



RADIATION SAFETY MANUAL

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University Emergency Contacts

24 Hour Radioactivity-Related After Hours Emergency: 864-4100

Emergency Contacts	Telephone
St. John's Campus	864 - 4100
Health Sciences Centre	864 - 4100
Marine Institute	778 - 0456
Grenfell Campus	637- 2888
Ocean Sciences Centre	864 - 4100

Environmental Health and Safety

General Contacts	Telephone	Email	Fax
Radiation and Biosafety Officer	864-8250	rso@mun.ca	864-3116
Associate Director of Environmental Health and Safety	864-3779	health.safety@mun.ca	864-3116

Website: http://www.mun.ca/health_safety

ACRONYMS

ALARA	As Low As Reasonably Achievable
ALI	Annual Limit of Intake
CNSC	Canadian Nuclear Safety Commission
DCP	Dosimetry Contact Person
EHS	Environmental Health and Safety
EQ	Exemption Quantity
MUN	Memorial University of Newfoundland
PI	Principal Investigator
RSO	Radiation Safety Officer
RSP	Radiation Safety Program
URSC	University Radiation Safety Committee

1.0 Organization & Administration of Radiation Safety

1.1 Purpose and Scope

This manual applies to all members of the University community (including, but not limited to: faculty, staff and students) that receive, possess, use, transfer or dispose of nuclear substances and radiation devices in any facilities (including field locations) controlled by Memorial University of Newfoundland (MUN). The governing body, the Canadian Nuclear Safety Commission (CNSC) has issued MUN a Nuclear Substance and Radiation Device (NSRD) License. This license allows MUN to receive, possess, use, transfer or dispose specified nuclear substances and radiation devices under specified conditions and restrictions.

1.2 Mission and Vision Statement

All individuals within the university community must work together to identify and control situations that could cause harm. Members of the university community must also integrate health and safety practices into their daily activities. Employee participation is crucial for an effective health and safety program.

The University Radiation Safety Committee (URSC) is established under the authority of the President. The URSC is authorized by the President to advise in the safe use of nuclear substances, radiation devices and prescribed equipment, make recommendations on policies, and approve procedures and guidelines. Further, the Tier II subcommittee of the URSC is authorized to issue internal radioisotope user permits (RUP), as required under the Nuclear Safety and Control Act. In accordance with the University's administrative framework and on the recommendations of the URSC, the University's Environmental Health and Safety (EHS) shall administer the Radiation Safety Program (RSP). EHS has the authority to enforce University policies and regulatory standards.

1.3 ALARA Principle

ALARA is an acronym for **As Low As Reasonably Achievable**. This principle means making every reasonable effort to maintain exposures to ionizing radiation as far below the regulated limits as is practical. ALARA is consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socio-economic considerations, and in relation to utilization of nuclear energy and license material in the public interest.

In accordance with CNSC legislation, it is MUN's practice that exposure to ionizing radiation will be far below the regulated dose limit. Exposures will be limited by utilizing strict policies or procedures, ensuring worker training, well maintained facilities and personal protective equipment.

MUN is committed to minimizing radiation exposure to staff, students, and the public that may result from the use of nuclear substances and radiation devices in diagnostic, therapeutic and research procedures. The URSC and the Radiation Safety Officer (RSO)

will advise and assist in all matters of radiation safety. The URSC will recommend to the University administration the policies and procedures to be required for minimizing and monitoring radiation exposure. The ALARA principle, through safe handling, storage, use, transport and disposal of radiation sources, will guide the interpretation of the Nuclear Safety & Control Act, Regulations and License conditions.

Sources of radiation include materials or equipment which are capable of emitting ionizing radiation at or above those levels regulated by the CNSC. Ionizing radiation sources include nuclear substances, nuclear reactors, particle accelerators, and x-ray machines.

1.4 University Radiation Safety Committee (URSC)

The purpose of the URSC is to ensure that all nuclear substances and radiation devices authorized under MUN's NSRD license are used with proper consideration for the health and safety of staff, researchers, volunteers, visitors and the public, as well as protection of the environment. This committee is responsible for the oversight and administration of the University's Radiation Safety Program (RSP) and functions according to its Terms of Reference (TOR). All practices will be in conformity with CNSC regulations and all other provincial and federal radiation-related legislation and regulations.

1.5 Roles and Responsibilities for Radiation Safety

1.5.1 Applicant Authority

The Applicant Authority is a corporate officer for the institution, and has the highest level of legal signing authority on a license on behalf of the University. This person is ultimately responsible for all licensed activities at the University. The Vice-president (Administration and Finance) is the Applicant Authority.

1.5.2 University Radiation Safety Committee (URSC)

The URSC is responsible for development of all policy related to radiation including, but not limited to: permit approvals, purchasing, safety, environmental protection, training, and disposal.

The URSC is also responsible for monitoring the implementation of its policy as per the Committee's terms of reference.

1.5.3 Executive and Senior Management

The executive and senior management of the University will ensure that adequate funds and resources are provided to run the radiation safety program effectively. Furthermore, the executive and senior management will provide support for radiation safety in operations.

Although the ultimate responsibility for radiation safety within the University and affiliated institutions lies with the President, information and concerns regarding radiation safety are communicated through the Vice-president (Administration and Finance).

The Vice-president (Administration and Finance) appoints members to the URSC in consultation with appropriate Deans or Directors, and approves the terms of reference for the URSC in consultation with the Vice-president (Research).

1.5.4 Managers, Supervisors and Permit Holders

These responsibilities extend to all corporations, contractors, onsite personnel, or research laboratories.

