UNIVERSITY of GUELPH

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RADIATION SAFETY MANUAL

University of Guelph

Human Resources

Environmental Health and Safety

Prepared by:

Radiation Safety Officer(s)

Approved by the Radiation Safety Committee

December 2023

REVISION HISTORY

Revisions to the Radiation Safety Manual are to be documented in *Table 1 Revision History*. All amendments are to be made by the Radiation Safety Officer (RSO) or their delegate and are to be approved by the Radiation Safety Committee prior to being incorporated into the manual. The manual is to be reviewed *annually* by the Radiation Safety Committee.

Table 1: Revision and Annual Review History Revision

Revision Number	Revision or Review	Document Section	Details of Amendments	Date
0			New Document	February 2016
1			Added Module 3 to Incorporate 915 Procedures	March 2017
2			Incorporated CNSC Comments to Module 3 to Incorporate 915 Procedures	May 2017
3			Separated 915 Procedures for 815	July 2017
4			Updated Procedures	April 2018
5	Revision	Various	CNSC recommendations incorporated following 817 license renewal, minor formatting and editorial changes	February 2020
6	Revision	All	AODA compliance	October 2020
7	Revision	Various	Minor Editorial changes	February 2021
8	Revision	Various	Minor Editorial changes and regulatory updates	April 2022
9	Revision	2.4.21	Added details regarding special projects approval	February 2023
10	Revision	Various	Minor Editorial changes and regulatory updates. Added Section 2.5	April 2023
11	Revision	Appendix 14	Updated the NEW Letter (Section 4 of the letter)	December 2023

PREFACE

The Radiation Safety Manual is the governing document in the administration of the University of Guelph Radiation Safety Program. The Radiation Safety Manual is intended for the users of nuclear substances, radiation devices and ionizing and non-ionizing radiation producing devices.

The policies and procedures contained herein are designed to provide a reasonable and practical standard of safety in compliance with government regulations and codes and University expectations while allowing the users flexibility in establishing and implementing their own internal programs and procedures.

The intent of this manual is to provide a ready reference to the legislative requirements and procedures, a guide to acceptable methods of practice and a degree of safety awareness contributory to self-regulation for users of nuclear substances, radiation devices and ionizing and non-ionizing equipment. This manual is divided into multiple Modules to encompass the University's Radiation Safety Program.

For access to all current regulatory acts, regulations or standards as referenced in this manual please contact the Radiation Safety Officer.

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MODULE 1: ORGANIZATION AND ADMINISTRATION

1.1 REGULATORY REQUIREMENTS

There are several regulatory bodies that have jurisdiction over the use of ionizing and non-ionizing radiation. In Canada the possession and the use of radioactive materials is administered and governed primarily by the Canadian Nuclear Safety Commission (CNSC) under the Nuclear Safety and Control Act. Recommendations from the International Commission on Radiological Protection (ICRP) are specifically used as the common basis for radiological protection standards, legislation and overall guidelines under which radioisotopes or radiation emitting devises are managed.

Health Canada's Radiation Protection Bureau also conduct assessments under the Canadian Environmental Assessment Act and provides guidance to federal departments, governmental agencies, universities, hospitals, workers and the public on health issues related to radiation exposure. They manage the National Dose Registry, which contains the occupational radiation dose records of all monitored radiation workers in Canada. The bureau also conducts research on exposure trends and on the health outcomes of occupational exposures.

Both the Federal and Provincial Governments control the installation and use of radiation emitting devices. X-ray devices are regulated based on its use (non-medical vs. medical), operating energies, and how it's produced. X-ray sources operating at very high energies (above 1 MeV) are subject to licensing under the Canadian Nuclear Safety Act. However generally speaking, the Canadian Nuclear Safety Commission does not regulate X-ray emitting devices rather X-rays sources are normally under the jurisdiction of provincial governments. In Ontario, the primary regulating body for use in veterinary or analytical applications is the Ministry of Labour (MOL). In Ontario, X-ray devices that are used on humans are also regulated by the Ontario Ministry of Health.

1.1.1 Nuclear Safety and Control Act (NSCA) and Regulations

1.1.1.1 Nuclear Safety and Control Act (NSCA)

Under the NSCA a series of regulations are also applicable to the University and its activities. These include:

- General Nuclear Safety and Control Regulations
- Administrative Monetary Penalties Regulations
- Radiation Protection Regulations
- Class II Nuclear Facilities and Prescribed Equipment Regulations
- Nuclear Substances and Radiation Devices Regulations
- Nuclear Security Regulations

- Packaging and Transport of Nuclear Substance Regulations, 2015.

1.1.2 Ontario X-Ray Regulations

In Ontario safety considerations for the use of x-ray emitting devices not used on humans are governed by the Ontario Ministry of Labour (MOL) under O.Reg. 861 X-Ray Safety. Each x-ray emitting device must be registered with the MOL prior to its use and the registration must be amended should the unit be moved or disposed.

The Federal Government regulates all x-ray emitting devices through the Radiation Emitting Devices Act.

Safety considerations for the use of x-ray emitting devices used on humans are governed by the Ontario Ministry Health (MOH) under the Healing Arts and Radiation Protection Act and regulations. Each x-ray emitting device must be registered with the MOH prior to its use and the registration must be amended should the unit be moved or disposed.

- MOL: R.R.O 1990 Regulation 861
- MOH: Healing Arts and Radiation Protection Act and regulation

1.1.3 Other Acts, Regulations and Standards

In addition to the above Acts and Regulations other federal and provincial governance may apply to the activities involving ionizing and non-ionizing radiation use at the University.

The Transportation of Dangerous Goods Act and its associated regulations is one such body of legislation. It outlines regulatory requirements for safe practices in the handling, offering for transport, transporting of dangerous goods including radioactive materials.

- Transportation of Dangerous Goods Act

The Ontario Health and Safety Act under which the x-ray safety regulations are made is another such Act which safeguards the health and safety of all workers.

- Occupational Health and Safety Act

The American National Standard for Safe Use of Lasers (ANSI.Z136.1) is a consensus standard providing safe practices for the use of lasers.

- American National Standard for Safe Use of Lasers ANSI Z136.1
- Ministry of Labour Guideline – Lasers in Ontario Workplaces
- University of Guelph Safety Policy – Lasers 851.05.03

1.2 RADIATION SAFETY POLICY

The Radiation Safety policy outlines the executive-level commitment to radiation safety at the University of Guelph. The Radiation Safety policy is available on the EHS website.

1.2.1 CNSC Issued Licenses

The CNSC has issued the University of Guelph several licenses in the following categories:

License Category	Applicability
Consolidated (License Type 815) (Nuclear Substances & Radioactive Devices)	Permits traditional laboratory research and teaching involving the use of radioisotopes and equipment containing radiation sources.
Veterinary Nuclear Medicine (License Type 915) (Nuclear Substances & Radioactive Devices)	Nuclear medicine at the Ontario Veterinary College – iodine Cat clinic that provides for clinical treatment of cats with hyperthyroidism as well as use of radioisotopes for diagnostic imaging in horses.
Development and Testing (License Type 817) (Nuclear Substances & Radiation Devices)	Associated with a defined research program.
Operate a Veterinary Teletherapy Machine (License Type 545) Operate a Research or Industrial Particle Accelerator Facility (License Type 619) (Class II Nuclear Facility & Prescribed Equipment)	Associated with veterinary clinical operations. Associated with other research activities at the University.

1.2.2 Other Equipment within the Radiation Safety Program

Equipment	Scope
X-Ray	• Both clinical use as part of the OVC and use within research programs at the University. • X-Ray machines for non-human use are registered with the Ontario Ministry of Labour. X-ray machines for human use are registered with the Ontario Ministry of Health.

Equipment	Scope
Lasers	• Both clinical uses as part of the OVC and use within research and teaching programs at the University.

1.3 RADIATION SAFETY PROGRAM

The radiation safety program encompasses the CNSC licenses in the categories of Nuclear Substances & Radioactive Devices and Class II Nuclear Facility & Prescribed Equipment as well as x-ray emitting devices and lasers.

1.3.1 Responsibilities for Radiation Safety

Working safely with radiation is the responsibility of everyone involved in the use and management of radioactive sources and equipment.

The Radiation Safety Program incorporates.

1. Senior Management (Vice President, Finance and Operations)
2. Radiation Safety Officer(s)
3. Radiation Safety Committee
4. Deans, Directors, Department Chairs
5. Principal Investigators
6. Authorized User of Nuclear Substances and Devices including Nuclear Energy Workers
7. X-ray Users
8. Laser Users
9. Ancillary Workers

1.3.2 Senior Management

The VP, Finance and Operations is the Applicant Authority with the CNSC for the University and has the overall responsibility for regulatory compliance to all applicable legislation as it pertains to Radiation Safety and adherence to License conditions.

The VP, Finance and Operations has the following duties and responsibilities,

- Holds the CNSC licenses issued to the University
- Designates the Radiation Safety Officer(s)
- Appoints the members of the Radiation Safety Committee

- Ensures that essential physical, human and financial resources are provided as required for the operation of the Radiation Safety program.
- Acts on the recommendations made by the Committee
- Informs the Committee on the status of recommendations

1.3.3 Radiation Safety Committee (RSC)

Members of the Radiation Safety Committee (RSC) are approved by the VP, Finance and Operations. The committee provides general oversight for the Radiation Safety program and advises the RSO and/or VP, Finance and Operations (if necessary) on matters of compliance, program/policy/procedure development and/or improvements. The RSC is governed by its Terms of Reference and consists of members with expertise in radiation safety matters.

1.3.4 Radiation Safety Officer (RSO)

The Radiation Safety Officer is the subject matter expert in all aspects of radiation safety who provides day-to-day management and administration of the overall radiation safety program on behalf of the University.

For CNSC issued licenses, the Radiation Safety Officer is designated by the Applicant Authority and must be approved by the CNSC. In addition, pursuant to the *Class II Nuclear Facilities and Prescribed Equipment Regulations*, RSO certification by the CNSC is required for persons designated as RSO for a Class II nuclear facility.

The RSO acts as liaison with the CNSC on radiation safety matters pertaining to the University's CNSC issued licenses.

The RSO acts as liaison with applicable regulators on radiation safety related to x-rays, lasers and other radiation emitting sources as applicable.

