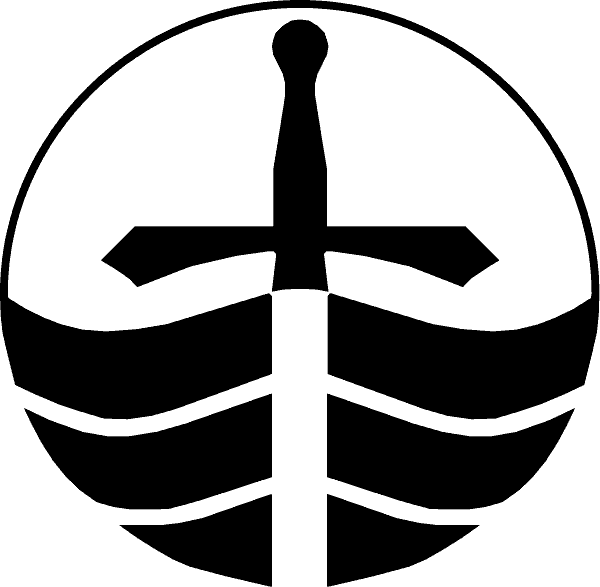
****

## Trent University

Radiation Safety

Program for Users

Emergency Procedures

In case of a radioactive spill:

1. Notify everyone in the immediate vicinity and have them move away from the affected area. Do not let anyone leave the general area until they have been checked for contamination. Perform urgent first aid if necessary.

2. Inform Trent University Security (705 748-1333) of the incident. They will secure the affected area/room and put into action the Radioactive Incident Response Plan.

3. Inform the Radiation Safety Officer (705 748-1011 x7061) who will direct the clean-up and decontamination program.

4. If safety won’t be compromised, confine the spill by covering it with absorbent material. A chemical spill kits are located in SC 132.1, DNA A 119, LHS C 261 and LHS D 119.3

5. Once the hazard has been assessed by the RSO, begin decontamination procedures as outlined in this manual.

If unsure of the hazard, **BACK AWAY**. Wait for the appropriate personnel to assist/direct the cleanup.

This manual is provided to assist you in maintaining high standards of safety practices and programs in adherence to the obligations of the Nuclear Safety and Control Act, the Regulations made under the Act and the conditions of Trent University’s Consolidated Radioisotope Licence. It is required reading for persons who use radioactive materials or sources of ionizing radiation for teaching or research at Trent University. While written for employees, students are encouraged to read, and will be expected to work according to the procedures outlined in this handbook.

This manual assumes that the reader is familiar with the Trent University Laboratory Safety Handbook. The Laboratory Safety Handbook is required reading for all employees who work in science laboratories at Trent University. Contact your supervisor or the Health and Safety Advisor, Office of Risk Management for more information.

Please read this manual carefully. If you have any questions about how to undertake a task or project safely, contact your supervisor. The Radiation Safety Officer can also serve as an additional resource.

We trust that this manual will help you to work safely and to develop effective radiation safety procedures. We welcome your recommendations to improve both this manual and Trent University’s Radiation Safety Program.

### Our goal is a safe environment for everyone.

Mr. R. Chris Williams, M.Sc. Dr. Cathy Bruce

Radiation Safety Officer V.P. Research and Innovation

Trent University Applicant Authority

December 2001

Revised

April 5, 2007

January 2012

October, 2013

Jan, 2016

Feb 2017

Dec. 2020

Dec. 2021

Feb 2022.

## TABLE OF CONTENTS

Emergency Procedures 2

Table of Contents 4

Definitions and Glossary 6

Measurement Units Conversion Table 10

1.0 Introduction and Purpose 11

1.1 Purpose of Manual 12

1.2 Mandatory Reading 12

1.3 Responsibilities and Liabilities 12

1.4 Disclaimer 13

2.0 Responsibility for Radiation Safety at Trent University 14

2.1 Student Use of Radioisotopes 14

2.2 Permit Users 15

2.3 Permit Holders 15

2.4 Responsibilities of the Radiation Safety Officer 16

3.0 Training and Authorization 17

3.1 Radiation Safety Training 18

3.2 Application for Radioisotope Use Permits and Project Authorization 18

4.0 Acquisition and Receiving Prescribed Substances and Equipment 19

4.1 Receipt of Radioactive Prescribed Substances 20

5.0 Inventory and Storage of Radioisotopes 20

5.1 Transportation of Radioactive Materials 21

5.2 Transfers of Radioactive Material 22

6.0 General Work Procedures 22

6.1 Radiation Surveys and Monitoring 23

6.1.2 Dose Monitoring Program 24

6.1.3 Contamination Monitoring 25

6.1.4 Sealed Source Leak Testing 30

6.2 Decontamination 30

7.0 Procedures for Disposal of Radioactive Waste 31

7.1 Short-lived Isotopes (half-life <150 days) 31

7.2 Longer-lived Isotopes (half-life >150 days) 32

8.0 X-Ray Sources and Other Radiation Emitting Devices 32

8.1 X Ray devices 32

8.2 Other Radiation Devices 33

9.0 Radiation Incidents 33

9.1 Spill Response Process 34

9.2 Contaminated Areas and Equipment 34

9.3 Personnel Monitoring and Decontamination 35

9.4 Loss, Theft and Fire 36

9.5 Reporting Requirements 37

10.0 Project Termination 37

10.1 Work Permit Closure 37

10.2 Record Retention 38

# Appendices

Appendix 1. Permit Holder Annual Report 39

Appendix 2. Application for Radioisotope Permit 40

Appendix 3. Trent University Radioisotope Use Permit 45

Appendix 4. Quick Reference: Regulatory Quantities for Typical Radionuclides 47

Appendix 5. Radionuclide Inventory Forms 48

Appendix 6. Sample Contamination Monitoring Results Log 49

Appendix 7. Decontamination Techniques for Areas and Equipment 50

Appendix 8. Termination of Radionuclide Use Form 51

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# DEFINITIONS AND GLOSSARY

#### Absorbed dose (Da): Absorbed dose (Da) means the quotient, in gray (Gy) obtained by dividing the energy absorbed through exposure to radiation by the mass of the body or part of the body that absorbs the radiation.

#### Action level: Action level is a specific dose of radiation or other parameter that, if reached, may indicate a loss of control on the part of the licensee’s radiation protection program, and triggers a requirement for a specific action to be taken.

#### ALARA: As Low As Reasonably Achievable. All doses must be kept below dose limits and as low as achievable, economic and social factors taken into account. This is the defining philosophy behind radiation safety internationally and within the Radiation Safety Program at Trent University.

#### ALI: Annual Level of Intake: An ALI is the activity of a radionuclide that taken by itself would result in an effective committed dose to “Reference Man” of 20 mSv (the annual limit), or 200 mSv dose equivalent to any tissue, whichever is more restrictive.

#### Canadian Nuclear Safety Commission (CNSC): The federal regulatory agency for the use of radioactive substances in Canada.

#### Device: For the purposes of this guide and the application form, a device is any piece of equipment designed to use a sealed source(s) with the sealed source(s) installed and for which a Device Certification has been issued by the CNSC.

#### Diagnostic nuclear medicine: Administration of unsealed nuclear substances to humans for diagnostic purposes related to their health care. The processing of radio-pharmaceuticals and laboratory studies which are part of the diagnostic studies are included.

#### Dismantle: To take apart prescribed equipment for the purpose of repairing, replacing, removing faulty components which may include the nuclear substance of that device (part of the licensed activity of servicing, installation and dismantling of devices containing radioisotopes).

#### Effective dose (De): De means the sum of the products, in sievert (Sv) obtained by multiplying the equivalent dose of radiation received by and committed to each organ or tissue by the weighting factor of that organ. (See Radiation Protection Regulations Schedule 1 for specific weighting factors).

#### Equivalent dose (eD): eD means the product, in sievert (Sv) obtained by multiplying the absorbed dose of radiation of a specific type by a weighting factor for that type. (See Radiation Protection Regulations Schedule 2 for specific weighting factors).

#### Exemption Quantity (EQ): An EQ is a quantity of a radioactive nuclear substance which may be possessed, used, stored, transferred etc... without a license. This is specifically defined in the *Nuclear Substances and Radiation* *Devices Regulations.* Examples of some EQ quantities for commonly used isotopes can be found in appendix 4.

#### Export: to send a nuclear substance or prescribed equipment out of Canada.

#### Five-year dosimetry period: The period of five calendar years beginning on January 1 of the year following the year in which the CNSC Regulations come into force, and every period of five calendar years thereafter.

#### Human research studies: Studies which involve the administration of unsealed nuclear substances to, or external irradiation of humans for purposes not related to their personal health care are defined as human research studies. The processing of radio-pharmaceuticals and laboratory studies which are part of the human research study are also included.

#### Import: to bring a nuclear substance or prescribed equipment into Canada.

#### Licensed Activity: A licensed activity for the purpose of this safety manual means an activity, in relation to a nuclear substance or a radiation device described below, that a licence authorises the licensee to carry on:

a) possess, transfer, import, export, use or abandon a nuclear substance, prescribed equipment or prescribed information;

b) mine, produce, refine, convert, enrich, process, reprocess, package, transport, manage, store or dispose of a nuclear substance; or

c) produce or service prescribed equipment.

#### Licensed Use Type: A particular use of nuclear substances as described in the *Cost Recovery Fees Regulations.*

#### Location: Any land, base(s) of operations, or premises the licensee occupies, where the licensee uses or stores nuclear substances for more than 90 consecutive days.

#### Nuclear Energy Worker (NEW): A person who is required, in the course of the person’s business or occupation in connection with a nuclear substance or nuclear facility, to perform duties in such circumstances that there is a reasonable probability that the person may receive a dose of radiation that is greater than the prescribed limit for the general public.

#### Nuclear Substance:

(a) deuterium, thorium, uranium or an element with an atomic number greater than 92;

(b) a derivative or compound of deuterium, thorium, uranium or of an element with an atomic number greater than 92;

(c) a radioactive nuclide or atoms that disintegrate by emission of corpuscular or electromagnetic radiations;

(d) a substance that is prescribed as being capable of releasing nuclear energy or as being required for the production or use of nuclear energy;

(e) a radioactive by-product of the development, production, or use of nuclear energy; and

(f) a radioactive substance or radioactive item that was used for the development or production of, or in connection with the use of, nuclear energy.

#### One-year Dosimetry Period: The period of one calendar year beginning on January 1 of the year following the year in which these Regulations come into force, and every period of one calendar year thereafter is referred to as a one-year dosimetry period.

#### Package: To put a nuclear substance or prescribed equipment into a form of containment for purposes of transport.

#### Possess: To have the care and control of a nuclear substance or prescribed equipment.

#### Radiation: The emission by a nuclear substance, the production using a nuclear substance, or the production at a nuclear facility of, an atomic or subatomic particle or electromagnetic wave with sufficient energy for ionization.

#### Radiation Device:

(a) a device that contains more than the exemption quantity of a nuclear substance and that enables the nuclear substance to be used for its radiation properties; and,

(b) a device that contains a radium luminous compound.