Responsibilities of managers, supervisors, and permit holders include:

1. ensuring compliance with radiation safety policies and procedures as they are outlined in the radiation safety manual;
2. reporting incidents or concerns to the RSO;
3. responding to inspection reports;
4. ensuring workers attend the required radiation safety training;
5. reporting any unresolved issue(s) to their immediate superior and the RSO;
6. ensuring any corrective actions required are implemented;
7. receiving suggestions on changes and improvements to radiation safety procedures and practices in the interest of ALARA;
8. designating a Dosimetry Contact Person (DCP) who will liaise with the RSO. (Note: In the absence of a DCP, the permit holder will serve as the liaison);
9. providing cost coverage for dosimetry service when replacement or late fees are incurred;
10. investigating higher than average area/group doses and forwarding a report to the DHS stating the results of the investigation;
11. ensuring dose reports are mailed for review by all intended workers.
12. ensuring the availability of an appropriate spill kit at all times.

1.5.5 Radiation Safety Officer

The RSO is delegated the authority to apply for a specific license (NSRD license) on behalf of the University. The RSO will be the CNSC's contact and correspondent for all matters associated with the license and, unless otherwise specified, is the only person who can request changes to a license on behalf of the University.

The RSO has the authority to suspend operations in the cases where he or she perceives an immediate threat to health, safety, or the environment.

The RSO shall:

1. maintain contact as necessary with the Canadian Nuclear Safety Commission (CNSC) and with the Department of Government Services of the Government of Newfoundland and Labrador, and ensure all information and reports required by legislation are submitted;
2. make evaluations (e.g., concerning the applications for permits, suitability of space, equipment, disposal, safe practices, training), and make recommendations regarding these to the URSC;

3. suspend the use of radioactive material by any person when, in the judgment of the RSO, the safety of any person or the environment is in jeopardy. Such suspension will be reported to the URSC Tier II Committee as soon as possible;
4. investigate and, where necessary, supervise after accidents or incidents involving radioactive materials, and report the event to the CNSC and to the chair of the URSC;
5. investigate any exposures over action levels recorded on dosimeters;
6. arrange to provide radiation safety training for staff and students who wish to use radiation or radioactive materials at the University;
7. prepare annual reports and radioisotope license renewal applications, as required and ensure the approved reports and applications are sent to CNSC;
8. ensure radiation detection equipment is obtained, maintained and calibrated as required;
9. submit an annual written report to the URSC on radiation and radioactive materials use and safety activities;
10. submit other reports as requested and prepare regular updates for monthly URSC meetings;
11. maintain an inventory of all radioactive material;
12. manage the ordering, receipt, distribution, storage and disposal of all radioactive material at the University;
13. oversee the dosimetry program and report all exposures as required;
14. ensure wipe testing is conducted in accordance with license requirements and that leak testing is conducted according to license requirements and manufacturer specification;
15. provide on-going advice and technical assistance to persons using radiation at the University;
16. provide recommendations for the radiation safety budget;
17. maintain records required by the Canadian Nuclear Safety Commission and the Department of Government Services of the Government of Newfoundland and Labrador;
18. audit Permit Holder records;
19. conduct lab inspections including wipe tests to confirm compliance;
20. oversee the safe disposal of radioactive waste;
21. attend meetings of the URSC;
22. conduct other related duties as requested by the URSC.

1.5.6 Authorized Users

Individuals, who regularly use, manipulate or handle radioisotope substances or devices such that he/she could receive a measurable annual radiation dose- above the background level as identified by CNSC are considered authorized users. All authorized users, including faculty, employees, students, physicians, volunteers, contractors must:

1. follow all applicable procedures in the Radiation Safety Manual;
2. follow the guidance and direction provided by University's Environmental Health and Safety staff;
3. inform their managers or supervisors anytime they believe a procedure involving radiation or radioisotopes is inappropriate, impractical, or incorrect;

4. report incidents (*e.g.*, spills, accidental exposure, etc.) to their managers and to the RSO;
5. report non-compliance, defects in radiation generating or radiation safety device, loss of control of radioactive source or substance, and act of sabotage;
6. follow directives given by their manager, supervisor and/or Radiation Safety contact person to implement means of reducing radiation exposure according to ALARA.

1.5.7 Dosimetry Contact Person

Where dosimeters are assigned or mandated, the Permit Holder or department of the Permit Holder shall designate, in consultation with the RSO, a person who is responsible for their work area, to:

1. ensure that all new personnel working with nuclear substances or radiation devices complete, submit and maintain a radiation worker registration form;
2. coordinate dosimeter requests and handling;
3. ensure area supervisor(s) receive dose reports;
4. report any suspicions or observations of dosimeter non-compliance to his or her supervisor.

1.5.8 Health Physicist

A health physicist is available to consult with the URSC at the request of the chair or in an emergency situation at the request of the RSO or the Director of the University's Environmental Health and Safety.

1.5.9 Environmental Health and Safety (EHS)

The RSO provides administrative support for the URSC and the functions of the radiation safety program. The Associate Director of EHS is an *ex officio* member of the URSC Tier I Committee and communicates with the Vice-President (Administration and Finance) at the request of the URSC or as appropriate to maintain the radiation safety program.

1.5.10 Campus Enforcement and Patrol

Campus Enforcement and Patrol (CEP) provides security related to the radiation safety program and provides communication and support for emergencies and incidents related to radiation safety. CEP services are available 24 hours per day for this purpose. CEP maintains emergency contact information that is supplied by the RSO. A member of CEP serves on the URSC Tier I Committee.