As such the RSO should:

- Possess both relevant work experience and formal training in radiation safety
- Understand methods and technology to control use, handling, storage and disposal of nuclear substances and to monitor and control radioactive contamination, radiation fields and radiation exposures
- Understand pertinent regulatory processes and requirements

1.3.4.1 Role & Responsibilities:

Overall:

1. The RSO is also the designated Laser Safety Officer (LSO) and oversees the use of X-rays.

2. Communicate with senior managers, the radiation safety committee, internal Principal Investigators, nuclear substance users, x-ray users, laser users, Class II facility workers and regulatory agencies on all matters related to radiation safety.
3. Provide to the Radiation Safety Committee updates on the status of the radiation safety program and revisions of associated policies, procedures and reports for review.
4. Act as signing authority and/or prepare all required reports to the CNSC, MOL, and MOH. For example, annual compliance reports, security plan, X-Ray registration/deregistration, etc.
5. Ensure that records and reports that are required of the University by legislation and licenses are prepared, maintained and submitted as required.
6. Report to the CNSC any required changes to the Radiation Safety Manual.
7. Develop and implement administrative controls or procedures with consideration to ALARA and to comply with regulatory requirements, license conditions and the Radiation Safety program.
8. Review and authorize requests to purchase or use nuclear substances or devices to ensure that the proposed use and locations of use comply with relevant legislation, license conditions and the requirements of the radiation safety program.
9. The Radiation Safety Officer authorizes all acquisitions and transfers of Radioactive Materials.
10. Notify Nuclear Energy Workers (NEWs) in accordance with regulations.
11. Provide or verify that person(s) who may be exposed to radiation in the course of their duties receive appropriate radiation safety training.
12. Authorize the disposal of nuclear substances in accordance with legislation, the CNSC and institutional processes. Maintain all records.
13. Develop and implement programs to inspect and review the conduct of licensed/ registered/ internally permitted activities.
14. Identify and recommend remedial actions to correct deficiencies identified through the inspection program. Confirm corrective actions are implemented accordingly.
15. Stop all work and suspend any activity involving the use of radioactive sources or equipment that may pose a threat to the health and safety of an individual or that would violate the University's CNSC licenses or regulatory compliance.
16. Initiate revisions to procedures, changes to equipment and facilities, and amendments to the CNSC license(s) to maintain compliance with regulatory requirements.
17. Working with Occupational Health and Wellness design and implement appropriate personnel medical surveillance and bioassay programs.
18. Administer, control and issue dosimeters and manage the dosimetry program.

19. Monitor the occupational radiation exposures received by persons by reviewing their records of exposure (dosimetry) and analyzing bioassay trends.
20. Communicate with the individual and investigate where the above reviews of radiation exposure indicate that exposures are elevated.
21. Communicate exposures at least annually to Nuclear Energy Workers.
22. Coordinate or participate in emergency response and report all incidents or accidents involving nuclear substances to the CNSC if required and other relevant authorities in accordance with license conditions and legislative requirements.
23. Investigate and follow-up on incidents involving potential exposures to ionizing radiation, accidents involving nuclear substances, loss of nuclear substances and/or Class II facilities.
24. Investigate and follow-up on incidents involving users of lasers and/or x-ray equipment.
25. Notify the CNSC within 15 days of changes in RSO and applicant authority.

1.3.5 Deans, Directors and/or Department Chairs

1. Ensure that all persons within the College, unit or department who acquire, purchase, use, store, transport and dispose of nuclear substances, radiation devices and prescribed equipment do so in compliance with all regulatory requirements and in accordance with the University of Guelph Radiation Safety Manual.
2. Ensure that areas previously using radiation are appropriately decommissioned before the space is transferred for use.
3. Ensure that radiation devices, x-ray and lasers are appropriately removed from service, and decommissioned prior to disposal.
4. Bear the cost for decommissioning/clean-up/disposal activities required for abandoned materials/activities.
5. Approve all nuclear substance permit applications in their area.

MODULE 2: NUCLEAR SUBSTANCES

2.1 INTRODUCTION

This module includes general policies and procedures associated with activities at the University regulated by the CNSC including the use and handling of nuclear substances and devices along with Class II facilities.

2.2 ROLES AND RESPONSIBILITIES

2.2.1 Radiation Safety Officer (RSO)

1. Review and assess all requests for the issuance of internal permits. Approve with the RSC Chair and issue internal permits.
2. Assess the proposed use of nuclear substances in laboratories and designate laboratories for use of nuclear substances.
3. Maintain record of the status of all laboratories that use or store nuclear substances.
4. Provide training or verify that persons who handle nuclear substances are adequately trained in radiation safety.
5. Assess the adequacy of survey programs for measuring and managing radiation hazards and radioactive contamination during licensed activities such as during use, storage and disposal of nuclear substances.
6. Ensure radioactive contamination monitoring and removal is conducted to meet regulatory requirements.
7. Maintain a current sealed source inventory list and ensure that sealed radiation sources are leak tested in accordance with the University's policies and regulatory requirements.
8. Ensure that personnel involved in transporting nuclear substances are trained in TDG.

2.2.2 Principal Investigator

The Principal Investigator is the Radiation Safety Permit Holder and is responsible for confirming that they and all those listed on the permit:

1. Participate in all required radiation safety training sessions.
2. Comply with the Nuclear Safety and Control Act (NSCA), the CNSC Regulations, CNSC license conditions and internal permit conditions.
3. Ensure that work-specific training is provided to all nuclear substance/radiation device users in their laboratories and they have informed all users of the risks associated with exposure to ionizing radiation as applicable to the work being done.

4. Comply with policies and procedures as set out in the University of Guelph Radiation Safety Manual.
5. Ensure weekly contamination monitoring is performed when radioisotopes are handled and that appropriate records are maintained.
6. Maintain radioisotope inventories, storage and waste disposal records. The Principal Investigator must authorize and limit the release of nuclear substances only in quantities specified in the regulation under the guidance and approval of the RSO.
7. Report immediately to the RSO incidents of loss, theft, sabotage, illegal use of possession of any nuclear substance or radiation device.
8. Report immediately any incident or accident involving nuclear substances to the RSO and follow the University incident reporting process.
9. Designate a responsible and trained individual to oversee radioisotope work during any absence (<4 weeks) and an alternate stand in Principal Investigator during extended absences (greater than 4 weeks).
10. Address all inspection deficiencies in a timely manner and communicate their closure to the RSO.
11. Ensure that the information on their permit is current and notify the RSO of any changes.
12. Notify the RSO when the work as per the permit is completed and if Dormant Permit status is sought.
13. Inform and work with the RSO to decommission their laboratory.
14. Maintain all required records in the specified lab binder.

2.2.3 Authorized Users of Nuclear Substances and Devices including Nuclear Energy Workers

Every Authorized User of Nuclear Substances and Devices including Nuclear Energy Workers shall:

1. Attend all required radiation safety training sessions; comply with the Nuclear Safety and Control Act (NSCA), the CNSC Regulations, CNSC license conditions and requirements as applicable.
2. Participate in all work-specific training sessions and comply with all work specific procedures. Be informed of the risks associated with exposure to ionizing and non-ionizing radiation.
3. Comply with policies and procedures as set out in the University of Guelph Radiation Safety Manual.

4. Use equipment, devices, facilities and clothing for protecting the environment or health and safety of persons, or for determining dose of radiation, dose rates or concentrations of radioactive substances in accordance with all license conditions and regulatory requirements.
5. Report to their supervisor and/or RSO any incident involving known or suspected radiation exposure, personal contamination, any contamination or spill exceeding permissible limits as prescribed in the University of Guelph Radiation Safety Manual.
6. Inform their supervisor and/or the RSO immediately of any situation involving
    a. a risk to the environment or health and safety of persons,
    b. a threat of security or incident with respect to security,
    c. a failure to comply with required regulatory and/or license conditions,
    d. an act of sabotage, theft, loss illegal use or possession of a nuclear substance/radiation device,
    e. a release of an authorized quantity of nuclear substance or hazardous substance.
7. Observe and comply with all notices and warning signs posted by the University of Guelph.
8. Take all reasonable precautions to protect the worker's own safety and the safety of the other persons at the site of the licensed/registered activity, the protection of the environment, the protection of the public and the maintenance of security.
9. Wear the required monitoring dosimeters and participate in the required bioassay programs.
10. Perform all regular contamination checks and clean up contamination.
11. A female worker is encouraged to inform the Occupational Health and Wellness, and/or her supervisor and/or the RSO of a pregnancy as soon as she becomes aware of it so that a fetal dosimeter can be assigned as required.

2.3 GENERAL POLICIES (NUCLEAR SUBSTANCES)

2.3.1 As Low As Reasonably Achievable (ALARA) Policy

The University of Guelph is committed to limiting all occupational exposures in accordance with the ALARA Principle (**A**s **L**ow **A**s **R**easonably **A**chievable) and taking appropriate measures to reduce doses where practical with consideration of socio-economic factors. All exposures will be limited as per provisions of the CNSC regulations made under the *Nuclear Safety and Control Act (NSCA),* and the *Packaging and Transport of Nuclear Substances Regulations, 2015*.

All work associated with the use of radioactive sources or devices shall be governed by considerations for the risk of the radiation. Work-related doses will be reviewed periodically to ensure that they are adequately controlled.

The University of Guelph Radiation Safety Program is designed to keep exposures to ALARA by:

1. Management and control over work practices
2. Personnel training and qualification
3. Control of occupational and public exposure to radiation
4. Planning for unusual situations

2.3.2 Worker Classification Policy

The Radiation Safety Officer (RSO) along with Radiation Safety Committee (RSC) reviews and approves all uses and operations that involve radioactive materials at the University and confirms that only trained personnel are permitted to work with radioactive materials. In general, workers are classified into two categories: Nuclear Energy Workers (NEW) and members of the public.

2.3.2.1 Nuclear Energy Worker (NEW)

The University through the RSO all those requiring dosimetry for working with nuclear substances, radiation devices or class II prescribed equipment as a Nuclear Energy Worker (NEW). The University maintains a list of the names of all personnel notified of their status as Nuclear Energy Workers (NEWs).

It is pertinent to note that High School Students are not permitted to use or handle nuclear substances, radiation devices or class II prescribed equipment.

2.3.2.2 Nuclear Energy Worker Notification Policy

As per the *General Nuclear Safety and Control Regulations and the Radiation Protection Regulations*, the University of Guelph through the RSO will notify all individuals in writing of their status as NEWs and notify them of their risks related to the radiation to which they may be exposed, applicable effective dose limits, typical dose levels received for their roles and their rights as specified by the *Radiation Protection Regulations*. Any person working with radioactive materials and having a reasonable probability of exceeding the dose limits for members of the general public must be notified of their status as a Nuclear Energy Worker (NEW). The University of Guelph will maintain the documented acknowledgment from each NEW that the above information has been received and understood.

See section 2.4.2 for further information.

2.3.3 Worker Training & Authorization Policy

All radiation users (including Principal Investigators) must participate in the University's Radiation Safety training course prior to handling or working with nuclear substances and/or radiation devices. *Radiation users must participate in refresher training* ***at least every 3 years***.

Principal Investigators are responsible for confirming that all radiation users under their supervision:

- are trained in the specific procedures and/or hazards associated with their work;
- participate in the University Radiation Safety Training and refresher training at the frequencies indicated above; and
- are compliant with best practices and follow the ALARA principle when operating under the internal permit.

Personnel that may have incidental contact with nuclear substances and radiation devices will be provided Radiation Awareness training. This includes personnel in Campus Community Police, Fire Prevention, Custodial and Maintenance as applicable. *Refresher training will also be provided **at least every 3 years***.

The University's Radiation Safety training and refresher training courses includes Transportation of Dangerous Goods (TDG) Class 7 training. Individuals not otherwise radiation users that offer for transport, transport, or receive radioactive materials classified as dangerous goods, as per the TDG Act and Regulations must participate in TDG training every 3 years to maintain current TDG Class 7 certification.

