging and transport program. TAI specified that it manages the shipment of radioactive materials from TAI's facilities and verifies that all regulatory requirements are met for each shipment. TAI noted that regular shipments include the disposal of spent targets to Canadian Nuclear Laboratories.
99. CNSC staff verified the regulatory compliance of TAI's packaging and transport program through regulatory oversight activities including 4 inspections over the current licence term. CNSC staff informed the Commission that all findings from these inspections were of low safety significance and were adequately addressed by TAI. The Commission is satisfied that TAI has implemented a packaging and transport program that meets regulatory requirements.

²⁶ SOR/2015-145.

²⁷ SOR/2001-286.

100. TAI reported 2 transportation events under the PTNSR, 2015 during the current licence period. CNSC staff reported that these events were of low safety significance and that TAI implemented appropriate corrective actions in response. The Commission is satisfied that TAI has adequately addressed the transportation events that occurred during the current licence term.
101. The Commission is satisfied that the evidence provided demonstrates that TAI's packaging and transport program meets regulatory and will continue to do so over the proposed licence period. In reaching its conclusion, the Commission considered CNSC staff's assessment that TAI's packaging and transport program meets regulatory requirements, and that TAI has implemented adequate corrective actions in response to events and inspection findings over the current licence term.

4.2.15 Conclusions on Safety and Control Areas

102. The Commission is satisfied that TAI has adequate programs and measures in place with respect to the 14 SCAs to ensure that the health and safety of workers, the public and the environment will be protected over the proposed 10-year licence term. The Commission is further satisfied that TAI has measures in place to provide for the maintenance of national security and to implement international obligations to which Canada has agreed. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's rating of TAI's performance in the majority of the 14 SCAs as "satisfactory" over the current licence term
 - regarding the SCAs for which CNSC staff rated TAI's performance as "below expectations" over the current licence period, the Commission is satisfied that the evidence shows that TAI has either already improved its performance to a "satisfactory" rating or that TAI has an adequate plan in place to do so in the near future
 - the Commission agrees with CNSC staff's assessment that the remaining Management System SCA deficiencies are of low safety significance
 - the Commission agrees with CNSC staff's assessment of TAI's performance in the 14 SCAs which demonstrates that TAI has the programs, resources, and measures in place to ensure the health and safety of persons and the environment, and the maintenance of security and Canada's international obligations

4.3 Indigenous Engagement and Consultation

103. The Commission considered the information provided by CNSC staff and TAI regarding Indigenous consultation and engagement activities in respect of this application. Indigenous consultation refers to the common law duty to consult with Indigenous Nations and communities pursuant to section 35 of the [*Constitution Act, 1982*](#).²⁸

²⁸ Schedule B to the Canada Act 1982 (UK), 1982, c 11

104. The common law duty to consult with Indigenous Nations and communities is engaged when the Crown contemplates action that may adversely affect established or potential Aboriginal²⁹ and/or treaty rights. The CNSC, as an agent of the Crown and as Canada's nuclear regulator, recognizes and understands the importance of building relationships and engaging with Canada's Indigenous Nations and communities. The CNSC ensures that its licensing decisions under the NSCA uphold the honour of the Crown and consider Indigenous Nations and communities' potential or established Indigenous and/or treaty rights pursuant to section 35 of the *Constitution Act, 1982*.
105. The duty to consult is engaged wherever the Crown has "knowledge, real or constructive, of the potential existence of an Aboriginal right or title and contemplates conduct that might adversely affect it".³⁰ Licensing decisions of the Commission where Indigenous interests may be adversely impacted can engage the duty to consult, and the Commission must be satisfied that it has met the duty prior to making the relevant licensing decision.
106. CNSC staff submitted that this licence renewal will not change the activities authorized by the current licence and therefore will not result in changes to TAI's operations that would cause adverse impacts on potential or established Aboriginal and/or treaty rights. CNSC staff stated that, midway through the current licence term, it assessed the level of interest from Indigenous Nations and communities regarding TAI's operations and did not note any interest or concerns. CNSC staff also reported that no concerns were expressed from local Indigenous Nations and communities regarding TAI's licence renewal and transfer applications. CNSC staff noted that it is open to engagement with any Indigenous Nation or community if interest is expressed.
107. The Commission enquired if CNSC staff had engaged with Indigenous Nations and communities regarding IEMP campaigns around the TAI facility. CNSC staff stated that engagement had not occurred due to a lack of expressed interest from local Indigenous Nations and communities, however, CNSC staff are open to future engagement if interest is expressed.
108. TAI reported that it works closely with UBC to engage with the Musqueam First Nation. UBC has a Memorandum of Understanding with Musqueam First Nation and meets with them monthly to discuss land-use updates including activities at the TAI facility. TAI reported that, with UBC coordination, it also engaged with Musqueam First Nation in summer 2021 to discuss the TAI licence renewal process and participation methods. TAI did not report any concerns raised by Musqueam First Nation regarding the licence renewal application.

²⁹ "Aboriginal" is the term used in this document when referring to the Crown's duty to consult as that is the term used in S. 35 of the Constitution Act, 1982. In all other cases, "Indigenous" is the preferred terminology and used accordingly.

³⁰ *Haida Nation v. British Columbia (Minister of Forests)*, 2004 SCC 73 at para 35

109. The Commission is satisfied that TAI's application for renewal and licence transfer will not authorize any new licenced activities and will not cause novel adverse impacts to any Aboriginal or treaty rights. The Commission acknowledges the efforts made by TAI in relation to Indigenous engagement and notes the lack of participation in this proceeding by local Indigenous Nations and communities. Efforts made by CNSC staff with regard to Indigenous engagement are key to the important work of the Commission toward reconciliation and relationship-building with Canada's Indigenous peoples. The Commission concludes that, for this licence renewal application, the Commission's responsibility to uphold the honour of the Crown and its constitutional obligations with respect to engagement and consultation have been satisfied. The Commission expects CNSC staff to continue to build meaningful long-term relationships with Indigenous Nations and communities as part of the CNSC's reconciliation efforts.

4.4 Other Matters of Regulatory Importance

4.4.1 Public Information and Engagement

110. The Commission assessed TAI's public information and disclosure program (PIDP). A public information program is a regulatory requirement for licence applicants and licensed operators of Class I nuclear facilities as detailed in [REGDOC 3.2.1, *Public Information and Disclosure*](#). TAI submitted that it maintains a PIDP to ensure the timely communication of information related to the health, safety, and security of persons and the environment to the public. TAI's public engagement initiatives include its public website, public tours of the facility, use of social media, and participation in community events. CNSC staff submitted that TAI has met its public disclosure and reporting obligations throughout the current licence term, and that TAI's PIDP meets the requirements of REGDOC 3.2.1. The Commission is satisfied that TAI has a PIDP in place that meets regulatory requirements.
111. The Commission asked if TAI had received specific concerns from the public through its public engagement initiatives. A representative from TAI informed the Commission that members of the public have previously raised concerns regarding environmental emissions and radiation protection. The TAI representative explained that when concerns are raised by the public, TAI uses those opportunities to inform the public about TAI's programs and the nature of particle accelerators. The Commission is satisfied with TAI's public engagement efforts.
112. The Commission is satisfied that TAI's PIDP meets regulatory requirements and is of the opinion that TAI will continue to communicate to the public information about the health, safety and security of persons and the environment and other issues related to its particle accelerator facilities over the proposed licence term. The Commission is satisfied that the evidence provided demonstrates that TAI met its public disclosure and reporting obligations through the current licence term and is in agreement with CNSC staff's assessment that TAI's PIDP meets the requirements of REGDOC 3.2.1.

4.4.2 Decommissioning Plans and Financial Guarantee

113. The Commission requires that TAI have operational plans for the decommissioning and long-term management of waste produced during the lifespan of TAI's particle accelerator facilities. TAI submitted its updated preliminary decommissioning plan (PDP) and cost estimate to the CNSC in December 2018. Based on the updated PDP, TAI estimated the cost for decommissioning to be \$69.87 million (in 2022 dollars). Based on its review of TAI's revised PDP, CNSC staff found that the PDP meets the requirements described in CNSC regulatory guide [G-219, Decommissioning Planning for Licensed Activities](#), and CSA N294-09, *Decommissioning of Facilities containing nuclear substances*³¹. CNSC staff stated that the cost estimate is adequate for the future decommissioning of the TAI site.
114. The Commission has decided to include a licence condition that the licensee provide and maintain a financial guarantee, in an amount and format acceptable to the Commission, for realization of the planned decommissioning, pursuant to subsection 24(5) of the NSCA. As reported by CNSC staff, TAI currently maintains a financial guarantee for the decommissioning of the TAI facility consisting of an Escrow Fund containing \$12.21 million (as of March 31, 2021) and a Contribution Gap Agreement. In June 2021 the Commission approved an administrative change to the financial guarantee instruments to reflect the transfer of the TRIUMF joint venture's assets and obligations to TRIUMF Inc. The transfer of assets and obligations from the TRIUMF joint venture to TRIUMF Inc. is further discussed in section 4.6 of this Record of Decision.
115. CNSC staff submitted that TAI's proposed revised financial guarantee is composed of \$14.78 million (as of March 31, 2023) in an Escrow Fund, a Contribution Gap Agreement, and the related *CNSC Financial Security and Access Agreement*. CNSC staff recommends that the proposed financial guarantee is adequate and that an Escrow fund is an acceptable financial instrument that meets the requirements of certainty and adequacy of value, ease of liquidity, and continuity of protection, as described in CNSC [G-206 Financial Guarantees for the Decommissioning of Licensed Activities](#) (G-206). CNSC staff noted that newly published regulatory documents [REGDOC-2.11.2, Decommissioning](#) and [REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities](#) will be applicable to the next review cycle in 2023.
116. Regarding the Contribution Gap Agreement, CNSC staff submitted that the agreement requires all of TAI's member universities to cover any funding gaps for TAI's decommissioning liability. The Commission asked for further information on how TAI can ensure that the member universities are able to fulfill their portion of the decommissioning liability. A TAI representative explained that the Escrow Fund is sufficient to cover the cost of the beginning of the decommissioning plan and that, two years into the decommissioning process, TAI plans to sell its assets to cover the remaining decommissioning liability. After the sale of assets, the member universities

³¹ CSA N294-09, *Decommissioning of Facilities containing nuclear substances*, CSA Group, 2009.

would be required to cover the remaining expenses as part of the Contribution Gap Agreement, with each university paying a proportionate share. TAI expects this expense to be minimal.

117. CNSC staff informed the Commission that, should the Commission approve the proposed licence renewal and transfer, the licensee would submit updated financial guarantee instruments for the Commission's signature. Noting the licensee's intention to amalgamate TAI with TRIUMF Inc. if the Commission were to authorize the renewal and transfer of the licence, CNSC staff stated that the updated instruments would reflect an administrative change to remove references to TAI and reflect TRIUMF Inc. as the licensee.
118. The Commission agrees with CNSC staff's assessment that TAI's PDP meets regulatory requirements and finds the evidence on the proposed cost estimate to be credible. Therefore, the Commission concludes that TAI's PDP and cost estimate are acceptable for the purpose of this licence renewal and transfer application. The Commission finds the financial guarantee in the form of an Escrow Fund (\$14.78 million as of March 31, 2023) and a Contribution Gap Agreement to be appropriate for the safe and secure future decommissioning of the site. The Commission directs the licensee to provide the original financial guarantee instrument documentation that conforms with G-206 within 90 days from the issuance of this Record of Decision. As financial guarantees remain a matter for Commission acceptance, the Commission will consider any future updates to the financial guarantee as applicable.

4.4.3 Cost Recovery

119. CNSC staff reported that TAI is a not-for-profit organization and is exempt from the [*Cost Recovery Fees Regulations*](#)³² (CRFR) requirements under section 2(b). The Commission is satisfied that the CRFR do not apply to TAI.

4.5 Licence Length, Licence Conditions, and Delegation of Authority

120. The Commission considered TAI's application for the renewal of its particle accelerator operating licence for a period of 10 years. TAI's current licence, PA1OL-01.00/2022, expires on June 30, 2022.

4.5.1 Licence Length

121. TAI is requesting a 10-year term for the renewed licence. CNSC staff recommended the renewal of the licence for a period of 10 years, until June 30, 2032, submitting that TAI is qualified to carry on the licensed activities which would be authorized by the proposed licence. CNSC staff noted that TAI's performance has been adequate over

³² SOR/2003-212.

the current licence period, and that a 10-year licence term is consistent with the current licence term and with other particle accelerator facilities in Canada. The Commission notes that the public would have the opportunity to provide feedback on TAI's operations during the proposed licence period when CNSC staff present the associated Regulatory Oversight Report to the Commission.

122. The Commission is satisfied that a 10-year licence term is appropriate. The Commission comes to this conclusion on the basis that:
- the Commission agrees with CNSC staff's assessment that TAI is qualified to carry on the licensed activities
 - a 10-year licence term is consistent with TAI's current licence term
 - the Commission is satisfied that the evidence demonstrates that TAI has mature programs in place, with adequate performance and oversight
 - the public will have the opportunity to provide feedback to the Commission on TAI's operations periodically during the renewed 10-year licence period

4.5.2 Licence Conditions

123. CNSC staff CMD 22-H6 includes a proposed draft licence in a format that incorporates the CNSC's standardized licence conditions applicable to TAI. In CMD 22-H6, CNSC staff proposed the following minor changes to the existing licence conditions:
- the separation of the Safety Analysis SCA and Physical Design SCA sections, to be consistent with other CNSC licences
 - change the period for filing a written report for dose and environmental action level exceedances from 30 working days to 21 days

During its presentation, CNSC staff proposed additional changes to reflect the most recent standardized licence conditions. These changes do not impact the intent or requirements of the licence conditions.

124. The Commission includes in the licence the conditions as recommended by CNSC staff in CMD 22-H6, with changes to reflect the most recent standardized conditions. The Commission is imposing the licence conditions that are in the licence that goes with this record of decision, which is not exactly as was drafted in CNSC staff's CMD but which reflects updated conditions as discussed in the hearing. The Commission finds that the proposed changes to the licence conditions are minor and appropriate.

4.5.3 Delegation of Authority

125. In order to provide adequate regulatory oversight of changes that are administrative in nature, and do not require a licence amendment nor Commission approval, CNSC staff recommended that the Commission delegate authority for certain approvals or consent, as contemplated in licence conditions that contain the phrase "a person authorized by

the Commission” to specific CNSC staff. CNSC staff noted an error in the delegation of authority as outlined in section 4.7 of CMD 22 H-6 and provided a correction on the record at the hearing. Delegations are as detailed in the following paragraph.

126. As recommended by CNSC staff during the hearing, the Commission delegates its authority for the purposes of licence conditions G.3 *Resolution of Conflict or Inconsistency*, and 7.2 *Dose Action Levels*, 9.4 *Environmental Action Levels* to the following CNSC staff:
- Director, Accelerators and Class II Facilities Division
 - Director General, Directorate of Nuclear Substance Regulation
 - Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch

The Commission delegates its authority for the purposes of licence condition 13.2 *Changes that Would Affect the Implementation of Safeguards Measures* to the following CNSC staff:

- Director, International Safeguards Division
- Director General, Directorate of Security and Safeguards
- Vice President, Technical Support Branch

127. The Commission is satisfied that this approach is reasonable and consistent with the current licence.

4.5.4 Conclusion on Licence Length and Conditions

128. The Commission is satisfied that a 10-year licence is appropriate. The Commission accepts the licence conditions as recommended by CNSC staff, with the proposed changes described during the hearing to reflect the most recent standardized conditions. The Commission accepts CNSC staff’s recommendation regarding the delegation of authority for the purposes of licence conditions G.3, 7.2, 9.4 and 13.2.

4.6 Licence Transfer

129. TAI is requesting that its particle accelerator operating licence, if renewed, be transferred to TRIUMF Inc, a not-for-profit corporation under the [*Canada Not-for-profit Corporations Act*](#).³³
130. TRIUMF, a joint venture between several Canadian universities, incorporated TAI in 2008 to hold the CNSC licence and operate its particle accelerator facilities. On June 1, 2021, the TRIUMF joint venture transferred its assets, obligations, operations, and agreements with TAI, to TRIUMF Inc. TAI indicated that, if the Commission authorizes transfer of the licence, TAI intends to amalgamate with TRIUMF Inc. when

³³ S.C. 2009, c. 23.

the renewed licence term begins on July 1, 2022. TAI submitted that the amalgamation would have no substantive impact on TRIUMF's operations or management.

131. CNSC staff recommended that the Commission transfer the licence, if renewed, from TAI to TRIUMF Inc. The Commission asked CNSC staff about the risk associated with the proposed licence transfer. CNSC staff stated that the proposed licence transfer would not pose a risk to the safe operations of the facilities, as TRIUMF Inc. is qualified to carry out the activities authorized by the particle accelerator operating licence. CNSC staff explained that, following the licence transfer, the same staff will be responsible for the operation, management, and control of the licensed activities under the same programs. CNSC staff noted that TRIUMF Inc. already assumed TAI's liabilities when the Commission approved the change in financial guarantee signatories in 2021.
132. The Commission is of the opinion that TRIUMF Inc., is qualified to carry on the activity that the transferred licence will authorize and that it will 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. Therefore, the Commission is satisfied that TRIUMF Inc. meets the test set out in subsection 24(4) of the NSCA for the transfer of a licence.

5.0 CONCLUSION

133. The Commission has considered TAI's applications to renew its Class IB particle accelerator operating licence for a 10-year period and to transfer the licence, if renewed, to TRIUMF Inc. The Commission has also considered the submissions of TAI, CNSC staff, and intervenors. Based on its consideration of the evidence on the record for this hearing, the Commission, pursuant to section 24 of the *Nuclear Safety and Control Act*, renews the Class IB particle accelerator operating licence issued to TRIUMF Accelerators Inc. for a period of 10 years, and authorizes the transfer of the licence from TRIUMF Accelerators Inc. to TRIUMF Inc. In doing so, the Commission also accepts the revised financial guarantee and delegates its authority as outlined in sections 4.4.2 and 4.5.3 of this Record of Decision, respectively. The renewed licence, PA1OL-01.00/2023 names TRIUMF Inc. as licensee and is valid from July 1, 2022 until June 30, 2032.

Velshi,
Rumina

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June 16, 2022

Rumina Velshi
President,
Canadian Nuclear Safety Commission

Date

Appendix A – Intervenor

Intervenor – Oral Presentations	Document Number
North American Young Generation in Nuclear, represented by M. Mairinger	CMD 22-H6.3
BWXT Medical Ltd., represented by M. Coombs	CMD 22-H6.5
Intervenor – Written Submission	Document Number
Sylvia Fedoruk Canadian Centre for Nuclear Innovation Inc.	CMD 22-H6.2
University of British Columbia	CMD 22-H6.4
McMaster University	CMD 22-H6.6
Canadian Nuclear Association	CMD 22-H6.7
BC Cancer Research Institute	CMD 22-H6.8



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:

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 4.3.

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 Notification of Changes

The licensee shall give written notification of change to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

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.

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 Fitness for Service Program

The licensee shall implement and maintain a fitness for service program.

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 Environmental Protection Program

The licensee shall implement and maintain an environmental protection program.

9.2 Release of Nuclear Substances

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

9.3 Release of Hazardous Substances

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 an emergency preparedness program.

10.2 Fire Protection Program

The licensee shall implement and maintain a fire protection program.

11. WASTE MANAGEMENT

11.1 Waste Management Program

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

11.2 Preliminary Decommissioning Plan

The licensee shall maintain a decommissioning plan.

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.

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.

15.2 Financial Guarantees

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

SIGNED at OTTAWA, this 21st day of June, 2022.

Velshi, Rumina

Digitally signed by Velshi, Rumina
DN: C=CA, O=GC, OU=CNSC-CCSN, CN="Velshi,
Rumina"
Reason: I am the author of this document
Location: your signing location here
Date: 2022-06-21 11:34:30
Foxit PhantomPDF Version: 9.7.1

Rumina Velshi, President
on behalf of the Canadian Nuclear Safety Commission

TRIUMF INC.

AMENDED AND RESTATED FUND CONTRIBUTION GAP AGREEMENT

THIS AMENDED AND RESTATED FUND CONTRIBUTION GAP AGREEMENT is made and entered into with effect as of July 1, 2022 (the “**Effective Date**”).

BETWEEN:

TRIUMF INC., a not-for-profit corporation and a registered charity under the laws of Canada

(“**TRIUMF**”)

- and -

EACH UNIVERSITY THAT EXECUTES AND DELIVERS THIS AGREEMENT, OR THAT BECOMES A PARTY TO THIS AGREEMENT BY EXECUTING AND DELIVERING A JOINDER AGREEMENT AS PROVIDED HEREIN

(each a “**Member University**” and collectively, the “**Member Universities**”)

WHEREAS the full member universities of the joint venture known as “**TRIUMF**” (the “**Joint Venture**”) incorporated TRIUMF on February 18, 2020 to assume, among other things, the operations and assets of the Joint Venture as of June 1, 2021;

WHEREAS in connection therewith, the parties to the Fund Contribution Gap Agreement dated January 7, 2008 (the “**Original Agreement**”) agreed to (1) novate the Original Agreement to replace the Joint Venture with TRIUMF as a party, and (2) execute and deliver an Amended and Restated Fund Contribution Gap Agreement as of June 1, 2021 (the “**2021 Agreement**”);

WHEREAS the Licence was issued to TRIUMF as of the Effective Date and on that date TRIUMF Accelerators Inc. (“**TAI**”) ceased to hold the Licence;

WHEREAS it is advisable to amend and restate the 2021 Agreement by executing and delivering this Agreement to, among other things, provide for TRIUMF as the holder of the Licence and to remove references to TAI;

WHEREAS TRIUMF has filed plans with the CNSC in accordance with the NSCA for fulfilling TRIUMF’s obligations to decommission the TRIUMF Facility at the end of its useful life and to manage and dispose of associated waste and by-products in accordance with applicable law;

WHEREAS pursuant to subsection 24(5) of the NSCA, a licence may be granted on such terms and conditions as the CNSC deems necessary for the purposes of the NSCA;

WHEREAS the parties hereto together with the CNSC have entered into the CNSC Financial Security and Access Agreement in order to give the CNSC access to the Fund and to certain covenants, in accordance with the CNSC Financial Security and Access Agreement; and

WHEREAS the CNSC has indicated its preference that the several covenants of the Member Universities relating to a Fund Contribution Gap be placed in an agreement separate from the CNSC Financial Security and Access Agreement.