#### Radiation Contamination Meter: An instrument that is capable of measuring the activity of radioisotopes (becquerels, cpm).

#### Radiation Survey Meter: An instrument that is capable of measuring radiation dose rates (mrem/h or mSv/h).

#### Radioisotope: An isotope of an element which produces ionizing radiation.

#### Sealed Source: A radioactive nuclear substance in a sealed capsule or in a cover to which the substance is bonded, where the capsule or cover is strong enough to prevent contact with or the dispersion of the substance under the conditions for which the capsule or cover is designed.

#### Source in Device: A sealed source which remains in a device giving mechanical protection from damage during use.

#### Store: To lay away for future purposes.

#### Therapeutic Nuclear Medicine: The administration of unsealed nuclear substances to humans for therapeutic purposes related to their health care; the processing of radio pharmaceuticals and laboratory studies which are part of the therapy are included.

#### Transfer: To change the possession of a nuclear substance or prescribed equipment from one person to another.

#### Transport: To handle, carry, store in transit, and receive goods at the final destination. Transport includes normal and accident conditions encountered in carriage and in storage during transit.

#### Unsealed Source: A source other than a sealed source.

#### Use: To put into operation.

#### Worker: A person who performs an activity that is referred to in the licence.

# Measurement Units Conversion Table 1.

**\* 1 Bq = 1 disintegration/second**

|  |  |  |
| --- | --- | --- |
| **The rad (rad) is replaced by the gray (Gy)** | | |
| 1 kilorad (Krad) | = | 10 grays (Gy) |
| 1 rad (rad) | = | 10 milligrays (mGy) |
| 1 millirad (mrad) | = | 10 micrograys (μGy) |
| 1 microrad (μrad) | = | 10 nanograys (nGy) |
|  |  |  |
| **The gray (Gy) replaces the rad (rad)** | | |
| 1 gray (Gy) | **=** | 100 rad (rad) |
| 1 milligray (mGy) | **=** | 100 millirad (mrad) |
| 1 microgray (μGy) | **=** | 100 microrad (μrad) |
| 1 nanogray (nnGy) | **=** | 100 nanonrad (nrad) |
|  |  |  |
| **The rem (rem) is replaced by the sievert (Sv)** | | |
| 1 kilorem (krem) | **=** | 10 sieverts (Sv) |
| 1 rem (rem) | **=** | 10 millisieverts (mSv) |
| 1 millirem (mrem) | **=** | 10 microsieverts (μSv) |
| 1 microrem (μrem) | **=** | 10 nanonsieverts (nSv) |
|  |  |  |
| **The sievert (Sv) replaces the rem (rem)** | | |
| 1 sievert (Sv) | **=** | 100 rem (rem) |
| 1 millisievert (mSv) | **=** | 100 millirem (mrem) |
| 1 microsievert (μSv) | **=** | 100 microrem (μrem) |
| 1 nanosievert (nSv) | **=** | 100 nanonrem (nrem) |
|  |  |  |
| **The curie (Ci) is replaced by the becquerel (Bq)\*** | | |
| 1 kilocurie (kCi) | **=** | 37 terabecquerels (TBq) |
| 1 curie (Ci) | **=** | 37 gigabecquerels (GBq) |
| 1 millicurie (mCi) | **=** | 37 megabecquerels (MBq) |
| 1 microcurie (μCi) | **=** | 37 kilobecquerels (kBq) |
| 1 nanocurie (nCi) | **=** | 37 becquerels (nBq) |
|  |  |  |
| **The becquerel (Bq)\* replaces the curie (Ci)** | | |
| 1 terabecquerel (TBq) | **=** | 27 curies (Ci) |
| 1 gigabecquerel (GBq) | **=** | 27 millicuries (mCi) |
| 1 megabecquerel (MBq) | **=** | 27 microcuries (μCi) |
| 1 kilobecquerel (kBq) | **=** | 27 nanocuries (nCi) |
| 1 becquerel (Bq) | **=** | 27 picocuries (pCi) |

# *1.0 INTRODUCTION AND PURPOSE*

Canadians are exposed to ionizing radiation every day from a variety of natural (cosmic rays, minerals) and man-made (medical, nuclear powerplants) sources. In Canada, we are exposed to an average of 0.3 mSv – 0.5 mSv of cosmic radiation per year, 0.2 mSv – 2 mSv per year from the earth’s crust and radon depending on where you live and 0.01-.2 mSv per year from isotopes of potassium and carbon which are in our bodies naturally. We call the sum of these doses the background radiation dose. Some areas of the world such as areas in Brazil and Kerala, India have 20-100 times higher background dose levels.

The most commonly asked question involving radiation is “What is the safe level of radiation?” A great deal of research has been done on this question. The prevailing opinion at present is that the risk of a deleterious effect due to radiation is a function of the dose. That is to say that the risk increases as the total accumulated dose increases. The dose due to radiation exposure is a function of the intensity of the exposure, the type of radiation (alpha particle, beta particle, gamma ray, x-ray, neutrons) and the length of time of the exposure. All these factors affect the total dose an individual may receive and thus affect the risk. We attempt to limit an individual’s dose by limiting the intensity of the exposure through shielding, maintaining a suitable distance from the source and by limiting the time that people can be exposed to these sources of radiation. Experts use a linear non-threshold (LNT) model to estimate the risk. They assume that any exposure has some risk and that there is no level below which damage does not occurs. They also assume the effects at low doses are directly proportional to consequences at very high doses. All of this makes it sound like any exposure should be avoided at all costs. However, compared to other commonplace things that we do, the risk of death as a result of exposure to radiation is really quite small. For example, smoking 1.4 cigarettes in your life increases your chance of premature death by one in a million. Drinking one half litre of wine in your life increases your chance of premature death by one in a million. Living 1.5 years on a site boundary of a typical nuclear power plant increases your chance of premature death by one in a million (source: Readings in Risk, Eds. Glickman S.T. and Gough M., 1990). Many things that we do in our day to day lives can increase the risk of premature death by considerably more than one in a million. There is, however, a great deal of controversy regarding the LNT model. Many radiation protection experts would argue that the assumptions in this model are wrong and that there is a minimum limit of exposure at which biological effects occur. However, for the time-being the current regulatory policy is to use the LNT model as the basis for setting dose limits.

The use of radioactive substances contributes greatly to many fields of scientific endeavour. However, any exposure to ionizing radiation has the potential to be a health hazard. Hazards from radiation may arise from exposure to external sources of radiation (such as X -rays, gamma rays or particles) or from the effects of radioactive materials taken into the body. Limiting the exposure of individuals to ionizing radiation can reduce the risk of cellular damage. It is particularly important that the people exposed to radiation on a regular basis during the course of their work are monitored to ensure that their exposure does not exceed what are considered to be safe levels.

The Canadian Nuclear Safety Commision (CNSC) has granted Trent University a Consolidated Radioisotope Licence which allows Trent University to approve the use of certain radioisotopes in teaching and research. The administration of this licence is the responsibility of the Radiation Safety Officer (RSO). The Radiation Safety Officer derives authority from, and is advisory to the Vice-President Research and Innovation, who is the Applicant Authority. The Radiation Safety Officer authorizes and controls the use of radioactive materials or radiation-emitting devices by the issue of permits. Permits are granted only to qualified personnel or to Research Project Leaders with adequate experience. Permit Holders are responsible for ensuring that all activities undertaken under their authority are consistent with established procedures and the conditions of the Radioisotope Licence and their permit.

The effectiveness of the Radiation Safety Program is monitored by the Radiation Safety Officer. The Radiation Safety Officer will conduct annual laboratory inspections and periodic spot-checks to ensure that appropriate safety precautions and procedures are in place. CNSC inspectors will also periodically conduct inspections of University facilities to ensure compliance with CNSC regulations and the conditions established by the University’s Consolidated Radioisotope Licence.

The purpose of Trent University’s Radiation Safety Program is to ensure that the use of radioactive material in the pursuit of scientific knowledge is based on the As Low as is Reasonably Achievable (ALARA) principle of Radiation Safety and does not constitute an unnecessary risk to Trent personnel, students and the public.

# *1.1 PURPOSE OF MANUAL*

The purpose of this manual is:

to define radiation safety responsibilities and accountabilities within the University;

to outline specific policies and procedures which may apply; and

to outline basic emergency procedures.

# *1.2 MANDATORY READING*

Every employee working or intending to work with radioisotopes or radiation-emitting devices at Trent University must read this document.

# *1.3 RESPONSIBILITIES AND LIABILITIES*

Everyone actively engaged in the use of radioisotopes or radiation-emitting devices is legally responsible for safety performance. All personnel must meet the requirements of the Canadian Nuclear Safety Control Act and its associated regulations. It is expected that adherence to this manual is a good starting point for establishing an acceptable radiation safety program within each laboratory.

More detailed and specific safety procedures and practices may be necessary and everyone is encouraged to develop and use practices which exceed the basic safety practices outlined in this manual.

Any deviation from this manual should be toward safer practices. Everyone should be able to justify that reasonable care and deliberation has been exercised before the implementation of any changes.

By not adhering to the recommended practices in this manual or safer alternatives, individual liability may increase. Therefore, always take reasonable care to ensure that safety considerations are included in all work involving radioisotopes.

# *1.4 DISCLAIMER*

This manual is intended to provide basic guidelines and practices for safe work with radioisotopes or radiation-emitting devices. The procedures may be supplemented with safer work practices where applicable.

This manual is by no means all encompassing and any omission is not an excuse for unsafe practices.

In all cases the Permit Holder is ultimately responsible for establishing safe work practices and must insist on the use of such (proper procedures) in order to eliminate unnecessary hazards. The Permit Holder must identify and supplement this manual with safe procedures and training, specific to the needs of their radiation safety programs, when any subject area is not adequately covered by this manual.

# *2.0 RESPONSIBILITY FOR RADIATION SAFETY AT TRENT UNIVERSITY*

Board of Governors

President

Vice

-

President Research

and International

(Applicant Authority as of

March 1, 2012)

Vice

-

President

Academic and Provost

Dean Of Arts and

Science

(Science)

Principle Investigator

Faculty Supervisor

(Permit Holders)

Science Facilities Manager

RSO, BSO, LSO

Permit Users

Students

Canadian Nuclear

Safety Commission

Research Fund

Administration

*2.1 STUDENT USE OF RADIOISOTOPES IN FORMAL CLASSROOM INSTRUCTION*

Permit Applicants who wish to have students use radioisotopes or radiation-emitting devices in formal graduate or undergraduate courses within a classroom setting at Trent University should include the name and title of the course under the category of “Other Users” when applying for a Permit. The application should include a description of the work to be performed by the student(s).