2.3.3.1 User Training Policy for Nuclear Substances

Training requirements for personnel involved in Class II facilities are addressed in the corresponding facility specific procedure. The following provides a list of topics that will be covered in the training courses:

Radiation User Training

Required for all new users working with nuclear substances or radiation devices:

- Introduction to Radiation & Radioactivity
- Regulatory Requirements & Overview of University of Guelph RP Program
- Radiation Quantities & Units
- Biological & Health Effects
- Radiation Measurement & Instrumentation
- Dosimetry
- Controlling Exposures
- University of Guelph Standard Operation Procedures
- Purchasing, Shipping & Receiving of Radioactive Materials
- Emergency Procedures & Response

Radiation Awareness Training

- Introduction to Radiation & Radioactivity
- Biological & Health Effects
- Detection of Radiation & Instrumentation
- ALARA Principle & Controlling Exposures
- University of Guelph Standard Operation Procedures
- Radioactive Packages & Emergency Procedures
- X-rays
- Lasers
- Where to find further information

2.3.3.2 Training Requirements for the RSO

The RSO will participate and successfully complete an RSO Training course by a recognized training provider and should include the following topics:

- Theory on radiation physics
- Radiation detection, instrumentation and dosimetry
- Biological and health effects of exposure to radiation
- Radiation protection principles and practices
- Workplace radiation safety program: organization and administration
- Emergency procedures
- Packing and Transport of nuclear substances (TDG-7)
- Workplace inspections and audits
- Regulatory agencies and standard-setting organizations (CNSC, ICRP, etc.)
- Licensing of nuclear substances and radiation devices
- The Nuclear Safety and Control Act (NSCA) and Regulations

In addition, the RSO will regularly participate (at minimum once every 5 years) in the Canadian Radiation Protection Association (CRPA) annual conferences for refresher training, ongoing continuous learning, professional development, and networking with peers.

2.3.3.3 Undergraduate Teaching Program Policy

All undergraduate students who handle nuclear substances, in group teaching classrooms or laboratories must always participate in the required radiation safety training specific to their

programs and work under direct supervision. Compliance is the responsibility of the Heads of Departments. Training records must be maintained by the Department.

2.3.4 Policy for Ascertaining and Recording Doses to Workers

All occupational exposures shall be limited in accordance with regulatory requirements outlined by the CNSC and as per the ALARA principle. All NEWs will be monitored with TLD/OSL monitors from a CNSC licensed dosimetry service provider. Corresponding doses will be reviewed by the RSO. All exposures relating to incidents must be reported through the University's incident reporting process. The RSO will investigate all radiation related incidents accordingly. Please refer to the Appendix 9 for proper care and use of TLDs.

2.3.4.1 Policy for Ascertaining and Recording Doses to Pregnant and Breastfeeding Workers

As soon as a user is aware of her condition, a pregnant or breastfeeding woman is encouraged to inform the Occupational Health and Wellness and/or the RSO of her condition **in writing**. The University of Guelph Pregnancy Protocol will be followed. All pregnant NEWs will be monitored with an appropriately modified schedule using TLD/OSL monitors from a CNSC licensed service provider.

2.3.4.2 Radioiodine Bioassay Policy

In accordance with the U of G Medical Surveillance Policy and Program, radioiodine users must participate in a bioassay program based on the radioisotope they use, and the University's license conditions as indicated in the "Internal Permit".

2.3.5 Policy on Action Levels

The University of Guelph sets 'Action levels' as per the '*Radiation Protection Regulations*'.

If 'Action Levels' are reached, the University through the RSO shall:

- Investigate to establish the cause for reaching the set U of G action level.
- Identify and take action to restore the effectiveness of the radiation safety program as per section 4 of the '*Radiation Protection Regulations'*.

2.3.6 Policy on Control of Radioactive Contamination (Where unsealed materials are used or stored)

Monitoring for surface contamination is a key aspect to the Radiation Safety Program at the University of Guelph. Contamination checks are necessary for the overall radiation safety of a facility. Laboratories that use and/or store unsealed radioisotopes must conduct regular contamination checks via direct and/or indirect monitoring. Direct measurement entails the use of

portable meters to detect both removable and fixed contaminants. Indirect measurement detects only removable contamination via wipe tests. Labs that use strong beta emitters or gamma/x-ray emitters such as P-32 must have calibrated portable contamination survey meters available to monitor surfaces after each use (direct testing). Labs that use long-lived radionuclides such as H-3, C-14 or S-35 that emit alpha radiation or weak beta radiation must conduct regular wipe tests (indirect monitoring) by using devices such as liquid scintillation counters (LSC). In both cases, monitoring for surface contamination is required and must be completed:

- at least weekly in all radioisotope work areas when radioisotopes are in use
- immediately after any spill or incident
- before equipment (instruments, glassware, pipettes etc.) is released for non-radioactive use
- before a designated room is decommissioned for non-radioactive use

Facilities that use unsealed nuclear substances are required to routinely survey their work areas for contamination at the end of each session to limit exposure. If radioisotopes were not used in a given week, it must be clearly stated on the recording sheet irrespective of the time delay in-between experiments.

Wipe test and contamination monitoring results are to be stored in the 'Radiation Binder' in the lab. All records must be maintained by the Principal Investigator and be readily available in case of an inspection. Upon decommissioning and cancellation of the permit, the contamination records are to be forwarded to the Radiation Safety Officer (RSO).

2.3.7 Radiation-Detection Instrument Policy

All purchases of radiation detection instruments at the University of Guelph must follow the 'Purchasing Policy' and be approved by the RSO prior to its purchase. All meters in service must have a valid calibration sticker and are to be catalogued with the RSO office. Meters are to be calibrated annually and calibration is to be done in accordance with CNSC expectations.

2.3.8 Policy for Leak Testing of Sealed Sources

For sealed sources, leak tests are to be performed immediately after an incident that may have caused damage to the source. After having been stored for 12 or more consecutive months; sealed sources that return to use must also be leak tested before use occurs. All leak tests are to be performed as per CNSC guidelines and expectations for leak testing. Please refer to CNSC's *Nuclear Substance and Radiation Devices Regulations* or contact the RSO for sealed sources that do not require leak testing.

Sealed sources containing 50Mbq or more of a nuclear substance or a nuclear substance as shielding (e.g. depleted uranium shields) shall be leak tested using instruments and procedures

that are capable of detecting a leakage of 200 Bq or less. Leak testing of sealed sources is generally conducted by the RSO.

2.3.9 Policy on Access Control and Security

All nuclear substances and radiation devices and class II facilities are to be used by *Principal Investigator* authorized radiation users including Principal Investigators only.

All radiation rooms including Class II facilities must be kept secure and when not in use or not under the direct supervision of an authorized worker, nuclear substances and radiation device must be kept in a locked room, area or enclosure. Access to nuclear materials and devices should be controlled from the time of acquisition until disposal or transfer. Class II facilities are to follow site-specific policies/procedures on security and access.

In case of loss, theft or unauthorized use of nuclear substance or radiation device, the Radiation Safety Officer (RSO) must be notified immediately. After hours the RSO can be reached via Campus Police via x 2000.

Upon confirmation of loss or theft of a nuclear source or device, the RSO will notify Campus Police.

All visitors must be accompanied by authorized radiation users Principal Investigator and need to follow all applicable guidelines, procedure and policies of the University of Guelph.

2.3.10 Policy on Receipt of Packages

Radioactive packages and radiation devices are to be handled by trained workers. Upon receipt of packages, workers should inspect for evidence of leaking or damage. Upon suspicion of any damage, or leakage, the Radiation Safety Officer (RSO) needs to be notified immediately. Contamination monitoring must be completed by the principal investigator or authorized radiation user and indicated on the 'Purchasing Receipt form' that is forwarded to the RSO. If contamination is detected, the RSO is to be contacted.

Receipt of radioactive packages and radiation devices must be performed in accordance to the CNSC's *Guidelines for Handling Packages Containing Nuclear Substances, Nuclear Substance and Radiation Devices Regulations* and *Transportation of Dangerous Goods Regulations.*

To ensure safety, only trained personnel are permitted to handle the receipt of radioactive materials or nuclear substances. All personnel that receive radioactive packages must be TDG trained.

2.3.11 Packaging and Transport of Nuclear Substances and Radiation Devices Policy

The Packaging and Transport of all Nuclear Substances and Radiation Devices should be in accordance to CNSC's *Packaging and Transport of Nuclear Substances Regulations, 2015* and Transport Canada's *Transportation of Dangerous Goods Regulations.*

The Radiation Safety Officer (RSO) must be consulted prior to the packaging and transport of any Nuclear Substances or Radiation Devices. Approval must be granted by the RSO prior to transferring any radioactive material or radiation device.

It should be noted that the University of Guelph needs to register and receive confirmation of registration from the CNSC before using certain types of packages (Example: Type B).

Records for all radioactive materials prepared in a Type-A, IP-2 or IP-3 package needs to be maintained by the RSO.

2.3.12 Policy on Controlling Possession of Nuclear Substances

2.3.12.1 Purchasing Policy

Acquisition of all nuclear substances and radiation devices must be reviewed and approved by the Radiation Safety Officer (RSO) prior to purchase. All purchases of nuclear substances and radiation devices must go through the University's Purchasing Department procedure for a High Value Purchase Order. Regular, frequent purchases of a similar nature may be completed using the blanket order system with special approval of the RSO.

Nuclear substances and radiation devices are not to be procured directly from any supplier or via the University's Low Value Purchase Order procedure. Each Principal Investigator is responsible for keeping their purchasing receipts in their 'Radiation Binder' in their respective labs.

All purchases must be documented by the Principal Investigator or radiation user and must be traceable via the U of G Inventory Record Form.

2.3.12.2 Inventory Policy

Current inventories of nuclear substances and radiation devices whether in use or in storage or material that is awaiting disposal are to be maintained. Current records need to be maintained in the designated Radiation Binder.

It is the responsibility of the Principal Investigator to maintain accurate and current inventory records including, the name, quantity, form, location and supplier's information. Fridges if in use for storage of nuclear substances should also have active inventory record. Principal Investigators are also responsible for maintaining transfer and disposal records of all nuclear substance and radiation devices.

2.3.13 Policy on Management of Radioactive Wastes

2.3.13.1 Radioactive Waste Disposal Policy

All radioactive materials or radiation devices that are no longer required at the University of Guelph must be disposed of in a way that prevents unreasonable risk to the public or the environment. All radioactive waste disposals must be managed and handled as per the CNSC's *Nuclear Substances and Radiation Devices Regulations*. Disposal of all sealed sources and or devices must be done in conjunction with the RSO. For open sources, authorized users and Principal Investigators are to use the Radioactive Waste Disposal Request Forms for regularly scheduled disposals.

2.3.13.2 Transfer of Nuclear Substances

The University of Guelph will track and maintain a list of each nuclear substances and radiation devices transferred. It is the responsibility of the Principal Investigator to notify EHS and the RSO of any transfers and non-deliverable items that are returned to suppliers.

2.3.14 Policy on Emergency Procedures

The RSO must be informed immediately of any accident or emergency related to nuclear substances, and radiation devices including the Class II Facilities (OVC - Clinac & Physics Pelletron).