NOW THEREFORE in consideration of the respective covenants and agreements hereinafter contained, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties agree as follows:

Definitions

1. In this Agreement, unless the context otherwise requires, the following terms have the meanings respectively ascribed to thereto:
 - 1.1 “**2021 Agreement**” has the meaning set out above;
 - 1.2 “**Agreement**” means this Amended and Restated Fund Contribution Gap Agreement including its recitals and Schedule dated as of the Effective Date, as amended from time to time;
 - 1.3 “**Business Day**” means any day other than a Saturday or Sunday or any statutory holiday in the Provinces of British Columbia and Ontario;
 - 1.4 “**Claim**” has the meaning set out in the CNSC Financial Security and Access Agreement and, in addition, for the purposes of this Agreement includes any amount demanded by TRIUMF, as permitted by this Agreement, pursuant to the several covenants of the Member Universities contained in this Agreement;
 - 1.5 “**CNSC**” means the Canadian Nuclear Safety Commission, a body corporate established under Section 8 of the *Nuclear Safety and Control Act*;
 - 1.6 “**CNSC Financial Security and Access Agreement**” means the Amended and Restated Financial Security and Access Agreement made between the CNSC, TRIUMF and the Member Universities dated as of the Effective Date, as amended from time to time;
 - 1.7 “**Decommissioning Plan**” has the meaning set out in the CNSC Financial Security and Access Agreement;
 - 1.8 “**Demand**” has the meaning set out in the CNSC Financial Security and Access Agreement;
 - 1.9 “**Effective Date**” has the meaning set out above;
 - 1.10 “**Escrow Agent**” has the meaning set out in the CNSC Financial Security and Access Agreement;
 - 1.11 “**Extraordinary Resolution**” has the meaning set out in Section 8;
 - 1.12 “**Fund**” has the meaning set out in the CNSC Financial Security and Access Agreement;
 - 1.13 “**Fund Contribution Gap**” has the meaning set out in the CNSC Financial Security and Access Agreement;

- 1.14 “**Fund Demand Deficiency**” has the meaning set out in Section 4;
- 1.15 “**Fund Demand Payment**” has the meaning set out in Section 4;
- 1.16 “**Joint Venture**” has the meaning set out above;
- 1.17 “**Licence**” has the meaning set out in the CNSC Financial Security and Access Agreement;
- 1.18 “**Members’ Council**” has the meaning set out in Section 8;
- 1.19 “**NSCA**” has the meaning set out in the CNSC Financial Security and Access Agreement;
- 1.20 “**Original Agreement**” has the meaning set out above;
- 1.21 “**parties**” means TRIUMF and each Member University, and “**party**” means any one of them, as the context may require;
- 1.22 “**TAI**” has the meaning set out above;
- 1.23 “**Total CNSC Requirement**” has the meaning set out in the CNSC Financial Security and Access Agreement; and
- 1.24 “**TRIUMF Facility**” has the meaning set out in the CNSC Financial Security and Access Agreement.

Schedules

- 2. The following Schedule is attached to and forms part of this Agreement:

Schedule “A” - Joinder Agreement

Fund Contribution Gap

- 3. The parties hereto acknowledge that, pursuant to the CNSC Financial Security and Access Agreement, at any given time, there may exist a Fund Contribution Gap.

Covenants of Member Universities with Respect to a Fund Contribution Gap

- 4. In respect of any Fund Contribution Gap, each Member University at the time of (i) a Claim referred to in Section 4(a) below, or (ii) a written request by TRIUMF pursuant to Section 4(b) below, hereby severally covenants and agrees as follows:
 - (a) in the event of a Claim pursuant to Section 20 of the CNSC Financial Security and Access Agreement and to the extent that the amount of such Claim exceeds the fair market value of assets in the Fund (such excess being a “**Fund Demand Deficiency**”), to pay to the Escrow Agent within one (1) year of a TRIUMF Demand and subject to the provisions of Sections 21 through 25 of the CNSC Financial Security and Access Agreement, an amount determined by multiplying the amount of the Fund Demand Deficiency by a fraction, the numerator of which is one (1) and the denominator of which is the number of Member Universities on the date the Claim is made (each such fractional amount being a “**Fund Demand Payment**”); and

- (b) at the cessation of operation of the TRIUMF Facility, to the extent there is a Fund Contribution Gap, and assuming that TRIUMF has undertaken implementation of the Decommissioning Plan, to pay to the Escrow Agent, within one (1) year after a written request by TRIUMF a proportional share of the Fund Contribution Gap determined by multiplying the amount of the Fund Contribution Gap by a fraction, the numerator of which is one (1) and the denominator of which is the number of Member Universities on the date of the cessation of operations of the TRIUMF Facility.

General

5. In the event that the CNSC makes a change in the amount or form of the financial covenants required from the Member Universities pursuant to Section 6 of the CNSC Financial Security and Access Agreement, the parties agree to renegotiate this Agreement to provide for an equitable allocation of any additional requirements of the CNSC on principles as similar as may be feasible to the principles for distribution of liability on which this Agreement is based, including several liability and equal division of liability among the Member Universities.
6. This Agreement shall be governed by and construed in accordance with the laws in force in the Province of British Columbia and the federal laws of Canada applicable therein.
7. This Agreement constitutes the entire agreement between the parties in connection with the subject matter contained herein.
8. If TRIUMF's council of representatives of the Member Universities ("**Members' Council**") approves an amendment to this Agreement by a resolution passed by a majority of not less than four-fifths (4/5) of the Member Universities that includes the University of British Columbia (an "**Extraordinary Resolution**"), TRIUMF and each Member University shall execute and deliver an amended version of this Agreement as of the effective date of such Extraordinary Resolution or on such date as the Members' Council may determine.
9. The parties agree to promptly do, make, execute, deliver or cause to be done, made, executed or delivered, all such further acts, documents and things another party may reasonably require from time to time for the purpose of giving effect to this Agreement.
10. Any notice or demand to be given to any party to this Agreement shall be in writing and shall be either: (i) personally delivered; (ii) sent by first class mail, postage prepaid; (iii) sent by facsimile or (iv) sent by e-mail to the party or parties at the following at the following respective addresses (or as set out in the applicable joinder agreement):
- (a) if to The Governors of the University of Alberta:

The Governors of the University of Alberta
2-51 South Academic Bldg.
Edmonton, AB T6G 2G7
Attention: Walter Dixon
Telephone: 780-492-6378
Email: wdixon@ualberta.ca

- (b) if to The University of British Columbia:

The University of British Columbia
Finance Leadership Office
1958 Main Mall, 6th Floor, Walter C. Koerner Library
Vancouver BC V6T 1Z2
Attention: Vice-President, Finance & Operations
Telephone: 604 822 2823
Email: vp.finops@ubc.ca

The University of British Columbia
Old Admin Building
6328 Memorial Road
Vancouver BC V6T 1Z2
Attention: University Counsel
Telephone: 604 822 1897
Fax: 604 822 8731
Email: university.counsel@ubc.ca

- (c) if to The Governors of the University of Calgary:

The Governors of the University of Calgary
2500 University Drive NW
Calgary, AB T2N 1N4
Attention: Vice-President (Research)
Telephone: (403) 220-5460
Email: vpr@ucalgary.ca and legaladm@ucalgary.ca

- (d) if to Carleton University:

Carleton University
Room 607, Robertson Hall
1125 Colonel By Drive
Ottawa, ON K1S 5B6
Attention: Steve Levitt, General Counsel
Telephone: (613) 520-2600 Ext. 4479
Email: steven.levitt@carleton.ca

Carleton University
503H Tory Building
1125 Colonel By Drive
Ottawa, ON K1S 5B6
Attention: Rafik Goubran, Vice-President (Research and International) & Chancellor's
Professor
Telephone: (613) 520-7838
Email: rafik.goubran@carleton.ca

- (e) if to the University of Guelph:

University of Guelph
50 Stone Road East
Guelph, ON N1G 2W1
Attention: Malcolm Campbell, PhD, Vice-President (Research)
Telephone: 519-824-4120 x 53081
Email: vpres@uoguelph.ca

- (f) if to the University of Manitoba:

University of Manitoba
Office of the Vice President (Research and International)
Room 202, Administration Building
66 Chancellors Circle
Winnipeg, MB R3T 2N2
Attention: Digvir Jayas, Vice President (Research and International)
Telephone: 204-474-6915
Fax: 204-261-1318
Email: vpri@umanitoba.ca

- (g) if to the Université de Montréal:

For notices sent by courier services:

Université de Montréal
Vice-rectorat à la recherche, à la découverte, à la création et à l'innovation
Pavillon Roger-Gaudry
2900 Édouard-Montpetit, bureau H-635
Montréal (QC) H3T 1J4
Attention: Marie-Josée Hébert
Téléphone: 514-343-7270
Fax: no fax
Email: marie-josée.hebert@umontreal.ca

For notices sent by mail:

Université de Montréal
Pavillon Roger-Gaudry
Vice-rectorat à la recherche, à la découverte, à la création et à l'innovation
C.P. 6128, succursale Centre-ville
Montréal (QC) H3C 3J7
Attention: Marie-Josée Hébert
Téléphone: 514-343-7270
Fax: no fax
Email: marie-josée.hebert@umontreal.ca

- (h) if to Queen's University at Kingston:

Queen's University at Kingston
Office of Vice-Principal (Research)
74 University Avenue
Richardson Hall, Room 251
Kingston, ON K7L 3N6
Attention: Associate VP (Research)
Telephone: 613-533-6933
Email: research@queensu.ca

- (i) If to the University of Regina:

University of Regina
3737 Wascana Parkway
Regina, SK S4S 0A2
Attention: Chris Yost, Associate Vice-President Research
Telephone: 306-585-5223
Fax: 306-585-5255
Email: avp.research@uregina.ca

- (j) if to Simon Fraser University:

Simon Fraser University
Vice President Research and International
8888 University Drive
Burnaby, BC V5A 1S6
Attention: VPRI
Telephone: 778-782-5080
Email: vpriea@sfu.ca

- (k) if to The Governing Council of the University of Toronto:

The Governing Council of the University of Toronto
Rm 106, Simcoe Hall
27 King's College Circle
Toronto, ON M5S 1A1
Attention: Sheree Drummond, Secretary to the Governing Council
Telephone: 416-978-6576
Fax: 416-978-8182
Email: sheree.drummond@utoronto.ca

The Governing Council of the University of Toronto
Simcoe Hall, Room 109
27 King's College Circle
Toronto, Ontario M5S 1A1
Attention: Leah Cowen, Vice-President Research and Innovation, and Strategic Initiatives
Telephone: 416-978-4085
Email: leah.cowen@utoronto.ca

- (l) if to the University of Victoria:

University of Victoria
Vice President Research and Innovation
Suite A-110
Michael Williams Building
3800 Finnerty Road
Victoria, BC V8P 5C2
Attention: Vice-President Research and Innovation
Telephone: 250-721-7973
Fax: 250-472-5477
Email: vpr@uvic.ca

- (m) if to York University:

York University
4700 Keele Street
Kaneff Tower, 946
Toronto, ON M3J 1P3
Attention: Vice-President, Finance & Administration
Telephone: 416-736-2100 ex 33655
Email: cmcaulay@yorku.ca

with a copy to:

York University
4700 Keele Street
Kaneff Tower, 1050
Toronto, ON M3J 1P3
Attention: University Secretary
Tel: 416-736-2100 x 33905
Email: pascalr@yorku.ca

- (n) if to McMaster University:

McMaster University
Gilmour Hall 208
1280 Main Street West
Hamilton, ON L8S 4L8
Attention: Dr. Karen Mossman, Vice-President, Research
Telephone: (905) 525-9140, Ext. 27270
Fax: (905) 521-2100
Email: vprsrch@mcmaster.ca

- (m) if to TRIUMF:

TRIUMF
4004 Wesbrook Mall
Vancouver, B.C.
V6T 2A3

Attention: Executive Director
Telephone: 604-222-1047
Email: nigel.smith@triumf.ca

Any party may from time to time change its address by written notice to the other parties given in accordance with the provisions of this Section 10.

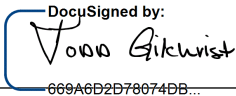
Any notice given by personal delivery shall be deemed to have been received on the date of delivery. Any notice given by first class mail shall be deemed to have been received on the fourth (4th) Business Day following the date of mailing. Any notice given by facsimile or e-mail shall be deemed to have been received on the first (1st) Business Day following the date of transmission.

Notwithstanding the foregoing provisions of this section 10, in the event of mail strike, slowdown, or other labour dispute which might reasonably be assumed to affect the delivery of any notice, such notice shall not be mailed but must be personally delivered or given by fax or e-mail and shall be effective when actually delivered or received.

11. This Agreement may not be assigned by any party without the prior written consent of the other parties, same not to be unreasonably withheld. Subject to the restrictions or transfer, this Agreement shall enure to the benefit of, and be binding on, the parties and their respective successors and permitted assigns.
12. The benefit of any provision of this Agreement may be waived in whole or in part by the party for whose benefit the provision operates and any party may waive any or all of its rights in the event of a breach of any provision of this Agreement by the other parties. A waiver is binding on the waiving party only if it is in writing and may be absolutely or may be limited in any way as to duration or scope. The failure by one party to insist one or more instances on the performance by the other party of any term or condition of this Agreement shall not be construed as a waiver by the party of any subsequent breach by the other party of its obligation under this Agreement.
13. It is intended that all provisions of this Agreement shall be fully binding and effective between the parties, but in the event that any particular provision or provisions or a part of one is found to be void, voidable or unenforceable for any reason whatever, then the particular provision or provisions or part of the provision shall be deemed severed from the remainder of this Agreement.
14. This Agreement may be executed in counterparts each of which shall be deemed an original, and all of which together shall constitute one and the same instrument.
15. TRIUMF and the Member Universities covenant and agree that no prospective Member University may be admitted to the membership of TRIUMF without having executed a joinder agreement in the form of Schedule "A" hereto. The parties agree that each signatory of a joinder agreement in the form of Schedule "A" hereto shall thereupon become a party to this Agreement as if it was an original party hereto. Any Member University may withdraw from this Agreement and cease to be a party to this Agreement upon at least one (1) years prior written notice of such withdrawal to the other parties hereto, provided that, such notice shall not be effective unless the party proposing to withdraw from this Agreement also withdraws from TRIUMF as a Member University effective as at the same time, complies with all of its obligations with respect to its withdrawal from TRIUMF, as contemplated by the Member Agreement and is not in default of any of its obligations under this Agreement as at the effective date of such withdrawal.

IN WITNESS WHEREOF the parties hereto have executed and delivered this Agreement as of the Effective Date.

THE GOVERNORS OF THE UNIVERSITY OF ALBERTA

Per: 
Name: Todd Gilchrist
Title: Vice-President (University Services and Finance)

THE UNIVERSITY OF BRITISH COLUMBIA

Per: _____
Name: Dr. Gail Murphy
Title: Vice-President Research and Innovation

Per: _____
Name: Mark Crosbie
Title: Associate University Counsel

CARLETON UNIVERSITY

Per: _____
Name: Lorraine Dyke
Title: Vice-President Finance and Administration

Per: _____
Name: Rafik Goubran
Title: Vice-President (Research and International)

SIMON FRASER UNIVERSITY

Per: _____
Name: Dr. Dugan O'Neil
Title: Vice President, Research and International

UNIVERSITY OF VICTORIA

Per: _____
Name: Rachael Scarth
Title: Associate Vice-President Research Operations

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Name: Dr. Gail Murphy
Title: Vice-President Research and Innovation

Per: _____
Name: Mark Crosbie
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CARLETON UNIVERSITY

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Per: _____
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UNIVERSITY OF VICTORIA

Per: _____
Name: _____
Title: _____

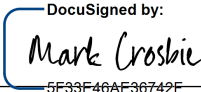
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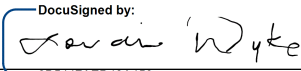
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Title: Vice-President Research and Innovation

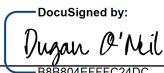
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UNIVERSITY OF VICTORIA

Per: _____
Name: _____
Title: _____

IN WITNESS WHEREOF the parties hereto have executed and delivered this Agreement as of the Effective Date.

THE GOVERNORS OF THE UNIVERSITY OF ALBERTA

Per: _____
Name: _____
Title: _____

THE UNIVERSITY OF BRITISH COLUMBIA

Per: _____
Name: Dr. Gail Murphy
Title: Vice-President Research and Innovation

Per: _____
Name: Mark Crosbie
Title: Associate University Counsel

CARLETON UNIVERSITY

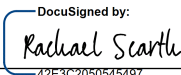
Per: _____
Name: Lorraine Dyke
Title: Vice-President Finance and Administration

Per: _____
Name: Rafik Goubran
Title: Vice-President (Research and International)


SIMON FRASER UNIVERSITY

Per: _____
Name: Dr. Dugan O'Neil
Title: Vice President, Research and International

UNIVERSITY OF VICTORIA

Per: 
Name: Rachael Scarth
Title: Associate Vice-President Research Operations

**THE GOVERNING COUNCIL OF THE
UNIVERSITY OF TORONTO**

DocuSigned by:
Per: 
Name: Leah Cowen
Title: Vice-President Research and
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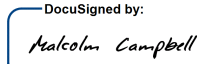
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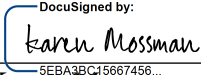
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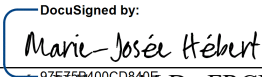
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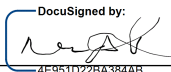
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TRIUMF INC.

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Name: Angus Livingstone
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Dr. Teri Shearer
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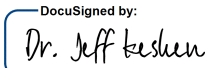
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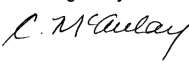
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Schedule "A"

Joinder Agreement

TO: The parties to the Amended and Restated Fund Contribution Gap Agreement

Reference is made to the Amended and Restated Fund Contribution Gap Agreement dated as of July 1, 2022 between TRIUMF and the Member Universities (the "**Amended and Restated Fund Contribution Gap Agreement**").

In consideration of the undersigned becoming a member of TRIUMF and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the undersigned agrees that, as of the date written below, the undersigned shall become a party to the Amended and Restated Fund Contribution Gap Agreement, as a Member University, and shall be bound by all of the terms and provisions of the Amended and Restated Fund Contribution Gap Agreement as though it was an original party thereto.

For the purpose of section 10 of the Amended and Restated Fund Contribution Gap Agreement, the address of the undersigned is as follows:

Attention: _____

Telephone: _____

Fax: _____

Email: _____

Dated the _____ day of _____, 20__.

Print name of additional party

Per: _____ c/s
Authorized Signing Officer

TRIUMF INC.

AMENDED AND RESTATED CNSC FINANCIAL SECURITY AND ACCESS AGREEMENT

THIS AMENDED AND RESTATED CNSC FINANCIAL SECURITY AND ACCESS AGREEMENT is made and entered into with effect as of July 1, 2022 (the “**Effective Date**”).

BETWEEN:

CANADIAN NUCLEAR SAFETY COMMISSION, a body corporate established under Section 8 of the *Nuclear Safety and Control Act*

(“**CNSC**”)

- and -

TRIUMF INC., a not-for-profit corporation and a registered charity under the laws of Canada

(“**TRIUMF**”)

- and -

EACH UNIVERSITY THAT EXECUTES AND DELIVERS THIS AGREEMENT, OR THAT BECOMES A PARTY TO THIS AGREEMENT BY EXECUTING AND DELIVERING A JOINDER AGREEMENT AS PROVIDED HEREIN

(each a “**Member University**” and collectively, the “**Member Universities**”)

WHEREAS the full member universities of the joint venture known as “**TRIUMF**” (the “**Joint Venture**”) incorporated TRIUMF on February 18, 2020 to assume, among other things, the operations and assets of the Joint Venture as of June 1, 2021;

WHEREAS in connection therewith, the parties to the CNSC Financial Security and Access Agreement dated January 7, 2008 (the “**Original Agreement**”) agreed to (1) novate the Original Agreement to replace the Joint Venture with TRIUMF as a party, and (2) execute and deliver an Amended and Restated CNSC Financial Security and Access Agreement as of June 1, 2021 (the “**2021 Agreement**”);

WHEREAS the Licence was issued to TRIUMF as of the Effective Date and on that date TRIUMF Accelerators Inc. (“**TAI**”) ceased to hold the Licence;

WHEREAS it is advisable to amend and restate the 2021 Agreement by executing and delivering this Agreement to, among other things, provide for TRIUMF as the holder of the Licence and to remove references to TAI;

WHEREAS TRIUMF has filed plans with the CNSC in accordance with the NSCA for fulfilling TRIUMF’s obligations to decommission the TRIUMF Facility at the end of its useful life and to manage and dispose of associated waste and by-products in accordance with applicable law;

WHEREAS pursuant to subsection 24(5) of the NSCA, a licence may be granted on such terms and conditions as the CNSC deems necessary for the purposes of the NSCA;

WHEREAS the CNSC has deemed the execution and delivery of this Agreement as a condition necessary for the purposes of the NSCA in relation to the grant of the Licence;

WHEREAS one purpose of this Agreement is to provide for the maintenance of the Fund and deposits into the Fund on and subject to the terms and conditions of this Agreement;

WHEREAS a further purpose of this Agreement is to give TRIUMF access to the Fund, on and subject to the terms and conditions of this Agreement; and

WHEREAS a further purpose of this Agreement is to give the CNSC, in the stipulated circumstances, the right to require each Member University to deposit monies into the Fund and to give CNSC access to the Fund and to certain covenants of the Member Universities relating thereto, on and subject to the terms and conditions of this Agreement.