Permit Holders and Permit Users are required to complete the Trent University Radiation Safety course before working with isotopes or radiation-emitting devices at Trent University. Students may be authorized to work under a valid permit without completing the Radiation Safety course only if the following conditions are met:

1. The Permit Holder or a Designated Permit User, who is adequately trained in the safe handling of radioactive materials, provides formal radiation safety instruction to the students prior to the use of radioactive materials or radiation-emitting devices in class; and,

2. The students are directly supervised by the Permit Holder or a Designated Permit User during their initial work with radioactive materials or radiation-emitting devices until the supervisor is assured that they can work with the material safely and confidently. Directly supervised is defined as “line of sight” which means that the supervisor is essentially watching everything that the student is doing; and,

1. The use of radioactive materials or radiation-emitting devices is consistent with the conditions authorized by the permit, the ALARA principle of Radiation Safety and will only occur in an authorized teaching space listed on the approved permit.

This does not include the use of radioactive material or devices containing radioactive material or which emit radiation except in a formal class room teaching setting in a course approved by the Senate of Trent University. Honours Thesis projects are considered Research for the purposes of this program and honours thesis students must take the Radiation Safety Course.

# *2.2 RESEARCH USE OF RADIOACTIVE MATERIAL: PERMIT USERS*

Permit Holders may wish to name students, technical assistants or university employees as Permit Users who would be authorized to use the radioisotopes or radiation-emitting devices obtained under their permit.

Individuals named as Permit Users on permit applications are required to complete the Trent University Radiation Safety course as a condition of approval as a Permit User. Permit Users are responsible for complying with the procedures and precautions contained within the radioisotope licence, the permit, this manual and any additional instruction or precautions provided by the Permit Holder. Every Permit User is required to comply with the Canadian Nuclear Safety Act, its regulations and licence conditions.

# *2.3 RESEARCH USE OF RADIOACTIVE MATERIAL: PERMIT HOLDERS*

# Permit Holders are:

a) qualified university personnel in academic departments/programmes that offer courses involving experimental/instructional work with radioisotopes or radiation-emitting devices; or,

b) qualified research project leaders who require the use of radioisotopes or radiation-emitting devices for their research,

who have applied for and received authorization for work involving radioisotopes or radiation-emitting devices from the Radiation Safety Officer. Authorization is granted in the form of a radioisotope permit issued to the Permit Holder by the Radiation Safety Officer.

Permit Holders are responsible for the safe use of those radioisotopes and radiation-emitting devices authorized by their permit. Permit Holders should be familiar with established radiation safety procedures including the conditions established by the Trent University Radioisotope Licence, their Permit, and by this manual. All Permit Holders are required to complete the Trent University Radiation Safety Course.

The responsibilities of Permit Holders include:

a) ensuring that the required facilities, equipment and instruments are available for controlling radiation hazards,

b) ensuring that students and Permit Users receive the supervision and instruction necessary for controlling radiation hazards,

c) ensuring that radioactive materials are stored or handled only in locations authorized by the Permit,

d) ensuring that the project does not exceed the allotment of radioactive materials authorized by the Permit,

e) ensuring that a complete and accurate inventory of radioisotopes is maintained at all times,

f) ensuring that a complete and accurate record of all disposed radioactive materials is maintained at all times, and the records are maintained for at least three (3) years,

g) ensuring that only authorized persons have access to radioactive materials,

h) ensuring that licences, permits, warning signs and labels are posted as required by the Radioisotope Licence, the Permit and this Manual,

i) establishing routine laboratory procedures to ensure that:

1) external radiation levels are monitored and maintained within permissible limits,

2) a suitable form of contamination monitoring is undertaken on a regular basis and records are maintained of the results of contamination monitoring for at least three (3) years as per the procedures in this manual.

3) radiation sources are properly labelled and stored, and,

4) experiments that will be in progress after normal working hours will be properly attended,

j) ensuring that Students and Permit Users wear Thermoluminescent detectors (TLD) or pocket dosimeters if required by the Permit;

k) ensuring that all radiation incidents are reported to the Radiation Safety Officer.

l) ensuring that radioisotopes or radiation-emitting devices are only shipped or transported from Trent University with the approval of the Radiation Safety Officer and in compliance with the Transportation of Dangerous Goods Act and the CNSC Transport and Packaging Regulations.

m) ensuring that an annual report is completed and submitted to the Radiation Safety Officer within 14 days of the end of each calendar year or at the end of the project. This annual report shall take the form of that shown in Appendix 1.

# *2.4 RESPONSIBILITIES OF THE RADIATION SAFETY OFFICER*

The Radiation Safety Officer (RSO) derives authority from and is advisory to the Vice-President Resarch and International of Trent University, who is the applicant authority for the radioisotope licence issued to Trent University by the Canadian Nuclear Safety Commission. The RSO is responsible for co-ordinating and controlling all activities at the University related to radiation safety.

The RSO has the following authority:

a) to authorize and control, by the issue of permits, the use of radiation-emitting materials and devices within the limits of the relevant consolidated or individual licences issued by the CNSC and the X-ray regulations made under the Occupational Health and Safety Act,

b) to suspend the use, at Trent University, of radiation-emitting materials and devices, regardless of any other source of authorization,

c) to produce and continually review Trent University Radiation Safety Policy and Procedures,

d) to organize and administer a campus-wide radioactive waste collection and disposal service in accordance with established procedures as per the Trent University Radioactive Waste Management System RSO SOP.

e) to ensure that each incident involving spills of more than 100 E.Q.. of a radioisotope or exposure to greater than permissible doses of radiation are evaluated to determine whether decontamination procedures and/or medical examination should be carried out; and to advise the CNSC of such incidents as required,

f) to ascertain the requirements for personnel monitoring, approve the use of radiation detection instruments, and administer a centralized TLD and neutron monitor record keeping system, ensure that Dose Survey meters are calibrated annually as per CNSC regulations.

g) to approve according to CNSC standards, all proposed radiation laboratories,

h) supervise the leak testing of all large sealed sources as required by CNSC regulations,

i) to ensure that general advice on radiation hazards and protection is available to Permit Holders,

j) to present an annual report (ACR) of the Radiation Safety Programme, to the Joint Health and Safety Committee, the Vice-President (Academic) and the CNSC,

k) to conduct formal inspections and periodic spot-checks of laboratories and approved radioisotope locations to ensure compliance with permit conditions, licence conditions, Radiation Safety Program procedures and policies, and CNSC Regulations. An inspection checklist shall be used which covers areas of Personnel, Dosimetry, Handling and Contamination Control, Security Signage Inventory and Disposal,. This form reflects the requirements of the GN, NS, RP regulations and NSC act.

l) to maintain files on all active projects. These shall include inventories of all radioactive sources under a Permit Holder’s control. Such files shall be considered active until all of the radioactive sources have been accounted for, either by disposal or by safe storage;

m) to give final approval of all purchase orders for radioactive materials or radiation-emitting devices in accordance with the specifications of authorized projects;

n) to advise local Fire Department authorities of locations where radioactive materials are stored or used;

o) to serve as the CNSC’s contact on licencing matters. The RSO will be responsible for providing the CNSC with all information required for maintenance and renewal of the consolidated radioisotope licence.

p) The RSO shall make any and all reports to the CNSC as defined and required by the Canadian Nuclear Safety Act section 27, the General Nuclear Safety Regulations Sections 15 and 29, Radiation Protection Regulations Sections 15 , 16, and 17, Nuclear Substance and Radiation Devices Regulations (section 38) and the Packaging and Transportation of Nuclear Substances regulations Sections 35-38.

q) The RSO shall report any skin contamination event in which a NEW was calculated to have received and extremity (skin) dose above 50 mSv or if a Non-New was calculated to have received an extremity (skin) dose above 5 mSv to the CNSC as per Section 16 of the Radiation Protection Regulations and as per CNSC/DNSR article CNSC Expectations for Licensee Response During Skin Contamination Events.

r) maintain all records required by the GNSCR and ensure that the CNSC is contacted a minimum of 90 days prior to the intended date of disposal of records.

# *3.0 TRAINING AND AUTHORIZATION*

# *3.1 RADIATION SAFETY TRAINING*

All personnel who may be exposed to ionizing radiation as a result of their employment must be instructed in advance regarding related radiation hazards, the principle of ALARA in radiation safety and appropriate radiation safety procedures. Permit Holders and Permit Users are **required** to complete the Trent University Radiation Safety Course **before** they will be authorized to work with radioactive materials or radiation-emitting devices at Trent University. In addition, Permit Holders and Permit Users are required to retrain every three years.

Customized radiation safety courses are offered by the Radiation Safety Officer (RSO) through the Office of the Dean of Arts and Science (Science). They follow the CNSC regulatory guides: Radiation Safety in Educational, Medical and Research Institutions, and Radiation Safety Training for Radioisotope, Medical Accelerator and Transportation Workers (Regulatory Guide G-121, C-200 E). The RSO will issue ‘Radiation Safety Course’ certificates to applicants who have successfully completed the Radiation Safety Course. Records of the names of all people who have completed the Radiation Safety Course will be kept on file by the RSO.

For more information, or to register for the Radiation Safety Course contact Chris Williams at 748-1011 ext. 7061, email [CWilliams@Trentu.ca](mailto:CWilliams@Trentu.ca) or visit the Science Safety Program.

# *3.2 APPLICATION FOR RADIOISOTOPE USE PERMITS AND PROJECT AUTHORIZATION*

Prior to possessing or using radioactive material or radiation-emitting devices, authorization must be obtained from the Radiation Safety Officer.

Qualified Applicants (see Section 2.3, Permit Holders) may complete an “Application for Radioisotope Permit” and forward the application to the Radiation Safety Officer. A copy of the application form is illustrated in Appendix 2. Research projects which will be using open sources are also required to submit a radiation contamination monitoring plan which includes a map of the room in which the work will be performed, radioactive work areas and monitoring locations (see Contamination Monitoring Section 6.1.3). When approved, the application will be assigned a number and a permit will be returned to the applicant (Appendix 3). The conditions of approval will be indicated on the permit. The Radiation Safety Program at Trent requires that work with radioactive substances or equipment must be authorized. Work with radioisotopes of quantities less than the EQ are exempt from the authorization process provided the total quantity of isotope purchased throughout a year is less than 3 EQ and that the possession limit of 1 EQ is not exceeded. An “Exemption Quantity” (E.Q.) is the quantity listed in Schedule 1, Part 1, of the Canadian Nuclear Safety Commission Regulations. Sources less than exempt quantities are licence exempt according to the Regulations. Exempt quantities for some commonly used radioisotopes can be found in Appendix 4.

The quantity and radiotoxicity of radioactive material required relative to the Annual Limit on Intake (ALI) (Appendix 4) determine the manner in which approval is given:

a) for unsealed radioisotopes where the quantity does not exceed 5 ALI for the isotope listed in Column 1 of Appendix 3, immediate conditional approval may be given.

b) for unsealed radioisotopes where the quantity will exceed 5 ALI , written approval must be obtained from the CNSC through the RSO.

c) sealed sources or radiation devices containing sealed sources or radiation emitting devices will be assessed on a case by case basis and may require CNSC approval.

If any changes are to be made to a previously authorized project, the Permit Holder must apply in writing to the Radiation Safety Officer for an amendment to the project prior to instituting the changes. Permits are normally valid for one year. Permit Holders are required to submit to the Radiation Safety Officer a brief summary of their work over the past year involving radioisotopes (see section 2.3 and Appendix 1). The summary should include, the amount of radioisotopes purchased, a brief description of the work performed and, if they are continuing their work, a brief description of what they anticipate they will be doing over the next year (this is not an extensive description but rather a summary). Permit Holders who wish to renew their permit for another year should contact the Radiation Safety Officer by the end of November of each year.