1.6 Radiation Safety Training

1.6.1 Available training courses

New staff/students

Radiation safety training is a prerequisite for any student or staff member (*i.e.* worker) who will work in an authorized radioisotope laboratory. Before commencing work in an authorized radioisotope laboratory, one of two radiation safety courses must be successfully completed. Separate training courses are available depending on the type of work performed within the laboratory:

1. **Radiation Safety** – required for workers who **directly** handle radioactive sources or devices containing radioactive sources. This course is designed to provide workers with the fundamental information pertaining to the characteristics of radiation, modes of decay, biological effects, review of units and calculations, means of reducing exposure (ALARA), emergency procedures and other procedures and policies associated with MUN's radiation safety program (RSP).
2. **Radiation Safety Awareness** - required for workers who **DO NOT** directly handle radioactive sources or devices containing radioactive sources. This course provides basic knowledge of hazard and signage identification as well as emergency procedures and important contact information.

Existing Radiation Workers

Radiation Safety Refresher - Authorized radiation workers are required to renew their training periodically. This can be achieved by completing the Radiation Safety Refresher training every **five (5)** years.

Laboratory Safety Awareness for Non-laboratory Workers

This course is intended for MUN employees who may occasionally be required to enter an authorized radioisotope laboratory to perform their employment function (i.e. facilities management personnel, custodians, ITS staff, administrative staff, etc.). This training will provide an overview of the laboratory environment, with special attention paid to the importance of recognizing and adhering to radiation signage, identification of the potential radiation hazards a worker may encounter, and what to do in the event that a radiation hazard is encountered. These employees will not perform their work in an area designated for nuclear substance or radiation device use without prior authorization from the RSO.

All training courses can be registered for by following the link below:

http://www.mun.ca/health_safety/training/

In addition, each worker must receive **laboratory-specific training** pertaining to the characteristics and risks associated with the radioisotopes that will be used in the laboratory, how to reduce exposure while working in the laboratory, and how the requirements of the RSP are implemented and complied within the laboratory. This training must be provided by the permit holder or a qualified delegate.

All training (both online and laboratory-specific) must be documented in the worker in-house training log (Appendix A).

1.6.2 New User Requirements

Before using, manipulating or handling any radioisotope substances or devices, new users must:

- Complete a Radioisotope User Registration Form;
- Complete the applicable online radiation safety training course;
- Receive the additional training specified in section 1.6;

- Receive any necessary dosimeters from the person responsible for the department;
- Be added to the authorized user's list of a Permit Holder by the RSO (via HSMS).

1.6.3 Permit Holder Requirements

Permit holders must ensure that:

- All users have completed the applicable online training based on worker type, received additional training as per section 1.6. and received any required dosimeters;
- All users are aware of any pertinent information regarding isotope, chemical form and laboratory specific procedures;
- All users are made aware of any changes in policies and procedures of the University.

1.7 Compliance Enforcement

The CNSC has issued MUN a Nuclear Substance and Radiation Device License for the possession, use and importation of nuclear substances and/or radiation devices.

A Nuclear Substance and Radiation Device License is a single broad-scope license issued by the CNSC to an institution having many users of radioactive materials who are primarily in one location. The application for an issuance of a consolidated license to an institution rather than to each individual radioisotope user emphasizes to the institution its responsibility for a radiation safety program.

1.7.1 Overview of Role and Authority of CNSC

Within Canada the Federal government's regulatory body is the CNSC. The CNSC has issued MUN a Nuclear Substance and Radiation Device License for its radioactive materials. This license allows MUN to possess, store and use specific radioactive materials under specific conditions, locations and restrictions.

1.7.2 Radiation Safety Enforcement – RSO

Permit holders are required to complete an annual Radiation Safety Inspection for each location authorized under their Radioisotope User Permit. Additional inspections for higher risk locations may be required by the Radiation Safety Officer. A compliance checklist (HSMS>Documentation) will be used. All non-compliances (major or minor) will be categorized as incidents. The RSO will periodically audit each lab to which a Radioisotope User Permit is issued and maintains the right to inspect any authorized radioisotope laboratory at any reasonable time.

While all individuals working in a lab associated with a Radioisotope User Permit are expected to carry out their work in a manner that is compliant with the terms of the Radioisotope User Permit, oversight of compliance is a shared responsibility between Permit Holder and Administrative Head of the unit where the Radioisotope User Permit is held.

Major non-compliances are reported for incidents that pose immediate risk or danger to safety, health, release to the environment of reportable quantities, doses of substantial amount to staff, or place the CNSC Consolidated Radioisotope License in jeopardy.

Examples of major non-compliance include:

- contamination above license criteria
- inadequate contamination monitoring program
- use or storage of food or drink in the laboratory
- inadequate training of new staff
- non-participation in required bioassay programs
- inadequate and/or unsafe work and storage areas for radioisotopes
- inadequate and/or unsafe storage areas for radiation waste

The above is not an all-inclusive list.

Minor non-compliances are reported for incidents that pose no immediate risk or threat to health, safety, the environment, but nonetheless illustrate non-compliance to regulatory and/or internal procedural requirements. Examples of minor non-compliance include:

- inadequate signage
- incorrect worker list
- non-removal of expired permits and forms
- inadequate posting (internal radioisotope permit, CNSC posters, etc.)
- inadequate inventory records
- inappropriate use of warning labels
- inappropriate segregation and/or identification of radiation waste for disposal or decay

The above is not an all-inclusive list.