NOW THEREFORE in consideration of the respective covenants and agreements hereinafter contained, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties agree as follows:

Definitions

1. In this Agreement, including its recitals, unless the context otherwise requires, the following terms have the meanings respectively ascribed thereto:
 - 1.1 “**2021 Agreement**” has the meaning set out above;
 - 1.2 “**Agreement**” means this Amended and Restated CNSC Financial Security and Access Agreement dated as of the Effective Date as amended from time to time;
 - 1.3 “**Annual Payment Schedule**” has the meaning set out in Section 22;
 - 1.4 “**Business Day**” means any day other than a Saturday or Sunday or any statutory holiday in the Provinces of British Columbia and Ontario;
 - 1.5 “**Claim**” means any amount demanded (i) by CNSC or TRIUMF to be paid from the Fund under this Agreement; and (ii) by CNSC, as permitted by this Agreement, pursuant to the several covenants of the Member Universities contained in this Agreement;
 - 1.6 “**CNSC**” means the Canadian Nuclear Safety Commission, a body corporate established under Section 8 of the NSCA;
 - 1.7 “**CNSC Contribution Gap**” has the meaning set out in Section 7;
 - 1.8 “**CNSC Demand Deficiency**” has the meaning set out in Section 8;
 - 1.9 “**CNSC Demand Payment**” has the meaning set out in Section 8;

- 1.10 “**Decommissioning**” means those actions taken, in the interest of health, safety, security and protection of the environment, to retire a licensed activity/facility permanently from service and render it to a predetermined state as set out in the Decommissioning Plan;
- 1.11 “**Decommissioning Licence**” means a licence issued by the CNSC to TRIUMF to commence decommissioning of the TRIUMF Facility;
- 1.12 “**Decommissioning Obligations**” means the obligations of TRIUMF as set out in the Decommissioning Plan;
- 1.13 “**Decommissioning Plan**” means the Detailed Decommissioning Plan submitted to and accepted by the CNSC, or if no such plan has been accepted, the Preliminary Decommissioning Plan or, in the case of premature shutdown of the TRIUMF Facility, a decommissioning plan developed and approved under the NSCA;
- 1.14 “**Default Notice**” has the meaning set out in Section 9;
- 1.15 “**Demand**” has the meaning set out in Schedule “B” or Schedule “D”, as the context may require;
- 1.16 “**Demand Amount**” has the meaning set out in Section 9;
- 1.17 “**Detailed Decommissioning Plan**” means a plan setting out the detailed work program, safety and environmental protection procedures, and management systems that will be followed in the decommissioning of the TRIUMF Facility submitted to the CNSC in support of an application for a Decommissioning Licence;
- 1.18 “**Effective Date**” has the meaning set out above;
- 1.19 “**Escrow Agent**” means a nationally recognized third party escrow company that holds the Fund as required by this Agreement;
- 1.20 “**Escrow Agreement**” means the Amended and Restated Escrow Agreement between the CNSC, TRIUMF, the Member Universities, and the Escrow Agent respecting the holding of the Fund;
- 1.21 “**Extraordinary Resolution**” has the meaning set out in Section 31;
- 1.22 “**Fund**” means those funds being held by the Escrow Agent pursuant to the terms of this Agreement;
- 1.23 “**Fund Contribution Gap**” has the meaning set out in Section 18;
- 1.24 “**Fund Contribution Gap Agreement**” has the meaning set out in Section 19;
- 1.25 “**Fund Payment**” means any payment to the CNSC or to TRIUMF from the Fund under this Agreement;
- 1.26 “**Joint Venture**” has the meaning set out above;
- 1.27 “**Licence**” means the Class 1B Particle Accelerator Operating Licence PA10L-01.00/2012 as the same may be amended, renewed or replaced from time to time;

- 1.28 “**Member Universities**” has the meaning set out above;
- 1.29 “**Members’ Council**” has the meaning set out in Section 31;
- 1.30 “**Membership Agreement**” has the meaning set out in Section 22(a);
- 1.31 “**NSCA**” means the *Nuclear Safety and Control Act* (Canada) and any amendments to that Act and any successor legislation thereto;
- 1.32 “**Original Agreement**” has the meaning set out above;
- 1.33 “**parties**” means CNSC, TRIUMF, and each Member University, and “**party**” means any one of them, as the context may require;
- 1.34 “**Preliminary Decommissioning Plan**” means an overview of the overall decommissioning approach that is sufficiently detailed to assure that the proposed approach is, in the light of existing knowledge, technically and financially feasible and appropriate in the interests of health, safety, security and protection of the environment submitted to the CNSC in support of an application for a licence to operate the TRIUMF Facility;
- 1.35 “**TAI**” has the meaning set out above;
- 1.36 “**Total CNSC Requirement**” has the meaning set out in Section 3;
- 1.37 “**Triggering Event**” means any of the triggering events as described in Sections 9(a) and 9(e);
- 1.38 “**TRIUMF**” has the meaning set out above; and
- 1.39 “**TRIUMF Facility**” means the TRIUMF particle accelerator laboratory located on the campus of the University of British Columbia, as more particularly described in the Decommissioning Plan.

Schedules

2. The following Schedules are attached to and form part of this Agreement:

Schedule “A” - Deposits and Projected Earnings Schedule

Schedule “B” - CNSC Demand for Payment of Claim

Schedule “C” - CNSC Authorized Signatories

Schedule “D” - TRIUMF Demand for Payment of Claim

Schedule “E” - TRIUMF Authorized Signatories

Schedule “F” - Joinder Agreement

Total CNSC Requirement

3. The aggregate amount which may be required by CNSC under this Agreement, from time to time during the term of this Agreement (the “**Total CNSC Requirement**”) shall be the amount specified in the then current Decommissioning Plan minus (i) all payments previously made to the CNSC or its agents from the Fund and from any Member University directly in relation to any CNSC Contribution Gap; and (ii) all payments previously made to TRIUMF from the Fund and from any Member University directly in relation to any Fund Contribution Gap under the Fund Contribution Gap Agreement.
4. The parties confirm that contributions have been made to the Fund.
5. The parties agree to review the status of the Fund and the Total CNSC Requirement at least ninety (90) days in advance of March 31, 2027 and every five (5) years thereafter and make any adjustments that are needed, as determined by the CNSC to ensure that TRIUMF can meet its Decommissioning Obligations. The parties agree that Schedule “A” shall be amended at least ninety (90) days in advance of the date contemplated by Schedule “A” as its five (5) year review date to reflect such changes. Such amended Schedule “A” shall specify the effective date and five (5) year review date for that amended Schedule “A”. If the parties fail to agree to so amend Schedule “A”, the amount for the period then ending shall continue to be in effect until amended in accordance with this Section 5.
6. Notwithstanding Sections 3 through 5 above, the parties acknowledge that nothing in this Agreement shall affect the right of the CNSC to take action under the NSCA to require a change to the amount and/or form of the financial covenants required by the CNSC.

CNSC Contribution Gap

7. The CNSC acknowledges that at any given time there may exist a difference between the Total CNSC Requirement and the aggregate fair market value of assets deposited on account of the Fund (a “**CNSC Contribution Gap**”).

Covenants of the Member Universities with Respect to a CNSC Contribution Gap

8. In respect of a CNSC Contribution Gap, each Member University at the time of (i) a Claim referred to in Section 8(a) below or (ii) a written request by the CNSC pursuant to Section 8(b) below, hereby severally covenants and agrees as follows:
 - (a) in the event of a Claim pursuant to Section 10 hereof and to the extent that the amount of such Claim exceeds the fair market value of assets in the Fund (such excess being a “**CNSC Demand Deficiency**”), to pay to the CNSC within one (1) year of a CNSC Demand and subject to the provisions of Sections 9 through 17 and 25 hereof, an amount determined by multiplying the amount of the CNSC Demand Deficiency by a fraction, the numerator of which is one (1) and the denominator of which is the number of Member Universities on the date the Claim is made (each such fractional amount being a “**CNSC Demand Payment**”), or at the option of the Member University, to pay the CNSC Demand Payment to the Escrow Agent for the purposes of satisfying its obligation with respect to any such Claim; and

- (b) at the cessation of operation of the TRIUMF Facility, to the extent there is a CNSC Contribution Gap and assuming that the CNSC has undertaken the implementation of the Decommissioning Plan as permitted pursuant to Section 9, to pay to the CNSC within one (1) year after a written request by the CNSC a proportional share of the CNSC Contribution Gap determined by multiplying the amount of the CNSC Contribution Gap by a fraction, the numerator of which is one (1) and the denominator of which is the number of Member Universities on the date of the cessation of operation of the TRIUMF Facility.

CNSC Access to the Fund

- 9. The CNSC shall be entitled to demand payment from the Fund under Section 10 of this Agreement only if conditions 9(a) through (d) or condition 9(e) have or has, as the case may be, been met, and shall be entitled to require contributions from the Member Universities under Section 8 only if those same conditions have been met:
 - (a) the CNSC, having provided TRIUMF and each Member University with written notice that it has reasonably concluded that (i) TRIUMF is in material default of one or more of its Decommissioning Obligations, or that (ii) an event or condition has occurred such that TRIUMF will not be able to perform its Decommissioning Obligations as and when required to do so (a “**Triggering Event**”) and has provided TRIUMF and each Member University within such written notice, details of the Triggering Event(s) and a demand that TRIUMF pay to the CNSC or its agent(s) on behalf of the Member Universities the CNSC’s present value estimate of the cost required to be expended to cure each such Triggering Event (the “**Demand Amount**”) (the notice described in this Section 9(a) is herein called the “**Default Notice**”);
 - (b) where, if TRIUMF has, within ten (10) Business Days after receiving the Default Notice delivered a written request to the CNSC that the Default Notice be reconsidered, the CNSC has provided TRIUMF with an opportunity to be heard in relation to the matter and has confirmed the issuance of the Default Notice, with any variation, in writing to TRIUMF and each Member University;
 - (c) TRIUMF has not paid in full the Demand Amount stated in the Default Notice, with any variation, or otherwise cured the Triggering Event(s) within the later to expire of (i) one hundred and eighty (180) Business Days of the date the Default Notice was received by TRIUMF and the Member Universities, where there has been no request for reconsideration under Section 9(b); or (ii) one hundred and eighty (180) Business Days following the date the confirmation by the CNSC of the issuance of the Default Notice, with any variation, as required by Section 9(b), has been received by TRIUMF and the Member Universities, where reconsideration has been requested by TRIUMF; and
 - (d) the CNSC has not waived, in writing, any right to payment from TRIUMF on behalf of the Member Universities or any of its rights against any of TRIUMF, the Member Universities, or the Fund under this Agreement; or
 - (e) TRIUMF (i) has dissolved, wound-up or otherwise ceased to maintain its corporate existence; or (ii) has made an assignment or a proposal under *the Bankruptcy and Insolvency Act* (Canada); or (iii) is the subject of an application for a bankruptcy order

under the *Bankruptcy and Insolvency Act* (Canada) which is unopposed by TRIUMF; or (iv) has sought protection under the *Companies' Creditors Arrangement Act* (Canada) or other similar legislation (each of such events also being a “**Triggering Event**”). In any of such events, TRIUMF shall not be entitled to reconsideration or an opportunity to be heard hereunder.

10. The CNSC may make one or more demands for payment, from the Fund, addressed to the Escrow Agent, with a copy or copies to TRIUMF and each Member University. Each such demand shall be in the form attached hereto as Schedule “B”, signed by a duly authorized officer of the CNSC, and shall:
 - (a) specify that conditions 9(a) through (d) or condition 9(e) have or has, as the case may be, been satisfied;
 - (b) specify the CNSC’s estimate of the remaining cost required to be expended to cure each Triggering Event;
 - (c) specify the amount of the Claim, which shall not exceed the amount set out in Section 10(b);
 - (d) specify the then current Total CNSC Requirement;
 - (e) specify the CNSC’s instructions regarding payment of the Claim; and
 - (f) attach a copy of the CNSC decision determining a Triggering Event.
11. The parties agree, as part of their contractual arrangements with the Escrow Agent, to irrevocably direct the Escrow Agent to provide (without liability) a certificate estimating the fair market value and adjusted cost base of the Fund as of the date of a CNSC Demand under Section 10 to each of the parties hereto within ten (10) Business Days of receiving a written request for such certificate from the CNSC.
12. The CNSC agrees that from time to time during the term of this Agreement it will provide the other parties, and the Escrow Agent, with a certificate signed by an officer or employee of the CNSC stating the names and titles of the persons authorized to execute a request for a statement of value under Section 11 of this Agreement or a demand for payment under Section 10 of this Agreement, in the form as set out in Schedule “C” hereto.

Disbursement to the CNSC from the Fund

13. The parties agree as part of their contractual arrangements with the Escrow Agent, to direct the Escrow Agent to pay from the Fund an amount equal to the lesser of:
 - (a) the Claim amount demanded by the CNSC; and
 - (b) the value of all cash available for distribution from the Fund after the disposition of non-cash assets in accordance with the Escrow Agreement, if necessary as certified (without liability) by the Escrow Agent.

14. The Escrow Agreement shall include terms that require Escrow Agent to pay the amount referred to in Section 10 of this Agreement to the CNSC within thirty (30) days of receipt by the Escrow Agent of a CNSC Demand in compliance with Section 10 of this Agreement. The obligation of the Escrow Agent to pay under the Escrow Agreement shall be limited to the amount of the Fund.
15. The Escrow Agreement shall provide that any Fund Payment shall be made by the transfer of Canadian funds from the Fund having a fair market value, as determined (without liability) by the Escrow Agent, equal to the payment then due. The Escrow Agreement shall also provide that any other payment out of the Fund shall be made by the transfer of Canadian funds from the Fund.

CNSC use of the Fund, Demand Amounts

16. The CNSC agrees to cause all Fund Payments, Demand Amounts and payments from any Member University directly in relation to any CNSC Contribution Gap to be used only to implement the Decommissioning Plan and in a manner as the CNSC considers appropriate for the purposes of the NSCA consistent with subsection 24(6) of the NSCA. Periodically during the work undertaken to implement the Decommissioning Plan and, in any event, at least every six (6) months, the CNSC shall provide to the other parties hereto a reasonably detailed statement indicating the actual expenses incurred, work completed and projected future expenses.
17. The CNSC agrees to cause all Fund Payments, Demand Amounts and payments from any Member University directly in relation to any CNSC Contribution Gap which are not required to be expended immediately in accordance with Section 16 to be held and invested in the manner of a prudent investor until such time as the amounts in question (together with any net income earned thereon) are required to be expended in accordance with Section 16 or all outstanding Triggering Events have been cured.

Fund Contribution Gap

18. TRIUMF and each Member University acknowledge that at any given time there may exist a difference between the Total CNSC Requirement and the aggregate fair market value of assets deposited on account of the Fund (a “**Fund Contribution Gap**”).

Fund Contribution Gap Agreement

19. Any Fund Contribution Gap shall be dealt with in accordance with the amended and restated agreement between the Member Universities and TRIUMF with respect thereto, as amended from time to time (the “**Fund Contribution Gap Agreement**”).

TRIUMF Fund Withdrawal

20. TRIUMF shall be entitled to make a Claim and to demand payment from the Fund in two circumstances:
 - (a) upon receipt by TRIUMF of a Decommissioning Licence; or
 - (b) with the written consent of the CNSC, if an emergent situation arises requiring the fulfillment of some or all of the Decommissioning Obligations.

21. TRIUMF may make one or more Claims and demands for payment, from the Fund, addressed to the Escrow Agent, with a copy to other parties hereto. Each such Claim and demand shall be in the form attached hereto as Schedule “D”, signed by a duly authorized officer of TRIUMF.
22. If:
- (a) the specified condition prompting the Claim and demand by TRIUMF for payment is that set out in Section 20(a), the Fund shall be paid to TRIUMF in annual instalments based upon the projected annual Decommissioning costs reflected in the Detailed Decommissioning Plan in respect of which the Decommissioning License was issued (the “**Annual Payment Schedule**”) with the first of such annual instalments to be paid within thirty (30) days following receipt by the Escrow Agent of the demand from TRIUMF and each other annual instalment to be paid in accordance with the Annual Payment Schedule provided that the amount of any annual instalment to be paid pursuant to the Annual Payment Schedule may be increased pursuant to joint written instructions issued by TRIUMF and the Decommissioning project manager appointed pursuant to the membership agreement required by TRIUMF to be signed by TRIUMF and each Member University, as amended (the “**Membership Agreement**”); or
 - (b) the specified condition prompting the Claim and demand by TRIUMF for payment is that set out in Section 20(b), and if the requirements of Section 20 and Schedule “D” are met, the Escrow Agent shall make payment to TRIUMF in the instalments and as otherwise required by Schedule “D”, Section B.
23. TRIUMF agrees that any Fund Payments and payments from any Member University directly in relation to any Fund Contribution Gap will be used solely for the purpose of carrying out one or more of TRIUMF’s Decommissioning Obligations as specified in the then current Decommissioning Plan and only in a commercially reasonable manner or, in the absence of such a plan, any other plan that the CNSC may determine, acting reasonably, is appropriate and in accordance with the technical and financial standards that are generally recognized at that time for carrying out decommissioning work and only in a commercially reasonable manner. Periodically during the work undertaken to fulfill TRIUMF’s Decommissioning Obligations, and, in any event, at least every six (6) months, TRIUMF shall provide to the Member Universities a reasonably detailed statement indicating the expenses incurred, worked completed and projected future expenses.
24. If:
- (a) the NSCA is to be repealed and not replaced;
 - (b) the Licence is revoked and not replaced; or
 - (c) if the requirement to establish a decommissioning fund as contemplated by this Agreement is removed,

then the parties shall immediately issue a joint, written demand to the Escrow Agent for full payment of the Fund to TRIUMF to be dealt with in accordance with the terms and conditions of the Membership Agreement, and this Agreement shall be thereafter terminated.

Residual Funds

25. It is acknowledged that upon conclusion of the Decommissioning process and certification thereof by the CNSC, any funds, including principal and interest then remaining in the Fund and any payments made due to any CNSC Contribution Gap, not used for that purpose shall be returned to TRIUMF, by payment in the form of Canadian funds, to be dealt with in accordance with the terms and conditions of the Membership Agreement. Further, should the CNSC be called upon to carry out or complete the Decommissioning process as set-out in Sections 8 to 17 above, then upon its completion as certified by the CNSC, any funds, including principal and interest then remaining in the Fund, any payments made due to any CNSC Contribution Gap, and any interest paid pursuant to section 24(7) of the NSCA shall be returned to TRIUMF, by payment in the form of Canadian funds, to be dealt with in accordance with the terms and conditions of the Membership Agreement.

Valuation

26. The parties agree that they will accept as the fair market value of the Fund at any time, the aggregate fair market value of the assets of the Fund at that time, as determined by the Escrow Agent (without liability).

Records

27. On or before June 30 of each year, TRIUMF shall provide the CNSC a certificate (without liability) as to the fair market value of the Fund as determined by the Escrow Agent as of ninety (90) days prior to that date. The said certificate is for accounting purposes only and shall not limit or restrict the right of the CNSC to the payments to which it is entitled in accordance with the terms of this Agreement.
28. TRIUMF agrees that from time to time during the term of this Agreement it will provide the other parties, and the Escrow Agent, with a certificate signed by an officer or employee of TRIUMF stating the names and titles of the persons authorized to execute a request for a statement of value under Section 27 or this Agreement or a demand for payment under Section 20 of this Agreement, in the form as set out in Schedule "E" hereto.

General

29. This Agreement shall be governed by and construed in accordance with the laws in force in the Province of British Columbia and the federal laws of Canada applicable therein.
30. This Agreement constitutes the entire agreement between the parties in connection with the subject matter contained herein.
31. If TRIUMF's council of representatives of the Member Universities ("**Members' Council**") approves an amendment to this Agreement by a resolution passed by a majority of not less than four-fifths (4/5) of the Member Universities that includes the University of British Columbia (an "**Extraordinary Resolution**"), TRIUMF and each Member University shall execute and deliver an amended version of this Agreement as of the effective date of such Extraordinary Resolution or on such date as the Members' Council may determine. For greater certainty, any amendment to this Agreement will not be effective unless and until executed and delivered by the CNSC.

32. The parties agree to promptly do, make, execute, deliver or cause to be done, made, executed or delivered, all such further acts, documents and things another party may reasonably require from time to time for the purpose of giving effect to this Agreement.
33. Any notice or demand to be given to any party to this Agreement shall be in writing and shall be either: (i) personally delivered; (ii) sent by first class mail, postage prepaid; (iii) sent by facsimile or (iv) sent by e-mail to the party or parties at the following at the following respective addresses (or as set out in the applicable joinder agreement):
- (a) if to The Governors of the University of Alberta:
- The Governors of the University of Alberta
2-51 South Academic Bldg.
Edmonton, AB T6G 2G7
Attention: Walter Dixon
Telephone: 780-492-6378
Email: wdixon@ualberta.ca
- (b) if to The University of British Columbia:
- The University of British Columbia
Finance Leadership Office
1958 Main Mall, 6th Floor, Walter C. Koerner Library
Vancouver BC V6T 1Z2
Attention: Vice-President, Finance & Operations
Telephone: 604 822 2823
Email: vp.finops@ubc.ca
- The University of British Columbia
Old Admin Building
6328 Memorial Road
Vancouver BC V6T 1Z2
Attention: University Counsel
Telephone: 604 822 1897
Fax: 604 822 8731
Email: university.counsel@ubc.ca
- (c) if to The Governors of the University of Calgary:
- The Governors of the University of Calgary
2500 University Drive NW
Calgary, AB T2N 1N4
Attention: Vice-President (Research)
Telephone: (403) 220-5460
Email: vpr@ucalgary.ca and legaladm@ucalgary.ca

- (d) if to Carleton University:

Carleton University
Room 607, Robertson Hall
1125 Colonel By Drive
Ottawa, ON K1S 5B6
Attention: Steve Levitt, General Counsel
Telephone: (613) 520-2600 Ext. 4479
Email: steven.levitt@carleton.ca

Carleton University
503H Tory Building
1125 Colonel By Drive
Ottawa, ON K1S 5B6
Attention: Rafik Goubran, Vice-President (Research and International) & Chancellor's Professor
Telephone: (613) 520-7838
Email: rafik.goubran@carleton.ca

- (e) if to the University of Guelph:

University of Guelph
50 Stone Road East
Guelph, ON N1G 2W1
Attention: Malcolm Campbell, PhD, Vice-President (Research)
Telephone: 519-824-4120 x 53081
Email: vpres@uoguelph.ca

- (f) if to the University of Manitoba:

University of Manitoba
Office of the Vice President (Research and International)
Room 202, Administration Building
66 Chancellors Circle
Winnipeg, MB R3T 2N2
Attention: Digvir Jayas, Vice President (Research and International)
Telephone: 204-474-6915
Fax: 204-261-1318
Email: vpri@umanitoba.ca

- (g) if to the Université de Montréal:

For notices sent by courier services:

Université de Montréal
Vice-rectorat à la recherche, à la découverte, à la création et à l'innovation
Pavillon Roger-Gaudry
2900 Édouard-Montpetit, bureau H-635
Montréal (QC) H3T 1J4
Attention: Marie-Josée Hébert

Téléphone: 514-343-7270
Fax: no fax
Email: marie-josée.hebert@umontreal.ca

For notices sent by mail:

Université de Montréal
Pavillon Roger-Gaudry
Vice-rectorat à la recherche, à la découverte, à la création et à l'innovation
C.P. 6128, succursale Centre-ville
Montréal (QC) H3C 3J7
Attention: Marie-Josée Hébert
Téléphone: 514-343-7270
Fax: no fax
Email: marie-josée.hebert@umontreal.ca

- (h) if to Queen's University at Kingston:

Queen's University at Kingston
Office of Vice-Principal (Research)
74 University Avenue
Richardson Hall, Room 251
Kingston, ON K7L 3N6
Attention: Associate VP (Research)
Telephone: 613-533-6933
Email: research@queensu.ca

- (i) If to the University of Regina:

University of Regina
3737 Wascana Parkway
Regina, SK S4S 0A2
Attention: Chris Yost, Associate Vice-President Research
Telephone: 306-585-5223
Fax: 306-585-5255
Email: avp.research@uregina.ca

- (j) if to Simon Fraser University:

Simon Fraser University
Vice President Research and International
8888 University Drive
Burnaby, BC V5A 1S6
Attention: VPRI
Telephone: 778-782-5080
Email: vpria@sfu.ca

- (k) if to The Governing Council of the University of Toronto:

The Governing Council of the University of Toronto
Rm 106, Simcoe Hall
27 King's College Circle
Toronto, ON M5S 1A1
Attention: Sheree Drummond, Secretary to the Governing Council
Telephone: 416-978-6576
Fax: 416-978-8182
Email: sheree.drummond@utoronto.ca

The Governing Council of the University of Toronto
Simcoe Hall, Room 109
27 King's College Circle
Toronto, Ontario M5S 1A1
Attention: Leah Cowen, Vice-President Research and Innovation, and Strategic Initiatives
Telephone: 416-978-4085
Email: leah.cowen@utoronto.ca

- (l) if to the University of Victoria:

University of Victoria
Vice President Research and Innovation
Suite A-110
Michael Williams Building
3800 Finnerty Road
Victoria, BC V8P 5C2
Attention: Vice-President Research and Innovation
Telephone: 250-721-7973
Fax: 250-472-5477
Email: vpr@uvic.ca

- (m) if to York University:

York University
4700 Keele Street
Kaneff Tower, 946
Toronto, ON M3J 1P3
Attention: Vice-President, Finance & Administration
Telephone: 416-736-2100 ex 33655
Email: cmcaulay@yorku.ca

with a copy to:

York University
4700 Keele Street
Kaneff Tower, 1050
Toronto, ON M3J 1P3

Attention: University Secretary
Telephone: 416-736-2100 x 33905
Email: pascalr@yorku.ca

- (n) if to McMaster University:

McMaster University
Gilmour Hall 208
1280 Main Street West
Hamilton, ON L8S 4L8
Attention: Dr. Karen Mossman, Vice-President, Research
Telephone: (905) 525-9140, Ext. 27270
Fax: (905) 521-2100
Email: vprsrch@mcmaster.ca

- (o) if to TRIUMF:

TRIUMF
4004 Wesbrook Mall
Vancouver, B.C.
V6T 2A3
Attention: Executive Director
Telephone: 604-222-1047
Email: nigel.smith@triumf.ca

- (p) if to the CNSC:

Canadian Nuclear Safety Commission
280 Slater Street
P.O. Box 1046, Station B
Ottawa, Ontario
K1P 5S9
Attention: TRIUMF Project Officer, Directorate of Nuclear Substance Regulation
Telephone: 1-888-229-2672
Facsimile: 613-995-5086
Email: acfd-dica@cnsccsn.gc.ca

Any party may from time to time change its address by written notice to the other parties given in accordance with the provisions of this Section 33.