# *4.0 ACQUISITION AND RECEIVING RADIOACTIVE SUBSTANCES AND EQUIPMENT*

All acquisitions of radioactive material must be authorized by the Radiation Safety Officer. Vendors of radioactive prescribed substances and equipment require a letter of authorization from the Radiation Safety Officer at the University prior to fulfilling any request to purchase. Only CNSC certified equipment may be purchased and used in Canada.

Permit Holders who wish to purchase radioisotopes are required to inform the RSO prior to placing the order for the substance. Upon receipt of the order a copy of the packing slip indicating the supplier, the activity, and the name of the person who placed the order, must be given to the RSO within 2 days. Failure to do so will result in a loss of ordering privileges. Only Permit Holders are permitted to purchase radioactive prescribed substances. A Permit Holder may delegate this responsibility to a Permit User provided that the individual has been sufficiently trained, and this delegation is in writing with a copy of the letter to be sent to the RSO.

All purchase requests should be consistent with the conditions of the Permit. Purchase requests that are consistent with the Permits will be authorized without delay. The Radiation Safety Officer will contact Permit Holders to discuss and clarify purchase requests that are inconsistent with the conditions of the permits. Ongoing, regular purchases of radioisotopes may be authorized in advance through the RSO. Contact the RSO for more information.

Permit Holders must ensure that the purchase of any new radioactive substance will not result in an increase the amount of material possessed such that the possession limits of the permit are exceeded. This can result when orders are placed in advance of using up all the existing stock. Radioactive materials may not be assigned or transferred to the possession of any unauthorized person, nor used for any purpose in any place other than that originally authorized, without prior approval of the RSO.

# *4.1 RECEIPT OF RADIOACTIVE SUBSTANCES*

The procedure for receiving packages is outlined in the Information Document Radioisotope Safety – Identifying and Opening Radioactive Packages (INFO-0744). This poster can be obtained from the RSO.

The recommended procedure for opening packages which contain unsealed radioactive material is as follows:

1. Wear a lab coat and disposable gloves while handling the package.

2. If an appropriate survey meter is available, monitor the radiation fields around the package and compare with the units stated on the package. Note any discrepancies.

3. If the material is volatile (unbound iodine, tritium, radioactive gases, etc) or in powder form, place the package in a fume hood.

4. Open the outer package and check for possible damage to the contents, broken seals or discoloration of packing materials. If the contents appear to be damaged, isolate the package to prevent further contamination and notify the RSO.

5. If no damage is evident, remove the inner package or primary container, check for damage and wipe test the container. If contamination is detected, monitor all packaging and if appropriate, all areas coming into contact with the package for contamination. Contain the contamination, decontaminate and dipose in accordance with the conditions of the radioisotope licence.

6. Avoid unnecessary direct contact with unshielded containers.

7. Verify the radioisotope, the activity, and other details with the information on the packing slip and with the purchase order. Log the radioisotope, activity, date received and any anomalies in the inventory record.

8. Report all anomalies (radiation levels in excess of the package labelling, incorrect transport index, contamination, leakage,damage to package, short or wrong shipment) to the project supervisor or RSO. The RSO will inform the CNSC as per the Packaging and Transport Nuclear Substances Regulations section 35-38.

Note: The Transportation of Dangerous Goods Act requires that all persons, shipping or receiving radioactive substances be certified under the act. Contact the RSO for details.

5.0 INVENTORY AND STORAGE OF RADIOISOTOPES

Permit Holders are required to establish “cradle-to-grave” documentation for all radioisotopes acquired under their permit. Cradle to grave means that documentation exists which tracks the substance from the time it arrives on-site, through all aspects of its use and up to and including its final disposal. Records of all radioisotope purchases and inventories must be maintained up-to-date and available for inspection in the areas where the radioisotopes are used or stored. Each inventory should be able to trace each container or source from the date and location of delivery to the date and location of disposal or transfer. A recommended format for inventory records is presented in Appendix 5.

Permit Holders should establish procedures that are in keeping with the *ALARA Principle*: When using or storing radioisotopes or radiation-emitting devices radiation exposure/dose must be kept ***A****s* ***L****ow* ***A****s* ***R****easonably* ***A****chievable*. At a minimum the following directions must be followed.

Permit Holders shall:

a) ensure that when in storage radioactive nuclear substances or radiation devices are accessible only to authorized personnel who have been trained and are listed by the Permit Holder as being authorized to handle the material.,

b) ensure that the dose rate at any occupied location outside the storage area, room or enclosure resulting from the substances or devices in storage does not exceed 2.5 μSv/h, and

c) have measures in place to ensure that the dose limits in the Radiation Protection Regulations are not exceeded as a result of the substances or devices in storage.

Radioactive material shall be kept or stored in a manner that:

a) provides adequate radiation shielding recognizing the ALARA (As Low As Reasonably Achievable) principle; and

b) provides adequate protection against theft, fire, explosion, flooding or accidental breakage of primary storage containers.

c) provides that rooms that contain radioactive material shall remain locked when the room is not occupied.

Every Permit Holder who stores a nuclear substance shall post and keep posted, in a readily visible location at the place where the nuclear substance is stored, a legible sign that indicates that, “in case of emergency, contact the security office at 748-1333”. Security has the protocol for initiating the accident procedure.

More information on how to meet the requirement to keep all exposures as low as reasonably achievable can be obtained from the CNSC Regulatory Guide G129(e).

5.1 TRANSPORTATION OF RADIOACTIVE MATERIALS

The packaging and labelling of radioactive shipments are governed by the CNSC’s Packaging and Transport of Nuclear Substances Regulations (2015) and Transportation Dangerous Goods Act.

No radioactive materials shall be shipped or transported from Trent University without the written authorization of the RSO. Contact the RSO, for more information.

In-house transportation of radioactive materials requires that the material be placed on a cart or other device to either increase the distance between the user and the material or ensure appropriate levels of shielding are present in order to minimize the radiation exposure.

**5.2 *Transfer of Radioactive Material***

Transfers of radioactive material are not permitted between internal permit holders without the express written consent of the RSO. The RSO will examine, the purpose of the transfer, inventory records, validity of request, urgency and ensure that the recipient of the transfer has a valid permit and the controls in place in advance of authorizing the transfer.

Transfers of radioactive material for use externally to Trent university are rare, but when they come up, again express written authorization by the RSO is required. The RSO will ensure that the recipient’s RSO is made aware of the request, that the recipient is authorized to possess, use and dispose of the material, and that all packaging and transport regulations are met prior to authorizing the transfer. The RSO will also ensure that internal inventories are updated and that there is written documentation from the recipient that they accept the transfer.

***6.0 GENERAL WORK PROCEDURES***

The following guidelines for working with radioisotopes were developed with the principle of ensuring that all exposures and doses are maintained “as low as reasonably achievable” (ALARA).

a) Radioactive materials or radiation-emitting devices shall only be used by persons authorized by the RSO and identified in a permit or a list of qualified, trained personnel. This list shall be posted in the radiation work area.

b) Radioactive materials or radiation-emitting devices shall only be used in those radioisotope laboratories authorized by the RSO and identified by a permit.

c) A copy of the permit shall be posted in every radioisotope laboratory.

d) A copy of the Trent University Radioisotope Licence shall be posted in every radioisotope laboratory.

e) A copy of the Radiation Safety Manual shall be available to all persons who work with radioisotopes or radiation-emitting devices.

f) An up-to-date inventory of all radioactive materials shall be maintained at all times. The quantity of radioactive material used or stored in a laboratory shall not exceed that specified on the radioisotope permit issued by the RSO.

g) Radiation surveys and monitoring shall be undertaken and records maintained as outlined in section 6.1.

h) A suitable radiation monitor should be available during the course of work with ionizing radiation.

i) Disposal of radioactive wastes shall be undertaken and records maintained as outlined in section 7.0.

j) Permit Holders are required to complete and submit an annual report (appendix 1) to the RSO within 14 days of the end of the calendar year.

k) All laboratories approved for radioactive work will display the required information and notification posters. As part of the permitting process, signage is required on all labs which contain radioactive material that states “Rayonnement – Danger- Radiation and the 24 hr Campus Security emergency phone number (It also contains the trefoil symbol). All labs are required to post this sign on the outer door to a lab In addition all basic labs must post the Basic Lab, Receiving Packages,and Spill Response posters in the lab. These will be supplied to them (this is stated specifically on the permit issued to the permit holder. Signage will be checked as part of the inspection process.

l) Records for Training, Leak Tests, Inspections, Contamination monitoring, doses etc.. are not to be disposed of without consulting the RSO who will verify record retention requirements as per the Record Retention Period Summary for NSRD licenses. If you wish to dispose of records contact the RSO.

m) Classification of rooms:

1) basic-level if the quantity does not exceed 5 ALI,

2) intermediate-level if the quantity used does not exceed 50 ALI,

3) high-level if the quantity does not exceed 500 ALI,

4) containment-level if the quantity exceeds 500 ALI, or

5) special purpose if approved in writing by the Commission or a person authorized by the Commission.

All laboratories in which radiation emitting substances are present shall have posted at each entrance to that laboratory a sign with the radiation warning symbol (trefoil) and the words “Radioactive Laboratory”.

n) Cupboards, cabinets, refrigerators and other containers used to store active materials in the radioisotope laboratory must be identified with a radiation warning label.

o) Primary storage containers must be identified with a radiation warning symbol and the words “Radioactive” and information regarding the name, quantity, date of measurement and the form of the nuclear substance contained within. Labelling is not required for temporary use of the containers within. Labelling is not required for containers such as beakers, flasks and test tubes which are used temporarily while the responsible individual is present.

p) All equipment containing radioactive isotope sources must be identified with a radiation warning symbol and a notice saying “DO NOT MOVE - CNSC Licence permits use of this equipment only in Room #\_\_\_\_”. Any change in location must be approved in advance by the Radiation Safety Officer.

q) Appropriate radiation warning labels are required on all X-ray and other ionizing radiation-producing devices.

r) There shall be no smoking, eating, drinking or storage of food in any area containing radioactive material.

s) There shall be no mouth pipetting of solutions.

t) Whenever practical, the user should perform a trial experiment using stable or low activity material to establish the adequacy of the procedures and equipment.

u) Before the start of an operation on a source of radioactive material, radiation levels will be measured. Handling tongs or a suitable remote handling device must be used for handling any source or container which emits, at contact, a dose rate in excess of 2 mSv/hr.

v) In the course of operations that might produce airborne contamination (eg. boiling, evaporating, sanding or grinding), work shall be carried out in a fume hood.

w) A glove box shall be used for work involving exemption quantities or more, of dry radioactive powdered material.

x) When hand or clothing contamination is possible, protective gloves and clothing shall be worn; employees should not work with radioactive materials if they have open cuts or abrasions.

y) After handling open radioactive material, hands shall be washed before leaving the laboratory and clothes, shoes and hands shall be monitored for contamination.

z) Whenever possible, work with radioactive material should be carried out in trays lined with disposable absorbent material;

aa) Objects and equipment used in work with radioactive material should not be used for other purposes and must be surveyed for contamination prior to removal from the laboratory.

ab) Containers used for storage of radioactive waste (solid and liquid) shall be labelled with the radiation warning symbol and the words “Radioactive Waste- Caution”

6.1 RADIATION SURVEYS AND MONITORING

**6.1.1. Exposure Levels:**

Every Permit Holder shall implement a radiation protection program and shall, as part of that program;

a) keep the amount of exposure to ionizing radiation at the lowest reasonable level (ALARA) through the implementation of;

i) management control over work practices,

ii) personnel qualification and training,

iii) control of occupational and public exposure to radiation, and

iv) planning for unusual situations; and

b) ascertain the quantity and concentration of any nuclear substance released as a result of the licensed activity;

i) by direct measurement as a result of monitoring, or

ii) if the time and resources required for direct measurement as a result of monitoring outweigh the usefulness of ascertaining the quantity and concentration using that method, by estimating them.