For minor non-compliance incidents that are observed, the following procedures will apply:

- A radiation safety non-compliance incident is observed and recorded by the RSO during the inspection. By way of a copy of the inspection report or memorandum, the RSO will notify the Permit Holder and Administrative Head of the unit where the Radioisotope User Permit is held of the non-compliance incidents that require correction within an identified time frame.
- If the Permit Holder and Administrative Head have not replied within the identified time frame or the same non-compliance incident is observed during the follow-up inspection, the RSO will revise the deadlines and notify the Permit Holder, the Administrative Head of the unit where the Radioisotope User Permit is held, the Associate Director of Environmental of Health and Safety and the Chair of the University Radiation Safety Committee of the required actions.
- For continued minor non-compliance incidents the RSO will notify the Permit Holder and the Administrative Head of the unit where the Radioisotope User Permit is held, the Associate Director of Environmental of Health and Safety, the Chair of the Radiation Safety Committee, and the appropriate Vice-President(s) that continual minor non-compliance incidents have been observed. This latter group along with other individuals identified by the appropriate Vice-President(s), following due process, will determine the appropriate sanctions to apply. Sanctions could include, but are not limited to suspension or revocation of

RAM purchasing privileges, suspension or revocation of the Radioisotope User Permit and/or confiscation of radioactive materials.

- Furthermore, in addition to the aforementioned sanctions, disciplinary measures may be taken, subject to the processes outlined in the applicable collective agreements.

For a major non-compliance incident, the following procedures will apply:

- When a major non-compliance incident occurs, the RSO will notify the Permit Holder, the Administrative Head of the unit where the Radioisotope User Permit is held, the Associate Director of Environmental of Health and Safety and the Chair of the Radiation Safety Committee of the non-compliance incidents that require correction within an identified time frame.
- For repeated major non-compliance incidents the RSO will inform the Permit Holder and the Administrative Head of the unit where the Radioisotope User Permit is held, the Associate Director of Environmental of Health and Safety, the Chair of the Radiation Safety Committee, and the appropriate Vice-President(s) that repeated major non-compliance incidents have been observed. This latter group along with other individuals identified by the appropriate Vice-President(s), following due process, will determine the appropriate sanctions to apply. Sanctions could include, but are not limited to suspension or revocation of RAM purchasing privileges, suspension or revocation of the Radioisotope User Permit and/or confiscation of radioactive materials.
- Furthermore, in addition to the aforementioned sanctions, disciplinary measures may be taken, subject to the processes outlined in the applicable collective agreements.

1.7.3 Administrative Monetary Penalties - CNSC

Administrative Monetary Penalties (AMP's) are fines imposed by the CNSC, without court involvement, for the violation of a regulatory requirement. These fines can be applied against any individual or the University as a whole for regulatory violations. Fines range from \$300 - \$25,000 for individuals, and from \$1,000 - \$100,000 persons other than individuals (i.e. corporations). A list of finable offences can be found in the Administrative Monetary Penalties Regulations (link available in Appendix B).

2.0 Emergency Situations

Response to all types of accidents involving radioactive substances follows a methodological process approach. Please refer to the radiation safety operating procedure RSOP02 Emergency Evacuation.

2.1 Fire/Explosion

In the event of a fire or explosion, where nuclear substances are known to be present, the RSO shall immediately be notified. Emergency personnel responding to the scene should be advised that nuclear substances are present.

2.2 Radioisotope Incident Response

2.2.1 Spill

Any unplanned or unauthorized release or contamination involving radioactivity is considered a 'spill'. All spills are to be reported to the RSO who in turn reports these to the CNSC. Spills can be of a minor or major nature. When spills involve the release of airborne radioactivity, leakage of sealed sources, explosions etc. additional procedures may be required. Please refer to the radiation safety operating procedure RSOP03 Spill Response.

A. Minor Spills

If the spill involves less than one hundred exemption quantities of a nuclear substance and there is no radiation hazard to personnel, the Worker or Permit Holder can clean it using the procedure outlined in the radiation safety operating procedure RSOP03 Spill Response.

B. Major Spills

If the spill involves more than one hundred exemption quantities of material, or contamination of personnel, or release of a volatile material, or there is a radiation hazard to personnel, the protocol given in the Radiation Safety Operating Procedure RSOP03 Spill Response should be followed. In all major spills all personnel are to secure and evacuate the area immediately.

2.2.2 Theft or Loss

Theft or loss of nuclear substances are serious matters. The type and amount of missing nuclear substance must be immediately reported to the RSO. An investigation will follow. The CNSC will be notified.

2.3 Personnel Radioactive Decontamination (Internal & External)

All personnel contamination must be reported to the RSO as soon as practicable. Please refer to radiation safety operating procedure RSOP04 Decontamination

3.0 Radioisotope Permit

The purchase, use and disposal of nuclear substances is strictly controlled by the CNSC. Permission to use nuclear substances must be licensed accordingly. The requirements are dealt with in the following sections, as well as regulations, procedures and guides to good practice.

3.1 Permit Application

Individuals who plan to use nuclear substances shall complete a permit application form and forward the original copy to the RSO. Application forms may be obtained from the

Environmental Health and Safety, [Radiation Safety website](#). The RSO may request other relevant details prior to approval. Permits are processed by the RSO, but all applications will be reviewed by the University Radiation Safety Committee before approval is granted.

Any project that will involve the use of greater than 10,000 times any exemption quantity is considered a “Special Project” and requires written authorization from the CNSC. Indicate on your permit application if your project will be classified as a “Special Project.”

Permit holders **shall** comply with all conditions forming part of the permit.