Any:

- Person suspected of having been or is likely to be exposed to a dose exceeding maximum permissible levels
- Situation that may pose a threat to the health and safety of an individual or that would violate the University's CNSC license conditions or regulatory compliance including events such as but not limited to, spills, fire, loss, theft, damage, security breach, transportation mishaps.
- All reportable events must be reported to the CNSC duty officer at 1-844-879-0805 (toll-free, 24/7)

If damage to a sealed source and /or the spillage of an open-source isotope has occurred, the Principal Investigator is responsible for taking immediate action to contain the radiation and mitigate the risk to personnel. This includes decontamination of personnel and equipment and where necessary the evacuation of personnel from the affected area. Afterhours – Contact Campus Police x 2000.

2.3.15 Decommissioning Policy

The Department Chair and internal Principal Investigator are responsible for ensuring that all rooms, areas or enclosures that have been licensed for the use of nuclear substances are decommissioned prior to being released for non-radioactive use or renovation.

The Principal Investigator is responsible for completing the University of Guelph Decommissioning Report prior to releasing their responsibility for the area. Responsibility for the area is maintained until the RSO confirms proper decommissioning and releases the space for other uses. In the absence of the Principal Investigator, the Department Chair will assume these duties.

There will be no decommissioning of class II facilities without the proper approvals and issuance of a decommissioning license by the CNSC.

2.3.16 Records and Reporting System Policy

All records and reports relating to nuclear substance and radiation devices and Class II facilities must be available for inspection on site. All records and reports are to be submitted and maintained as per as the *General Nuclear Safety and Control Regulations*.

It is the responsibility of each Principal Investigator and Class II facility supervisor to maintain records pertaining to their labs or designated space. Upon decommissioning of a lab all records are to be passed on to the RSO for maintenance.

The RSO will report all incidents and events as per the NSCA and any applicable license conditions set by the CNSC. This includes the immediate reporting of events and a detailed written report to CNSC within 21 days of an incident.

The RSO will provide written notification to CNSC at least 90 days prior to the disposal of any documents.

2.3.17 Policy on Posting of Radiation Warning Sign

Radiation warning signs identify areas where radioactive material or radiation emitting devices are used or stored. The use and posting of all types of radioactive warning labels and signs shall be in accordance with the CNSC Radiation Protection Regulations. Accordingly, the Radiation Protection Regulations prohibits the posting of radioactive signs in areas or on equipment where radiation is not present, all such signs and labels must be removed or at a minimum defaced.

The University of Guelph must post and keep posted, at the boundary of and at every point of access to an area, room, vehicle or enclosure, a durable and legible sign that bears the radiation warning symbol set out in Schedule 3 and the words “RAYONNEMENT — DANGER — RADIATION where there is a reasonable probability that a person will be exposed to a dose rate greater than 25μSv/h or the quantity of a nuclear substance that is greater than 100 times its

regulated exemption quantity (EQ). For Basic Level labs postings will be within the designated area/space.

Posting of the 24hr emergency contact information is also mandatory.

2.3.17.1 Policy on labelling of Containers and Devices

No person at the University of Guelph shall possess a container or device that contains a radioactive nuclear substance unless the container or device is labelled with:

1) the radiation warning symbol set out in Schedule 3 and the words "*RAYONNEMENT — DANGER — RADIATION*"; and
2) the name, quantity, date of measurement and form of the nuclear substance in the container or device.

The above policy does not apply to containers and devices if

- it is an essential component for the operation of the nuclear facility at which it is located;
- it is used to hold radioactive nuclear substances for current or immediate use and is under the continuous direct observation of the licensee or PI;
- the quantity of radioactive nuclear substances is less than or equal to the exemption quantity;
- or it is used exclusively for transporting radioactive nuclear substances and labelled in accordance to the CNSC Packaging and Transport of Nuclear Substance Regulations.

2.3.17.2 Policy on Notice of Licensee

(1) 14 (1) Every licensee other than a licensee who is conducting field operations shall post, at the location specified in the licence or, if no location is specified in the licence, in a conspicuous place at the site of the licensed activity,

(a) a copy of the licence, with or without the licence number, and a notice indicating the place where any record referred to in the licence may be consulted; or

(b) a notice containing

(i) the name of the licensee,

(ii) a description of the licensed activity,

(iii) a description of the nuclear substance, nuclear facility or prescribed equipment encompassed by the licence, and

(iv) a statement of the location of the licence and any record referred to in it.

(2) Every licensee who is conducting field operations shall keep a copy of the licence at the place where the field operations are being conducted.

(3) Subsections (1) and (2) do not apply to a licensee in respect of

(a) a licence to import or export a nuclear substance, prescribed equipment or prescribed information;

(b) a licence to transport a nuclear substance; or

(c) a licence to abandon a nuclear substance, a nuclear facility, prescribed equipment or prescribed information.

2.3.18 Policy on Classification of Rooms (for unsealed nuclear substances only)

The use and storage of nuclear substance at the University of Guelph are to be limited to the locations authored in the CNSC license(s). All locations for the use and storage of nuclear substances must be pre-approved by the Radiation Safety Officer (RSO).

The area classification and room design for unsealed nuclear substances are to follow the CNSC Regulatory Document REGDOC-2.5.6,'*Design of Rooms Where Unsealed Nuclear Substances Are Used'.* Rooms used in academic research settings are classified by the CNSC as basic, intermediate, high, or containment-level laboratories, depending on the amount of nuclear substances handled in the room and on the nature of the work performed. All rooms are to be classified as per CNSC's guidelines and license conditions.

2.3.19 Internal Review Policy

The University of Guelph assumes the responsibility of overseeing the safe use of nuclear substances and radiation devices and Class II facilities under its licenses, as per CNSC guidelines and regulations.

Laboratory inspections are a critical component of an effective Radiation Safety Program. Such inspections provide an assessment as to the compliance of laboratory facilities with the required radiation safety policies, procedures and practices.

All basic, intermediate and high level laboratories will be inspected **at least once per year** using the Laboratory Radiation Safety Inspection Checklist. These inspections may either be announced or unannounced. The inspections will include a laboratory visit, and may include interviews with personnel and Principal Investigators, and observation of normal work practices. All incidences of non-compliance will be recorded by the University. Enforcement action will be taken by the University to encourage compliance and prevent ongoing non-compliance in accordance to guidelines set by the CNSC.

Inspection results will be recorded and communicated to the Principal Investigator via email. Overall inspection results will be classified as follows:

A- Exceeds expectations, compliant

B- Meets Requirements, compliant

C- Below Requirements, but low risk

D- Non-compliant, significantly below requirements, a follow-up audit will take place

E- Unacceptable, radioactive work will be stopped immediately

It is the responsibility of the Principal Investigator to communicate inspection findings to authorized workers under the permit and implement corrective actions to non-compliances in a timely manner. Overall inspection results as well as individual inspection reports will be reviewed by the Radiation Safety Committee, who may recommend additional actions on the part of the RSO or the Principal Investigator.

The Radiation Safety Officer has the authority to stop all work and suspend any activity involving the use of radioactive sources or equipment that may pose a threat to the health and safety of an individual or that would violate the University's CNSC licenses or regulatory compliance. Class II facilities will be inspected based on their site-specific procedures.

All University personnel shall give the RSO and CNSC inspector all reasonable assistance to enable the inspector(s) to carry out his/her duties under the NSCA.

2.3.20 Radiation Safety Permit Policy

All applications for permits are reviewed and approved by the Radiation Safety Officer and the Chair of the Radiation Safety Committee. With the exception of any permits that are held by the RSO or the Chair of the RSC, to avoid a conflict of interest, such permits are approved by the Director of Health Safety & Wellness (or delegate) and Chair or Vice-Chair of the Radiation Safety Committee as applicable.

Internal Principal Investigators are responsible for complying with all CNSC regulatory and University requirements as well as permit conditions. The RSO will recommend suspension or cancellation of an internal permit, where a violation of any of the above has occurred to the extent that it is deemed necessary.

The University of Guelph issues internal permits under its consolidated license. The internal Principal Investigator is responsible for fully following all CNSC regulations and U of G policies and procedures are fully followed.

2.3.21 Policy on Incident Reporting

The University of Guelph Incident Reporting system is to be used to notify of any incidents involving radioactive material.

Notify the RSO immediately if:

1) A device containing radioactive material is lost/stolen or damaged or if the source has been removed,

2) Sealed sources or radioactive materials are lost or stolen,
3) A major radioactive spill occurs i.e., greater than 100 exemption quantity (EQ).
4) Contamination of personnel.

It is pertinent to note that the RSO must be notified of all incidents/accidents for investigation as the University may need to notify the CNSC immediately. The University may also have additional requirements for reporting as per CNSC regulations and applicable guidelines. All personnel who becomes aware of the becomes aware of any of the following situations shall immediately inform the RSO and RSO will make a preliminary report to the Commission of the location and circumstances of the situation and of any action that the University of Guelph has taken or proposes to take with respect to it. Please refer to section 2.4.22 on reporting requirements for the CNSC.

2.3.22 Policy on Retention of Records

All records relating to the Radiation Safety Program at the University of Guelph must be maintained for at least 1 year after expiry of the license. Training records are to be maintained for 3 years after termination of employment. Servicing records for devices must be maintained for 3 years after expiry of the license. Furthermore, the dosimetry records must be maintained for 5 years from the day the dose information is collected. The complete list of records and their corresponding retention period can be found at this link.

All records are to be maintained by the University of Guelph. Records should be available for inspection both by the CNSC and the RSO. Records to be maintained by the Permit holders and the RSO office are listed in section 2.4.23.

2.4 PROCEDURES

2.4.1 As Low As Reasonably Achievable (ALARA)

The ALARA Principle acronym for **A**s **L**ow **A**s **R**easonably **A**chievable is used in radiation protection as a commitment to putting forth that every effort is used to keep radiation exposures below the regulated dose limit. The University of Guelph is committed to the concept of maintaining doses ALARA and to take appropriate measures to reduce doses where practical taking into account socioeconomic factors, benefits to public health and current technologies available. The University is committed to maintaining radiation exposures from radioisotopes and radiation emitting devices to students, staff and the general public to ALARA.

1. Each Principal Investigator is expected to design, implement and maintain their internal procedures to reduce exposures of radiation to ALARA.
2. All personnel are expected to practice the ALARA principle in their work practices.

2.4.2 Worker Classification

2.4.2.1 Nuclear Energy Worker (NEW)

At the University of Guelph, only trained workers are authorized to handle nuclear substances, radiation devices or class II prescribed equipment. A person is informed of their NEW status only after they attend a Radiation Safety training conducted by the RSO.

The following must be adhered to by NEWs:

a) Have participated in the Radiation Safety Training conducted through the Environment Health & Safety Department.

b) Fill in and sign the NEW declaration form.

c) Be able to demonstrate safe laboratory handling techniques and be able to understand the hazards and risks associated with the uses of radionuclides.

d) Be able to understand and demonstrate general and specific safety procedures to be followed during the use, storage and disposal of all radioactive materials.

e) Provide EHS with all the necessary information for the issuance of a dosimeter.