To accomplish this each Permit holder should establish appropriate dose monitoring and contamination monitoring programs as well as emergency procedures for their lab.

**6.1.2. Dose Monitoring Programs: (CNSC Radiation Protection Regulations)**

Dose monitoring programs are used to determine the effective and equivalent dose as a result of exposure to ionizing radiation. Permit holders shall establish proper dose monitoring procedures which will be capable of ensuring that the Trent limits (Table 2, column 4) are measurable. If the use of a dosimetry service is determined as the best method of ensuring this, it should be co-ordinated through the RSO. If a dosimetry service is deemed impractical then recording direct measurement of doses through the use of a calibrated dose rate meter is acceptable. A dosimetry service is mandatory for those operations where an individual has a reasonable chance of receiving an effective dose of 5 mSv per year. It is recommended that for classes or projects where exposure to ionizing radiation will occur over an extended period of time (months-years) a dosimetry service be used. Dosimetry services must be certified by the CNSC.

The exposure from sources of radiation shall normally be controlled in such a way as to provide assurance that no individual or user, except a Nuclear Energy Worker (NEW), shall receive an absorbed dose in excess of 800 μSv. Non-NEWs receiving more than 200 μSv in a quarter year (three months) must notify the RSO immediately upon learning of this.

Table 2. Person Classification for Working with Radioactive Substances, CNSC Radiation Protection Regulations Section 13.

|  |  |  |  |
| --- | --- | --- | --- |
| Person | Period | Effective Dose (mSv (RPR Sect. 13) | Effective Dose (mSv) (Trent) |
| Nuclear energy worker (NEW), including a pregnant nuclear energy worker. | (a) One-year dosimetry period.  (b) Five-year dosimetry period. | 50  100 | 45  95 |
| Pregnant NEW. | Balance of pregnancy. | 4 | 3 |
| A person who is not a NEW. | One calendar year. | 1 | 0.8 |
|  |  |  |  |

The CNSC Radiation Protections Regulations, section 20, requires that a radiation survey meter must have been calibrated by a certified installation. The University maintains two calibrated dose survey meters. Contact the RSO for details.

**6.1.3. Contamination Monitoring (Monitoring for Radioactive Contamination)**

The use of open sources of radioactivity (sources which are not sealed from escape into the environment) has the inherent risk of contamination. The purpose of contamination monitoring is to reduce or prevent inadvertent exposure of workers and the public to radioactive material. A secondary objective is to detect any loss of control resulting from failures of containment or departures from good operating practice as well as assisting in preventing the spread of contamination from a controlled area.

Contamination monitoring is a relatively straightforward task, which is highly effective in monitoring for contamination and limiting the spread of contamination. Monitoring for contamination must occur following each use of a radioisotope or at a minimum of once a week.

Elements of a Contamination Monitoring Program

1. A lab map which indicates sites where monitoring for contamination will occur. One site should be designated as the background site. This site should be protected from any radioactive isotope as the results of monitoring at this location are used to determine the radioactivity at all other sites. Other sites should identify areas where contamination is possible. This map should be used as a reference each time monitoring is conducted.

2. Areas to be monitored should include the radioactive work area, a “spill” zone around the work area, sinks, taps, door handles, floors around the work area, non-radioactive waste container, and any other area that may have a reasonable chance of becoming contaminated.

3. Determine the suitable method for monitoring for contamination.

1. Direct monitoring: Direct monitoring involves the use of a portable contamination meter and is typically used for monitoring contamination of radioactive substances that emit gamma rays or higher energy beta particles.
2. Indirect or removable contamination monitoring: Indirect monitoring typically involves swiping an absorbent material over the sites and measuring activity with non-portable radiation measuring device (such as a liquid scintillation counter, gamma ray spectroscopy). This method is typically used for radioisotopes that emit beta particles, but may also be used for other forms of radiation if portable equipment is not available. Wipes may also be used when monitoring in areas of a high radiation field. Wipes will not detect fixed (i.e., that is unremovable) contamination.
3. Secondary method of measuring for radioactive contamination in the event of a failure with the primary method chosen in either a) or b)

Direct Monitoring Method

1. Determine the type of portable contamination meter required to detect the type of radiation emitted.

2. Determine the efficiency of the meter.

a) At your background site, determine the background activity by recording 25 measurements of the background radiation (usually in counts per second (CPS) or counts per minute (CPM). Determine the mean count rate and the standard deviation. This is measure of the natural background radiation and the variation in your work area.

b) Using a small, known activity of the radioactive substance, in a form similar to that used experimentally, record 20 measurements. Determine the mean count rate.

c) Determine the efficiency of your meter using the following equation:



where: *E* = the efficiency of the survey meter as a percentage,

*Sample (CPS)* = the mean of the measured count rates from the sample, as counts per second, and;

*Background (CPS)* = the mean of the measured count rates of the background, as counts per second.

*KA(Bq)*= Known Activity of the sample.

Meters with efficiencies of less then 10 % are probably not suitable and alternative methods of measuring contamination or different equipment should be explored.

d) Once the efficiency is determined it should be recorded with the contamination records. The meter should be re-tested annually to ensure there is no change in the detection efficiency.

e) Determine the area of the probe (cm2) (Check the manufacture’s documentation for this information). Record the efficiency and the area of the probe in contamination records

3. Begin the contamination monitoring by checking the battery status, and ensure the meter is functioning properly. Proper functionality can be determined using a check source of a known count rate or by checking that the background activity is similar to previous readings.

4. Set the response time (if adjustable) to slow and record 15 measurements of the background radiation at the background site.

5. Set the response time to fast (if adjustable) and survey each area labelled on the monitoring plan for contamination by slowly (2-5 cm per second) moving the meter around the site. If no obvious contamination is present , switch to a slow response and record 5 measurements of the count rate. If contamination is obviously present, record 5 measurements, decontaminate and then record 5 more measurements. Repeat as necessary until there is either no decrease in activity or background levels are reached. More details regarding decontamination can be found below.

6. Continue monitoring as described in 5. above for all of the sites. Keep all raw data.

7. Upon completion of monitoring and recording the count rates, it is then necessary to convert the count rates to activities. Use the following equation to convert from counts per minute (CPM) to Activity (Bq/cm2).



where: A= Activity (Bq/cm2)

N= the mean count rate (cpm) of site

Nb= the mean count rate (cpm) background

E= the efficiency of the detector as a decimal (i.e., 0.10 not 10%)

a= the area of the detector in cm2

8. Record the activity. If the activity is greater than the allowable limit listed on your work permit or as per Appendix 4. then decontamination is necessary. Return to step 5. If activity is less than that listed on the work permit or as per Appendix 4, then no action is required.

9. Keep records of results for at least 1 after the expiry of the current license. To simplify this you are welcome to forward the monitoring records to the RSO. Sample records can be found in Appendix 6.

Indirect or Removable Contamination Monitoring

1. Determine the appropriate type of detection equipment to use. Typically liquid scintillation counters are used for alpha and beta particle emitters while gamma spectroscopy and Na(Th)I detectors are used for gamma ray emitters.

2. Determine the efficiency of detector by measuring a known activity of the radioisotope on a swipe identical to the ones to be used for contamination monitoring. Determine the efficiency of the detector using the equation as described in the previous section Direct Monitoring.

3. Using a suitable swipe material (47 mm diameter filter paper filter disks or cotton swabs are recommended) wipe each site. The swipe may be moistened with alcohol or water.

4. Wipe an area of 100 cm2 (10 cm x 10 cm)

5. If necessary let the swipe dry and place each swipe in a properly labelled scintillation vial.

6. Follow the protocol for measuring the swipe based on the type of instrument to be used.

7. Once count rates have been determined use the following equation to determine activity:



where: A= Activity (Bq/cm2)

N= the count rate (cpm) of swipe from the site

Nb= the count rate (cpm) of the background site

E= the efficiency of the detector as a decimal (i.e., 0.10 not 10%)

a= the area of the swipe (not less than 100 cm2)

F= the collection factor (0.1 unless determined experimentally to be higher) an estimate of the efficiency of the material to pickup the isotope.

8. Identify any areas that have activities greater than those listed in Appendix 4.. Decontaminate, swipe, recount and record results. Repeat as necessary using different decontamination techniques until removable activity is reduced to background levels.

9. Contamination monitoring records must be kept for at least one year following the expiry of the license (CNSC REGDOC1-6-1 Appendix BB.2.7)

**6.1.4 Sealed Sources:**

Except for gaseous sources or sources of tritium, leak tests shall be performed on all sealed sources containing more than 50 MBq of radioactive prescribed substance. Analysis of the the swipe sampled must be performed by a competent person who meets the requirements listed in Appendix AA.3.5 of REGDOC 1-6-1.

# The frequency for leak testing shall be:

a) every 24 months for each sealed source continuously in storage,

b) every 12 months for each sealed source in use in a device approved for use in Canada by the CNSC,

c) every 6 months for any other sealed source,

d) immediately after any incident that could result in damage to the source.

If leakage in excess of 200 Bq of a radioactive prescribed substance, or a leakage rate in excess of 50 Bq of radon in 24 hours, is detected, the sealed source shall remain out of service, and the RSO shall be notified immediately. The RSO shall inform the CNSC immediately of any sealed source where leakage has been detected in excess of 200 Bq. Records of results of leak tests shall be retained for three (3) years.

Sealed Sources Sampling for Leak Testing.