Any notice given by personal delivery shall be deemed to have been received on the date of delivery. Any notice given by first class mail shall be deemed to have been received on the fourth (4th) Business Day following the date of mailing. Any notice given by facsimile or e-mail shall be deemed to have been received on the first (1st) Business Day following the date of transmission.

Notwithstanding the foregoing provisions of this section 33, in the event of mail strike, slowdown, or other labour dispute which might reasonably be assumed to affect the delivery of

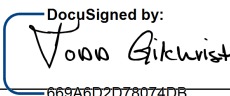
any notice, such notice shall not be mailed but must be personally delivered or given by facsimile or e-mail and shall be effective when actually delivered or received.

34. This Agreement may not be assigned by any party without the prior written consent of the other parties, same not to be unreasonably withheld. Subject to the restrictions on transfer, this Agreement shall enure to the benefit of, and be binding on, the parties and their respective successors and permitted assigns.
35. The benefit of any provision of this Agreement may be waived in whole or in part by the party for whose benefit the provision operates and any party may waive any or all of its rights in the event of a breach of any provision of this Agreement by the other parties. A waiver is binding on the waiving party only if it is in writing and may be absolute or may be limited in any way as to duration or scope. The failure by one party to insist in one or more instances on the performance by the other party of any term or condition of this Agreement shall not be construed as a waiver by the party of any subsequent breach by the other party of its obligation under this Agreement.
36. It is intended that all provisions of this Agreement shall be fully binding and effective between the parties, but in the event that any particular provision or provisions or a part of one is found to be void, voidable or unenforceable for any reason whatever, then the particular provision or provisions or part of the provision shall be deemed severed from the remainder of this Agreement.
37. This Agreement may be executed in counterparts each of which shall be deemed an original, and all of which together shall constitute one and the same instrument.
38. TRIUMF and the Member Universities covenant and agree that no prospective Member University may be admitted to the membership of TRIUMF without having executed a joinder agreement in the form of Schedule "F" hereto. The parties agree that each signatory of a joinder agreement in the form of Schedule "F" hereto shall thereupon become a party to this Agreement as if it was an original party hereto.
39. Any Member University may withdraw from this Agreement and cease to be a party to this Agreement upon at least one (1) years prior written notice of such withdrawal to the other parties hereto, provided that, such notice shall not be effective unless the party proposing to withdraw from this Agreement also withdraws from TRIUMF effective as at the same time, complies with all of its obligations with respect to its withdrawal from TRIUMF, as contemplated by the Membership Agreement and provided further that it is not in default of any of its obligations under this Agreement as at the effective date of such withdrawal.
40. Pursuant to the periodic reviews of the Fund as contemplated in Section 5 of this Agreement, TRIUMF shall retain the right to make the necessary modifications to the assets comprising the Fund that are on deposit with the Escrow Agent subject always to the terms of the Escrow Agreement. In the intervening periods between the periodic reviews of the Fund as contemplated in Section 5 of this Agreement, economic and financial market conditions may require timely modifications to the assets comprising the Fund that are on deposit with the Escrow Agent to help preserve the integrity of the Fund. TRIUMF shall retain the right to make such modifications during the intervening period to the assets of the Fund subject always to the terms of the Escrow Agreement and subject to the approval of the CNSC which shall not be unreasonably withheld. The CNSC shall respond to such requests from TRIUMF within ten (10) Business Days.

[Signature page follows]

IN WITNESS WHEREOF the parties hereto have executed and delivered this Agreement as of the Effective Date.

THE GOVERNORS OF THE UNIVERSITY OF ALBERTA

Per: 
 Name: Todd Gilchrist
 Title: Vice-President (University Services and Finance)

THE UNIVERSITY OF BRITISH COLUMBIA

Per: _____
 Name: Dr. Gail Murphy
 Title: Vice-President Research and Innovation

Per: _____
 Name: Mark Crosbie
 Title: Associate University Counsel

CARLETON UNIVERSITY

Per: _____
 Name: Lorraine Dyke
 Title: Vice-President Finance and Administration

Per: _____
 Name: Rafik Goubran
 Title: Vice-President (Research and International)

SIMON FRASER UNIVERSITY

Per: _____
 Name: Dr. Dugan O'Neil
 Title: Vice President, Research and International

UNIVERSITY OF VICTORIA

Per: _____
 Name: Rachael Scarth
 Title: Associate Vice-President Research Operations

THE GOVERNING COUNCIL OF THE UNIVERSITY OF TORONTO


Per: _____
 Name: Leah Cowen
 Title: Vice-President Research and Innovation, and Strategic

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**THE GOVERNORS OF THE UNIVERSITY
OF ALBERTA**

Per: _____
Name: _____
Title: _____

**THE UNIVERSITY OF BRITISH
COLUMBIA**

Per: _____
Name:  Dr. Gail Murphy
Title: Vice-President Research and Innovation

Per: _____
Name: Mark Crosbie
Title: Associate University Counsel

CARLETON UNIVERSITY

Per: _____
Name: Michel Piché
Title: Vice-President Finance and
Administration

Per: _____
Name: Rafik Goubran
Title: Vice-President (Research and
International)

SIMON FRASER UNIVERSITY

Per: _____
Name: Dr. Dugan O'Neil
Title: Vice President, Research and
International

UNIVERSITY OF VICTORIA

Per: _____
Name: _____
Title: _____

**THE GOVERNING COUNCIL OF THE
UNIVERSITY OF TORONTO**

Per: _____
Name: Leah Cowen
Title: Vice-President Research and
Innovation, and Strategic

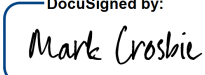
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**THE GOVERNORS OF THE UNIVERSITY
OF ALBERTA**

Per: _____
Name: _____
Title: _____

**THE UNIVERSITY OF BRITISH
COLUMBIA**

Per: _____
Name: Dr. Gail Murphy
Title: Vice-President Research and Innovation

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Per: _____
Name: Mark Crosbie
Title: Associate University Counsel

CARLETON UNIVERSITY

Per: _____
Name: Michel Piché
Title: Vice-President Finance and
Administration

Per: _____
Name: Rafik Goubran
Title: Vice-President (Research and
International)

SIMON FRASER UNIVERSITY

Per: _____
Name: Dr. Dugan O'Neil
Title: Vice President, Research and
International

UNIVERSITY OF VICTORIA

Per: _____
Name: _____
Title: _____

**THE GOVERNING COUNCIL OF THE
UNIVERSITY OF TORONTO**

Per: _____
Name: Leah Cowen
Title: Vice-President Research and
Innovation, and Strategic

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THE GOVERNORS OF THE UNIVERSITY OF ALBERTA

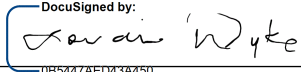
Per: _____
Name: _____
Title: _____

THE UNIVERSITY OF BRITISH COLUMBIA

Per: _____
Name: Dr. Gail Murphy
Title: Vice-President Research and Innovation

Per: _____
Name: Mark Crosbie
Title: Associate University Counsel

CARLETON UNIVERSITY

Per: 
Name: Lorraine Dyke
Title: Vice-President Finance and Administration

Per: _____
Name: Rafik Goubran
Title: Vice-President (Research and International)

SIMON FRASER UNIVERSITY

Per: _____
Name: Dr. Dugan O'Neil
Title: Vice President, Research and International

UNIVERSITY OF VICTORIA

Per: _____
Name: Rachael Scarth
Title: Associate Vice-President Research Operations

THE GOVERNING COUNCIL OF THE UNIVERSITY OF TORONTO

Per: _____
Name: Leah Cowen
Title: Vice-President Research and Innovation, and Strategic

IN WITNESS WHEREOF the parties hereto have executed and delivered this Agreement as of the Effective Date.

**THE GOVERNORS OF THE UNIVERSITY
OF ALBERTA**

Per: _____
Name: _____
Title: _____

**THE UNIVERSITY OF BRITISH
COLUMBIA**

Per: _____
Name: Dr. Gail Murphy
Title: Vice-President Research and Innovation

Per: _____
Name: Mark Crosbie
Title: Associate University Counsel

CARLETON UNIVERSITY

Per: _____
Name: Michel Piché
Title: Vice-President Finance and
Administration

Per: _____
Name: Rafik Goubran
Title: Vice-President (Research and
International)

SIMON FRASER UNIVERSITY

Per: _____
Name: Dr. Dugan O'Neil
Title: Vice President, Research and
International

UNIVERSITY OF VICTORIA

Per: _____
Name: _____
Title: _____

**THE GOVERNING COUNCIL OF THE
UNIVERSITY OF TORONTO**

Per: _____
Name: Leah Cowen
Title: Vice-President Research and
Innovation, and Strategic

IN WITNESS WHEREOF the parties hereto have executed and delivered this Agreement as of the Effective Date.

**THE GOVERNORS OF THE UNIVERSITY
OF ALBERTA**

Per: _____
Name: _____
Title: _____

**THE UNIVERSITY OF BRITISH
COLUMBIA**

Per: _____
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Title: Vice-President Research and Innovation


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Per: _____
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CARLETON UNIVERSITY

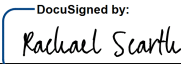
Per: _____
Name: Lorraine Dyke
Title: Vice-President Finance and Administration

Per: _____
Name: Rafik Goubran
Title: Vice-President (Research and International)

SIMON FRASER UNIVERSITY

Per: _____
Name: Dr. Dugan O'Neil
Title: Vice President, Research and International

UNIVERSITY OF VICTORIA

Per: 
Name: Rachael Scarth
Title: Associate Vice-President Research Operations

THE GOVERNING COUNCIL OF THE UNIVERSITY OF TORONTO

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THE GOVERNORS OF THE UNIVERSITY OF CALGARY

DocuSigned by:

William A. Ghali

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Per: _____
 Name: Dr. William A. Ghali
 Title: Vice-President (Research)

UNIVERSITY OF GUELPH

Per: _____
 Name: Malcolm Campbell
 Title: Vice President (Research)

Per: _____
 Name: Genevieve Gauthier-Chalifour
 Title: University Secretary

UNIVERSITY OF MANITOBA

Per: _____
 Name: Naomi Andrew
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MCMASTER UNIVERSITY

Per: _____
 Name: Dr. Karen Mossman
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Per: _____
 Name: Saher Fazilat
 Title: Vice President (Operations and Finance)

UNIVERSITÉ DE MONTRÉAL

Per: _____
 Name: Marie-Josée Hébert, M.D., FRCPC, FCAHS
 Title: Vice-Rector, Research, Discovery, Creation and Innovation

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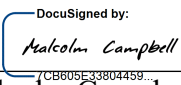
THE UNIVERSITY OF REGINA

Per: _____
 Name: Dr. Jeff Keshen
 Title: President and Vice-Chancellor

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Genevieve Gauthier-Chalifour
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Naomi Andrew

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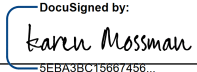
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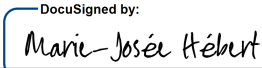
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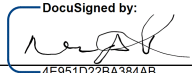
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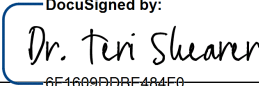
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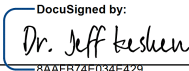
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THE UNIVERSITY OF REGINA

Per: 
Name: Dr. Jeff Keshen
Title: President and Vice-Chancellor

YORK UNIVERSITY

Per: _____
Name: Amir Asif
Title: Vice-President Research & Innovation

Per: _____
Name: Carol McAulay
Title: VP Finance & Administration

TRIUMF INC.

Per: _____
Name: Angus Livingstone
Title: Chair of Board of Governors

DocuSigned by:
Angus Livingstone
DE56B37CBC32423...

CANADIAN NUCLEAR SAFETY COMMISSION

Per: _____
Name: _____
Title: _____

YORK UNIVERSITY

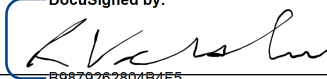
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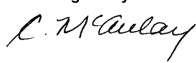
**CANADIAN NUCLEAR SAFETY
COMMISSION**

DocuSigned by:

Per: _____
Name: _____
Title: _____
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YORK UNIVERSITY

Per: _____
Name: Amir Asif
Title: Vice-President Research & Innovation

Per: _____
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TRIUMF INC.

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Name: Angus Livingstone
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**CANADIAN NUCLEAR SAFETY
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YORK UNIVERSITY

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Per: _____
Name: Angus Livingstone
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**CANADIAN NUCLEAR SAFETY
COMMISSION**

Per: _____
Name: _____
Title: _____

Schedule “A”

Deposits and Projected Earnings Schedule

Initial and Supplementary Deposits:		\$9,600,000
Fund Balance:	As at March 31, 2018	\$11,176,375
Projected Fund Balance:	As at March 31, 2023	\$14,787,957
Return Assumption:		5.76%

Review Dates of Schedule A:

Fund Agreement	Review
The TRIUMF Facility Decommissioning Fund	At least ninety (90) days in advance of March 31, 2027 and every five (5) years thereafter.

Permitted Investments:

All amounts required for Decommissioning shall be invested in cash or near cash investments and investment funds, as defined in the CNSC’s regulatory documents, REGDOC-3.3.1, *Financial guarantees for decommissioning of nuclear facilities and termination of licensed activities*.

Schedule "B"

CNSC Demand for Payment of Claim

TO: Escrow Agent

WITH A COPY TO: TRIUMF

AND TO: Each Member University

DATE: _____

Pursuant to the Amended and Restated CNSC Financial Security Access Agreement dated July 1, 2022 between the Canadian Nuclear Safety Commission (the "CNSC"), TRIUMF and the Member Universities, as amended, (the "Access Agreement"), the CNSC hereby makes this Demand for Payment of a Claim (this "Demand") and confirms that:

- (a) the following Triggering Event(s) has occurred and has not been cured as of the date of this Demand: _____;
- (b) the CNSC's estimate of the remaining cost required to be expended to cure each Triggering Event is \$_____;
- (c) the amount of the Claim is \$_____;
- (d) the Total CNSC Requirement as of the date of this Demand is \$_____;
- (e) the CNSC has complied with the requirements of the Access Agreement and has not waived any right to payment; and
- (f) the CNSC has attached a copy of the CNSC decision determining a Triggering Event.

The CNSC is hereby entitled to payment from the Fund of an amount equal to the lesser of

- (a) the Claim amount; and
- (b) the value of all cash available for distribution from the Fund after the disposition of non-cash assets in accordance with the Escrow Agreement as certified (without liability) by the Escrow Agent,

within thirty (30) days following the date of this Demand.

The CNSC hereby irrevocably authorizes and directs the Escrow Agent to pay this amount by cheque payable to the Receiver General for Canada, care of its authorized agent:

Capitalized terms used but not defined in this Demand have the meanings given to them in the Access Agreement.

CANADIAN NUCLEAR SAFETY COMMISSION

By: _____

Schedule “C”

CNSC Authorized Signatories

TO: **Escrow Agent**

WITH A COPY TO: **TRIUMF**

AND TO: **Each Member University**

RE: **[CNSC Demand / CNSC Request for Statement]**

I, ■, the ■ of the Canadian Nuclear Safety Commission (the “CNSC”), hereby certify on behalf of the CNSC that the persons whose names appear below are officers or employees of the CNSC who are authorized to execute a CNSC Demand or request statements from the Escrow Agent.

Name

Position

Signature

■

■

■

■

■

■

Dated this ■ day of ■, 20■■

**CANADIAN NUCLEAR SAFETY
COMMISSION**

By: _____

Name:

Title:

Schedule “D”

TRIUMF Demand for Payment of Claim

TO: Escrow Agent

WITH A COPY TO: CNSC

AND TO: Each Member University

DATE: _____

Pursuant to the Amended and Restated CNSC Financial Security Access Agreement dated July 1, 2022 between the Canadian Nuclear Safety Commission (the “CNSC”), TRIUMF and the Member Universities, as amended, (the “Access Agreement”), TRIUMF hereby makes this Demand for Payment of a Claim (this “Demand”) and confirms that:

- A. The condition set out in Section 20(a) has been met, attached hereto is a copy of the Decommissioning Licence, and TRIUMF is hereby entitled to payment of the Fund in annual instalments based upon the Annual Payment Schedule, a copy of which is attached, with the first of such annual instalments to be paid within thirty (30) days of the date of this Demand and the remaining annual instalments to be paid in accordance with the Annual Payment Schedule provided that the amount of any annual instalment to be paid pursuant to the Annual Payment Schedule may be increased pursuant to written instructions issued jointly by TRIUMF and the Decommissioning project manager appointed pursuant to the Membership Agreement; or
- B. The condition set out in Section 20(b) has been met and attached hereto is a copy of the CNSC’s consent;
 - (i) the amount of the Claim is \$ _____
 - (ii) TRIUMF has complied with the requirements of the Access Agreement; and
 - (iii) TRIUMF is hereby entitled to payment from the Fund of an amount equal to the lesser of
 - (a) the Claim amount; and
 - (b) the value of all cash available from the Fund after disposition of non-cash assets in accordance with the Escrow Agreement as certified (without liability) by the Escrow Agent.

TRIUMF hereby irrevocably authorizes and directs the Escrow Agent to pay such amount by cheque payable to _____ in the instalments contemplated by the payment schedule attached hereto with the first of such instalments to be paid within thirty (30) days following the date of this Demand and the remaining instalments in accordance with the attached payment schedule, provided that the amount of any instalment to be paid pursuant to the attached payment schedule may be increased pursuant to written instructions issued jointly by TRIUMF and the Decommissioning project manager

appointed pursuant to the Membership Agreement and otherwise in accordance with the Escrow Agreement.

Capitalized terms used but not defined in this Demand have the meanings given to them in the Access Agreement.

TRIUMF INC.

By: _____

Schedule “E”

TRIUMF Authorized Signatories

TO: **Escrow Agent**

WITH A COPY TO: **Canadian Nuclear Safety Commission**

AND TO: **Each Member University**

RE: **[Licensee Demand / Licensee Request for Statement]**

I, the ■ of TRIUMF INC. (“**TRIUMF**”), hereby certify on behalf of TRIUMF that the persons whose names appear below are officers or employees of TRIUMF who are authorized to execute a TRIUMF Demand or request statements from the Escrow Agent.

<u>Name</u>	<u>Position</u>	<u>Signature</u>
■	■	_____
■	■	_____
■	■	_____

Dated this ■ day of 20■■

TRIUMF INC.

By: _____

Name:

Title:

Schedule “F”

Joinder Agreement

To: Each of the parties to the Amended and Restated CNSC Financial Security and Access Agreement

Reference is made to the Amended and Restated CNSC Financial Security and Access Agreement dated as of July 1, 2022 between the Canadian Nuclear Safety Commission, TRIUMF INC. and the Member Universities.

In consideration of the undersigned becoming a member of TRIUMF and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the undersigned agrees that, as of the date written below, the undersigned shall become a party to the Amended and Restated CNSC Financial Security and Access Agreement, as a Member University, and shall be bound by all of the terms and provisions of the Amended and Restated CNSC Financial Security and Access Agreement as though it was an original party thereto.

For the purposes of Section 33 of the Amended and Restated CNSC Financial Security and Access Agreement, the address for the undersigned is as follows:

Attention: _____

Telephone: _____

Facsimile: _____

DATED the _____ day of _____, 20■■.

Print name of additional party

Per: _____ c/s
Authorized Signing Officer

**TRIUMF
PRELIMINARY DECOMMISSIONING FUND
MAINTENANCE COSTS**

1.0612

escalation indexes: 1.104

2003 dollars

SECURITY	60,000
INSURANCE	20,000
MAINTENANCE	6,000
INFRASTRUCTURE LEVY	25,000
UTILITIES	10,000
ADMINISTRATION	30,000
	<hr/>
	151,000
CONTINGENCY	45,300
	<hr/>
	<u>196,300</u>

Phase1-2 years	25 years
Phase 2-3 years	20 years

Licensing Fees in 2025 \$

	5 K\$/year	this may not get used every year, but mo
Care & Maintenance (Phase1-2)	125	for the 25 years
Care & Maintenance (Phase2-3)	100	and an additional 20 to 45 years

NOTE - Licensing fees are currently waived owing to TRIUMF's educational institution affiliation

in 2025 \$

Phase 1-2 costs	Phase 2-3 costs
Scaling for ARIEL & E-Hall 0-25 years	Scaling for reduced MAB and removed ISAC
91,659	91,659
33,608	33,608
28,120	23,902
38,191	38,191
25,206	21,425
45,830	45,830
262,614	254,615
262,614	

\$6,712	\$5,209 K
---------	-----------

in 2022 \$

Ratio of floor space	1.65
Scaling for ARIEL & E-Hall 0-25 years	
86,372	
31,670	
26,498	
35,988	
23,752	
43,186	
247,467	
247,467	

Phase 1-2 costs	\$6,333.14 K\$
-----------------	----------------

N.b. Contingency included in total spr

in 2025 \$

re may be required

268.47	5.86 per year
260.47	5.86 per year

146
117

in 2022 \$

Ratio of floor space
Scaling for reduced MAB and removed ISAC
86,372
31,670
22,523
35,988
20,190
43,186
239,930
239,930
Phase 2-3 costs
\$4,915.76

eadsheet, therefore do not include here.

1.304

2017 dollars

78,230
26,077
7,823
32,596
13,038
39,115

196,879

59,064

255,943

in 2017 \$

Ratio of floor space
Scaling for ARIEL & E-Hall 0-25 years
78,230
28,684
24,000
32,596
21,513
39,115
224,139
224,139
Phase 1-2 costs
\$5,728.47

N.b. Contingency inclu

	in 2017 \$	
1.65	Ratio of floor space	0.85
	Scaling for reduced MAB and removed ISAC	
	78230	
	28684	
	20400	
	32596	
	18286	
	39115	
	217,312	
	<hr/>	
	217,312	
	<hr/> <hr/>	
	Phase 2-3 costs	
K\$	\$4,446.23	K\$

ided in total spreadsheet, therefore do not include here.