2.4.2.2 Nuclear Energy Worker Notification

The University of Guelph as per the CNSC's *General Nuclear Safety and Control Regulations and the Radiation Protection Regulations*, will notify all NEWs in writing of their status as NEWs and maintain their written acknowledgment from each NEW that their risks related to the radiation to which they may be exposed has been received and understood. **Nuclear Energy Workers (NEWs) will be notified once a year in writing of their dose levels via email or letter**.

2.4.3 Worker Training & Authorization

All radiation users (including Principal Investigators) must participate in the University's Radiation Safety training course prior to handling or working with nuclear substances and/or radiation devices.

Radiation users must participate in refresher training ***at least every 3 years. Passing the quiz with a mark of 75% or greater will suffice as having completed the refresher course.***

Radiation user training is provided by the Environment Health & Safety Department at the University of Guelph.

2.4.4 Ascertaining and Recording Doses to Workers

2.4.4.1 Exposure Limits

Organ/Tissue	Nuclear Energy Worker (mSv)	Non-Nuclear Energy Worker (mSv)
Whole Body	20**	1
Extremities	500	50
Skin	500	50
Pregnant Workers	4	1

**NEWs are permitted to receive up to 50 mSv in one year with a dose limit in a five-year dosimetry period of 100 mSv. The average annual dose limit in the 5-year period is 20 mSv.

Source: Radiation Protection Regulations

2.4.4.2 Dosimetry (External Monitoring)

1. All NEWs will be monitored with TLD/OSL monitors from a *CNSC licensed dosimetry service provider*. All exposures must be reported to the RSO. All users need to fill in a Dosimeter application and provide to EHS, prior to commencing radioactive work. Dosimeter applications are available at the EHS administration office.
2. Dosimeters are issued by EHS and dosimeters need to be gathered and returned to EHS in a timely fashion. Please see Appendix-A8 for information needed for issuing a dosimeter.
3. Dosimeters will only be issued upon the completion of radiation safety training.
4. All records of dosimetry are reviewed by the Radiation Safety Officer. Records are maintained at the EHS office.

Badge Monitoring Requirements

Isotope	Whole Body	Ring	Quantity/ Process
Gamma Sources	Yes	No	N/A
P32, Sr89, Y90, Sm153, Re186	Yes	Yes	>50 Mbq
P32, Sr89, Y90, Sm153, Re186	Yes	No	< 50 Mbq

Isotope	Whole Body	Ring	Quantity/ Process
C14, 3H, S35, Ca45, Fe55	No	No	N/A

2.4.4.3 Radioiodine Bioassay

All radioiodine users are required to participate in a bioassay program based on the radioisotope they use, the quantity and their conditions set in the "Internal Permit".

Prior to their appointment, users need to ensure, they first have a baseline assessment conducted prior to working with radioiodine.

Prior to radioiodine use, users are to book in an appointment with Occupational Health & Wellness.

For, proper detection, users need to participate in the bioassay monitoring, between one to five (1-5) days of their handling of radioactive work. All users requiring thyroid bioassay are to plan ahead to ensure, they get their scans done in a timely fashion.

Use of volatile radioiodine such as I-125 or I-131 may occur within research and clinical activities at the University of Guelph as permitted by our Consolidated and Nuclear Medicine licenses issued by the Canadian Nuclear Safety Commission (CNSC). As a condition of our licenses thyroid monitoring is required based on the following criteria,

In general monitoring is required for every person who in any 24-hour period:

a) uses a total quantity of Iodine 124, Iodine-125 or Iodine-131 exceeding:
    i. 2 MBq in an open room;
    ii. 200 MBq in a fume hood;
    iii. 20 000 MBq in a glove box; or
    iv. any approved quantity in any room, area or enclosure authorized in writing by the CNSC shall undergo thyroid screening within a period more than 24 hours after the last use that resulted in any of the above limits being exceeded and less than 5 days after the limit was exceeded.

b) Every person who in any 24-hour period uses a total quantity of Iodine-123 exceeding:
    i. 200 MBq in an open room;
    ii. 20,000 MBq in a fume hood;
    iii. 2,000,000 MBq in a glove box; or
    iv. any approved quantity in any room, area or enclosure authorized in writing by the CNSC shall undergo thyroid screening within a period more than 8 hours after the

last use that resulted in any of the above limits being exceeded and less than 48 hours after the limit was exceeded.

c) Every person who is involved in a spill greater than 2 MBq of Iodine-124, Iodine-125 or Iodine-131 or on whom external contamination is detected, shall undergo thyroid screening within a period more than 24 hours after the spill and less than 5 days after the spill or contamination.

d) Every person who is involved in a spill of greater than 200 MBq of Iodine-123 or on whom external contamination is detected, shall undergo thyroid screening within a period more than 8 hours after the spill and less than 48 hours after the spill or contamination.

2.4.4.4 Results of Bioassay Monitoring

a) A direct measurement of the thyroid with an instrument must be able to detect at least 1 kBq of I-125 or I- 131.

b) If thyroid screening measurement results ≥ 1 kBq and < 10 kBq, the Radiation Safety Officer will follow appropriate steps as per section E 6.2 & E 6.3 of the *REGDOC-2.7.2, Dosimetry, Volume I: Ascertaining Occupational Dose*;

c) If thyroid screening measurement results is > 10 kBq, the Radiation Safety Officer will follow appropriate steps in section E 6.3 of the *REGDOC-2.7.2, Dosimetry, Volume I: Ascertaining Occupational Dose* and immediately inform the CNSC and have a bioassay performed within 24 hours by a person licensed by the CNSC to provide internal dosimetry.

d) Thyroid monitoring procedure and instrumentation details is in Appendix A10.

2.4.5 Action Levels

The University of Guelph sets 'Action levels' as per the '*Radiation Protection Regulations*' such that if reached, may indicate a loss of control of the radiation safety program and may trigger requirements for a specific action to be taken.

Activity	Action Level	Action to be Taken
Personnel Dosimetry (NEW)	2 mSv/yr	Investigate cause of exposure

2.4.6 Control of Radioactive Contamination (Where unsealed materials are used or stored)

Monitoring for surface contamination is a key aspect to the Radiation Safety Program at the University of Guelph. Monthly recoding forms much be used as outlined in Appendix A5.

Facilities that use unsealed nuclear substances are to routinely survey their work areas for contamination at the end of each session to limit exposure. If radioisotopes were not used in a

given week, it must be clearly stated on the recording sheet irrespective of the time delay in-between experimental operations.

Wipe test and contamination monitoring results should all be stored in the 'Radiation Binder' in the lab. All records must be maintained by the Principal Investigator and be readily available in case of an inspection. Upon decommissioning and cancellation of the permit, the contamination records are to be forwarded to the Radiation Safety Officer.

2.4.6.1 Laboratory Radioactive Monitoring Procedures

At the University of Guelph, all Principal Investigators are required to monitor their designated rooms/labs for contamination. Monitoring for surface contamination must be done

1) at least once per week,
2) each time work is completed in a radioisotope area and,
3) immediately after a spill.

It is recommended that contamination is surveyed at the end of each session to limit exposure to personnel and decrease the risk of contamination of non-radiation areas in the workplace. If radioisotopes are not being used, this must be clearly stated in the recording sheet and logged weekly irrespective of the time delay between experiments. Wipe test records and/or surface surveys must correspond with the frequency of use of isotopes logged in the inventory. All records must be maintained in their respective designated labs/rooms in the radiation binder.

2.4.6.2 Measurement of Contamination by Use of Wipe Tests

One of the best ways to monitor and measure removable radioactive surface contamination is by conducting wipe tests, an indirect monitoring technique. This is applicable for radioisotopes with low energy beta or alpha emitters such as **H-3, C-14, S-35**, etc. and for gamma radiation monitoring especially during spills. Before beginning a wipe test, ensure that you have a sketch of your laboratory with the location of the wipe tests marked and numbered (in sequential order).

1. Use absorbent filter paper (~ 5cm) and moisten with alcohol or water. Note that dry wipes can also be used. Swipe approximately 100 cm2 by pressing the filter paper against the surface, normally in an S-shaped pattern. Try to use the center of the paper to contact the surface.
2. Fold the paper and place it in a vial so it can be counted (usually via scintillation).
3. Add scintillation fluid and cap the vial. Using a channel setting that can detect all types of radiation, count between 1 to 2 minutes. Use a wide-open window.
4. Perform the measurement and record it.
5. Repeat the measurement using a blank wipe and record it. This is the background level. You may use this background for all wipes conducted during a given session.

6. The background level is subtracted from your wipe counts to determine the net count for your wipe area.
7. Convert the readings from cpm or cps to Bq/cm^2 and record the results in the University of Guelph monthly recording form in the radiation binder. **Sample calculation and procedure in** Appendix A5.

Decontamination and Spill procedure is outlined in Section 2.4.14 and Appendix 13. For CNSC Poster on Spills and Decontamination Please refer to documents in Appendix 13.

The non-fixed contamination limit at the University of Guelph is 3 Bq/cm^2. However, if you suspect contamination great than 2 Bq/cm^2, please contact the RSO. It is pertinent to note Tc-99m and I-131 users are subject to additional monitoring techniques. Users of Tc-99m and I-131 need to conduct both direct and indirect monitoring methods of contamination. Please consult the RSO if you are going to be working with these isotopes.

The following table outlines the required actions based on the contamination level detected.

Contamination level	**Required Action**
<3 Bq/cm^2	Record the background, the value read and the result in Bq/cm^2 in the monthly U of G recording form.
≥3 Bq/cm^2	Decontaminate and re-wipe the area. Record the results before and after the decontamination including the printout in the radiation binder. Repeat above steps until the contamination is removed. If the contamination cannot be removed, contact the RSO *immediately*, as upon investigation reporting to the *CNSC may be required.*

The following table contains the contamination criteria set by CNSC.

Radionuclides Grouping	**Controlled Areas**	**Public Areas**
Class A (Bq/cm^2)	3	0.3
Class B (Bq/cm^2)	30	3
Class C (Bq/cm^2)	300	30

Appendix 12 provides a table with the classifications of radionuclides as prescribed by the CNSC based on their inherent radiological characteristics.

2.4.6.3 Measurement of Contamination Using a Survey Meter

Portable contamination meters are used for direct monitoring only and are only to be used with certain isotopes. They can detect both removable and fixed contamination on a surface and are effective even at very low contamination levels. However, to be effective these detectors should have sensitivity in accordance with CNSC regulatory guidelines and must be able to detect the specific radionuclide under investigation. These meters are suitable for monitoring for P-32, I131, I-125, among others. However, these meters are ineffective and must not be used when monitoring H-3 or C-14. Meters can be used when background radiation levels are negligible. Therefore, the use of survey meters is only suitable depending on the radioisotope in use. If unsure, please consult with the RSO for assistance with any questions about the suitability of a meter for monitoring purposes in a given laboratory.

All meters must have a valid calibration sticker and should be catalogued with the RSO. Meters are to be calibrated annually. Please check your calibration dates prior to operations. To arrange for a calibration, please contact the RSO. Survey meters detect a very small percentage of what is actually being emitted by a spot of radioactive material.