Sampling of sealed sources for leak testing and measuring will be performed by only competent personnel who are familiar with the requirements of the CNSC REGDOC-1.6.1 License Application Guide: Nuclear Substances and Radiation Devices Appendix AA.3 “Program requirements for leak testing”. Personnel performing wipes of sealed sources for leak testing will :

1. knows the type and activity of the sealed source and the sealed source containment
2. can recognize and minimize the potential contamination and radiation hazards associated with:
   1. the sealed source and its containment, including any sealed source windows
   2. wipe sampling the sealed source or its immediate environment
   3. the wipe sample
3. has available and follows the procedure detailed in section 3.1 of Appendix AA.3 of REGDOC 1.6.1.
4. has available sufficient wipe sampling materials and wipe sample containers
5. follows all manufacturer’s instructions for the safe operation of any radiation device for the purposes of leak testing
6. follows all radiation and other safety precautions for working in the area in which the sealed source is located, including lock-out and personal protection requirements be know the type and activity of the sealed source and its containment.
7. Will complete the proper sample record as outlined
8. Personnel who will be sampling a source for testing can also contact the RSO for assistance.

Measuring of Leak Test Samples

Measuring of samples for leak testing will be performed by competent personnel who know the regulator requirements and the expectations outlined in the CNSC REGDOC 1.6.1 Licence Application Guide: Nuclear Substances and Radiation Devices Appendix AA.3 Program requirements for leak testing. In most cases at Trent, samples to be measured for leak testing will be sent to qualified external consultants for analysis, or have an approved (CNSC) method of analysis. Contact the RSO for further information on Leak Test Analysis.

6.2 DECONTAMINATION:

Good working habits and good housekeeping will prevent most contamination incidents and circumvent the need for decontamination. When decontamination is indicated, (when surface contamination exceeds designated limits) the following general suggestions apply:

1. Decontamination may be carried out using chemical and/or physical cleaning processes;

2. Various chemicals may be used, but the initial approach should be scrubbing with hot water containing suitable cleaning agents;

3. All waste chemicals, water, rags, etc. created as a result of decontamination are radioactive waste and should be disposed of accordingly;

4. Specific decontamination agents are listed in appendix 7. Specific instructions for incident response can be found in Section 9.0.

5. Monitor site after decontamination. If contamination persists repeat the decontamination process and remonitor. Repeat until reading indicate background radiation levels have been achieved.

Our License stipulates specific isotopes and radioactivity levels for which decontamination procedures will need to be implemented. The limits will be included on your permit.

7.0 PROCEDURES FOR DISPOSAL OF RADIOACTIVE WASTE

Radioactive materials (open or sealed sources, animal carcasses in which radioactive substances have been incorporated, contaminated equipment or laboratory materials) awaiting disposal shall be stored in the radioactive storage and waste room (SC 119). Access to this room is limited to authorized personnel only (the RSO). Radioactive waste collections will be arranged by the RSO in conjunction with a contracted disposal service. Materials for waste collection (containers and garbage bags) will be supplied. Every radioisotope permit holder is reminded that it is a federal requirement to maintain records regarding the use, storage and disposal of all radioactive materials at the university.

Each radioisotope Permit Holder is responsible for the control, containment, and identification of radioactive wastes generated within approved locations/laboratories, and for arranging the removal of waste containers through the Radiation Safety Officer.

In general, laboratory radioactive wastes should be segregated and contained. Material must not be put into waste collection containers if there is any possibility of a chemical reaction. Radioactive waste containers should be clearly labelled with the radiation symbol and labelled with “Caution – Radioactive Waste”

7.1 SHORT LIVED ISOTOPES (HALF-LIFE <150 DAYS)

Each radioisotope lab should keep its waste segregated into two streams. Non-radioactive (regular waste) and radioactive waste. Each of these are explained in greater detail below.

1. Non-radioactive: Non radioactive waste refers to all waste that could not possibly have come in contact with radioactive substances. Disposal shall occur through the normal waste systems (chemicals to chemical waste, glass to glass waste etc...). Monitoring should occur from time to time to ensure that no radioactive substances are being disposed of accidentally.

2. Radioactive: Radioactive waste refers to those wastes produced in a lab which have come in direct contact with radioactive substances such as pipet tips, gels, centrifuge tubes disposable containers, scintillation vials, etc…, Disposal shall be through the following procedure.

a. Solid waste shall be placed into two thick garbage bags as supplied by the RSO. Liquid waste should be bulked as much as is possible in proper storage containers. The containers should then be placed in a box which contains absorbent material to reduce the risk of accidental release.

b. Contact the RSO who will then arrange with you the storage of the waste until sufficiently decayed for disposal.

3. A radioactive waste label shall be attached to the bag and the following information shall be supplied:

a) Name of Permit Holder

b) lab room number

c) Trent Permit number.

d) Isotopes present

e) Half-life of the longest lived isotope contained therein.

f) Approximate activity of waste, for example If the waste represents all the isotope from one lot, than the activity of the lot shall be used as the activity of the waste.

g) If in a liquid form, label the container with the name of the solvent or carrier as well as on the waste label.

h) Enter the waste label number into the Waste Log Book, and copy the information to the log book.

If unsure treat the waste as radioactive.

7.2 LONGER LIVED RADIOSIOTPES (HALF- LIFE >150 DAYS)

Radioactive waste which contains longer lived isotopes will be stored by the RSO until disposal through a licenced service is arranged. The waste will be labelled with the following information, double bagged and stored in an appropriately shielded container until disposal

a) Name of permit Holder

b) Lab/room number

c) Radioisotope permit number

d) Isotopes present

e) half-life of the longest lived isotope contained therein.

f) Activity of waste

g) If in a liquid form, label the container with the name of the solvent or carrier as well as on the waste label.

h) Enter the waste label number into the waste log book.

If other chemicals are present in the waste as well as the radioactive substance, a copy of the appropriate Material Safety Data Sheet(s) should be passed on to the RSO upon acceptance of the waste into the storage facility.

8.0 X-RAY SOURCES AND OTHER RADIATION-EMITTING DEVICES

**8.1** X ray Devices

A copy of Regulation 861, X-ray Safety, under the Occupational Health and Safety Act shall be available in each area where X-ray equipment is used. Care shall be taken to avoid personal exposure in a primary X-ray beam. Exposure in areas where radiation scatter is possible shall be kept to a minimum. No interlock or other safety devices shall be deliberately defeated. No “live” adjustments or alignments shall be made with any safety cover removed, except where the procedure has been specifically checked for safety and the method is documented. When a modification to an X-ray source is introduced, either temporary or permanent, in operating technique, equipment arrangement or in ancillary equipment the modification shall be checked for safety and all changes documented. Any person to whom a Monitoring Film Badge has been issued must wear it when in the vicinity of an X-ray source. Any defect in X-ray equipment resulting in possible radiation hazard shall be reported to the responsible user who will inform the Radiation Officer.

**8.2 Other Radiation Devices**

Other radiation devices include those devices defined in the Nuclear Substances and Radiation Devices regulations as those that a) contain more than the exemption quantity of a nuclear substance and that enables the nuclear substance to be used for it radiation properties and b) a device that contains a radium luminous compound. As per the NSRD regulations Section 11. No person shall use a radiation device unless it is a certified model; or b) it is used in accordance with a licence that authorizes its use. No person shall transfer a radiation device for use within Canada unless it is certified.

If a radiation device is damaged to the extent that could impair its use, the situation must be reported to the CNSC as per NSRD regulation 38.

9.0 RADIATION INCIDENTS AND EMERGENCY PROCEDURES

The RSO shall be notified immediately following every radiation safety incident. This includes:

* Exposure to external radiation in excess of established maxima (see Table 2);
* Exposure due to inhalation, ingestion or injection of radioactive materials;
* Accidental contamination of laboratory or accidental release of radioactive material to drains, ventilation systems or laboratory atmosphere;
* Loss or theft of radioactive material.
* Damaged Packages
* Major Spill in excess of 100 EQ of a radioactive substance

Persons exposed to internal or external radiation usually present no hazards to others. Such persons will be placed under medical supervision. Re-entry into the radiation area is prohibited until authorized by the RSO.

Know when to back out. Be aware of the quantity and hazard of the radioactive substance so that if an incident occurs, you already know the relative risk.

In the event of a major spill, laboratory contamination, or environmental contamination, vacate the immediate area, but do not leave the general area until the arrival of the RSO. Inform Campus Security (ext. 1333) that a radioactive spill has occurred. They will secure the area. Do not attempt decontamination procedures and do not remove contaminated articles from the area. The RSO will direct decontamination operations and authorize re-entry into the radiation area.

In the event of a minor spill, the Permit Holder shall be responsible for decontamination procedures, in consultation with the RSO.

9.1 SPILL RESPONSE PROCESS

1. Respond to injuries.

2. Alert personnel in area. Have them move out of room, but do not leave general area. Inform Security and the RSO.

3. If spill could result in airborne activity, evacuate area and shut off ventilation. Call Physical Resources at 1366 or Security at 1328, give them the building and room number, and ask them to shut down the ventilation but leave the fume hood, if present, running.

4. Monitor personnel for contamination prior to their departure.

5. If there is an identifiable source of the spill, stop the source (eg., a leaking bottle, place bottle in a pail or pan).

6. Confine the spill by covering it with absorbent material or using spill socks.

7. Make the required notifications as per the Nuclear Substances and Radiation Devices Regulations section 38 ss 1 f ., Radiation Protection Regulations Section 16 and the CNSC Spill Response poster.

9.2 CONTAMINATED AREAS AND EQUIPMENT

1. For short-lived radionuclides, post and let decay.

2. Wear gloves, shoe covers and lab coat. (A chemical spill cart is available in the Emergency Room in the Science Complex (SC 132.1).

3. Determine contaminated areas/equipment through appropriate survey techniques (see contamination monitoring above). Define contaminated areas/equipment with a marker or pen.

4. Remove absorbent material previously placed on spill to a plastic bag and seal.

5. Place broken glass and objects in cardboard or plastic container

6. Use paper towel or mop to collect remaining liquid. Change towel and mop head frequently. Start at outside and work in.

7. Once dry, monitor area.

8. If contaminated, use soap and water to wash. Do not flood area with water.

9. Continue repeated cleaning and monitoring (using agents in Appendix 7) until background levels achieved.

10. Treat all cleaning materials as contaminated. Bag wastes.

11. Bag and seal and label “do not discard” any materials worth saving (eg clothing)

12. Post area to prevent inadvertent entry until verified not contaminated.

13. Monitor all personnel.

14. Monitor surrounding area and traffic routes for cross contamination.

15. Consider equipment (including mop) contaminated.

9.3 PERSONNEL MONITORING AND DECONTAMINATION

If personnel contamination (skin) is suspected use the following procedure for monitoring and decontamination.

1. Choose the correct equipment for monitoring (see Contamination monitoring above)

2. If a meter is appropriate, check meter is calibrated for the isotope in question.

3. Check batteries and source check if possible.

4. Check background (ensure detector is away from person or source). If greater than 200 cpm, find a lower background.

5. With meter on fast response, carefully pass monitor over person. Detector should be passed 1 cm above surface at a rate of 2 cm/sec.

6. Pay special attention to mouth, hands, feet, cuffs, knees, elbows, seat and any wetted area. Monitoring the whole body should take at least 2 minutes.