TRIUMF Preliminary Decommission

Planning Envelope - Detail Plan

Option B - Demolition & Disposal of Existing Facilities (Greenfield Estimates

in 2025 \$

Work Description	Project Manager/Engineer		Radiological Health/Physics Controls	
	Labour		Labour	
	No. Shifts	Unit Cost (\$)	No. Shifts	Unit Cost (\$)
AREA 1.0				
Detail Plan Development				
Overall Decommissioning Strategy				
Description of Detail Plan for each phase and end-state objectives	20	\$ 2,030	20	\$ 2,030
Description of monitoring between each phases			5	\$ 2,030
Development of programs and procedures for;				
· Management system & Project Mngmt structure	10	\$ 2,030		
· Work planning and hazard assessment	10	\$ 2,030	10	\$ 2,030
· Emergency response & fire safety	10	\$ 2,030		
· Site security	5	\$ 2,030		
· Environmental emissions and effluent monitoring			20	\$ 2,030
· Radiation protection and conventional safety	10	\$ 2,030	10	\$ 2,030
· Radiological assessment procedures			20	\$ 2,030
· Waste management	5	\$ 2,030	20	\$ 2,030
· Contractor management & training	5	\$ 2,030		
Preparation of Drawings, Operational history and Facility radiation surveys				
Development & Review of post-operational radiation surveys			5	\$ 2,030
Development & Review of release of material and equipment surveys			5	\$ 2,030
Development & Review of hazardous waste handling, disposal procedure			5	\$ 2,030
Envelope specific packages				
Develop envelope work packages	60	\$ 2,030		
Develop envelope schedules	40	\$ 2,030		
Develop envelope waste disposal plan	10	\$ 2,030	30	\$ 2,030
Detail Plan Document Preparation & Review	40	\$ 2,030	50	\$ 2,030
Preparation of Licence Submission and Regulatory Responses	15	\$ 2,030	20	\$ 2,030
Preparation of Safety Analysis and Environmental Assessment Report	20	\$ 2,030	40	\$ 2,030
Submission for Enviromental Protection Review	5	\$ 2,030	10	\$ 2,030
Extra Detail Plan Contingency	47	\$ 2,030		
Total Detail Plan				
Regulatory Review and Licensing				
Environmental Protection Review				
Licence to Decommission Review				

CNSC Licensing Assessment & Decision				
Extra Regulatory Contingency				
Total Regulatory				
Total Detail Plan Development & Approval				

ing Plan

n
Site) @ Shutdown + 0 Years Cost

Date:	Rev. No.	Date:	Rev. No.
Jan. 2003		Feb. 2013	
Oct. 2003		May. 2017	
Jun. 2004			
Nov. 2006			

Designer/Surveyor/ Technical Support		Regulatory & Licensing				Sub-Total Costs		Sum Total(s) Costs (\$)
Labour		Labour				Labour (\$)		
No. Shifts	Unit Cost (\$)	No. Shifts	Unit Cost (\$)					
						81,192		81,192
						10,149		10,149
						20,298		20,298
						40,596		40,596
						20,298		20,298
						10,149		10,149
						40,596		40,596
						40,596		40,596
						40,596		40,596
						50,745		50,745
						10,149		10,149
20	\$ 1,353					27,064		27,064
20	\$ 1,353					37,213		37,213
20	\$ 1,353					37,213		37,213
20	\$ 1,353					37,213		37,213
10	\$ 1,353					135,321		135,321
10	\$ 1,353					94,724		94,724
10	\$ 1,353					94,724		94,724
						182,683		182,683
						71,043		71,043
						121,789		121,789
						30,447		30,447
						95,401		95,401
								1,330,203
		20	\$ 2,368			47,362		47,362
		25	\$ 2,368			59,203		59,203

[illegible]

in 2022 \$

Work Description	Project Manager/Engineer		Radiological Health/Physics Controls	
	Labour		Labour	
	No. Shifts	Unit Cost (\$)	No. Shifts	Unit Cost (\$)
AREA 1.0				
Detail Plan Development				
Overall Decommissioning Strategy				
Description of Detail Plan for each phase and end-state objectives	20	1822	20	1822
Description of monitoring between each phases			5	1822
Development of programs and procedures for;				
· Management system & Project Mngmt structure	10	1822		
· Work planning and hazard assessment	10	1822	10	1822
· Emergency response & fire safety	10	1822		
· Site security	5	1822		
· Environmental emissions and effluent monitoring			20	1822
· Radiation protection and conventional safety	10	1822	10	1822
· Radiological assessment procedures			20	1822
· Waste management	5	1822	20	1822
· Contractor management & training	5	1822		
Preparation of Drawings, Operational history and Facility radiation surveys				
Development & Review of post-operational radiation surveys			5	1822
Development & Review of release of material and equipment surveys			5	1822
Development & Review of hazardous waste handling, disposal procedure			5	1822
Envelope specific packages				
Develop envelope work packages	60	1822		
Develop envelope schedules	40	1822		
Develop envelope waste disposal plan	10	1822	30	1822
Detail Plan Document Preparation & Review	40	1822	50	1822
Preparation of Licence Submission and Regulatory Responses	15	1822	20	1822
Preparation of Safety Analysis and Environmental Assessment Report	20	1822	40	1822
Submission for Environmental Protection Review	5	1822	10	1822
Extra Detail Plan Contingency	47	1822		
Total Detail Plan				
Regulatory Review and Licensing				
Environmental Protection Review				
Licence to Decommission Review				

CNSC Licensing Assessment & Decision				
Extra Regulatory Contingency				
Total Regulatory				
Total Detail Plan Development & Approval				

Designer/Surveyor/ Technical Support		Regulatory & Licensing				Sub-Total Costs		Sum Total(s) Costs (\$)
Labour		Labour				Labour (\$)		
No. Shifts	Unit Cost (\$)	No. Shifts	Unit Cost (\$)					
						72,869		72,869
						9,109		9,109
						18,217		18,217
						36,435		36,435
						18,217		18,217
						9,109		9,109
						36,435		36,435
						36,435		36,435
						36,435		36,435
						45,543		45,543
						9,109		9,109
20	1214					24,290		24,290
20	1214					33,398		33,398
20	1214					33,398		33,398
20	1214					33,398		33,398
10	1214					121,449		121,449
10	1214					85,014		85,014
10	1214					85,014		85,014
						163,956		163,956
						63,761		63,761
						109,304		109,304
						27,326		27,326
						85,621		85,621
								1,193,843
		20	2125			42,507		42,507
		25	2125			53,134		53,134

[illegible]

2% inflation rate

OPTION B (Greenfield Site)

Revised Cost (x1000) in 2025 Dollar:

Time Frame	Envelopes I - V (per AMA report + option A cost)					
	I (Office)	II (ISAC)	III (BWXT)	IV (Accelerator)	V (ARIEL)	VI (IAMI)
Detail Plan						
At Shutdown + 0 yrs	\$1,620	\$4,273	\$2,081	\$6,971	\$1,048	\$0
At Shutdown + 25 yrs.	\$0	\$2,328	\$2,095	\$11,968	\$3,734	\$2,048
At Shutdown + 45 yrs.	\$0	\$0	\$0	\$12,735	\$0	\$0
Subtotal	\$1,620	\$6,601	\$4,177	\$31,674	\$4,782	\$2,048

15% contingency for Detail Plan and At Shutdown

30% contingency for At Shutdown + 25 yrs and At Shutdown + 45 yrs

Total including contingencies

Time Frame	Additional cost (added by Anne Trudel)					
	I (Office)	II (ISAC)	III (BWXT)	IV (Accelerator)	V (ARIEL)	VI (IAMI)
Detail Plan						
At Shutdown + 0 yrs	\$59	\$35	\$21	\$105	\$0	
At Shutdown + 25 yrs.	\$0	\$144	\$58	\$863	\$145	
At Shutdown + 45 yrs.	\$0	\$0	\$0	\$4,612	\$0	
Subtotal	\$59	\$179	\$79	\$5,580	\$145	\$0

Time Frame	Total cost					
	I (Office)	II (ISAC)	III (BWXT)	IV (Accelerator)	V (ARIEL)	VI (IAMI)
Detail Plan	\$0	\$0	\$0	\$0	\$0	\$0
At Shutdown + 0 yrs	\$1,679	\$4,308	\$2,102	\$7,076	\$1,048	\$0
At Shutdown + 25 yrs.	\$0	\$2,473	\$2,154	\$12,832	\$3,879	\$2,048
At Shutdown + 45 yrs.	\$0	\$0	\$0	\$17,347	\$0	\$0
Subtotal	\$1,679	\$6,781	\$4,256	\$37,255	\$4,927	\$2,048

15% contingency for Detail Plan and At Shutdown

30% contingency for At Shutdown + 25 yrs and At Shutdown + 45 yrs

Total including contingencies

OPTION B (Greenfield Site)

Revised Cost (x1000) in 2022 Dollars

Time Frame	Envelopes I - V					
	I	II	III	IV	V	Care & Maintenanc
Detail Plan						
At Shutdown	\$1,090	\$3,090	\$1,573	\$4,811	\$966	\$0
At Shutdown + 25 yrs.	\$0	\$1,885	\$1,619	\$8,988	\$2,554	\$6,325
At Shutdown + 45 yrs.	\$0	\$0	\$0	\$13,101	\$0	\$4,909
Subtotal	\$1,090	\$4,975	\$3,192	\$26,900	\$3,520	\$11,234

15% contingency for Detail Plan and At Shutdown

30% contingency for At Shutdown + 25 yrs and At Shutdown + 45 yrs

Total including contingencies

1,315 \$3,492.58 \$1,628.20 \$5,253.62

excluding recycling credit

s

		Excluding Licensing Fees
Licensing fee, Care & Maintenance	Total of All Envelopes	Total of All Envelopes
\$1,697	\$1,697	\$1,697
	\$15,993	\$15,993
\$6,712	\$28,885	\$28,747
\$5,209	\$17,945	\$17,834
\$13,619	\$64,520	\$64,272

	\$2,654	\$2,654
	\$14,049	\$13,975
	\$81,223	\$80,900

		Excluding Licensing Fees
Licensing fee, Care & Maintenance	Total of All Envelopes	Total of All Envelopes
	\$0	
	\$220	
	\$1,211	
	\$4,612	
\$0	\$6,043	\$0

		Excluding Licensing Fees
Licensing fee, Care & Maintenance	Total of All Envelopes	Total of All Envelopes
\$1,697	\$1,697	\$1,330
\$0	\$16,212	\$16,212
\$6,712	\$30,097	\$29,943
\$5,209	\$22,557	\$22,434
\$13,619	\$70,563	\$69,919

	\$2,686	\$2,631
	\$15,796	\$15,713
	\$89,046	\$88,264

3,337 recycling credit
\$67,226

Total of All Envelopes	Recycling credits	Total excluding recycling credits
\$1,523		\$1,523
\$11,530	(1,126)	\$12,656
\$21,371	(1,531)	\$22,902
\$18,010	(293)	\$18,303
\$52,434	(2,950)	\$55,384
\$1,958	(169)	\$2,127
\$11,814	(547)	\$12,362
\$66,207	(3,666)	\$69,873

\$12,656

	recycling credit	
	Phase 1	Phase 2
PE 1	- 225,232	-
PE 2	- 402,548	- 170,470
PE 3	- 55,425	- 50,125
PE 4	- 442,736	- 1,067,094
PE 5	-	- 243,560
	- 1,125,941	- 1,531,249

Phase 3

-

-

-

- 292,802

-

- 292,802

2% inflation rate

OPTION B (Greenfield Site)

Revised Cost (x1000) in 2025 Dollar:

Time Frame	Envelopes I - V (per AMA report + option A cost)					
	I (Office)	II (ISAC)	III (BWXT)	IV (Accelerator)	V (ARIEL)	VI (IAMI)
Detail Plan						
At Shutdown + 0 yrs	\$1,620	\$4,273	\$2,081	\$6,971	\$1,048	\$0
At Shutdown + 25 yrs.	\$0	\$2,328	\$2,095	\$11,968	\$3,734	\$2,048
At Shutdown + 45 yrs.	\$0	\$0	\$0	\$12,735	\$0	\$0
Subtotal	\$1,620	\$6,601	\$4,177	\$31,674	\$4,782	\$2,048

15% contingency for Detail Plan and At Shutdown

30% contingency for At Shutdown + 25 yrs and At Shutdown + 45 yrs

Total including contingencies

Time Frame	Additional cost (added by Anne Trudel)					
	I (Office)	II (ISAC)	III (BWXT)	IV (Accelerator)	V (ARIEL)	VI (IAMI)
Detail Plan						
At Shutdown + 0 yrs	\$59	\$35	\$21	\$105	\$0	
At Shutdown + 25 yrs.	\$0	\$144	\$58	\$863	\$145	
At Shutdown + 45 yrs.	\$0	\$0	\$0	\$4,612	\$0	
Subtotal	\$59	\$179	\$79	\$5,580	\$145	\$0

Time Frame	Total cost					
	I (Office)	II (ISAC)	III (BWXT)	IV (Accelerator)	V (ARIEL)	VI (IAMI)
Detail Plan	\$0	\$0	\$0	\$0	\$0	\$0
At Shutdown + 0 yrs	\$1,679	\$4,308	\$2,102	\$7,076	\$1,048	\$0
At Shutdown + 25 yrs.	\$0	\$2,473	\$2,154	\$12,832	\$3,879	\$2,048
At Shutdown + 45 yrs.	\$0	\$0	\$0	\$17,347	\$0	\$0
Subtotal	\$1,679	\$6,781	\$4,256	\$37,255	\$4,927	\$2,048

15% contingency for Detail Plan and At Shutdown

30% contingency for At Shutdown + 25 yrs and At Shutdown + 45 yrs

Total including contingencies

OPTION B (Greenfield Site)

Revised Cost (x1000) in 2022 Dollars

Time Frame	Envelopes I - V					
	I	II	III	IV	V	Care & Maintenanc
Detail Plan						
At Shutdown	\$1,090	\$3,090	\$1,573	\$4,811	\$966	\$0
At Shutdown + 25 yrs.	\$0	\$1,885	\$1,619	\$8,988	\$2,554	\$6,325
At Shutdown + 45 yrs.	\$0	\$0	\$0	\$13,101	\$0	\$4,909
Subtotal	\$1,090	\$4,975	\$3,192	\$26,900	\$3,520	\$11,234

15% contingency for Detail Plan and At Shutdown

30% contingency for At Shutdown + 25 yrs and At Shutdown + 45 yrs

Total including contingencies

1,315 \$3,492.58 \$1,628.20 \$5,253.62

excluding recycling credit

s

		Excluding Licensing Fees
Licensing fee, Care & Maintenance	Total of All Envelopes	Total of All Envelopes
\$1,697	\$1,697	\$1,697
	\$15,993	\$15,993
\$6,712	\$28,885	\$28,747
\$5,209	\$17,945	\$17,834
\$13,619	\$64,520	\$64,272

	\$2,654	\$2,654
	\$14,049	\$13,975
	\$81,223	\$80,900

		Excluding Licensing Fees
Licensing fee, Care & Maintenance	Total of All Envelopes	Total of All Envelopes
	\$0	
	\$220	
	\$1,211	
	\$4,612	
\$0	\$6,043	\$0

		Excluding Licensing Fees
Licensing fee, Care & Maintenance	Total of All Envelopes	Total of All Envelopes
\$1,697	\$1,697	\$1,330
\$0	\$16,212	\$16,212
\$6,712	\$30,097	\$29,943
\$5,209	\$22,557	\$22,434
\$13,619	\$70,563	\$69,919

	\$2,686	\$2,631
	\$15,796	\$15,713
	\$89,046	\$88,264

3,337 recycling credit
\$67,226

Total of All Envelopes	Recycling credits	Total excluding recycling credits
\$1,523		\$1,523
\$11,530	(1,126)	\$12,656
\$21,371	(1,531)	\$22,902
\$18,010	(293)	\$18,303
\$52,434	(2,950)	\$55,384
\$1,958	(169)	\$2,127
\$11,814	(547)	\$12,362
\$66,207	(3,666)	\$69,873

\$12,656

	recycling credit	
	Phase 1	Phase 2
PE 1	- 225,232	-
PE 2	- 402,548	- 170,470
PE 3	- 55,425	- 50,125
PE 4	- 442,736	- 1,067,094
PE 5	-	- 243,560
	- 1,125,941	- 1,531,249

Phase 3

-

-

-

- 292,802

-

- 292,802

Labour rates 2025		
Rad survey cost:	802	\$ per shift
Dismantling cost:	481	\$ per shift
Building Demolition costs:	24	\$ per m3
Trailer demo costs:	18	\$ per m3
Concrete demo costs:	401	\$ per m3
Project Mngr/Eng/Health Physic	2,029.81	\$ per shift
Regulatory Licensing	2,368.11	\$ per shift

Assume escalation indexes are 2% per annum.

1.061208 - 3 years from 2023 to 2025

Labour rates 2022		
Rad survey cost:	756	\$ per shift
Dismantling cost:	453	\$ per shift
Building Demolition costs:	23	\$ per m3
Trailer demo costs:	17	\$ per m3
Concrete demo costs:	378	\$ per m3
Project Mngr/Eng/Health Physic	1,913	\$ per shift
Regulatory Licensing	2,232	\$ per shift

Escalation indexes are from Statistics Canada CPI for 2018 to 2022

Radwaste disposal cost and Lump Sum Costs also corrected with inflation.

1.1592339 - 5 years from 2018 to 2022

Labour rates 2017		
Rad survey cost:	652	\$ per shift
Dismantling cost:	391	\$ per shift
Building Demolition costs:	20	\$ per m3
Trailer demo costs:	14	\$ per m3
Concrete demo costs:	326	\$ per m3
Project Mngr/Eng/Health Physic	1,650	\$ per shift
Regulatory Licensing	1,925	\$ per shift

Escalation indexes are from Statistics Canada CPI for 2013 to 2017

Radwaste disposal cost and Lump Sum Costs also corrected with inflation.

1.0719491 - 5 years from 2013 to 2017

Labour rates 2013		
Rad survey cost:	608	\$ per shift
Dismantling cost:	365	\$ per shift
Building Demolition costs:	18	\$ per m3
Trailer demo costs:	13	\$ per m3
Concrete demo costs:	304	\$ per m3

Escalation indexes are from Statistics Canada - CPI for 2007 to 2013

Radwaste disposal was \$12,600 in 2007. Correct that cost with inflation.

1.1149532

Labour rates 2007		
Rad survey cost:	545	\$ per shift
Dismantling cost:	327	\$ per shift
Building Demolition costs:	16	\$ per m3
Trailer demo costs:	12	\$ per m3
Concrete demo costs:	273	\$ per m3

Escalation indexes are from Statistics Canada - CPI for 2003 to 2007

1.0909176

Labour rates 2003		
Rad survey cost:	500	\$ per shift
Dismantling cost:	300	\$ per shift
Structural Dismantling	15	\$ per m3
Concrete Dismantling	250	\$ per m3

Disposal rates 2025		
Landfill disposal:	14	\$ per m3
Radwaste disposal:	20237	\$ per m3
Recycle:	30	\$ per m3
Landfill disposal:	219	\$ per tonne

Disposal rates 2022		
Landfill disposal:	12	\$ per m3
Radwaste disposal:	17457	\$ per m3
Recycle:	26	\$ per m3
Landfill disposal:	189	\$ per tonne

Disposal rates 2017		
Landfill disposal:	10	\$ per m3
Radwaste disposal:	15059	\$ per m3
Recycle:	22	\$ per m3
Landfill disposal:	163	\$ per tonne

Disposal rates 2013		
Landfill disposal:	10	\$ per m3
Radwaste disposal:	14048	\$ per m3
Recycle:	21	\$ per m3
Landfill disposal:	152	\$ per tonne

Disposal rates 2007		
Landfill disposal:	9	\$ per m3
Radwaste disposal:	12600	\$ per m3
Recycle:	19	\$ per m3
Landfill disposal:	136	\$ per tonne

Disposal rates 2003		
Landfill disposal:	8	\$ per tonne
Radwaste disposal:	10000	\$ per m3
Recycle:	17	\$ per m3
Building disposal:	125	\$ per tonne

2000	5.67	2.70%				
2001	5.82	2.50%				
2002	5.94	2.20%				
2003	6.11	2.80%				
2004	6.22	1.80%				
2005	6.36	2.20%				
2006	6.49	2.00%				
2007	6.63	2.20%				
2008	6.78	2.30%				
2009	6.8	0.30%				
2010	6.92	1.80%				
2011	7.12	2.90%				
2012	7.23	1.50%				
2013	7.3	0.90%	\$ 0.009			
2014	7.44	2.00%	\$ 0.020			
2015	7.52	1.10%	\$ 0.011			
2016	7.63	1.40%	\$ 0.014			
2017	7.75	1.60%	\$ 0.016	1.071949		
2018		2.30%	\$ 0.023			
2019		1.90%	\$ 0.019			
2020		0.70%	\$ 0.007			
2021		3.40%	\$ 0.034			
2022		6.80%	\$ 0.068		1.159234	
2023						

Cost at each of the time frames contain an allowance for mobilization and demobilization of contractors

Rad Survey Costs based on Consultant (\$2003) for Decommissioning Study

General labour costs based on 2007 costs (RS Means Construction Published Rates) corrected back for inflation to 2003 dollars.