3.2 Permit Application - Renewal

A permit renewal notice will be sent to each permit holder by the RSO prior to the official expiry date. A permit may also be cancelled at the time of permit renewal. It is recommended, if the permit holder is not currently using radioisotopes and has no immediate plans to resume such work, that the permit be cancelled. If the work with radioisotopes resumes, the permit may be reactivated upon re-application and approval of the URSC.

3.3 Permit Application - Amendment

To add or remove nuclear substances or locations from a permit or vary the possession limits, Permit Holders must complete a ***Nuclear Substances and Radiation Devices Permit Amendment Form*** (HSMS>Documentation).

3.4 Sabbatical or Extended Absence

The Permit Holder or in their absence, the Administrative Head must notify the RSO when taking a sabbatical or other extended leave of absence. The Permit Holder or in his or her absence, the Administrative Head will designate a responsible individual to act for the Permit Holder throughout the duration of the leave.

3.5 Permit Cancellation, Suspension or Revocation

The Canadian Nuclear Safety Commission issues MUN a Consolidated Radioisotope License for the possession, use and importation of radioactive prescribed substances or devices containing radioactive prescribed substances.

MUN is visited by CNSC inspectors to ensure that compliance to regulations and license conditions is achieved by radioisotope users. The CNSC has the ultimate authority to withdraw radioisotope user privileges if major violations occur. A serious violation by a radioisotope user could affect all radioisotope users under the University's Consolidated Radioisotope License.

Permit holders are required to complete internal Radiation Safety Inspections for all locations authorized under their Radioisotope User Permit, which are periodically audited by the RSO. Discrepancies identified between internal inspections and audits are

categorized as minor or major offences. All offences (major or minor) will be noted and the Permit Holder will be informed regarding required remediation or permit suspension or revocation as appropriate.

3.6 Decommissioning of a Radioactive Area

If a Permit Holder vacates a lab, or work with nuclear substances ceases, the lab must be decommissioned. The Permit Holder shall ensure that all areas (i.e. laboratories, storage and waste facilities) identified on his/her Radioisotope User Permit are decommissioned or free from radioactivity upon the expiry or termination of the permit. Please refer to the radiation safety operating procedure RSOP05 Decommissioning.

4.0 Laboratory Requirements

4.1 Record Keeping Requirements

Records in respect of any nuclear substance in the Permit Holder's possession shall be kept of the following:

- The name, quantity, form and location of the nuclear substance.
 - Model, serial number of a sealed source or where the nuclear substance is contained in a radiation device, the model and serial number of a radiation device and location of the sealed source or radiation device.
 - The quantity of the nuclear substance used and the manner in which the nuclear substance is/was used.
 - A record of the name of each worker who uses or handles a nuclear substance (Authorized Worker List).
 - A record of any transfer, receipt, disposal or abandonment of a nuclear substance, including
 - The date, name and address of the supplier or the recipient
 - The license number of the recipient
 - The name, quantity and form of the nuclear substance where the nuclear substance is a sealed source, the model and serial number of the source and where the nuclear substance is contained in a radiation device, the model and serial number of the device.
 - Record of the training received by each worker (these must be kept for at least 3 years after termination of the worker's employment).
 - Records of any spills, either major or minor.
 - Record of every inspection, measurement, test or servicing in accordance with the Act.
- ❖ **ALL records must be kept for 3 years after the expiry date of the last Radioisotope User Permit that was issued to the Permit Holder.**
- ❖ **The CNSC must be notified 90 days prior to the disposal of any record.**

4.2 Design and Physical Requirements

This CNSC guidance document (GD 52: Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms) provides laboratory planning information,

with specific features in ventilation, finishing and fixtures, plumbing, storage, security and miscellaneous topics including coat hooks, installation of radiation monitoring devices, desks, study spaces, food and beverage preparation and storage areas kept away from radioisotope laboratories and emergency lighting. Laboratories authorized for work with nuclear substances and/or radiation devices shall comply with the requirements outlined in GD-52.

The RSO should be contacted in the earliest stages of new laboratory design or renovation of old laboratories in order to ensure compliance with CNSC regulations and any other pertinent legislation. The CNSC requires that a Design Compliance Form be submitted for any new or renovated radioisotope laboratory. These forms are available through the RSO. The RSO will perform an assessment of the laboratory based on the criteria outlined by CNSC.

The CNSC classifies radioisotope laboratories and regulates the physical and operational requirements of these laboratories.

4.2.1 Classification Requirements

Radioisotope laboratories at the University may be classified as RAM Storage, Exempt Quantity (EQ), Sealed Source/Instrumentation, Basic, Intermediate or High level.

A room is classified as Basic, Intermediate or High level for the use of open source radioisotopes when more than one EQ is handled and where the largest quantity (Bq) of a radioisotope handled by any worker does not exceed 5, 50 or 500 times its corresponding annual limit of intake (ALI) (Table 1).

PERMISSIBLE QUANTITY OF RADIOACTIVITY IN ANNUAL LIMIT OF INTAKE (ALI)	
Laboratory Level	
Basic	EQ – 5 x ALI
Intermediate	5 – 50 x ALI
High	50 – 500 x ALI

Annual Limit on Intake (ALI) - the activity, expressed in Becquerel's (Bq), of a radionuclide that will deliver an effective dose of 20 mSv during the 50-year period after the radionuclide is taken into the body of a person 18 years old or older, or during the period beginning at intake and ending at age 70 after it is taken into the body of a person less than 18 years old.