7. If the meter indicates readings above background, turn the response time to slow, and spend more time in this area.

8. Record the net (CPM-Background CPM)

9. If the net CPM is 0 then there is no need to decontaminate, if it is above 0 then decontaminate and remeasure. Record the net CPM and time, Repeat as necessary until either the net CPM is 0 or the net CPM stops decreasing. Refer to CNSC/DNSR article CNSC Expectations for Licensee Response During Skin Contamination Events for details on dose calculation and reporting criteria

Note: If the incident involves injuries, first priority is medical treatment. With the exception of skin contamination, retain all decontamination materials. Consider bioassay samples and whole body counting to measure internal uptakes, if monitoring or the characteristics of the radionuclide indicate this may have occured.

10. Deal with injuries. Ensure medical personnel are aware of contamination.

11. Minor cuts: Flush the area and encourage bleeding. Wet swab area (prevent spreading contamination). If wound is contaminated, wash with large amount of water. For face, wash away from mouth, eyes, nose and ears.

12. After decontamination attempt, monitor for effectiveness and apply first aid dressing.

13. Skin can be decontaminated using mild soap and warm water. Monitor skin for effectiveness. Repeat as required. Do not use hot water.

14. If contamination persists, use soap and a soft brush. Do not redden the skin.

15. Take a shower for non-localized contamination.

16. After all decontamination efforts have been exhausted consider any remaining activity as fixed. Skin will replace itself in about a week. Rubber gloves overnight helps “sweat out” fixed contamination.

17. Contaminated hair: Shampoo in a sink. (be careful not to spread contamination)

18. Contaminated beard: wash and shave.

19. Contaminated eyes: flush eyes for 15 minutes as if chemical contamination. Seek medical attention

20. Throughout decontamination, monitor frequently and record results

a) Contamination levels before

b) Contamination levels after

c) Time.

21. In the event that contamination of personnel occurs or that the dose received by an individual has exceeded the applicable dose limit as described in the CNSC/DNSR article CNSC Expectations for Licensee Response During Skin Contamination Events, the RSO will inform the CNSC of such event as per RP regulation Section 16 and the CNSC Info Spill Response poster .

**9.4 Loss, Theft or Fire**

1. Loss of material

In the event that radioactivity is lost, the RSO and Campus Security must be contacted immediately. The General Nuclear Safety and Control Regulations section 17 stipulates that every worker shall “promptly inform the licensee or the worker’s supervisor of any situation in which the worker believes there may be … (iv) an act of sabotage, theft, loss or illegal use of possession of a nuclear substance, prescribed equipment or prescribed information. Once informed, the RSO will immediately inform the Applicant Authority (Vice President Research and Innovation) and begin an investigation in co-operation with campus security. The CNSC will be immediately informed.

1. Theft

As in 9.4.1 (iv) the RSO, Permit Holder and Campus security shall be notified immediately upon determination that radioactive material or device has been stolen. Peterborough Community Police will be called in to investigate. The University Communications office will be contacted to assist with Public enquiries and the CNSC will be immediately informed.

1. Fire

As per the Fire Code, the Peterborough Fire Department has been made aware of the locations where radioactive material is stored or used and will conduct themselves based on their SOPs. In the event of a fire, occupants of the space will, if safe to do so, secure the radioactive material to avoid or minimize the spread of contamination and then exit the area. Once the fire is extinguished, no lab or space which contained radioactive material shall be re-entered until a radiation survey of the area has been performed and the RSO is assured that no contamination has occurred. If contamination is detected, the appropriate clean up procedures for the situation will need to be performed and the survey repeated until the contamination is removed. The RSO in consultation with campus security and the EHSO will determine when it is safe to enter the area.

9.5 REQUIREMENTS FOR REPORTING TO THE CNSC.

The RSO shall make any and all reports to the CNSC as defined and required by the Canadian Nuclear Safety Act section 27, the General Nuclear Safety Regulations Sections 15 and 29, Radiation Protection Regulations Sections 13, 14,15 , 16, and 17, Nuclear Substance and Radiation Devices Regulations (section 38) and the Packaging and Transportation of Nuclear Substances Sections 35-38.

Permit Holders and Users are required to report any incidents that occur which may contravene the regulations listed above to the RSO upon becoming aware of the event. All unplanned exposures should be reported to the RSO for investigation. If the RSO determines that the unplanned exposure exceeds and dose limit established by the CNSC in the Radiation Protection Regulations (RPR) Sections 13, 14 or 15 the RSO is required to report the exposure to the CNSC and follow the requirements of RPR section 16.

In the event of personnel contamination (skin) resulting in a skin dose exceeding 50 mSv (NEW) or 5 mSv (Non-NEW), a spill exceeding 100 exemption quantities of an isotope, the loss or theft of radioactive material or Fire in permitted lab or storage facility the RSO will immediately inform the CNSC of the incident as per Section 16 of the Radiation Protection Regulations and as per CNSC, Spill Response Poster.

The CNSC Duty Officer can be contacted at 1 (844) 995-0495.

10. PROJECT TERMINATION

1. Permit Holders who no longer require the use of radioisotopes or radiation-emitting devices should complete and forward a copy of Appendix 8, Project and Permit Termination Final Report, to the RSO. Permit Holders will be required to account for all radioisotopes acquired and used under the permit. The laboratory where radioisotopes were stored and used will also need to be monitored for contamination and must meet the regulatory requirements for the isotopes used as per REGDOC 1-6-1 and, Appendix 4 of this manual : “Regulatory Quantities for Typical Raionuclides” as for maximum allowable contamination in public areas to be decommissioned.

**Radioactive material may not be transferred to the possession of any person nor used for any purpose in any place other than originally authorized without prior approval of the RSO.**

The RSO will co-ordinate the disposal and/or relocation of radioisotopes and the decommissioning of radioisotope laboratories.

1. Record Retention

All records including but not limited to inventory, contamination monitoring, authorized users lists, leak test results ect.. will be turned over to the RSO upon termination of a Radiation Work Permit. The RSO will keep such records as required by the CNSC Record Retention Period as outlined in the GNSC, NSRD, PTNS, TDG and RPR regulations. In all cases prior to record disposal the RSO will contact the CNSC to determine when information may be disposed.

# Appendix #1 Permit Holder Annual Report

Permit Holder Name:

Permit Number:

Building and Room Number:

Isotopes Used in last year:

Total Amount of Each Isotope Purchased (kBq):

Total Amount of Each Isotope Used (kBq):

Total Amount of Each Isotope in Storage at End of Year (kBq):

Total Amount of Each Isotope to Waste (kBq):

Summary of work performed over the past year:

Briefly describe your work for the coming year:

Are you requesting a renewal of your radioisotope permit? Yes No.

Date:

**Appendix #2 Application for Radioisotope Permit. (available in hardcopy here or as a web form at www.trentu.ca/scienceservices/sciencesafety/radiationsafety).**

# Radioisotope Permit Holder (Principle Investigator or Designate):

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Office location | Phone | Email |
|  |  |  |  |

Proposed Users:

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type of Person (Grad Student, Research Assistant, Undergraduate Student) | Email | Have they taken the Radiation Safety Course  (Y or N) at Trent |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Description of proposed use of radiation emitting substance or device (use additional paper if necessary):

# 

# Room number and building where work will be performed:

# 

# Room number where isotopes will be stored:

How will the material be securely stored so that only authorized personnel can access the material?

Isotope(s) to be used:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Name of Isotope | Unsealed (U) or Sealed (S) source | Half-life (include unit - day or years) | Maximum activity (KBq) in possession at any one time | Maximum activity (KBq) to be used on an open bench at any one time | Estimated Activity (KBq) to be purchased per year | If contained in device, make and model of device |
|  |  |  |  |  |  |  |
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# Type of radiation emitted (i.e., alpha, beta, gamma, neutron) for each isotope:

|  |  |  |
| --- | --- | --- |
| Name of Isotope | Type of Radiation | Energy of Radiation |
|  |  |  |
|  |  |  |
|  |  |  |

Radiation Dose Monitoring Program:

Is individual dose monitoring required (refer to the Radiation Protection Regulation and the Trent University Radiation Safety Program for guidance)?

(Circle one) Yes or No

# Radioactive Waste Management Program:

# 

# How do you expect to manage radioactive waste. (See radioactive waste management section in Radiation Safety Program).

# Note: If isotopes are long lived, there may be a charge for the disposal of the material. Equipment which contains radioactive material such as Gas Chromatographs with and an ECD will be required to cover the costs of disposal of the source to a licensed disposal company.

# Radiation Contamination Monitoring Program:

# Give Details of the proposed Radioactive Contamination Monitoring Program. Use of Open Sources requires a contamination monitoring plan as per the CNSC regulations and the Trent University Radiation Safety Program. Include a site map of the room, locations defined as radioactive work areas, locations to be monitored, method of measuring radiation (i.e., direct or indirect), instrument type, make and model #, probe type, make and model #, date of last calibration) Use additional pages if necessary.

# Anticipated Date of Project Termination:

Acknowledgement:

I, (permit holder name) , am familiar with and agree to abide by the principles and policies laid out within Trent University’s Radiation Safety Program, Trent University’s Radiation Safty Manual, the Canadian Nuclear Safety Act and its regulations.

Signature: Date:

**Upon completion of the application forward the original to Chris Williams, Science Facilities Manager, ESB A 203.**

# Appendix 3.

| **INTERNAL PERMIT NO**. | **DATE OF ISSUE:** | **EXPIRY/RENEWAL DATE:** | |
| --- | --- | --- | --- |
| **PERMIT HOLDER**: | **DEPARTMENT:** | **OFFICE NO:** | **TEL**.: |
| **OTHER USERS:** | **DEPARTMENT:** | **OFFICE NO:** | **TEL.:** |

| ISOTOPES: | POSSESSION  LIMIT: | OPEN/SEALED: | ANNUAL LIMIT: | FORM: |
| --- | --- | --- | --- | --- |

| APPROVED LOCATIONS(S) (ie: building & rooms where material will be handled/stored): |
| --- |

| APPROVED USAGE: | ADDITIONAL REMARKS: | LAB AUTHORIZATION:  Basic |
| --- | --- | --- |

| DISPOSAL METHOD: |
| --- |

**GENERAL USER REQUIREMENTS**

1. A copy of this Radioisotope Permit must be prominently posted in each location approved by this Permit. The list of other users must be kept up-to-date at all times.

2. A copy of the completed poster “Basic Level” must also be posted.

3. An up-to-date inventory of all radioactive materials must be regularly maintained. A copy of the up-to-date inventory shall be included with the annual report forwarded to the Radiation Safety Officer, by no later than November 1 of each year.

4. Students using radioactive material must have had prior instruction in radiation safety as outlined in Section 2 and Section 3 of the Radiation Safety Manual.

5. All faculty and staff members handling radioisotopes must be properly trained and informed of the potential hazards and are required to complete the Trent University Radiation Safety Course. A copy of the Trent University Radiation Safety Manual must be available to each faculty and staff member handling radioisotopes.

6. Transfers of radioactive material are expressly forbidden without the express written authorization of the RSO as per the RSM section 5.2.