**TRIUMF PRELIMINARY DECOMMISSIONING PLAN
OPTION B - DEMOLITION AND DISPOSAL
OF EXISTING FACILITIES
VANCOUVER, BRITISH COLUMBIA**

Budget Estimate

November 2023

Armstrong Moore & Associates

**TRIUMF Preliminary Decommissioning Plan
Option B - Demolition and Disposal of
Existing Facilities
Vancouver, British Columbia**

Prepared For:

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1.0 INTRODUCTION

- 1.1 General : The estimate presented in this report is intended to provide a realistic assessment of the direct and indirect construction costs for the demolition of the existing structures located at TRIUMF facility, Vancouver, British Columbia with exceptions of items as defined within item 1.3 below.
- The estimated construction costs provided within this report are based on documentations and drawings included with in Appendix B of this report and priced where possible at rates considered competitive for a project of this type in Vancouver, British Columbia.
- The estimate is deemed to provide a reasonable cost envelope for the de-construction cost and additional project costs, where stated. As such the estimate should not be deemed as the final estimate of costs for this project. It provides a realistic cost envelope from which the project design can be reasonably developed. It is recommended that further cost estimates be undertaken by Armstrong Moore & Associates or other Professional Cost Consultants as more detailed design is available and to reference these against the baseline provided within said report.
- 1.2 Project Description : The proposed works are the careful deconstruction and salvage of materials of the existing TRIUMF facility structures. Works will be confined to the three meters around the excising structure footprint. All HAZMAT materials with the facility will be handled and disposed of in accordance with current standards. All materials will be removed from the site and cost will include for the recycling of concrete, steel and any other reusable recycle material. All materials will become the property of the demolition Contractor.
- 1.3 Exclusions : This Demolition Estimate specifically excludes the following
- : Legal fees and expenses
 - : Owners administration and associated staff costs
 - : Financing and Fundraising
 - : Development charges - except where noted
 - : Removal of Hazardous materials - except where noted
 - : Allowances provided for unforeseen ground conditions - rock and additional dewatering
 - : Engineering, Environmental & Design Services required for Demolition
 - : Removal of TRIUMF machinery within the building
 - : Imported fill to grade level other than for basement areas
 - : UBC Campus and Community Planning Charge
 - : Escalation contingency
 - : Erratic market conditions - lack of bidders, unforeseen labour problems

2.0 EXECUTIVE COST SUMMARY

Summary Page

Option B - Work Package/Description Demolition & Disposal of Existing Facilities (Greenfield Site)	Structure Volume (m³)	Unit Cost (\$)	Waste Disposal				Deconstruction Labour / Equipment	Sum Total(s) Costs	If No Recycling
			Landfill Cost	Recycling Credit	HAZMAT Cost	Total			
	M3	\$/ M3	\$	\$	\$	\$	\$	\$	
Planning Envelope No. I - Office Facilities/Trailers & Support Facilities									
Shutdown + 0 Years Cost Estimates	34,311		\$388,000	\$226,300	\$183,200	\$344,900	\$832,200	\$1,177,100	\$1,403,400
Planning Envelope No. II - ISAC I & II Facilities									
Shutdown + 0 Years Cost Estimates	61,689		\$635,800	\$446,600	\$0	\$189,200	\$1,908,400	\$2,097,600	\$2,544,200
Shutdown + 20 Years Cost Estimates	16,218		\$397,400	\$164,100	\$0	\$233,300	\$1,840,500	\$2,073,800	\$2,237,900
Planning Envelope No. III - BWXT - Radiochemistry Annex Facilities									
Shutdown + 0 Years Cost Estimates	13,034		\$179,000	\$47,400	\$150,600	\$282,200	\$1,069,500	\$1,351,700	\$1,399,100
Shutdown + 20 Years Cost Estimates	8,532		\$199,200	\$45,800	\$40,000	\$193,400	\$1,774,800	\$1,968,200	\$2,014,000
Planning Envelope No. IV - Main Accelerator Building/Annexes & Remote Handling									
Shutdown + 0 Years Cost Estimates	49,543		\$730,700	\$489,200	\$412,200	\$653,700	\$3,220,700	\$3,874,400	\$4,363,600
Shutdown + 20 Years Cost Estimates	115,020		\$1,770,800	\$1,184,500	\$411,400	\$997,700	\$9,321,300	\$10,319,000	\$11,503,500
Shutdown + 45 Years Cost Estimates	58,942		\$804,600	\$267,000	\$479,900	\$1,017,500	\$10,956,300	\$11,973,800	\$12,240,800
Planning Envelope No. V - ARIEL Facility									
Shutdown + 20 Years Cost Estimates	25,928		\$1,737,100	\$280,700	\$0	\$1,456,400	\$1,852,000	\$3,308,400	\$3,589,100
Planning Envelope No. VI - IAMI Facility									
Shutdown + 20 Years Cost Estimates	17,243		\$754,500	\$55,700	\$0	\$698,800	\$1,213,600	\$1,912,400	\$1,968,100
Total (2023 Dollars)			\$7,597,100	\$3,207,300	\$1,677,300	\$6,067,100	\$33,989,300	\$40,056,400	\$43,263,700

3.0 PROJECT AREAS

Areas

Project Area

Planning Envelope No. I - Office Facilities/Trailers & Support Facilities	8,155	m2
Planning Envelope No. II - ISAC I & II Facilities	13,519	m2
Planning Envelope No. III - BWXT Radiochemistry Annex Facilities	5,881	m2
Planning Envelope No. IV - Main Accelerator Building/Annexes & Remote Handling	29,214	m2
Planning Envelope No. V - ARIEL Facility	5,150	m2
Planning Envelope No. VI - IAMI Facility	3,342	m2
TOTAL	65,261	m2

SITE DEVELOPED AREA

Area of property	62,000	m2
Footprint of Buildings	29,413	m2
SITE DEVELOPED AREA	32,587	m2

Site Developed Area is the area of the site less the foot-print area of the building.

The above areas have been measured in accordance with the Canadian Institute of Quantity Surveyors' Method of Measurement of Buildings by Area and Volume.

4.0 Construction Cost Summary

Cost Summary

Option B - Work Package/Description Demolition & Disposal of Existing Facilities (Greenfield Site)										
Structure Volume (m³)	Unit Cost (\$)	Waste Disposal				Deconstruction Labour/ Equipment	Sum Total(s) Costs	If No Recycling		
		Landfill Cost	Recycling Credit	HAZMAT Cost	Total					
M3	\$/M3	\$	\$	\$	\$	\$	\$	\$		
<u>Planning Envelope No. 1 – Office Facilities/Trailers & Support Facilities</u>										
<u>Shutdown + 0 Years Cost Estimates</u>										
<u>AREA 1.0</u>										
Main Office Building										
Trailers										
Trailer Ff	669	\$8.37	\$8,100	\$6,700	\$1,100	\$2,500	\$3,100	\$5,600	\$12,300	
Trailer Hh	1,087	\$8.46	\$13,200	\$10,900	\$1,800	\$4,100	\$5,100	\$9,200	\$20,100	
<u>AREA 2.0</u>										
Trailers										
Trailer A	335	\$8.67	\$4,100	\$3,400	\$600	\$1,300	\$1,600	\$2,900	\$6,300	
Trailer F	70	\$7.17	\$800	\$700	\$100	\$200	\$300	\$500	\$1,200	
Trailer Q	70	\$7.17	\$800	\$700	\$100	\$200	\$300	\$500	\$1,200	
Trailer Gg	2,963	\$8.47	\$35,900	\$29,700	\$5,000	\$11,200	\$13,900	\$25,100	\$54,800	
Trailer Ll	167	\$8.37	\$2,000	\$1,700	\$300	\$600	\$800	\$1,400	\$3,100	
Trailer Mm	167	\$8.37	\$2,000	\$1,700	\$300	\$600	\$800	\$1,400	\$3,100	
Trailer Pp	125	\$7.97	\$1,500	\$1,300	\$200	\$400	\$600	\$1,000	\$2,300	
Trailer Rr	335	\$8.67	\$4,100	\$3,400	\$600	\$1,300	\$1,600	\$2,900	\$6,300	
Machine Shop Building	5,053	\$23.73	\$45,800	\$36,600	\$9,400	\$18,600	\$101,300	\$119,900	\$156,500	
Stores & Design Office Building	2,848	\$37.89	\$32,800	\$14,400	\$0	\$18,400	\$89,500	\$107,900	\$122,300	
HAZMAT - Hazardous Materials Storage Building	123	\$176.69	\$4,300	\$900	\$5,100	\$8,500	\$13,200	\$21,700	\$22,600	
Plant Storage Building	732	\$26.37	\$8,900	\$8,000	\$0	\$900	\$18,400	\$19,300	\$27,300	
Plant Services Building	2,788	\$26.40	\$32,900	\$29,500	\$2,200	\$5,600	\$68,000	\$73,600	\$103,100	
Plant Storage Shed- temporary	1,046	\$11.00	\$13,300	\$8,400	\$0	\$4,900	\$6,600	\$11,500	\$19,900	
Equipment Marquee tent - temporary	392	\$11.22	\$5,000	\$3,100	\$0	\$1,900	\$2,500	\$4,400	\$7,500	
Machine Shop Material shed - temporary	392	\$11.22	\$5,000	\$3,100	\$0	\$1,900	\$2,500	\$4,400	\$7,500	
Sub Total			\$388,000	\$226,300	\$183,200	\$344,900	\$832,200	\$1,177,100	\$1,403,400	

4.0 Construction Cost Summary Cont'd

Option B - Work Package/Description Demolition & Disposal of Existing Facilities (Greenfield Site)		Structure Volume (m³)	Unit Cost (\$)	Waste Disposal				Total	Deconstruction Labour/ Equipment	Sum Total(s) Costs	If No Recycling
				Landfill Cost	Recycling Credit	HAZMAT Cost					
		M3	\$/M3	\$	\$	\$	\$	\$	\$	\$	
Planning Envelope No. II - ISAC I & II Facilities											
Shutdown + 0 Years Cost Estimates											
ISAC I Building - Experimental Hall from el. 289.00 to el. 333.75		23,745	\$36.37	\$176,000	\$167,300	\$0		\$8,700	\$854,900	\$863,600	\$1,030,900
ISAC II Building - complete		29,219	\$35.23	\$419,100	\$245,600	\$0		\$173,500	\$855,800	\$1,029,300	\$1,274,900
ISAC I Building - Service Annex from el. 289.00 to el. 317.83		6,061	\$33.78	\$40,700	\$33,700	\$0		\$7,000	\$197,700	\$204,700	\$238,400
Sub Total		61,689		\$635,800	\$446,600	\$0		\$189,200	\$1,908,400	\$2,097,600	\$2,544,200
Shutdown + 20 Years Cost Estimates											
Target Maintenance Hall Including Hot Cell Support Area - North at el. 264.00 and Mechanical Penthouse at el. 310.00		9,391	\$64.54	\$201,500	\$123,100	\$0		\$78,400	\$527,700	\$606,100	\$729,200
Mass Separator Pit at el. 264.00 and Mass Separator Experiment Room at el. 278.00		2,723	\$225.54	\$85,600	\$17,900	\$0		\$67,700	\$546,400	\$614,100	\$632,000
ISAC I Service Annex from el. 264.00 to el. 289.00		2,914	\$225.52	\$91,600	\$19,200	\$0		\$72,400	\$584,700	\$657,100	\$676,300
Interconnecting Beam Line Tunnel Between ISAC I & Main Accelerator Buildings		1,191	\$165.02	\$18,700	\$3,900	\$0		\$14,800	\$181,700	\$196,500	\$200,400
Sub Total		16,218		\$397,400	\$164,100	\$0		\$233,300	\$1,840,500	\$2,073,800	\$2,237,900
Planning Envelope No. III - BWXT - Radiochemistry Annex Facilities											
Shutdown + 0 Years Cost Estimates											
Radio Chemistry Annex		9,162	\$128.95	\$125,700	\$24,600	\$150,600		\$251,700	\$929,800	\$1,181,500	\$1,206,100
BWXT Building above el. 289.00 (Grade)		3,872	\$43.96	\$53,300	\$22,800	\$0		\$30,500	\$139,700	\$170,200	\$193,000
Sub Total		13,034		\$179,000	\$47,400	\$150,600		\$282,200	\$1,069,500	\$1,351,700	\$1,399,100
Shutdown + 20 Years Cost Estimates											
BWXT Building TR30-2 Cyclotron Area at el. 261.88 and RCA 3 Area at el. 275.88		4,499	\$261.61	\$102,300	\$23,500	\$0		\$78,800	\$1,098,100	\$1,176,900	\$1,200,400
TR30-1 Cyclotron		2,219	\$200.12	\$58,800	\$13,500	\$24,300		\$69,600	\$374,400	\$444,000	\$457,500
CP42 Cyclotron		1,815	\$191.36	\$38,100	\$8,800	\$15,700		\$45,000	\$302,300	\$347,300	\$356,100
Sub Total		8,532		\$199,200	\$45,800	\$40,000		\$193,400	\$1,774,800	\$1,968,200	\$2,014,000

4.0 Construction Cost Summary Cont'd

Option B - Work Package/Description Demolition & Disposal of Existing Facilities (Greenfield Site)									
Structure Volume (m³)	Unit Cost (\$)	Waste Disposal				Deconstruction Labour / Equipment	Sum Total(s) Costs	If No Recycling	
		Landfill Cost	Recycling Credit	HAZMAT Cost	Total				
M3	\$/M3	\$	\$	\$	\$	\$	\$	\$	
<u>Planning Envelope No. IV - Main Accelerator Building/Annexes & Remote Handling</u>									
Shutdown + 0 Years Cost Estimates									
Meson Hall Extension Service Annex	5,018	\$160.23	\$133,600	\$110,600	\$13,800	\$36,800	\$767,200	\$804,000	\$914,600
Meson Hall Extension Building	13,450	\$85.34	\$190,400	\$154,900	\$53,300	\$88,800	\$1,059,100	\$1,147,900	\$1,302,800
CMMS (Biomedical Facility)	18,555	\$28.84	\$159,500	\$104,400	\$137,900	\$193,000	\$342,100	\$535,100	\$639,500
M15 Experimental Building	1,867	\$52.17	\$41,800	\$37,500	\$6,400	\$10,700	\$86,700	\$97,400	\$134,900
Compressor Building - 1986	1,253	\$86.94	\$23,700	\$3,100	\$17,300	\$37,900	\$71,000	\$108,900	\$112,000
New Compressor Building - 2012	2,881	\$21.17	\$17,600	\$16,900	\$0	\$700	\$60,300	\$61,000	\$77,900
Service Annex Extension	3,586	\$72.16	\$65,300	\$33,700	\$77,400	\$109,000	\$149,800	\$258,800	\$292,500
Remote Handling Building & Service Tunnel	2,933	\$293.63	\$98,800	\$28,100	\$106,100	\$176,800	\$684,500	\$861,300	\$889,400
Sub Total	49,543		\$730,700	\$489,200	\$412,200	\$653,700	\$3,220,700	\$3,874,400	\$4,363,600
Shutdown + 20 Years Cost Estimates									
Proton Hall Extension Building	12,559	\$32.77	\$108,200	\$79,300	\$35,700	\$64,600	\$347,000	\$411,600	\$490,900
Electron Hall Building	21,862	\$72.52	\$337,000	\$230,900	\$119,600	\$225,700	\$1,359,700	\$1,585,400	\$1,816,300
Service Annex Building & 3rd IONSOURCE (over) - 1981	18,707	\$190.33	\$394,300	\$176,200	\$87,500	\$305,600	\$3,254,900	\$3,560,500	\$3,736,700
Manson Hall Building	49,057	\$70.11	\$633,800	\$406,500	\$161,000	\$388,300	\$3,051,000	\$3,439,300	\$3,845,800
Cyclotron Vault Building - Demolition & Removal of Superstructure Only	12,835	\$103.01	\$297,500	\$291,600	\$7,600	\$13,500	\$1,308,700	\$1,322,200	\$1,613,800
Sub Total	\$115,020		\$1,770,800	\$1,184,500	\$411,400	\$997,700	\$9,321,300	\$10,319,000	\$11,503,500
Shutdown + 45 Years Cost Estimates									
Cyclotron Vault Building - Demolition & Removal	58,942	\$203.14	804,600	\$267,000	479,900	1,017,500	10,956,300	11,973,800	\$12,240,800
Sub Total	58,942		\$804,600	\$267,000	\$479,900	\$1,017,500	\$10,956,300	\$11,973,800	\$12,240,800
<u>Planning Envelope No. V - ARIEL Facility</u>									
Shutdown + 20 Years Cost Estimates									
ARIEL Building Including Beam Line Tunnel Between ARIEL and MAB Buildings	25,928	\$127.60	1,737,100	\$280,700	0	1,456,400	1,852,000	3,308,400	\$3,589,100
Sub Total	25,928		\$1,737,100	\$280,700	\$0	\$1,456,400	\$1,852,000	\$3,308,400	\$3,589,100
<u>Planning Envelope No. VI - IAMI Facility</u>									
Shutdown + 20 Years Cost Estimates									
IAMI Building - Demolition & Removal	17,243	\$110.91	754,500	\$55,700	0	698,800	1,213,600	1,912,400	\$1,968,100
Sub Total	17,243	111	754,500	\$55,700	0	698,800	1,213,600	1,912,400	1,968,100
Total			\$7,597,100	\$3,207,300	\$1,677,300	\$6,067,100	\$33,989,300	\$40,056,400	\$43,263,700

5.0 COST CONSIDERATIONS

- 5.1 Pricing :** The cost estimate has been priced at current market rates taking into account the size, location and nature of the project. All unit rates are based on being competitive (a minimum of 4 general contractor bids and at least 3 subcontractor bids for each trade) being received in fourth quarter of 2023 (Q4 2023). Reasonable levels of productivity have been included when evaluating the rates and no allowance has been included for any extraordinary market conditions.
- 5.2 Escalation :** This estimate has an allowance of 0% included for construction cost escalation.
- 5.3 Taxes :** This estimate does not include Tax. It is recommended that the owner's budget makes provision for taxes, if applicable.
- 5.4 Risk Mitigation :** It is recommended that the client and project team review this document including documents utilized for its preparation. Should modifications be required due to either errors or omission notification must be made within two weeks and an amended report, if necessary will be issued.
- 5.5 Contingencies :** Pricing :
An allowance of 2% has been included within this estimate to cover pricing unknowns for demolition.

**Appendix A
Estimate Details**

TRIUMF Preliminary Decommissioning Plan Option B - Demolition & Disposal of Existing Facilities (Greenfield Site)													Unit Cost (\$)	Waste Disposal			Deconstruction Laborer / Equipment \$	Sum Total Costs \$
CFR	Footprint	Height	Perimeter	External Envelope	Volume	Unit Rate	Demo Total Sum	Waste	HAZMAT	Total	Recycling credit	Structure Volume (m³)						
M2	M2	M	m	M2	M3	\$	\$	\$	\$	\$	\$	M3						
Planning Envelope No. 1 – Office Facilities/Trailers & Support Facilities																		
Shutdown + 0 Years Cost Estimates																		
AREA 1.0																		
Main Office Building																		
Main Floor Office Building	3,430	2,060			14,950								14,950	\$51.10	\$167,500		\$502,100	\$765,900
Main Floor Office Building	1,380					\$167.03	\$502,860	\$105,239	\$156,449	\$763,807	\$62,140							
Second Floor Office Building	680	680			1,887	\$118.95	\$80,862											
Waste Disposal - office	1,370					\$139.19	\$190,694											
Waste Disposal - office						\$33.98		\$98,941			\$11.43							
Pre 1990 HAZMAT - Lab						\$45,411		\$6,336	\$7,908		\$453.19							
Pre 1990 HAZMAT - Lab						\$11.76		\$11,176	\$148,411		\$30,719							
Pre 1990 HAZMAT - office						\$53.97												
Trailers																		
Trailer Ff	178	178	3.75		669		\$3,148	\$1,400	\$1,130	\$5,677	\$6,719	669	669	\$8.37	\$8,100	\$1,100	\$2,500	\$5,600
Combined Trailer Unit (4 x 12 ft. x 40 ft. trailers - 12ft ht)	178					\$17.64	\$3,148	\$1,400	\$1,130		\$6,719							
Waste Disposal						\$7.84		\$1,400	\$1,130		\$37,666							
Pre 1990 HAZMAT - Trailer						\$6.33												
Trailer Hh	290	290	3.75		1,087		\$5,115	\$2,274	\$1,837	\$9,226	\$10,919	1,087	1,087	\$8.46	\$13,200	\$1,800	\$4,100	\$9,200
Combined Trailer Unit (5 x 12 ft. x 52 ft. trailers)	290					\$17.64	\$5,115	\$2,274	\$1,837		\$37,666							
Waste Disposal						\$7.84												
Pre 1990 HAZMAT - Trailer excel point						\$6.33												
AREA 2.0																		
Trailers																		
Trailer A	89	89	3.75		335		\$1,574	\$700	\$565	\$2,839	\$3,360	335	335	\$8.67	\$4,100	\$600	\$1,100	\$2,900
Combined Trailer Unit (2 x 12 ft. x 40 ft. trailers)	89					\$17.64	\$1,574	\$700	\$565		\$3,360							
Waste Disposal						\$7.84												
Pre 1990 HAZMAT - Trailer excel point						\$6.33												
Trailer F	19	19	3.75		70		\$328	\$146	\$118	\$591	\$700	70	70	\$7.17	\$800	\$100	\$200	\$500
(10 ft. x 20 ft. Unit)	19					\$17.64	\$328	\$146	\$118		\$700							
Waste Disposal						\$7.84												
Pre 1990 HAZMAT - Trailer excel point						\$6.33												
Trailer Q	19	19	3.75		70		\$328	\$146	\$118	\$591	\$700	70	70	\$7.17	\$800	\$100	\$200	\$500
(10 ft. x 20 ft. Unit)	19					\$17.64	\$328	\$146	\$118		\$700							
Waste Disposal						\$7.84												
Pre 1990 HAZMAT - Trailer excel point						\$6.33												
Trailer Gg	790	790	3.75		2,963		\$13,936	\$6,196	\$5,004	\$25,136	\$29,749	2,963	2,963	\$8.47	\$35,900	\$5,000	\$11,200	\$25,100
Combined Trailer Unit (12 x 12 ft. x 40 ft. trailers & 2 x 12 ft. x 20 ft. trailers)	790					\$17.64	\$13,936	\$6,196	\$5,004		\$29,749							
Waste Disposal						\$7.84												
Pre 1990 HAZMAT - Trailer excel point						\$6.33												
Trailer Ll	45	45	3.75		167		\$787	\$350	\$283	\$1,419	\$1,680	167	167	\$8.37	\$2,000	\$300	\$600	\$1,400
(12 ft. x 40 ft. Unit)	45					\$17.64	\$787	\$350	\$283		\$1,680							
Waste Disposal						\$7.84												
Pre 1990 HAZMAT - Trailer excel point						\$6.33												
Trailer Mm	45	45	3.75		167		\$787	\$350	\$283	\$1,419	\$1,680	167	167	\$8.37	\$2,000	\$300	\$600	\$1,400
(12 ft. x 40 ft. Unit)	45					\$17.64	\$787	\$350	\$283		\$1,680							
Waste Disposal						\$7.84												
Pre 1990 HAZMAT - Trailer excel point						\$6.33												
Trailer Pp	33	33	3.75		125		\$590	\$262	\$212	\$1,065	\$1,260	125	125	\$7.97	\$1,500	\$200	\$400	\$1,000
(12 ft. x 30 ft. Unit)	33					\$17.64	\$590	\$262	\$212		\$1,260							
Waste Disposal						\$7.84												
Pre 1990 HAZMAT - Trailer excel point						\$6.33												
Trailer Rr	89	89	3.75		335		\$1,574	\$700	\$565	\$2,839	\$3,360	335	335	\$8.67	\$4,100	\$600	\$1,100	\$2,900
Combined Trailer Unit (2 x 12 ft. x 40 ft. trailers)	89					\$17.64	\$1,574	\$700	\$565		\$3,360							
Waste Disposal						\$7.84												
Pre 1990 HAZMAT - Trailer excel point						\$6.33												
Machine Shop Building																		
Main Floor Office	1,066	933	6.70	134	800		\$101,331	\$9,165	\$9,271	\$119,867	\$36,608	5,053	5,053	\$22.73	\$45,800	\$9,400	\$18,600	\$119,900
Second Floor Office	70					\$139.19	\$9,744											
Main Floor machine	863					\$94.35	\$81,426											
Waste Disposal - office	73					\$139.19	\$10,161											
Waste Disposal - machine						\$33.98		\$5,145			\$9,52							
Pre 1990 HAZMAT - 1982 office						\$46,646		\$4,021	\$7,717		\$33,246							
Pre 1990 HAZMAT - 1982 machine						\$53.97			\$1,654									