Steps involved in using contamination meters:

1. Before operation, check battery, power, source response time, high voltage.
2. For your specific meter in use, ensure that you are aware of the minimum detectable activity (MDA), detector efficiency and the initial units that your measuring (whether its cps or cpm). This is needed for making sense of your reading and reporting in Bq/cm^2.
3. Measure the background activity by holding the probe over a clean surface away from monitoring area. Record the result, this is your background activity and may be used for all calculations during this session.
4. Proceed to the work area. Hold the detector/pancake at a distance of approximately 1cm from the surface under investigation.
5. Move the detector slowly, with caution and ensuring that you do not touch the surface.
6. Record the results in the University of Guelph monthly recording form in the radiation binder.
7. **Sample calculation and procedure in Appendix 5.**

2.4.6.4 Detector Efficiency

The Detector Efficiency (DE) of the probe can be calculated as:

$$Detector\ Efficiency\ (DE) = \frac{Detector\ Count\ rate - Background\ count\ rate}{Known\ activity\ of\ standard\ source}$$

Alternate format: Detector efficiency (DE) = (Detector count rate – Background count rate) ÷ (Known activity of standard source)

When determining the detector efficiency, ensure that the probe is directly over the standard with the active side up (~ 1cm) in a clean flat surface which is free from contamination.

When using the direct method for contamination verification, if the DE isn't known, the CNSC accepts that measurements below background indicate no contamination. All results above background must be decontaminated and verified using the indirect method.

Detector Efficiencies for each isotope will be provided upon calibration (yearly) of the meters. However, if the isotope you are using is extremely short-lived and the energy range does not match with isotopes provided in the calibration certificates, please consult the RSO, usage of wipes may be ideal in such cases.

The non-fixed contamination limit at the University of Guelph is 3Bq/cm^2. However, if you suspect contamination great than 2Bq/cm^2, please contact the RSO.

The following table outlines the required actions based on the contamination level detected.

Contamination level	Required Action
<3 Bq/cm^2	Record the background, the value read and the result in Bq/cm^2 in the monthly U of G recording form.
>3 Bq/cm^2	Decontaminate and re-wipe the area. Record the results before and after the decontamination including the printout in the radiation binder. Repeat above steps until the contamination is removed. If the contamination cannot be removed, contact the RSO *immediately*, as upon investigation reporting to the *CNSC may be required.*

2.4.7 Radiation-Detection Instrument

All radiation detection instruments at the University of Guelph must be approved prior to its purchase. All meters must have a valid calibration sticker and should be catalogued with the RSO office. Meters are to be calibrated annually. To arrange for a calibration, please contact the RSO.

a) All radiation monitoring instruments (portable and non-portable) must be registered with the Radiation Safety Officer.

b) Principal Investigators must ensure they have a properly functioning radiation monitoring instrument.

c) Non-functioning meters should be removed from service immediately.

d) A properly functioning portable contamination meter shall always be available to workers at the site of the licensed activity.

e) No personnel should use a radiation survey meter that has not been calibrated within the 12 months preceding its use.

f) If Liquid Scintillation counters are used, it is the Principal Investigator's responsibility to ensure they are being maintained and calibrated as per the manufacturer guidelines by an authorized service provider.

Pre-Operational checks:

a) Before operation, check battery, power, source response time, high voltage.

b) Please check your calibration dates prior to operations.

c) For your specific meter in use, ensure that you are aware of the minimum detectable activity (MDA), detector efficiency and the initial units that your measuring (whether its cps or cpm). This is needed for making sense of your reading and reporting in Bq/cm^2.

d) Measure the background activity by holding the probe over a clean surface away from monitoring area. Record the result, this is your background activity and may be used for all calculations during this session.

e) Record the results in the University of Guelph monthly recording form in the radiation binder.

Sample calculation and procedure in Appendix 5.

2.4.8 Leak Testing for Sealed Sources

Leak testing is mandatory for sealed sources that have an activity **>50mBq** as per CNSC's 'Nuclear Substance and Radiation Devices Regulations'. Leak testing is to be done as follows and is **completed by the RSO**:

- Every 6 months if the source is in use and not in a device
- Every 12 months if it is in a device
- Every 24 months if it is in storage
- Immediately after an event that may have damaged the source.
- Sealed sources that return for use, after having been stored for 12 or more consecutive months
- Leak tests are not required where the sealed source contains a gaseous nuclear substance or if it is contained in a static eliminator.

In case of leakage **> 200 Bq**, the use of the source must cease **immediately**. The RSO must be notified immediately and measures should be taken to limit the spread of contamination. Subsequently the RSO must notify the CNSC **immediately** that a leakage has been detected.

2.4.9 Access Control and Security

All nuclear substances and radiation devices are to be used by '*Principal Investigators'* or authorized radiation users only.

a) Access is to be controlled from the time of acquisition until transfer or disposal.

b) When sources are not in use or not under the direct supervision and control of an authorized worker, nuclear substances and radiation devices should be in a locked area, room or enclosure.

c) Users of sealed sources should contact the RSO for further instructions on how to safely store their sources. There is a strict policy for the tracking of sealed sources at the University of Guelph.

d) The internal Principal Investigator is responsible for ensuring that all CNSC regulations and U of G policies and procedures are fully followed with respect to access control and security.

In case of loss, theft or unauthorized use of nuclear substance or radiation device, the Radiation Safety Officer (RSO) must be notified immediately. Campus Police should be contacted via **x 2000** after hours. **The RSO must notify the CNSC immediately**.

2.4.10 Receipt of Packages

Receipt of radioactive packages and radiation devices should be in accordance to the CNSC's *Guidelines for Handling Packages Containing Nuclear Substances*, CNSC's *Nuclear Substance and Radiation Devices Regulations* and Transport Canada's *Transportation of Dangerous Goods Regulations*.

- Radioactive nuclear substance shipments entering the campus may only be delivered to buildings that have been authorized by the CNSC, as per the license issued to the University.
- Shipping documents and purchase order numbers should be verified and a visual inspection of the package for damage/tampering should be conducted by the person receiving the shipment.
- The Principal Investigator or their designate is to be contacted immediately by phone/e-mail upon receipt of shipments for buildings that have central receiving.
- Shipments must be picked up by the Principal Investigator or an authorized user under their permit.
- Each shipment is to be thoroughly checked prior to bringing into the designated lab.
- Personnel picking up the shipment must have TDG training and must be pre-authorized by the Radiation Safety Officer.
- Radioactive packages must be taken on an uninterrupted route, directly to the approved nuclear substance room.
- Shipments must be inspected as soon as possible upon arrival in the nuclear substance room using the guidance of CNSC poster INFO-0744 "Guidelines for Handling Packages Containing Nuclear Substances". See Appendix 13.
- The Inventory Form must be kept up to date in the Radiation Record Binder.
- **A copy of the receipt along with the unique requisition number is to be forwarded to the RSO**.

Any anomalies (contamination, leakage, incorrect shipment) are to be reported to the Principal Investigator/Supervisor and Radiation Safety Officer immediately.

2.4.11 Packaging and Transport of Nuclear Substances and Radiation Devices

The regulatory requirements for the packaging and transport of nuclear substances and radiation devices in Canada are specified in the CNSC's *Packaging and Transport of Nuclear Substances Regulations, 2015* and *Transport Canada's Transportation of Dangerous Goods Regulations.*

The University may be asked to demonstrate compliance with *the Packaging and Transport of Nuclear Substances Regulations, 2015* and the *Transportation of Dangerous Goods Regulations* by implementing and maintaining approved procedures. The procedures have to be consistent with the type of packaging and transport activities undertaken. Consideration should address the hazards inherent in the transportation of the radioactive materials, the quantities of materials, the types of packages and the number of shipments. Procedures for the transport and packaging of radioactive material must include:

- package preparation and shipment,
- marking, labelling and placarding,
- transport documents,
- instructions for carriers,
- measures to be employed in controlling radiation exposures during transport and packaging operations, shipment notifications and confirmations,
- carriage, stowage, segregation, and storage in transit,
- receipt of packages,
- if applicable undeliverable consignments,
- packaging inspection and maintenance,
- training and certification of workers.

The University of Guelph is required to maintain current records, for all radioactive material prepared in a Type A, or similar package. If the University or a Principal Investigator packages radioactive material in a package of a certified design (e.g., Type B package or package for fissile material), the University, through the RSO must register and receive confirmation of this registration from the CNSC before using the package.

Please Notify RSO of any radioactive transfers. For anyone who transfers a radiation device, the University/PI shall provide the transferee with the instructions referred to in the radiation device certificate for dealing with accidents, including fires and spills.

For anyone who transfers a sealed source or a nuclear substance as shielding shall provide the transferee with a record of the most recent leak test conducted in accordance with section 18 of the NSRD.

2.4.11.1 Transfer to other Licensees/Institutions

Without written notice and approval from the Radiation Safety Officer, no nuclear substance(s) or radiation device(s) may be transferred to an institution or person outside the University.

To obtain approval for transfer:

- Contact the Radiation Safety Officer for permission to transfer any radioactive material or radiation device.
- Provide the name, address, and CNSC License Number of the receiver.
- When approved for transfer the consignor must ensure that the goods are properly classified, packaged, labeled and documented according to Transport Canada, CNSC, and International Regulations, before they are shipped.

Prior to the export or transfer of any Nuclear Substance and Radiation Devices (NSRD), please contact and coordinate with the RSO. Approval and an export permit may be required from the Directorate of Security and Safeguards of the Canadian Nuclear Safety Commission. Items to be exported must be indicated as a licensed activity in our license. A minimum of 3-5 weeks is required for processing the application.

The external surfaces of approved packages containing radioactive materials must be monitored for non-fixed contamination and/or leakage and under routine conditions of transport, shall not exceed the following limits:

- 4 Bq/cm^2 for beta and gamma emitters and low toxicity gamma emitters,
- 0.4 Bq/cm^2 for all other alpha emitters.

Contamination and leakage monitoring can be performed by trained personnel holding a valid TDG7 certification or the RSO.

2.4.11.2 Transfer within the University of Guelph

All transfer of nuclear substance and radiation devices requires approval from the Radiation Safety Officer.

- Prior to transfer contact the Radiation Safety officer. The Radiation Safety Officer will verify that the "Borrower" is authorized to use the radioisotope and the quantity that is being requested.
- Radioisotope or Radiation Device can only be transferred to a Principal Investigator.
- Record the quantity, the name of the person "borrowing" and their Permit Number on your Inventory Record Form.
- Provide a new Inventory Record Form for the "borrower" and ensure the borrowed sample has all pertinent information such isotope, quantity, date of transfer, etc.

- The "borrower" must complete the new Inventory Record Form for their use and disposal of the borrowed nuclear substance. All inventory records must be retained in the Radiation Record Binder and available upon request.

