

TRIUMF Safety Note

TSN 1.8 Policy for Maximum Allowable Dose Rates in Accessible Areas at TRIUMF

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Author(s): H. McKnight

	Name:	<u>Approval Record</u>
Author:	H. McKnight	
Reviewed By:	M. Kinakin	
Approved By:	J. Mildenberger	

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History of Changes

Release Number	Date	Description of Changes	Author(s)
1	2012-03-29	Revised and Reformatted as Controlled Document	J. Drozdoff
2	2012-04-11	Add and define background dose rates.	J. Drozdoff
3	2021-09-22	Modernized document template and minor formatting.	H. McKnight

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1 Purpose and Scope

These policies and design considerations were developed to determine maximum allowable dose rates in accessible areas from radiation due to the operation of TRIUMF facilities. They complement the personnel [Policy on Radiation Exposure TSN 1.2](#) and other TRIUMF Action Levels relevant to exposure.

2 Definitions

Abnormal Beam Losses: Beam losses in excess of that associated with normal operation, and occurring only infrequently.

Accessible Area: Any room or other space, indoors or outdoors, that is likely to be occupied during accelerator operation, by any person, either regularly or periodically during the course of the individual's work, habitation or recreation. (Exclusion Areas, areas exposed by removed shielding for repair or maintenance, and physically locked areas are not considered accessible.)

Background Dose Rates: Background dose rates are generally determined by analysis of OSL control badges kept in a low background area. TRIUMF site fence boundary dose rates are determined by taking the difference between the OSL fence badge reading and the background control badge.

Exclusion Area: An area in which personnel access is prohibited and/or restricted by physical barriers and an interlocked door or gate. An area secure system is required to ensure no one is left inside an Exclusion Area prior to accelerator operation

Normal Beam Losses: Beam losses that are anticipated as part of routine and planned operation, such as a 100% beam loss in a beam stop or a fraction of beam loss in a collimator.

Occupancy Factor: The fractional factor ($OF \leq 1$) by which the radiation quantities in an area may be multiplied to correct for the degree or type of occupancy of the area specified in an effort to obtain the best dose estimate.

- Offices are considered to be High occupancy areas with an OF of 1.
- Other areas such as hallways, mezzanines above shielding, service rooms and experimental areas are considered to be Low occupancy areas with an OF of <1.
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Prompt Radiation: Radiation generated as a direct result of accelerated beam interacting with matter. When beam is off, prompt radiation is not generated.

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Radiation Monitoring System: An active system that measures and annunciates and/or terminates prompt radiation hazards when pre-set levels of radiation are detected.

Radiation Safety System: An active system to protect individuals from prompt radiation exposure due to accelerator operation, including the access control system and radiation monitoring system.

Rated Beam Current: The rated beam current for a beam line is that stipulated in the CNSC TRIUMF Accelerator Operating Licence.

Shielding: Physical or mechanical structures used to attenuate radiation and reduce dose rates.

3 Policies

3.1 All Radiation Sources at TRIUMF:

3.1.1 *Dose rate limits in accessible areas of TRIUMF facilities are based on Occupancy Factors. These dose rate limits, radiation safety systems, routine manual monitoring, facility schedules and layout, and the personnel dosimetry program shall be designed to keep the annual dose exposure of workers to significantly less than all regulatory dose limits (i.e. Nuclear Energy Worker and non- Nuclear Energy Worker) during normal facility operation.*

Area Occupancy	Dose Rate Limit ($\mu\text{Sv/h}$ at 0.5 m)	
	Uncontrolled	Controlled
Low	10	100
High	0.5	1.0

If dose rates exceed the uncontrolled limit, access to the area must be restricted using flagging tape and signage. The uncontrolled dose rate limit for Low occupancy areas is based on the integrated annual area dose scaled by the occupancy factor remaining below the ALARA limit of 1 mSv.

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3.1.2 *The maximum dose rate at the TRIUMF site fence boundary shall be 150 nSv/h above background.*

The dose rate limit at the site perimeter is governed by the nuclear facility regulatory requirements for dose to a member of the public and exposure scenarios for the maximally impacted member of the public. The above limit is arrived at assuming a two week exposure with an occupancy factor of 1 and an annual dose limit to a member of the public of 50 μ Sv.

3.2 Prompt Radiation Due to Abnormal Beam Loss Conditions:

The following policies guide the design of shielding and active radiation safety systems:

3.2.1 *Shielding shall be designed so that the maximum prompt radiation dose rate outside shielding cannot exceed 1 Sv/h with a point loss of rated beam intensity inside shielding.*

3.2.2 *The Radiation Monitoring System's effective trip time shall be designed so that for the point loss of rated beam intensity inside shielding the dose outside shielding per beam loss incident cannot exceed the 1 mSv non-Nuclear Energy Worker annual regulatory dose limit.*

3.2.3 *To provide the desired level of reliability, two independent Radiation Monitoring Systems shall be installed in areas where the maximum prompt radiation dose rate outside shielding could exceed 50 mSv/h with a point loss of rated beam intensity inside shielding. The systems shall be tested approximately 100 times per year to demonstrate their reliability.*

3.3 Exceptions

In some cases it may be advantageous to continue operations with dose rates exceeding the limits specified above. Continued operation under such circumstances can only be authorized by Divisional Management after all other options have been evaluated and documented.