TRIUMF Preliminary Decommissioning Plan Option B - Demolition & Disposal of Existing Facilities (Greenfield Site)	GFA M2	Footprint M2	Height M	Perimeter m	External Envelope M2	Volume M3	Unit Rate \$	Demo Total Sum \$	Waste \$	HAZMAT \$	Total \$	Recycling credit \$	Structure Volume (m³) M3	Unit Cost (\$) \$/M3	Waste Disposal				Deconstruction Labour / Equipment \$	Sum Total(o) Costs \$
															Landfill Cost \$	Recycling Credit \$	HAZMAT Cost \$	Total \$		
Stores & Design Office Building	721	356	8.00	91	728	2,848		\$89,807	\$18,361	\$0	\$107,868		2,848	\$37.89	\$32,800	\$14,400	\$0	\$18,400	\$89,500	\$107,900
Main Floor Office -	114						\$139.19	\$15,868												
Main Floor store - steel / combine	242						\$94.35	\$22,633												
Second Floor Office	365						\$139.19	\$50,806	\$17,234			\$9,52								
Waste Disposal - office							\$4.66		\$1,127.43	\$0.00		\$9,884								
Waste Disposal - stone							\$0.00			\$5,100	\$21,700	\$903	123	\$176.69	\$4,300	\$900	\$5,100	\$8,500	\$13,200	\$21,700
NIL - Pre 1990 HAZMAT - 2011 office	95	95	3.00	41	122.8125	123		\$13,200	\$3,400											
NIL - Pre 1990 HAZMAT - 2011 store								\$13,195.00												
HAZMAT - Hazardous Materials Storage Building																				
Main Floor - Cone Block	95							\$13,195.00												
Waste Disposal								\$13,195.00												
Pre 1990 HAZMAT - 1980	195	195	3.75	59	222.65625	732		\$18,400	\$900	\$5,116	\$19,300	\$7,971	732	\$26.37	\$8,900	\$8,000	\$0	\$900	\$18,400	\$19,300
Plant Storage Building	195							\$18,400												
Main Floor - steel								\$18,400												
Waste Disposal								\$18,400												
NIL - Pre 1990 HAZMAT - 2001								\$18,400												
Plant Service Building	721	558	5.00	106	531.25	2,788		\$88,000	\$3,400	\$2,200	\$73,600	\$29,454	2,788	\$26.40	\$32,900	\$29,500	\$2,200	\$5,600	\$68,000	\$73,600
Main Floor liquid helium liquification plant - Steel	279							\$26,306												
Mozzie level liquid helium liquification plant - Steel	164							\$15,433												
Main Floor storage building - steel	279							\$26,306												
Waste Disposal - liquid helium plant - Steel								\$2,661												
Waste Disposal - liquid helium plant - Steel								\$1,299												
Pre 1990 HAZMAT - 1979								\$3,111		\$2,240										
Plant Storage Shed - temporary	223	223	4.69	69	322.6563	1,046		\$6,558	\$4,918	\$0	\$11,476	\$8,399	1,046	\$11.00	\$13,300	\$8,400	\$0	\$4,900	\$6,600	\$11,500
Main floor steel tent structure - concrete perimeter	223							\$6,558												
Waste Disposal - storage building								\$6,558												
Pre 1990 HAZMAT - post 1990								\$6,558												
Machinery Tent - temporary	84	84	4.69	38	175.78125	392		\$2,459	\$1,844	\$0	\$4,303	\$3,150	392	\$11.22	\$5,000	\$3,100	\$0	\$1,900	\$2,500	\$4,400
Main floor tent structure	84							\$2,459												
Waste Disposal - storage building								\$2,459												
Pre 1990 HAZMAT - post 1990								\$2,459												
MS Material shed - temporary	84	84	4.69	38	175.78125	392		\$2,459	\$1,844	\$0	\$4,303	\$3,150	392	\$11.22	\$5,000	\$3,100	\$0	\$1,900	\$2,500	\$4,400
Main floor tent structure	84							\$2,459												
Waste Disposal - storage building								\$2,459												
Pre 1990 HAZMAT - post 1990								\$2,459												
Sub Total	8,155	6,183													\$388,000	\$276,400	\$183,200	\$344,900	\$832,000	\$1,177,100

TRIUMF Preliminary Decommissioning Plan Option B - Demolition & Disposal of Existing Facilities (Greenfield Site)	GFA M2	Footprint M2	Height M	Perimeter m	External Envelope M2	Volume M3	Unit Rate \$/M3	Demo Total Sum \$	Waste \$/M3	HAZMAT \$/M3	Total \$/M3	Recycling credit \$/M3	Structure Volume (m³) M3	Unit Cost (\$) \$/M3	Waste Disposal			Deconstruction Laborer / Equipment \$/M3	Sum Total(o) Costs \$
															Landfill Cost \$/M3	Recycling Credit \$/M3	HAZMAT Cost \$/M3		
TRIUMF Preliminary Decommissioning Plan Planning Envelope No. II - ISAC I & II Facilities Shutdown - 10 Years Cost Estimates																			
ISAC I Building - Experimental Hall from el. 289.00 to el. 333.75	2,169	1,698	14	294		23,745		\$8,54,913	\$8,794	\$0	\$865,617	\$167,258	23,745	\$36.37	\$176,000	\$167,200	\$0	\$8,700	\$863,600
Allow for sealing wall to Target and Maintenance Hall			13.0	53			\$264.60	\$183,372											
Main Floor EL 289 - Steel	1698		14	187			\$356.86	\$605,928											
Mezz Floor EL 304 - steel	471			107			\$139.19	\$65,613	\$3,697			\$37,66							
Waste Disposal - mezz							\$784	\$2,95	\$5,007	\$0		\$88,05							
Waste Disposal - main bldg.							\$0.00												
Pre 1990 HAZMAT - 1998																			
ISAC II Building - complete	5,388	3,451		302	3477	29,219		\$8,55,766	\$173,495	\$0	\$1,029,261	\$245,644	29,219	\$35.23	\$419,100	\$245,600	\$0	\$173,500	\$1,029,300
Experimental Hall/Gd. K to L Elev. 289 to 309	186		6.3	74.4			\$160.40	\$29,888											
Experimental Hall/Gd. K to L Elev. 289 to 315	97		8.1	40.6			\$283.06	\$27,569											
Experimental Hall/Gd. K to L Elev. 289 to 315	1050		12.1	132.8			\$244.13	\$256,359											
Experimental Hall/Gd. K to L Elev. 289 to 327.8	1745		3.1	318.4			\$139.19	\$242,943											
Offices Elev 289 to 304	371		7.8	127.8			\$278.39	\$103,413											
Offices Elev 289 to 314	1745		3.1	318.4			\$104.40	\$182,207											
Mechanical room Elev 315 to 327	192		3.8	301.6			\$69.75	\$13,386	\$6,749			\$132.08							
Waste Disposal - Experimental Hall							\$4.42		\$166,746	\$0		\$11.43							
Waste Disposal - Offices							\$43.17			\$0									
Pre 1990 HAZMAT - Experimental Hall built 1998							\$0.00			\$0									
Pre 1990 HAZMAT - Offices 1998										\$0									
ISAC I Building - Service Annex from el. 289.00 to el. 317.83	746	373	8.13	100	815	6,061		\$197,745	\$7,020	\$0	\$204,765	\$33,706	6,061	\$33.78	\$40,700	\$33,700	\$0	\$7,000	\$204,700
Allow for sealing wall to Target and Maintenance Hall			13.0	37			\$264.60	\$95,708											
Upper level EL 310	373		3.8	100			\$130.85	\$48,800											
Lower EL 289	373		4.4	100			\$142.74	\$53,237											
Waste Disposal							\$94.1												
Pre 1990 HAZMAT - 1992							\$0.00			\$0									
Sub Total	8,303	5,522													\$635,800	\$446,600	\$0	\$189,200	\$2,097,600
Shutdown - 20 Years Cost Estimates																			
Target Maintenance Hall including Hot Cell Support Area - North at el. 264.00 and Mechanical Penthouse at el. 310.00	2,732	248	3.44	82	283	9,391		\$527,718	\$78,377	\$0	\$606,095	\$123,104	9,391	\$64.54	\$200,500	\$123,100	\$0	\$78,400	\$606,100
Upper level EL 310	248		3.4	82			\$118.95	\$29,517											
Waste Disposal							\$7.84		\$1,946			\$37,66							
Pre 1990 HAZMAT - 1992							\$0.00												
ISAC I Target Maintenance Hall - from elevation level 333.75 to GL elevation level 289.0 - Slab left in place	392	252	7	55	398	1812		\$39,016											
Main floor	140		7	55			\$278.39	\$39,016											
Under PH	252		7.2				\$278.39	\$70,166											
Waste Disposal							\$0.00		\$38,221	\$0									
Pre 1990 HAZMAT - 1992																			
ISAC I Target Maintenance Hall - from elevation level 289.0 to 264	496	248	7.8	82	642	1939		\$93,258											
Upper level EL 278	248		3.4	82			\$375.82	\$93,258											
Lower EL 264	248		4.4	82			\$375.82	\$93,258											
Below Grade Fill							\$95.55	\$18,254											
Waste Disposal							\$97.14		\$48,210	\$0									
Pre 1990 HAZMAT - 1992							\$0.00												
Mass Separator Pit at el. 264.00 and Mass Separator Experiment Room at el. 278	697	349	7.81	50	391	2,723		\$546,375	\$67,710	\$0	\$614,085	\$17,919	2,723	\$225.54	\$85,600	\$17,900	\$0	\$67,700	\$614,100
Level EL 278	349		3.4	50			\$375.82	\$130,980											
Level EL 264	349		4.4	50			\$445.42	\$155,255											
Below Grade Fill							\$95.55	\$26,160											
Waste Disposal - main bldg.							\$97.14		\$67,710										
Pre 1990 HAZMAT - 1992							\$0.00												
ISAC I Service Annex from el. 264.00 to el. 289.00	746	373	7.8	100	784	2914		\$584,694	\$72,459	\$0	\$657,153	\$191,176	2914	\$225.52	\$91,600	\$19,200	\$0	\$72,400	\$657,100
Upper level EL 278	373		3.4	100			\$375.82	\$140,166											
Lower EL 264	373		4.4	100			\$445.42	\$166,122											
Below Grade Fill							\$95.55	\$27,840											
Waste Disposal							\$97.14		\$72,459	\$0									
Pre 1990 HAZMAT - 1992							\$0.00												
Interconnecting Beam Line Tunnel Between ISAC I & Mass Accelerator Buildings	152	152	7.8	66	513	1191		\$181,666	\$14,806	\$0	\$196,472	\$3,918	1,191	\$165.02	\$18,700	\$3,900	\$0	\$14,800	\$196,500
Level EL 264	152		7.8	66			\$445.42	\$67,890											
Below Grade Fill							\$95.55	\$13,776											
Waste Disposal - main bldg.							\$97.14		\$14,806										
Pre 1990 HAZMAT - 1992							\$0.00												
Sub Total	5,216	1,622													\$397,400	\$164,100	\$0	\$233,300	\$2,073,800

TRIUMF Preliminary Decommissioning Plan Option B - Demolition & Disposal of Existing Facilities (Greenfield Site)	GFA M2	Footprint M2	Height M	Perimeter m	External Envelope M2	Volume M3	Unit Rate \$/	Demo Total Sum \$	Waste \$	HAZMAT \$	Total \$	Recycling credit \$	Structure Volume (m³) M3	Unit Cost (\$) \$/ M3	Waste Disposal				Deconstruction Labour / Equipment \$	Sum Totals Costs \$
															Landfill Cost \$	Recycling Credit \$	HAZMAT Cost \$	Total \$		
Planning Envelope No. III - BWXT - Radiochemistry Annex Facilities																				
Shutdown + 0 Years Cost Estimates																				
Radio Chemistry Annex Building	2,325	802	15.53		1399	9162		\$929,824	\$101,041	\$150,564	\$1,181,428	\$24,622	9162	\$128.95	\$125,700	\$24,600	\$150,600	\$251,700	\$929,800	\$1,181,500
B1 Level EL 275.88 to 289 - labs	608		4.8	126			\$445.42	\$270,553												
B1 Level 289 to 300.89 - offices	802		3.6	141			\$167.03	\$133,984												
FF Level 200.89 to 321.62 - offices	655		3.6	123			\$167.03	\$109,379												
Penthouse EL 321.62 to 324	170		3.6	53			\$83.70	\$14,228												
Allow for sealing basement and stairwell			3.6	47			\$264.60	\$44,574												
Below Grade Fill							\$95.55	\$100,790				\$11.43								
Waste Disposal - office							\$46.77	\$251				\$52.83								
Waste Disposal - penthouse							\$147	\$251				\$8,980								
Pre 1990 HAZMAT							\$64.76	\$58,120				\$22,767								
BWXT Building above el.289.00 (Grade)	1,032	348	11.25		1065	3872		\$139,713	\$30,541	\$0	\$170,255	\$22,767	3872	\$43.96	\$53,300	\$22,800	\$0	\$139,700	\$170,200	
GF Level 289 to 301	348		3.8	100			\$167.03	\$58,120												
2nd Floor EL 301.88	348		3.8	100			\$167.03	\$58,120												
Penthouse EL 313.88	337		3.8	75			\$69.75	\$23,473												
Waste Disposal - office							\$43.17	\$30,045												
Waste Disposal - penthouse							\$147	\$496												
Pre 1990 HAZMAT - post 1990							\$100			\$0										
Sub Total	3,357	1,150						\$1,098,098	\$78,786	\$0	\$1,176,884	\$23,480	4499	\$261.61	\$102,300	\$23,500	\$0	\$78,800	\$1,176,900	\$1,351,700
Shutdown + 20 Years Cost Estimates																				
BWXT Building TR30-2 Cyclotron Area at el. 261.88 and RCA.3 Area at el. 275.88	1,296	948	8.13		1061	4499		\$1,098,098	\$78,786	\$0	\$1,176,884	\$23,480	4499	\$261.61	\$102,300	\$23,500	\$0	\$78,800	\$1,176,900	\$1,351,700
B1 - Target Caves	348		3.8	100			\$445.42	\$154,987												
B2 - Hot Filter EL 261.88 to 275.88	948		4.4	157			\$445.42	\$422,199												
Below Grade Fill							\$95.55	\$20,913												
Waste Disposal							\$60.80		\$78,786	\$0.00		\$18.12								
Pre 1990 HAZMAT - post 1990							\$100													
TR30-1 Cyclotron	745	377	5.94	87	518	2219		\$374,381	\$45,295	\$2,4263	\$445,939	\$13,499	2219	\$200.12	\$58,800	\$13,500	\$24,300	\$69,600	\$374,400	\$444,000
B1 Level EL 275.88 to 289 - vault	377		3.8	84			\$445.42	\$167,902												
GL level 289 to 296 - vault top sand	368		2.2	87			\$194.04	\$71,412												
Below Grade Fill							\$95.55	\$135,066												
Waste Disposal							\$60.80		\$45,295	\$2,4263		\$18.12								
Pre 1990 HAZMAT - 1988							\$32.57													
CP42 Cyclotron	483	296	6.94	91	629	1815		\$302,332	\$29,383	\$15,739	\$347,454	\$8,757	1815	\$191.36	\$38,100	\$15,700	\$45,000	\$302,300	\$347,300	\$1,968,200
B1 Level EL 275.88 to 289 - vault	296		4.8	78			\$445.42	\$131,722												
GL level 289 to 296 - vault top sand	188		2.2	91			\$194.04	\$36,992												
Below Grade Fill							\$95.55	\$14,218												
Waste Disposal							\$60.80		\$29,383	\$15,739										
Pre 1990 HAZMAT							\$32.57													
Sub Total	2,524	1,621													\$199,200	\$45,800	\$40,000	\$193,400	\$17,74,800	\$1,968,200

TRIUMF Preliminary Decommissioning Plan Option B - Demolition & Disposal of Existing Facilities (Greenfield Site)	GFA M2	Footprint M2	Height M	Perimeter m	External Envelope M2	Volume M3	Unit Rate \$/M3	Demo Total Sum \$	Waste \$	HAZMAT \$	Total \$	Recycling credit \$	Structure Volume (m³) M3	Unit Cost (\$) \$/M3	Waste Disposal			Deconstruction Laborer / Equipment \$	Sum Total(o) Costs \$
															Landfill Cost \$	Recycling Credit \$	HAZMAT Cost \$		
Planning Envelope No. IV - Main Accelerator Building/Annexes																			
Shutdown + 0 Years Cost Estimates																			
Meson Hall Extension Service Annex																			
Allow for sealing Building																			
Upper Floor Elev 302 to 314	392	392	12.81	88	1,133	5,018	154,688.12	\$767,208	\$23,038	\$13,823	\$804,068	\$110,608	5,018	\$160.23	\$133,600	\$110,600	\$13,800	\$36,600	\$804,000
Main floor Elev 286 to 302	392	392	15.6	32			\$264.60	\$133,075											
Vault Elev 273 to 286	392	392	3.8	88			\$154.64	\$181,685											
Below Grade Fill			5.0	88		1,591.02	\$237.90	\$93,172											
Pre 1990 HAZMAT - 1986			4.1	88			\$529.20	\$207,254											
Pre 1990 HAZMAT - 1986							\$95.55	\$132,022											
Pre 1990 HAZMAT - 1986							\$161.14	\$117,766											
Meson Hall Extension Building																			
Allow for sealing Building - all parts of accelerator building																			
Main floor Elev 286 to 338	823	823	16.24	378	6,175	13,450	\$264.60	\$1,069,082	\$35,500	\$53,250	\$1,147,833	\$154,949	13,450	\$85.34	\$190,400	\$154,900	\$53,300	\$88,800	\$1,147,900
Waste Disposal	823	823	15.6	126			\$654.24	\$538,409											
Pre 1990 HAZMAT - 1984			16.3	378			\$43.14	\$38,409											
Pre 1990 HAZMAT - 1984							\$64.71	\$53,250											
CMMS Building (Biomedical Facility)																			
Elev 305 to 305	1,278	377	14.52	93	1,343	18,555	\$278.39	\$516,055	\$55,129	\$137,938	\$535,164	\$104,388	18,555	\$28.84	\$159,500	\$104,400	\$137,900	\$193,000	\$535,100
Elev 292.75 to 305	377	377	3.8	38			\$278.39	\$105,055											
Elev 281.75 to 292.75	377	377	3.4	38			\$278.39	\$105,055											
Vault Elev 270.75 to 281.75	146	146	3.4	38			\$167.03	\$24,364											
Below Grade Fill			3.4	38			\$191.10	\$2,566											
Waste Disposal							\$43.14	\$2,566											
Pre 1990 HAZMAT - 1986							\$107.94	\$2,566											
M15 Experimental Building																			
Main floor Elev 287 to 313	230	230	8.13	63	510	1,867	\$377.41	\$692,723	\$4,282	\$6,423	\$97,428	\$37,539	1,867	\$52.17	\$41,800	\$37,500	\$6,400	\$10,700	\$97,400
Waste Disposal	230	230	8.1	63			\$18.64	\$4,282											
Pre 1990 HAZMAT - 1983							\$27.95	\$4,282											
Compressor Building - 1986																			
Bases other side of building	267	89	4.69	39	182	1,253	\$167.03	\$29,732	\$20,602	\$17,305	\$108,860	\$3,053	1,253	\$86.94	\$23,700	\$3,100	\$17,300	\$37,900	\$108,900
Main floor Elev 289 to 304	178	89	4.7	39			\$167.03	\$14,903											
Trench	32	32					\$211.68	\$6,767											
Below Grade Fill							\$152.88	\$19,550											
Waste Disposal							\$43.17	\$19,550											
Pre 1990 HAZMAT - 1986							\$64.76	\$19,550											
New Compressor Building - 2012																			
Main floor Elev 59.2 to 67.8	385	335	8.60	76	653.6	2,881	\$209.25	\$60,335	\$681	\$0	\$61,016	\$16,959	2,881	\$21.17	\$17,600	\$16,900	\$0	\$700	\$61,000
Mezzanine level Elev 63.05	240	90	8.6	62			\$69.75	\$3,488											
Single story attachment Elev 59.2 to 63.05	95	95	3.8	45			\$69.75	\$6,626											
Concrete Base - Tanks removed																			
Waste Disposal							\$14.47	\$6,626											
Pre 1990 HAZMAT - 2012							\$0.00	\$6,626											
Service Annex Extension																			
Upper Floor Elev 305.25 to 317.14 - office	717	359	10.00	83	831.25	3,586	\$149.763	\$149,763	\$31,529	\$7,7420	\$258,713	\$33,744	3,586	\$72.16	\$65,300	\$33,700	\$77,400	\$109,000	\$258,800
Main floor Elev 289 to 305.25 - office	359	359	5.0	130			\$130.19	\$49,921											
Main floor Elev 289 to 305.25 - set up area	38	38	5.0	130			\$278.39	\$10,821											
Waste Disposal	321	321	5.0	130			\$278.39	\$89,260											
Pre 1990 HAZMAT - 1981							\$9.32	\$89,260											
Remote Handling Building & Service Tunnel																			
Upper Floor Elev 301 to 310	983	201	6.20	72	231	2,933	\$107.94	\$684,477	\$70,746	\$106,120	\$861,343	\$28,084	2,933	\$293.63	\$98,800	\$28,100	\$106,100	\$176,800	\$861,300
Main floor Elev 290 to 301	95	95	3.1	43			\$94.35	\$8,962											
Main floor Elev 290 to 310	95	95	3.1	43			\$139.19	\$13,221											
Vault Elev 276 to 290	201	201	6.3	72			\$330.23	\$66,476											
Vault Elev 283 to 276	198	198	4.4	58			\$167.03	\$33,003											
Below Grade Fill	256	256	4.1	68			\$191.10	\$47,129											
Waste Disposal	138	138	4.1	61			\$28.56	\$48,658											
Pre 1990 HAZMAT - 1986							\$107.94	\$48,658											
Sub Total	5,858	2,806													\$730,700	\$499,200	\$412,200	\$653,700	\$3,874,400