7. Radioisotopes are not approved for use in or on human beings.

**SPECIFIC USER REQUIREMENTS FOR THIS INTERNAL PERMIT.**

Contamination limits for this permit are :

Decomission limits for this permit are:

Approved by:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Radiation Safety Officer

# APPENDIX 4. Quick Reference: Regulatory Quantities for Typical Radionuclides

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Radionuclide | Class | Exemption Quantity  (EQ) MBq | ALI  estimate  (ingest)  MBq/Yr | Basic  Level  MBq | Interm.  Level  MBq | High  Level  MBq | Wipes  Controlled  area  Bq/cm2 | Wipes  Public  area  Bq/cm2 | Garbage  MBq/kg | Sewer  MBq/yr | Air  kBq/m3 |
| C-14 | C | 10 | 34 | 170 | 1700 | 17000 | 300 | 30 | 3.7 | 10000 |  |
| Co-60 | A | 0.1 | 6 | 30 | 300 | 3000 | 3 | 0.3 | 0.01 | 0.1 |  |
| H-3 | C | 1000 | 1000 | 5000 | 50000 | 500000 | 300 | 30 | 37 | 1000000 | 37 |
| I-125 | C | 1 | 1 | 5 | 50 | 500 | 300 | 30 | 0.037 | 100 |  |
| Na-22 | A | 0.01 | 6 | 30 | 300 | 3000 | 3 | 0.3 | 0.01 | 0.1 |  |
| P-32 | C | 0.1 | 8 | 40 | 400 | 4000 | 300 | 30 | 0.37 | 1 |  |
| P-33 | C | 100 | 80 | 400 | 4000 | 40000 | 300 | 30 | 1 | 10 |  |
| Ra-226 | A | 0.01 | 0.07 | 0.35 | 3.5 | 35 | 3 | 0.3 | 0.01 | 1 |  |
| S-35 | C | 100 | 26 | 130 | 1300 | 13000 | 300 | 30 | 0.37 | 1000 |  |

Radioistope Licence Criteria for Radioactive Contamination from CNSC REGDOC1-6-1 Appendix BB.7

* Non fixed contamination in all areas, rooms or enclosures where unsealed nuclear substances are used or stored does not exceed:
* 3 Bq/cm2 for all Class A radionuclides
* 30 Bq/cm2 for all Class B radionuclides
* 300 Bq/cm2 for all Class C radionuclides
* Non-fixed Contamination in all other areas does not exceed:
* 0.3 Bq/cm2 for all Class A radionuclides
* 3 Bq/cm2 for all Class B radionuclides
* 30 Bq/cm2 for all Class C radionuclides

# Appendix 5. Radionuclide Inventory Forms

### **Sample Inventory Form for Sealed Sources**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Manufacturer | | | | Model Name and Number | | | |
| Radio-Nuclide | Source Size | Assay Date | Serial Number | Location | Date of Receipt | Date of Transfer | Transfer to |
|  |  |  |  |  |  |  |  |
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#### Sample Inventory Form for Unsealed Sources

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nuclear Substance Inventory Sheet (Use one sheet per lot) | | | | | |
| **Location** | | | **Source** | | **Shipment** |
| Building and Room #  Permit Holder: | | | Nuclear Substance:  Product:  Quantity:  Date Measured:  Volume:  Lot # | | Received:  Checked:  Lot #  Supplier: |
| Date | Worker | Procedure | Material Used | Material Remaining | | |
|  |  |  |  |  | | |
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# *Appendix 6. Sample Contamination Monitoring Results Log (Example)*

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| Radioactive Contamination Monitoring Record Template | | | | | | | | | | | | |  | | | | | | | |  | | | | | | | |  | | | | | | | |  | | | | | | | | |  | | | | | | |  | | | | | | | | |  | | | | | | |  | | | | | | |  | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |
| Isotope | |  | | Method | | | | |  | | | | | | | | |  | | | | | | Direct | | | | | | | | | |  | | | | | | | | Indirect (Swipes) | | | | | | | |  | | | | | | |  | | | | | | | | |  | | | | | |  | | | | | | | | |  | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | | | | | | | | |  | | | | | | | |  | | | | | | | | | | | |  | | | | | | | |  | | | | | | | | | | | |  | | | | | | | |  | | | | | | | | | | | |  | | | | | | | |  | | | | | | | | | | | |  | | | | | | | |  | | | | | | | | | | | |  | | | | | | | |  | | | | | | | | | | | | | | | | | |
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| **Direct Monitoring Calculation**  Bq/cm2 | = (Mean Site CPM-Mean Bkgd CPM) /(area of detector (cm2) x efficiency of detector\* 60 (secs)) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |
| Make and Model of Detector | | |  | | |  | | | | |  | | | | | | | |  | | | | | | | | |  | | | | | | | |  | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | |  | | | | | | |  | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | | | | | |
| Efficiency of Detector for the specific Isotope | | | | | | |  | | |  | | | | | |  | | | | | | | | |  | | | | | | |  | | | | | | |  | | | | | | | | | | | | | | |  | | | |  | | | | | |  | | | | | | | |  | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |
| area of detector | |  | |  | | | |  | | | | | | |  | | | | | | | |  | | | | | | | |  | | | | | | | | | |  | | | | | |  | | | | | | | |  | | | | | | | |  | | | | | | | |  | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | |
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| **Indirect Monitoring Calculation**  (Bq/cm2) | | | | | = (Swipe Site CPM-Swipe Bkgd CPM) / (area of swipe x efficiency of swipe (default =0.1) x 60 sec x efficiency of detector | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | |  | | | |
| Make and Model of Detector: | | | | | | | | | | | | | |  | | | | | | | |  | | | | | | | |  | | | | | | | |  | | | | | | |  | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | |  | | | |  | |
| Efficiency of Detector for the specific: **0.2** Isotope: | | | | | | | | | | | | | | | | | | | |  | | | | | |  | | | | | | |  | | | | | | | | | |  | | | | |  | | | | | | | | | | |  | | | | | |  | | | | | | | |  | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |  | | | | | | | | |  | | | | | | | | | | |  | | | | | | | |  | | | |
| area of swipe (10cm\*10cm): | | | | | | | | | | | | **100** | | | | | cm2 | | | | | | | | | |  | | | | | | | |  | | | | | | | | |  | | | | |  | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | |  | | |
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|  | |  | | | | | | | | | |  | | | | | Counts | | | | | | | | | | Bq/cm2 | | | | | | | | Counts | | | | | | | | | Bq/cm2 | | | | | Counts | | | | | | | Bq/cm2 | | | | | | | | | | | Counts | | | | | | | Bq/cm2 | | | | | | | | Counts | | | | | | | | | Bq/cm2 | | | | | | | | |  | | | | | | | | |  | | | | | | | | | Counts | | | | | | | | | Bq/cm2 | | | | | | | | | Counts | | | | | | | | | Bq/cm2 | | | | | | | | | Counts | | | | | | | | | | Bq/cm2 | | | | | | | | | | Counts | | | | | | | | | | Bq/cm2 | | | | | | | | | | Counts | | | | | | | | | | Bq/cm2 | | | | | | | | | | Counts | | | | | | | | | | Bq/cm2 | | | | | | | | | | Counts | | | | | | | | | | Bq/cm2 | | | | | | | | | | Counts | | | | | | | | | | Bq/cm2 | | | | | | | | Counts | | | | Bq/cm2 | | |
| example | |  | | | | | | | | | |  | | | | | 30 | | | | | | | | | | 0.06 | | | | | | | | 26 | | | | | | | | | 0.012 | | | | | 24 | | | | | | | -0.012 | | | | | | | | | | | 35 | | | | | | | 0.12 | | | | | | | | 28 | | | | | | | | | 0.036 | | | | | | | | |  | | | | | | | | | 36 | | | | | | | | | 23 | | | | | | | | | -0.024 | | | | | | | | |  | | | | | | | | |  | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | | | |  | | | | | | | |  | | | |  | | |
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Appendix 7. Decontamination Techniques of Areas and Equipment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Method | Surface | Action | Technique | Advantages | Disadvantages |
| Hot water detergent  (Tide) water softener  Calgon | All surfaces | Dissolves and erodes | For spills and small surfaces. Blot up liquid and wipe with cleaning solution. Glassware, other equipment, and clothing may be washed by immerision and agitation in solution | Extremely effective if done immediately after spil and on nonporous surfaces | Of little value in decontamination of long standing contaminants or porous surfaces |
| Complexing agents | Nonporous surfaces | Forms soluble complexes with contaminated material | Complexing agent sollution should contain 3% (by wt.) of agent. Spray surface with solution. Keep surface moist for 30 minutes by respraying. then flush with water. | Holds contamination in solution. Easily stored; carbonates and citrates are nontoxic, non-corrosive. | Requires application for 5 to 30 mins. Little penetration power. |
| Alconox-EDTA | All surfaces | Dissolves and complexes contaminating material. | Use standard cleaning procedures | A very good general decontaminating agent | Not very effective on porous surfaces or in decontamination of long standing contaminants. |
| Organic solvents | Non porous surfaces | Dissolves organic materials (oil, paint, etc) | Immerse entire unit in solvent or apply in wiping procedure (see detergents) | Quick dissolving action | Requires good ventilation and fire precautions. Toxic to personnel. |
| Abrasion (Dutch Cleanser) | Non porous surfaces | Removes surfaces | Use conventional procedures | Contamination may be reduced to as low a level as desired | Impractical for porous surfaces because of penetration by moisture. |
| Inorganic acids and mixtures of same | Metal surfaces | Dissolves porous deposits | Use dip-bath procedure for movable items. Acid should be kept at a concentration of 1 to 2 normal (9% to 18% HCl, 3%-6% for H2SO4). Flush surface with water, scrub with a water detergent solution, and rinse. | Corrosive action on metal and porous deposits. Corrosive action may be moderated by addition of corrosion inhibitors to solution. | Personal hazard. Acid mixtures should not be heated. Possibility of excessive corrosion if used without inhibitors. |
| Oven cleaner | All surfaces | Dissolves organic and some inorganic materials | Spray or paint on area. Wipe off with damp cloth after 30 minutes. | Extremely effective in removing material | Not every effective on porous surfaces or in decontamination of long standing contaminants. |

# Appendix 8. Termination of Radionuclide Use Form

Permit #:

Permit Holder:

Isotopes Used:

Sealed or Usealed

Disposition of remaining Isotope (check one):

Returned to Vendor:

To Waste: Indicate activity and to where (Sewage, Landfill, Air, other (please specifiy))

To Storage:

Transferred to:

Final Contamination monitoring Results (Attach last monitoring results)

Have all the signs, posters and radiation warning symbols, cautions and labels, been removed? Yes No

If applicable, Have you arranged to cancel the Dosimetry Service? Yes No

Attach the last contamination monitoring swipe test records showing that levels of contamination are below the decommission limits as specified on your permit.

Please complete the Annual Radionuclide Use Summary and return it with this form to the RSO.

This radionuclide use permit is not terminated until all the information is supplied, the lab(s) has (have) been inspected by the RSO, and this form has been signed and dated. Reminder: all records must be kept for a minimum of three years for possible inspection by the CNSC.

#### Signature of Permit Holder

##### Date

#### Signature of Radiation Safety Officer

Date