Table 1: ANNUAL LIMIT ON INTAKE

Radionuclide	Exemption Quantity (MBq)	Annual Limit of Intake (ALI)	Laboratory classification (based on ALI)	
		Ingestion (MBq)	Basic Level (EQ - 5 x ALI)(MBq)	Intermediate Level (5 - 50 x ALI)(MBq)
Calcium 45	10	26	10 - 130	130 - 1300
Carbon 14	10	34	10 - 170	170 – 1700
Chromium 51	10	530	10 - 2650	2650 – 26500
Cobalt 57	1	95	1 - 475	475 – 4750
Hydrogen 3	1000	1000	1000 - 5000	5000 – 50000
Iodine 125	1	1.3	1 - 6.5	6.5 – 65
Iodine 131	1	0.91	1 - 4.55	4.55 – 45.5
Lead 210	0.01	0.029	0.01 - 0.145	0.145 – 1.45
Neptunium 237	0.001	0.0013	0.001 – 0.0065	0.0065 – 0.065
Phosphorus 32	0.1	8.3	0.1 - 41.5	41.5 – 415
Phosphorus 33	100	83	100 - 415	415 – 4150
Sulfur 35	100	18 (inhalation)	n/a	100 – 1900
Thorium 230	0.01	0.095	0.01 – 0.475	0.475 – 4.75
Uranium 233	0.01	0.4	0.01 - 2	2 – 20
Uranium 238	0.01	0.45	0.01 – 2.25	2.25 – 22.5

Source: GD-52 – Design Guide for Nuclear Substance Labs & Nuclear Medicine Rooms.

If less than 1 EQ of a nuclear substance will be handled at any time, the laboratory will be classified as “exemption quantity.”

If only sealed nuclear sources or instruments containing sealed nuclear sources will be utilized, the laboratory will be classified as “sealed source/instrumentation.”

“RAM storage” areas are laboratories/rooms where nuclear substances and/or radiation devices are stored but not manipulated.

4.3 Posting of Rules

License conditions state that each laboratory which has been designated as a Radioisotope Laboratory must have the CNSC appropriate safety rules posted. Procedures for handling radioactive materials must be in accordance with the appropriate rules.

4.3.1 Safety Rules

The rules for working with radioisotopes in Basic, Intermediate, and High Level Laboratories are available online on the HSMS under Documentation.

It is the responsibility of the Permit Holder to post the rules. Once the rules for working with radioisotopes are initially posted, the Permit Holder will be responsible to ensure that all laboratory staff, students and authorized visitors are aware of the Rules. The Permit Holder must ensure that a copy of the Rules remains conspicuously posted at all times

4.4 Labeling Requirements

Specific areas within a laboratory must be defined for handling radioactive open sources to protect MUN's faculty, employees, students, and the general public. Well defined areas and equipment alert people to the fact that radioactive contamination of the areas or equipment may exist. The radiation warning symbol is to be prominently displayed when radioisotopes are **in use** or **contamination is present** and be of a size appropriate for the size of the container or area being labeled.

A durable, legible radiation warning sign is required to be posted at the boundary of and at every point of access of an authorized location where there is a quantity of nuclear substance greater than 100 times its exemption quantity or where there is a probability that a person may be exposed to a dose rate greater than 25 $\mu\text{Sv/hr}$.



Important Note: Radiation warning signs and symbols must be removed when the area or equipment will no longer be used for radioactive work or contamination is no longer present

4.5 Secure Access

Security elements must be incorporated into the design of the laboratory and should include access control, monitoring capacity, and be located away from public area.

Radioisotope laboratories must have a lock on the door or other appropriate mechanisms to control access to authorized workers.

5.0 Radiation Dosimetry

New users may only use radioisotopes after obtaining any required dosimeters. The type of dosimeter required is determined by the use limit on the permit and is clearly stated for each user listed on the permit. The dosimeters are changed on a regular basis (i.e. quarterly). Please contact the RSO to enroll in the dosimetry program. A national dosimetry registry is maintained by Health Canada. The effective dose received is measured in Sieverts (Sv). This is the absorbed dose multiplied by a 'quality factor' which takes into account the type of radiation and body tissue involved.

5.1 Regulations Regarding Permitted Dose

Under CNSC criteria, employees at the University are classified as members of the general public. Pregnant workers must notify the RSO.

MAXIMUM PERMISSIBLE ANNUAL EFFECTIVE DOSE LEVELS		
	Member of the General Public (Non-Nuclear Energy Worker)	Nuclear Energy Worker* (NEW)
Whole body, gonads, bone marrow	1 mSv	50 mSv
Skin, thyroid, bone	50 mSv	500 mSv
Hands, feet and forearms	50 mSv	500 mSv

SORL2000-203 – Nuclear Safety & Control Act Radiation Protection Regulations.

* A Nuclear Energy Worker is defined as anyone who, in the course of his or her work could exceed the dose limit of a member of the general public. Based on research design, historical records and anticipated dose, an individual will be identified and will be formally required to sign the appropriate documentation. Therefore, the RSO must be informed of any experimental design where an increased dose is anticipated.

5.2 Criteria for Dosimetry

Individuals working with radioisotopes may be required to wear a dosimeter depending on the type and energy of the radioactive emission as well as the amount of isotope used.

5.2.1 Radiation Dosimeters

Radiation dosimeters are used to provide two types of measurements:

- Dosimeters designated “Body” are used to measure the actual radiation dose absorbed by the body (effective dose) and monitor occupational risk.
- Dosimeters designated “Extremity” (e.g.: neck/collar, ring/finger, wrist) are used to measure the radiation exposure to the extremities of the body and to monitor non-uniform radiation exposure.