TRIUMF Preliminary Decommissioning Plan Option B - Demolition & Disposal of Existing Facilities (Greenfield Site)	GFA M2	Footprint M2	Height M	Perimeter m	External Envelope M2	Volume M3	Unit Rate \$/M3	Demo Total Sum \$	Waste \$/M3	HAZMAT \$/M3	Total \$/M3	Recycling credit \$/M3	Structure Volume (m³) M3	Unit Cost (\$) \$/M3	Waste Disposal			Deconstruction Laborer / Equipment \$/M3	Sum Total Costs \$
															Landfill Cost \$/M3	Recycling Credit \$/M3	HAZMAT Cost \$/M3		
Shutdown + 20 Years Cost Estimates																			
Proton Hall Extension Building																			
Upper Floor Elev 288.4 to 308 - office	1,021	818	15.34	119	1,827	12,559	\$130.19	\$3,467,933	\$28,921	\$35,675	\$411,569	\$79,329	12,559	\$32.77	\$108,200	\$79,300	\$35,700	\$64,600	\$411,600
Main floor Elev 289 to 298.4 - office	203		2.9				\$130.19	\$28,188											
Main floor Elev 289 to 338.2 - Hall	616		15.3				\$471.76	\$290,997	\$14,349			\$122.52							
Waste Disposal - office	405						\$23.29	\$3,598	\$14,472	\$35,675	\$141,828	\$9,552							
Pre 1990 HAZMAT - 1980							\$34.94	\$86,156	\$22,269	\$33,404		\$5,893	967	\$146.72	\$28,200	\$5,900	\$33,400	\$55,700	\$141,900
Service Annex Building & 3rd IONSOURCE (over) - 1981	155	155	6.25	51	320	967	\$556.78	\$86,156	\$22,269	\$33,404		\$38.09							
Separated floor Elev 302 to 322	155		6.25	51			\$143.91	\$22,269											
Pre 1990 HAZMAT - 1981							\$215.87	\$3,168,710	\$195,795	\$54,144	\$3,418,648	\$170,334	17,740	\$192.70	\$366,100	\$170,300	\$54,100	\$249,900	\$3,418,600
Service Annex Building - adjusted included with 3rd Insurance																			
B3 Elev 250 to 264 - storage area	3,727	705	25.16	119	3,003	17,740	\$695.97	\$490,802											
B2 Elev 264 to 276 - mechanical services	705		5.5	119			\$515.02	\$363,094											
B1 Elev 276 to 289 - RT Equipment	705		3.8	119			\$445.42	\$314,113											
GL Elev 289 to 302 - Data processing	705		4.1	119			\$139.50	\$98,378											
UF Elev 302 to 313 - Ion source and fan room	705		4.1	119			\$139.50	\$98,378											
Penhouse Elev 313 to 324	201		3.8	94			\$697.5	\$14,002											
Below Grade Fill						9366	\$191.10	\$1,789,842	\$192,944			\$453.30							
Waste Disposal - below grade							\$91.20	\$85,177	\$2,851			\$52.83							
Waste Disposal - steel superstructure							\$14.53	\$1,359,692	\$106,150	\$119,575	\$1,585,417	\$230,888	21,862	\$72.52	\$337,000	\$230,900	\$119,600	\$225,700	\$1,585,400
Pre 1990 HAZMAT - 1970																			
Electron Hall Building																			
B1 Elev 264 to 289 grade level	1,646	823	26.56	119	928	21,862	\$556.78	\$4,58,255											
GF Elev 289 to 349 - hall	823		7.8	119	227	6430	\$348.76	\$2,87,044											
Below Grade Fill			18.8	119			\$95.55	\$614,393											
Waste Disposal - below grade							\$121.60	\$100,083											
Waste Disposal - steel superstructure							\$7.37	\$6,068											
Pre 1990 HAZMAT - 1970																			
Meson Hall Building																			
B1 Elev 264 to 289 grade level - hall	3,694	1,847	26.56	183	4,447,653	49,057	\$72.64	\$3,051,015	\$227,299	\$160,989	\$3,439,303	\$406,541	49,057	\$70.11	\$633,800	\$406,500	\$161,000	\$388,300	\$3,439,300
B2 Elev 289 to 349 - hall	1,847		7.8	183	1426		\$556.78	\$1,028,278											
Below Grade Fill			18.8	183			\$348.76	\$644,099											
Waste Disposal - below grade							\$95.55	\$1,378,637											
Waste Disposal - steel superstructure							\$121.60	\$224,576											
Pre 1990 HAZMAT - 1970							\$147	\$2,723											
Cyclotron Vault Building - Demolition & Removal of Superstructure																			
Elev 308 to 339 - above grade - hall	1,325	1,325	9.69	150	1453,125	12,835	\$43.59	\$1,308,734	\$5,860	\$7,618	\$1,322,213	\$291,649	12,835	\$103.01	\$297,500	\$291,600	\$7,600	\$13,500	\$1,322,200
Waste Disposal - above grade - hall			9.7	150	1453		\$209.25	\$277,243											
Pre 1990 HAZMAT - 1970							\$5.75	\$4,42											
Allow for new Building over vault	2947						\$350.00	\$1,031,492											
Sub Total																			
Shutdown + 45 Years Cost Estimates																			
Cyclotron Vault Building - Demolition & Removal																			
Vault Elev 250 to 308 - above shielding	5,894	2,947	20.00	243	4862.5	58,942	\$529.20	\$3,109,615	\$537,554	\$479,909	\$1,1973,813	\$267,009	58,942	\$203.14	\$804,600	\$267,000	\$479,900	\$1,017,500	\$11,973,800
Below Grade Fill	2,947		20.0				\$152.88	\$9,011,111											
Waste Disposal							\$91.20	\$337,554											
Allow for demo of temporary building	2947						\$130.85	\$385,624											
Pre 1990 HAZMAT - 1970							\$81.42												
Sub Total																			
Planning Envelope No. V - AREL Facility																			
Shutdown + 20 Years Cost Estimates																			
AREL Building including Beam Line Tunnel Between AREL and MAB Buildings																			
Penhouse Elev 317 to 331.44	5,150	1,054	24.60	181	4452.6	25,928	\$697.5	\$7,518	\$1,456,417	\$0	\$3,308,420	\$280,662	25,928	\$127.60	\$1,737,100	\$280,700	\$0	\$1,456,400	\$3,308,400
Upper Floor Level Elevation 306 to 317	1054		6.0	181			\$139.19	\$25,751											
Upper Floor Level Elevation 306 to 317	185		3.8	67			\$139.19	\$25,751											
Main Floor Elevation 288.8 to 293	185		3.8	67			\$139.19	\$25,751											
Main Floor Elevation 288.8 to 317	250		8.7	92			\$139.19	\$34,799											
Target Hall Elevation 281 to 317	408						\$445.42	\$181,732											
Additional Shielding to Target Hall added Between 2017 and 2023	650						\$445.42	\$289,524											
Basement B1 Elev 276 to 289 - vault / target hall	672		4.0	115			\$445.42	\$299,323											
Basement B1 Elev 276 to 289 - office / lab	315		4.0	124			\$556.78	\$175,385											
Basement B2 Elev 252 to 276 - vault	570		6.0	101			\$556.78	\$317,363											
Basement B2 Elev 252 to 276 - office / lab	484		6.0	142			\$556.78	\$269,480											
B2 Level tunnel	192		3.0	106			\$95.55	\$133,627											
Below Grade Fill						11116	\$30.40	\$330,929											
Waste Disposal - vault / target hall							\$107.94	\$63,354											
Waste Disposal - office / lab							\$0.00												
Pre 1990 HAZMAT - 2014																			
Sub Total																			
Sub Total																			

TRIUMF Preliminary Decommissioning Plan Option B - Demolition & Disposal of Existing Facilities (Greenfield Site)	GFA M2	Footprint M2	Height M	Perimeter m	External Envelope M2	Volume M3	Unit Rate \$	Demo Total Sum \$	Waste \$	HAZMAT \$	Total \$	Recycling credit \$	Structure Volume (m³) M3	Unit Cost (\$) \$/M3	Waste Disposal			Deconstruction Labour / Equipment \$	Sum Total(o) Costs \$
															Landfill Cost \$	Recycling Credit \$	HAZMAT Cost \$		
Planting Envelope No. VI - IAMI Facility Shutdown + 20 Years Cost Estimates																			
IAMI Building - Demolition & Removal	3,342							\$1,213,571	\$698,824	\$0	\$1,912,396	\$55,690	17,243	\$110.91	\$754,500	\$55,700	\$0	\$1,213,600	\$1,912,400
Lower Roof Access Ely 72.2 to 73.6	37	835	20.65	125	2881	17,243	\$69.75	\$2,581											
Level 2 Upper Floor Offices Ely 66.75	390		2.8	27			\$139.19	\$54,286											
Level 2 Upper Mechanical Space Ely 66.75	270		5.5	120			\$139.19	\$37,382											
Level 1 Upper Floor Mech & Office Shell Space Ely 63.25	370		3.5	84			\$139.19	\$51,802											
Level 1 Upper Floor Lab Shell Space Ely 63.25	60		3.5	30			\$139.19	\$8,352											
Level 1 Upper Floor Office Shell Space Ely 63.25	230		3.5	94			\$139.19	\$32,015											
Main Floor Security Washroom/Storage Offices Ely 59.25	470		4.0	228			\$44.542	\$209,348											
Main Floor Labs Ely 59.25	230		3.0	99			\$102.447	\$23,560											
Basement B Shell Space M&E Service Space Ely 56.25	480		3.0	100			\$102.447	\$49,180											
Basement B Shell Space M&E Service Space Ely 56.25	420		3.0	88			\$102.447	\$43,026											
Basement Shell Space Mechanical/Storage/Hot Space B2 Ely 52.95	415		3.3	85			\$556.78	\$231,663	\$452,377										
Below Grade Fill						5261	\$95.55		\$12,768										
Waste Disposal - vault / target hall			6.3				\$10.40		\$233,680	\$0									
Waste Disposal - office / lab							\$107.94												
Pre 1990 HAZMAT - 2014							\$0.00												
Sub Total	3,342	835								\$0					\$754,500	\$55,700	\$0	\$1,213,600	\$1,912,400

B APPENDIX B

Drawing List

As Provided by TRIUMF

Survey Costs based on TRIUMF Envelope Decommissioning Study

Data References

General labour costs based on 2023 costs Stats Canada

Statistics Canada - British Columbia

June 2023

Construction Price Indexes (Non Residential)	139.8	*
Trades, Transport and Equipment Operators and Related Occupations - hourly rates	\$40.00	
Union Coverage - hourly rates	\$48.59	

February 2023

Landfill Disposal Rates

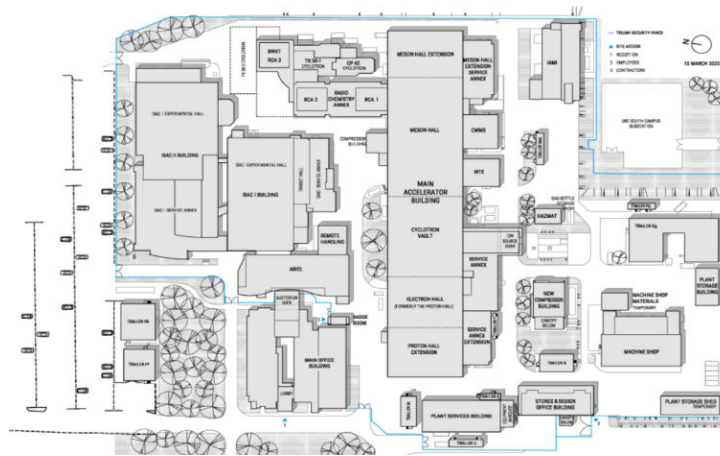
\$ / Tonnes

Gypsum / Drywall	\$200.00
Asphalt roofing	\$168.00
Asbestos	\$268.00
Construction Waste	\$150.00

* Construction Price Indexes (Non Residential) reset to 100 in 2017

C Representative Drawings

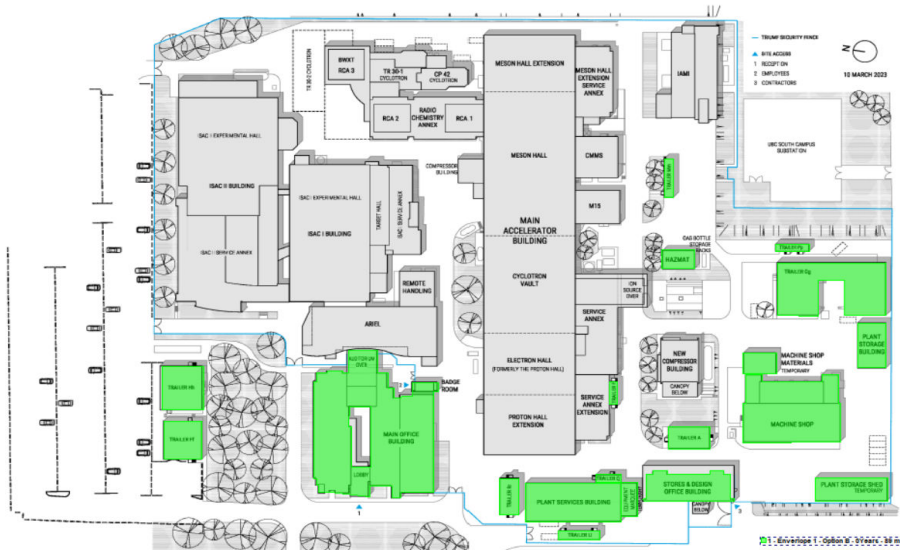
Site Plan



Envelope Phases

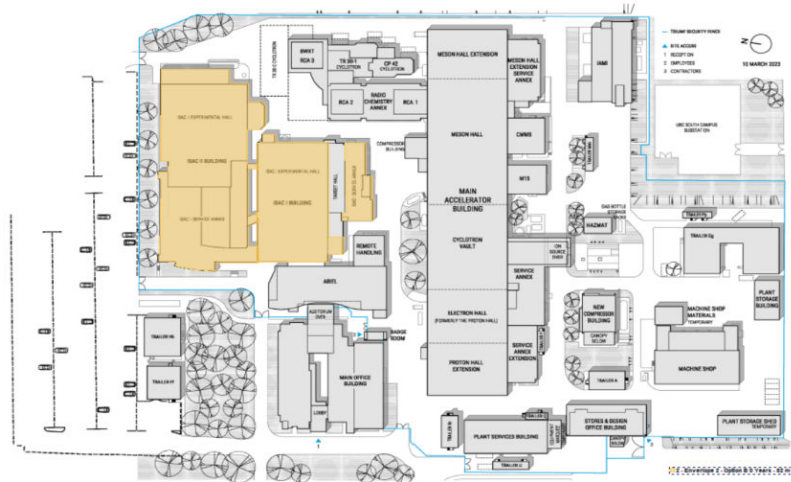


Envelope I - 0 Years



C Representative Drawings

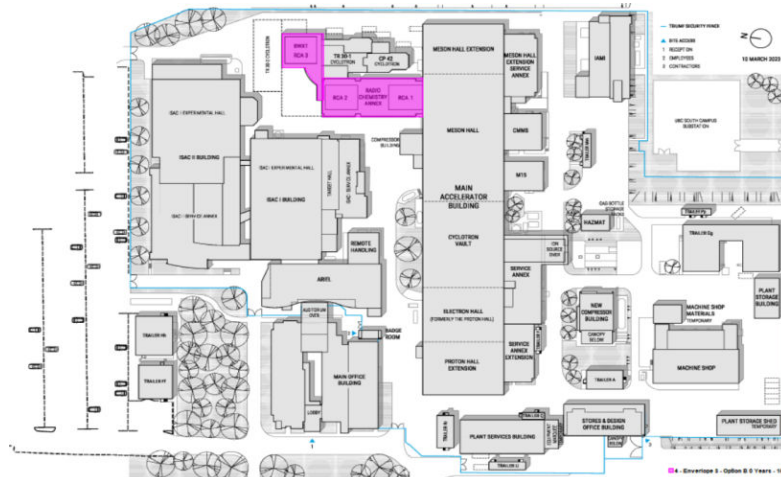
Envelope II - 0 Years



Envelope II - 20 Years

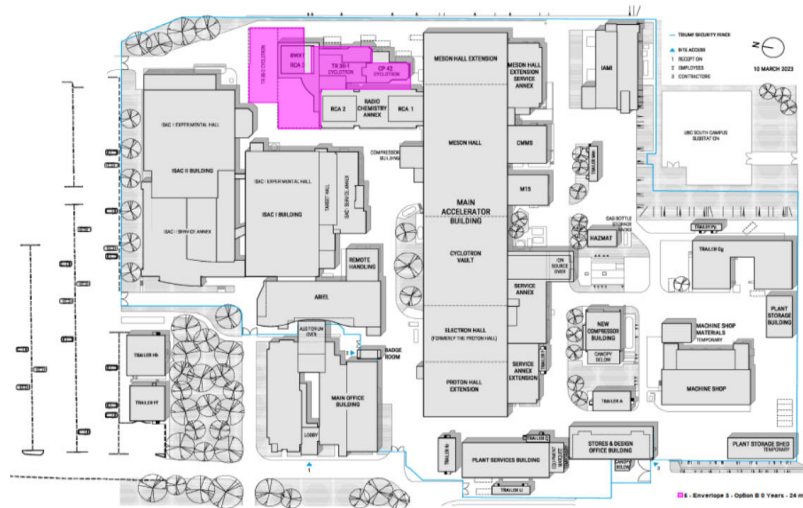


Envelope III - 0 Years

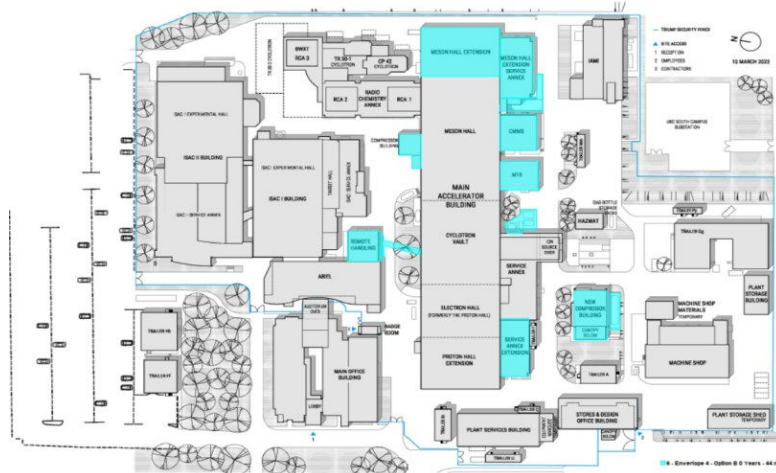


C Representative Drawings

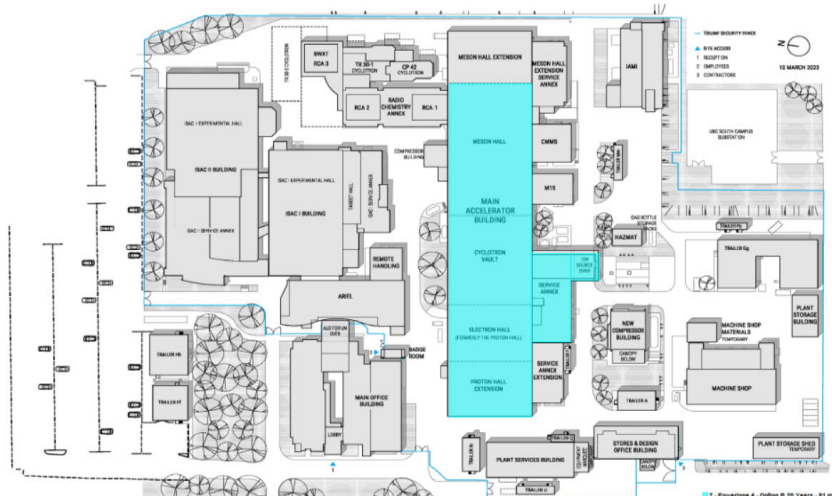
Envelope III - 20 Years



Envelope IV - 0 Years

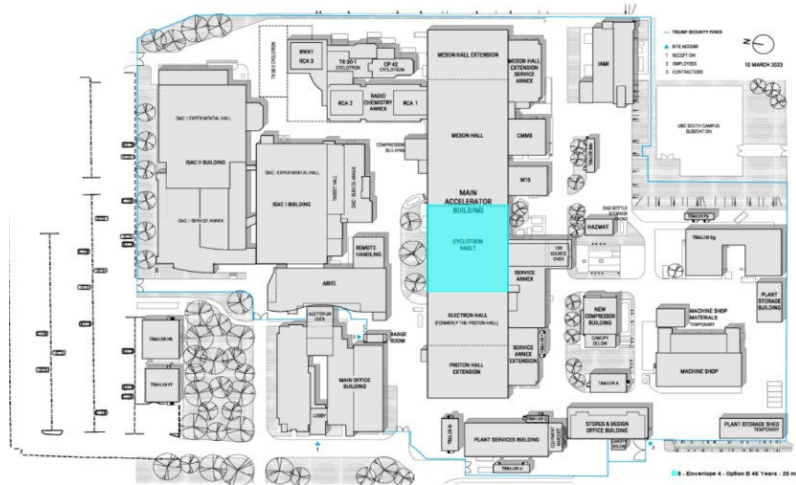


Envelope IV - 20 Years

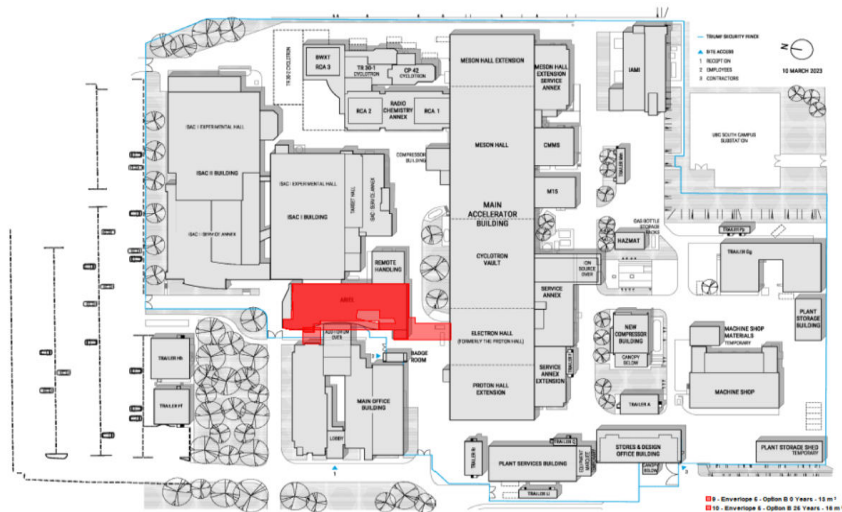


C Representative Drawings

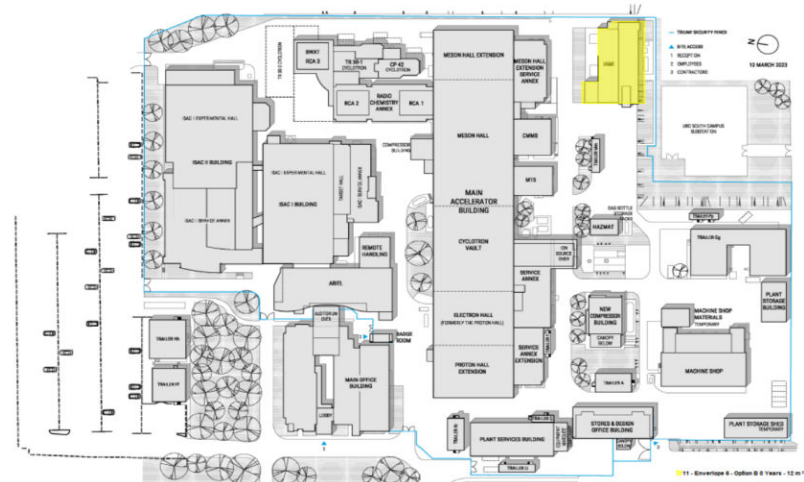
Envelope IV - 45 Years



Envelope V - 20 Years



Envelope VI - 20 Years



Schedule “A”

Deposits and Projected Earnings Schedule

Initial and Supplementary Deposits:		\$9,600,000
Fund Balance:	As at March 31, 2023	\$12,495,075
Projected Fund Balance:	As at March 31, 2027	\$15,632,363
Return Assumption:		5.76%

Review Dates of Schedule A:

Fund Agreement	Review
The TRIUMF Facility Decommissioning Fund	At least ninety (90) days in advance of March 31, 2027 and every five (5) years thereafter.

Permitted Investments:

All amounts required for Decommissioning shall be invested in cash or near cash investments and investment funds, as defined in CNSC’s regulatory documents, REGDOC-3.3.1, *Financial guarantees for decommissioning of nuclear facilities and termination of licensed activities*.