2.4.12 Procedures on Controlling Possession of Nuclear Substances

2.4.12.1 Purchasing

1) All purchases of nuclear substances and radiation devices must go through the iProcurement Online Requisition System, using the University's Purchasing Department procedure for a High Value Purchase Order.
2) All radioactive material, regardless of dollar value, **must** be purchased with High Value Purchase Order (HVPO). Low Value Purchase Order (LVPO) or Procurement Cards must not be used for radioactive material purchases.
3) Requisitions for radioactive material will be routed to Environmental Health and Safety Department for approval by the RSO **prior** to being processed by Purchasing Services.
4) All purchases need RSO approval.
5) The category code for radioactive material on purchase requisitions is **RAD.SUPP**. Any requisitions for radioactive material that's not using this category code will be returned.
6) Purchase requisition must identify with name of Principal Investigator, Permit Number, Isotope Type, name and quantity of nuclear substance.
7) Each Principal Investigator is responsible for keeping their purchasing receipts in their 'Radiation Binder' in their respective labs.
8) All purchases must be documented and traceable via the U of G Inventory Record Form.
9) Regular, frequent purchases of a similar nature may be completed using the blanket order system with **special approval** of the RSO.
10) Copies of all purchasing receipts must be sent to the RSO and a copy of it must be maintained in the 'Radiation Binder'.

2.4.12.2 Inventory of Nuclear Substance

Current inventories of nuclear substances and radiation devices whether in use, or in storage, or material that is awaiting disposal must be maintained at the University. Current records need to be maintained in the areas where the nuclear substance and radiation devices are used or stored via the **Inventory Record Form**.

1) The **Inventory Record Form** needs to be maintained by all Principal Investigators on a regular basis.
2) It is the responsibility of the Principal Investigator to maintain accurate and current inventory records including, the name, quantity, form, location, and supplier's information.

3) **Fridges** if in use, should also have active inventory records. Principal Investigators are also responsible for maintaining transfer and disposal records of all nuclear substance and radiation devices.

4) All Principal Investigators must provide a written summary of all their radioisotope purchases, current year-end inventory and waste disposal data for the previous year. This information is essential for preparing the University of Guelph's Annual Compliance Report to the CNSC.

5) All inventory records must be maintained until decommissioning upon which all records will be passed on to the RSO. Please check Appendix 6 & 7 for inventory record form and fridge inventory record form.

2.4.12.3 Storage of Nuclear Substances

A radionuclide storage area or container is defined as an area within a licensed facility that provides appropriate shielding, ventilation and security for the materials. The area may be constructed with lead as necessary, in a plexiglass box, refrigerator, cupboard, or a fume hood. Access is restricted to only those authorized by the Principal Investigator and persons on the permit.

All storage areas or containers must be stored securely, away from public areas. The dose rate at any occupied location outside the storage area, room or enclosure resulting from the substances or devices is not to exceed 2.5 uSv/hr (0.25 mR/hr).

Sealed or opened source storage areas are to be surveyed once a year with results posted. If there are any occupied areas adjacent to the long-term storage location, they are to be monitored by area monitors or dosimeters on a regular basis.

The RSO or principal investigator may change or modify the storage configuration, the storage unit construction, inventory. Changes in the distances of the occupied location and changes in the occupancy of adjacent areas will be assessed upon monitoring results or dose estimations performed by the RSO, while maintaining exposure rate according to ALARA.

Records of all monitoring will be maintained by the RSO.

All radionuclides (stock, aliquots, products, waste, etc.) must be stored in approved containers within approved areas/laboratories All approved containers must be labeled with the date, type and quantity of radionuclide.

The University of Guelph requires special provisions for storing **sealed/open sources**. If you would like provisions for storing sealed sources, please contact the Radiation Safety Officer. For storing waste please refer to section on procedures for storing waste. If you would like to go on dormancy and would like to store your sources temporarily, please contact the RSO for guidelines.

2.4.12.4 License to Service Radiation Device & Prescribed Equipment

The Principal Investigator must ensure that a company or a person who performs any maintenance of a device, including installation, repair or dismantling other than routine operating procedures as indicated in the manufacturer's operating manual for the device shall have a valid CNSC license to service the device.

Please contact the Radiation Safety Officer if you have any questions about the CNSC servicing license.

2.4.13 Management of Radioactive Wastes

2.4.13.1 Radioactive Waste Disposal

All radioactive waste disposals must be managed and handled as per the CNSC's *Nuclear Substances and Radiation Devices Regulations*. Sealed Sources cannot be disposed without the approval of the RSO. For open sources, authorized users and Principal Investigators should use the U of G disposal forms as provided by the Environmental Health & Safety (EHS) Department.

Radioactive waste is picked up from the lab during regularly scheduled pick-ups coordinated through EHS.

All waste must be securely stored within the lab in which it was generated. Different isotopes are to be kept separate if possible. Radioactive waste is to be separated from other waste streams.

Radioactive waste containers including boxes, pails, bags and jugs are provided by EHS.

To initiate removal of waste from your lab or workspace:

1. Complete radioactive hazardous waste disposal tag and attach to waste containers.
2. Wipe tests of the outer surfaces of the waste containers are to be conducted.
3. Complete "Request for Radioactive Waste Disposal" form which includes the following information:
    a. contact name, phone number/email, signature, permit number;
    b. building number, room number, date waste location;
    c. radionuclide, scheduled quantity, total activity, activity concentration;
    d. chemical composition (no abbreviations permitted);
    e. tag number;
4. Please ensure the radiation-warning symbol in your tag is visible, the name, quantity, date of measurement and form of the nuclear substance in the container or device is clearly listed in the tag. The tag must include the wording 'Rayonnement-Danger-Radiation';
5. Submit the completed form online and retain a copy of the form for your records. The completed forms are to be kept in the radiation safety binder.

If the waste cannot be removed (e.g., incomplete information, no tag, improper/defective packaging, inaccessible location etc.), the waste will be rejected for pick-up and the contact person will be made aware of the problem.

Radioactive waste is segregated accordingly to half-lives at the university of Guelph. Based on the isotope's half-life we segregate the nuclear substance in our storage facility. Depending upon certain isotope's half-life such as Tc-99m, they can be thrown as part of the normal waste stream. Please check this with the RSO. **If extremely short-lived isotopes are to be disposed of in the normal waste stream their residual activity should be measured and recorded in the binder prior to disposal. Please check with the RSO.**

After recording the residual activity if short-lived waste is disposed of, all the labels are to be removed or defaced and the residual activity needs to be recorded prior to disposal.

Other long-lived radionuclides are segregated by their half-life at the CMC (Chemical Management Centre) and are disposed of according to the RSO. Long-lived radionuclides such as C-14 and H-3 are transferred to specialized licensed waste contractors. Other shorter-lived isotopes are stored for a **minimum 10 half-lives**, prior to disposal.

All residual activity is to be recorded electronically in the waste spreadsheet file prior to any disposal. Please contact RSO at radsafe@uoguelph.ca for any questions.

2.4.13.1.1 Liquid Scintillation Vials

Liquid scintillation vials using different scintillation fluids are to be kept separated. Vials containing the same scintillation fluid are to be collected in clear plastic bags in appropriate plastic pails. Vials must remain capped with caps securely fastened to prevent leakage.

Any individual vials with an activity of greater than 10,000 cpm must be separated and collected as liquid radioactive waste.

2.4.13.1.2 Liquid Radioactive Waste

Aqueous solutions containing radioactivity are to be collected in radioactive waste jugs containing material that will solidify the waste. Solutions containing different isotopes are to be collected in different jugs to assist in final disposal.

Organic based solutions containing radioactivity are to be collected separately with solutions containing different isotopes kept separately if possible. These solutions cannot be solidified.

No liquid containing radioactive materials is to be discharged to the laboratory sanitary sewer without prior approval by the RSO. Only the RSO may authorize discharge of certain radioisotopes, if significantly below clearance levels. Such approval must be documented with documentation maintained and details of any authorized discharge must be recorded in the Radiation Safety Binder.

2.4.13.1.3 Solid Radioactive Waste

Solid radioactive waste is to be transferred to clear plastic bags for disposal. Bags with H-3, C-14, S-35, P-32, or P-33 wastes are to be maintained separately in provided cardboard boxes. Bags with I-125 wastes are to be maintained in provided metal pails. Please notify the RSO prior to any transfers.

2.4.13.1.4 Radioactive Stock Shipment Vials

All radioactive stock shipment vials with residual activity must be collected and disposed as solid radioactive waste. Radioactive warning signs are to be defaced or destroyed prior to collection. Radioactive materials may be received in lead or lead-lined containers. Any lead is to be disposed of via the University's hazardous waste program.

2.4.13.1.5 Radioactive sharps (needles and syringes)

Sharps used to dispense radioactive materials must be disposed in approved sharps containers with and can then be disposed of as solid radioactive waste.

2.4.13.1.6 Mixed Biological/Radioactive Contaminated Waste

The biological hazard is to be treated first normally via chemical treatment methods. Mixed biological/radioactive wastes are not to be autoclaved. After the biological hazard is inactivated, the waste is to be disposed of as radioactive waste. For additional information, please contact the Radiation Safety Officer.

2.4.13.1.7 Radioactive Animal Carcasses and Tissues

Radioactive animal carcasses and tissues are to be kept frozen and held until adequately decayed prior to caustic digestion or incineration via an appropriate biohazardous waste contract. The Principal Investigator is responsible for providing adequate freezer space during this decay period. Caustic digestion or incineration may occur once the activity is decayed to background or below CNSC regulatory limits for solid waste.

Animal carcasses contaminated with isotopes with long half-lives (e.g. H-3, C-14) may require off-site disposal through an authorized radioactive waste contractor. All costs associated with such disposal are the responsibility of the Principal Investigator.

2.4.13.1.8 Sealed Sources

Seal Sources cannot be disposed of by the Principal Investigator directly. The Radiation Safety Officer must be contacted prior to disposal of all sealed sources and radiation devices containing sealed sources. Sealed sources above EQ are normally transferred to Canadian Nuclear Laboratories for disposal.

2.4.13.1.9 Smoke Detectors

Smoke detectors may contain a small radioactive source. Disposal procedures will depend on the activity level of the source(s) and number of detectors.

2.4.13.1.10 Portable Gauges

Please refer to Appendix 13 for information on Portable gauges or devices. Please refer to CNSC document "*Responding to Accidents Involving Portable Gauges*".

2.4.13.1.11 Storage of Radioactive Waste for Delay Decay

Radioactive wastes that can be delay decayed are to be securely stored within the lab/workspace in which it was generated prior to the transferring to the Chemical Management Centre (CMC).

Upon removal from the lab, solid and liquid radioactive waste is normally transferred to the Chemical Management Centre for:

- Storage for a sufficient period to allow the activity to decay to background or below CNSC regulatory limits for solid waste.
- Storage pending removal by an appropriate hazardous waste contractor.

2.4.13.1.12 Transfer of Nuclear Substances (for renewals)

It is the sole responsibility of the Principal Investigator to notify the RSO of any transfers and non-deliverable items that are returned to suppliers. Please notify the RSO prior to any transfers.

2.4.14 Emergency Procedures

2.4.14.1 Spills

The RSO must be informed immediately of any accident or emergency related to nuclear substances, radioactive devices including the Class II Facilities (OVC-Clinac & Physics Pelletron).