Please refer to radiation safety operating procedure RSOP01A Dosimetry Use-External

5.2.2 Thyroid Bioassay

Unbound I^{125} or I^{131} presents special risks of accumulation in the thyroid. Individuals who, during a 24 hour period, use more than 2 MBq of I^{125} or I^{131} on the open bench or more than 200 MBq of I^{125} or I^{131} in a fume hood must participate in the thyroid bioassay program. Participation is also required for anyone involved in a spill of more than 2 MBq or where external contamination on personnel is detected. Any other individual who is deemed by the RSO to be likely to receive a significant intake of unbound radioiodine is also required to take part in the program. Please refer to radiation safety operating procedure RSOP01B Dosimetry Use-Internal.

6.0 Acquisition & Tracking of Nuclear Substances and Devices

6.1 Receiving of Radioactive Material

Shipping companies deliver the radioactive shipments to the appropriate stores areas or laboratories directly. Laboratory personnel must check the incoming shipments for leakage/damage (including dose surveys and wipe testing) prior to opening. Please refer to the radiation safety operating procedure RSOP06 Shipping and Transporting for complete receipt instructions.

6.3 Inventory Management

CNSC Regulations require that an inventory of all radioactive material in possession under the terms of the Nuclear Substances and Radiation Devices License be maintained. MUN requires that each permit holder maintain an accurate, current inventory of all radioactive materials in his/her possession. Records must be available for inspection by the RSO or the CNSC at all times.

6.3.1 Sealed Sources

Sealed sources are any radioactive materials where the radioisotope is encapsulated to prevent direct manipulation of the material. They are usually small sources used for instrument calibration. However, sealed sources also include any radioactive material incorporated into a device such as a liquid scintillation counter, gas chromatograph or other such unit. Much larger sealed sources exist in exposure devices or in irradiators. An inventory of all sealed sources held under a radioisotope permit is listed on the permit itself. This will constitute the inventory record provided that it is accurate. It is the responsibility of the permit holder to ensure that the record of sealed sources on the permit is accurate.

Sealed sources and devices containing sealed sources must be durably and clearly labeled with a radiation warning sign indicating the type and quantity of radioactive material present.

A permit holder is required to notify the RSO prior to the receipt of any sealed source or device containing a sealed source. Information on the radionuclide, its activity and the device in which it is located must be submitted in writing. The RSO will arrange for the permit amendment.

A permit holder is required to notify the RSO prior to the disposal or transfer of any sealed source or a device containing a sealed source. Information on the device and its intended destination must be submitted to the RSO. In the case of disposal, the RSO will make the appropriate arrangements for removal of the source and the revision of the permit. In the case of a transfer, the RSO will arrange for the permit revision and the leak testing of the source. Please refer to the radiation safety operating procedures RSOP07 A/B/C/D.

6.3.2 Open Sources

Open sources are any radioactive material where direct manipulation of the radioisotope or labeled material is possible. This includes most radioactive materials used for teaching and research.

The CNSC requires that all permit holders maintain an accurate and current inventory of all open source material in possession under the permit. The inventory records must show the requisition and inventory number, isotope, chemical form, total activity, date received, permit number and information about the use and disposal of the radioactive material.

The procurement of all radioactive material is carried out by the RSO. All radioisotope inventory records must be maintained for three years following termination of the internal radioisotope user permit. If a Permit Holder leaves the University, these records must be transferred to the RSO. The inventory records must be kept up to date and available for inspection by the RSO or the CNSC. Please refer to the radiation safety operating procedure RSOP08A/B/C.

6.4 Storage, Security and Labeling

All storage areas must be secured from unauthorized users. These areas must also be labeled with a radiation warning symbol, and a label indicating the isotopes that may be stored in the area.

6.4.1 Nuclear Substances in Use:

- Constant surveillance and control must be maintained for nuclear substances in use. This means that an individual who has received training in the safe use of radioactive material ***must be present*** in the laboratory or the laboratory must be locked if the material is left unsecured in the laboratory.

6.4.2 Transportation between Campus Buildings

Transportation between buildings on campus may be required for collaborative research.

- The RSO must be contacted to arrange for the transport of the materials between buildings on and off campus.

6.4.3 Shipping off Campus

The Permit Holder will be responsible for obtaining a copy of the current CNSC Radioisotope License of the recipient institute, company, etc. and forwarding to the RSO. Please note this is the CNSC license that is required not a radioisotope permit issued under the license. The Permit Holder must forward the following information to the RSO:

- Radioisotope and activity in MBq
- Physical form (solid, liquid, gas)
- Full chemical name
- Weight or volume
- Special handling requirements (dry ice, perishable, etc.)
- “No Commercial value” if the shipment is for a collaborative project
- The name and telephone number of the Radiation Safety Officer of the recipient institute, company, etc.

There may be research projects that require transportation by the Permit Holder or laboratory personnel. The Permit Holder must contact the RSO at least (4) four weeks prior to the commencement of the project to arrange for transportation.

6.5 Reporting of Missing Nuclear Materials

Any suspicion of missing nuclear substances such as loss or theft, misuse or suspicious activities must be reported immediately to the RSO at 709-864-8250. After-hours please contact MUN campus enforcement patrol at 709-864- 4100 who will contact the Radiation Safety Officer.

7.0 Waste Management

Please refer to radiation safety operating procedure RSOP09 Disposal of Radioactive Waste.

7.1 Open Source

Only long half-life radioactive materials (i.e. ^3H , ^{14}C) may be disposed of via local disposal routes [i.e. drains (aqueous liquid) or regular garbage (solids)] if below CNSC regulatory limits for radioactive waste AND PREAUTHORIZED BY THE RSO.

DO NOT DISPOSE OF WASTE VIA DRAIN OR GARBAGE WITHOUT PRIOR WRITTEN APPROVAL FROM THE RSO

In exceptional circumstances it may be necessary to dispose of radioisotope through external disposal companies where the methods outlined in this section are unable to

permit safe and legal disposal. If you are planning an experiment that you believe may require this type of disposal, contact the RSO for guidance.

Short half-life radioactive materials (i.e. ^{32}P , ^{51}Cr , ^{35}S , ^{125}I) shall be held for decay in authorized decay rooms. Contact the RSO for waste pick-up. Alternative means of disposal may be allowed with RSO authorization.

7.2 Sealed Sources

Contact the RSO for instructions regarding the disposal of a sealed source. The RSO can make arrangements for disposal of sealed sources. Sealed source permit holders may use liquid scintillation cocktail for leak testing.

7.3 Storage of Radioactive Waste Containers

Waste containers will be stored away from frequently used work areas, and dosimetry storage areas. Any containers that may pose a risk of spillage or injury will be rejected. Liquid waste containers that contain volatile radioactive compounds must be stored in a fume hood. The lid of a liquid waste container must not be left in the open position. Waste storage in the laboratory must not result in laboratory personnel being subjected to radiation levels of $2.5 \mu\text{Sv/h}$ (0.25 mRem/h) and must be inaccessible to unauthorized workers.

8.0 Contamination Monitoring

All radioisotope facilities must be monitored for contamination. At a minimum, all radioisotope laboratories actively using radioactive materials must be monitored **weekly** [within 7 days of RAM use (any manipulation of open source radioactivity)] for the possibility of surface contamination. There are two methods used for contamination monitoring: direct monitoring and indirect monitoring.

The **direct monitoring** method can be used for determining fixed contamination or loose contamination generated by high energy beta or gamma emitters. A hand held contamination instrument must be used for measurements in this method.

The **indirect monitoring** method can be used for measuring loose contamination. In this method swipes are taken over an area of 100 cm^2 and measured using a liquid scintillation counter or automatic gamma counter.

Please refer to the radiation safety operating procedure RSOP11 Contamination Monitoring.

There are different criteria for loose (non-fixed) contamination and for fixed contamination. The criteria for non-fixed contamination are established in Bq/cm^2 and those for fixed contamination in $\mu\text{Sv/h}$.

The records of the contamination monitoring must be kept by the Permit Holder and be available for inspection.

9.0 References

1. Canadian Nuclear Safety Commission - www.cnscccsn.gc.ca
2. Health Canada (Radiation Protection Bureau) –
<http://www.hc-sc.gc.ca/ahc-asc/branch-dirgen/hecs-dgsesc/sep-psm/rpb-br-eng.php>
3. International Commission on Radiological Protection (ICRP) - www.icrp.org

Professional Radiation Safety Organizations

1. Radiation Safety Institute of Canada - www.radiationsafety.ca
2. Canadian Radiation Protection Association - www.crpa-acrp.ca

Portions of this Manual were adapted with permission from the University of Calgary, McGill University and the University of Ottawa.

Special thanks for the use of their Radiation Safety Programs as a template.

APPENDIX A - Training Log (click to open PDF)

Training Log

May 2016

Permit/certificate holder/Permit/certificate #: _____

Authorized worker name: _____

Authorized worker job title: _____

[illegible]

***Note: the first entry must be the completed reading of the Radiation Safety Manual.**

Training Log, TL v1
Date of first issue: n/a

Responsible Committee: University Radiation Safety Committee
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Page 1 of 1
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2016-05-23

For the latest version of this document please go to: http://www.mun.ca/health_safety/OHSMS/BSMS/

APPENDIX B – List of Legislation, Regulatory Documents & Procedures/Manuals

Legislation

[Nuclear Safety and Control Act](#)
[General Nuclear Safety and Control Regulation](#)
[Radiation Protection Regulations](#)
[Nuclear Substances and Radiation Devices Regulation](#)
[Packaging and Transport of Nuclear Substances Regulation](#)
[Administrative Monetary Penalties Regulations](#)

Regulatory Documents

[P-290 Managing Radioactive Waste](#)
[Regulatory Guide G-121 Radiation in Educational, Medical and Research Institutions](#)
[Regulatory Guide G-129 Keeping Radiation Exposures “As Low As Reasonably Achievable \(ALARA\)”](#)
[GD-52 \(Rev 1\) Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms](#)
[Regulatory Guide RD-58 Thyroid Screening for Radioiodine](#)

Radiation Safety Manual

Radiation Safety Operating Procedures

RSOP01A	Dosimetry Use External
RSOP01B	Dosimetry Use Internal
RSOP02	Emergency Evacuation
RSOP03	Spill Response
RSOP04	Decontamination
RSOP05	Decommissioning
RSOP06	Shipping & Transportation
RSOP07A	Sealed Source – Records
RSOP07B	Sealed Source – Posting
RSOP07C	Sealed Source – Inventory
RSOP 07D	Sealed Source – Leak Testing
RSOP08A	Open Source – Records
RSOP08B	Open Source – Posting
RSOP08C	Open Source – Purchasing and Inventory
RSOP09	Disposal of Radioactive Waste
RSOP010	Security of Radioactive Materials
RSOP011	Contamination Monitoring