Minor Spills

Typically, less than 100 exemption quantities of a nuclear substance. Report the spill to the Principal Investigator immediately or person in charge and, if necessary, to the Radiation Safety Officer.

Major spill procedures should be implemented whenever minor spill procedures would be inadequate

1) Wearing protective clothing and disposable gloves clean up the spill using absorbent paper and place it in a plastic bag for transfer to a labelled waste container.
2) Avoid spreading contamination. Work from the outside of the spill towards the centre.

3) Wipe test or survey for residual contamination as appropriate. Repeat decontamination, if necessary, until contamination monitoring results meet the Nuclear Substances and Radiation Devices licence criteria.
4) Check hands, clothing, and shoes for contamination.
5) Report the spill and cleanup to the person in charge and, if necessary, to the Radiation Safety Officer.
6) Record spill details and contamination monitoring results. Adjust inventory and waste records appropriately.

Major Spills

Major spills involve more than 100 exemption quantity for isotopes listed in Schedule 1 of NSRDR or any quantity of an isotope not listed in Schedule 1, or contamination of personnel, or release of volatile material. Notify the Principal Investigator or person in charge and the Radiation Safety Officer.

1) Clear the area. Persons not involved in the spill are required to leave the immediate area. Limit the movement of all personnel who may be contaminated until they are monitored.
2) If the spill occurs in a laboratory, leave the fume hood running to minimize the release of volatile nuclear substances to adjacent rooms and hallways.
3) Close off and secure the spill area to prevent entry. Post warning sign(s).
4) Notify the Radiation Safety Officer or person in charge immediately.
5) The Radiation Safety Officer or person in charge will direct personnel decontamination and will decide about decay or cleanup operations.
6) In general, decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and mild soap.
7) Follow the procedures for minor spills (if appropriate).
8) Record the names of all persons involved in the spill. Note the details of any personal contamination.
9) The Radiation Safety Officer or person in charge will arrange for any necessary bioassay measurements.
10) If required, submit a written report to the Radiation Safety Officer or person in charge.
11) The Radiation Safety Officer or person in charge must notify the CNSC immediately and submit a full report within 21 day.
12) All reportable events must be reported to the CNSC duty officer at 1-844-879-0805 (toll-free, 24/7).

In the event that damage to a sealed source and /or the spillage of an open source isotope has occurred, the Internal Principal Investigator is responsible for taking immediate action to contain the radiation and mitigate the risk to personnel. This includes decontamination of personnel and equipment and where necessary the evacuation of personnel from the affected area.

After hours – Contact Campus Police x 2000.

Only those authorized through the internal permitting process are permitted to possess nuclear substances. All incidents and/ or injuries including as noted above accidents and emergencies will be reported in accordance with the University of Guelph Incident & Injury Reporting Process. All such occurrences shall be reviewed by the RSO and investigated as necessary.

As per license conditions the RSO will inform the **CNSC of incidents and/or injuries**. The RSO will ensure that all regulatory requirements for reports and timelines for reporting are met.

2.4.14.2 Personal Contamination

Under normal circumstances, contamination checks are made using a contamination meter. A proper scan should take approximately five minutes per person.

A reading on a contamination meter that is twice the background level indicates that a person is contaminated. All contaminated clothing must be removed, bagged and tagged. In the event that the number of individuals to be checked overwhelms all available resources, the decontamination process will need to be accelerated. The following process is recommended:

1) **Is the Individual Grossly Contaminated?**
    - With a contamination meter, check hands and feet thoroughly and then perform a 10 to15-second check over the rest of the person. A contamination meter reading that is in excess of ten times the background level (or, if no contamination meter is available, a gamma dose rate meter reading greater than 0.5 μSv/h) is an indication of gross contamination.
    - Note: The Radiation Safety Officer must be contacted, and a gamma dose rate meter is only to be used for decontamination monitoring as a last resort.
    - If GROSSLY CONTAMINATED: remove contaminated clothing.
    - If NOT: the individual may exit the decontamination zone.
2) **Is the individual still contaminated after removing contaminated clothing?**
    - Check skin with a contamination meter as described above.
    - If YES (over a large area): clean the contaminated area thoroughly, controlling runoff water.
    - If YES (over a small area): wipe with a damp cloth or wet wipes taking care not to irritate skin.

- If NO: the individual may exit the decontamination zone.

3) **Is the skin contamination persisting after washing?**
    - Check skin with a contamination meter as described above. Any readings that are above twice the background level indicate contamination. Readings greater than 10 times the background level should be checked with a gamma dose rate meter. A gamma dose rate reading greater than 100 µSv/h 10 cm from the skin could indicate the presence of a highly radioactive particle.
4) This area should be covered with whatever is available and noted. Prompt medical treatment to remove the radioactive particle should be sought. Any information available concerning the radionuclide should also be noted and relayed to the Radiation Safety Officer and medical staff.
    - If YES (over a large area): possible internal contamination.
    - If YES (over a small area): areas should be noted and covered if possible.
    - If NO: the individual may exit the decontamination zone.

All decontamination efforts after an accident/incident will be done in accordance with the RSO. If members of the public or non-nuclear energy workers are to be exposed of a dose greater than 1 mSv/yr. The incident must be reported immediately to the RSO, who will then upon investigation immediately notify the CNSC. Best efforts are made to ensure that members of the public do not receive a dose greater than 1 mSv per year. However, in addition workers who are not radiation workers should also not receive a dose greater than 1 mSv. If a general worker receives a dose greater than 1mSv in a year, the RSO must be notified immediately. All untrained workers are to be removed from any situation that could potentially increase their personal dose, especially non-NEWs.

2.4.14.3 Personal Overexposure

When the RSO becomes aware that a dose of radiation received by and committed to a person or an organ or tissue may have exceeded an applicable dose limit as described in section 2.4.4.1 of the Radiation Safety Manual, the RSO shall:

1) immediately notify the person and the CNSC of the dose;
2) require the person to leave any work that is likely to add to the dose if the person may have or has received a dose that exceeds a dose limit for a nuclear energy worker;
3) conduct an investigation to determine the magnitude of the dose and to establish the causes of the exposure;
4) identify and take any action required to prevent the occurrence of a similar incident; and
5) within 21 days after becoming aware that the dose limit has been exceeded, report to the CNSC the results of the investigation or on the progress that has been made in conducting the investigation.

2.4.14.4 Incident/Accident Involving Fire, Release of Airborne Contamination or Leakage of Sealed Sources

1) Contact the RSO immediately or Campus Police at extension 2000.
2) Notify people in the surrounding area immediately.
3) Stop the release of radioactivity material from the source to the environment if possible.
4) Isolate the area if possible and feasible. Close all the lab doors, windows, shut off fans, air conditioners, and any air outlets to other areas. Open fume hoods to the maximum.
5) Prevent further personnel access to area by closing and locking doors. Emergency personnel responding to the scene should be advised that radioactive materials may be present.
6) Monitor all persons who may be contaminated and determine which persons may have been exposed to internal/external radiation and to what extent.
7) Perform simple decontamination and contact the RSO.
8) The Internal Permit Holder must file an incident report and work with the RSO to complete and internal investigation.
9) If an exposure may have occurred that is in excess of applicable radiation dose limits, the CNSC shall be notified immediately as required by the *Radiation Protection Regulations.*

2.4.14.5 Skin Contamination

The Radiation Safety Officer and all Internal Permit Holders are required to document, record and investigate every skin contamination event to ensure work practices are optimized and to minimize the probability of repeat occurrences. Every skin contamination is to be reported to the RSO immediately or Campus Police after normal working hours.

Response to skin contamination events can be divided into three parts:

1) Phase 1 – Measuring the contamination and decontaminating the skin.
2) Phase 2 – Calculating the skin dose.
3) Phase 3 – Reporting to the CNSC, if necessary

Reporting skin contamination events to the CNSC is only required for the following circumstances:

1) If a nuclear energy worker (NEW) was calculated to have received an extremity (skin) dose above 50 mSv.
2) If a Non-NEW was calculated to have received an extremity (skin) dose above 5 mSv.

CNSC's, Director of Nuclear Substance Regulation (DNSR) article in Appendix 11 outlines the steps to be taken in the event of skin contamination. The flow diagrams and appendices in the appendix provide step-by-step instructions on how to respond to skin contamination events.

2.4.15 Decommissioning of Laboratories

Release of spaces may occur in conjunction with the termination of a permit, deletion of a location from a permit, pending renovations, etc. Decommissioning includes, but is not limited, to all of the following actions, as applicable to the particular Principal Investigator's operations:

1. Appropriate disposal of nuclear substances or radiation devices or their movement to an approved site;
2. Removal of all radioactive warning signs and labels;
3. The monitoring of all areas and decontamination actions to meet the prescribed limit(s) for decommissioning [see below];
4. Completion of a Decommissioning Report by the Principal Investigator and approval by the RSO;
5. The update of all records to reflect the change in area/room and Principal Investigator status by the RSO;
6. The transfer of records associated with NSRD use, including decommissioning, to the RSO for retention.

CNSC Contamination Criteria for Decommissioning

Classification	Non-fixed Contamination Limit (averaged over an area not to exceed 100 cm^2)
Class A	0.3 Bq/cm^2
Class B	3.0 Bq/cm^2
Class C	30 Bq/cm^2

Classification of radionuclides is found in the Radioactive Contamination Monitoring Policy.

2.4.16 Records and Reporting System

All incidents and events need to be reported as per the NSCA and any applicable license conditions set by the CNSC. This includes the immediate reporting of events and a detailed written report to CNSC within 21 days of an incident. The University of Guelph will provide written notification to CNSC at least 90 days prior to the disposal of any documents. For license specific requirements please check license specific procedures.

2.4.17 Posting of Radiation Warning Sign

The use and posting of all types of radioactive warning labels and signs shall be in accordance with the CNSC Radiation Protection Regulations (sections 20, 21, 22, 23). Accordingly, section 23 of the Radiation Protection Regulations prohibits the posting of radioactive signs in areas or on equipment where radiation is not present, all such signs and labels must be removed or at a minimum defaced.

The University of Guelph requires the posting of a durable and legible radiation warning sign at every access point where there is a reasonable probability that a person will be exposed to a dose rate greater than 25 µSv/h or the quantity of a nuclear substance that is greater than 100 times its regulated exemption quantity (EQ). Posting of the 24hr emergency contact information is also mandatory.

2.4.17.1 General Posting

All approved designated nuclear substance rooms must be posted with an approved Radiation Warning Sign or in any area where the activity may exceed 100 EQ or exposure may exceed 25 µSv/h or as required by the Radiation Safety Officer. CNSC posters need to be placed in each lab, especially the designated poster i.e., Basic Level L ab (BLL), Intermediate Level Lab (ILL) and High-Level Lab (HLL). For copies of the poster, please see Appendix 13.

Signs and labels must follow these general guidelines:

Location	Type of Posting
All points of entry to a designated nuclear substance room including radioactive storage room	Radiation Warning Sign with Principal Investigator name and office phone number, RSO office phone number, and Guelph Campus Police 24-hour contact number. For Basic level laboratories, the sign is to be posted within the room.
Work area/bench/equipment	Radiation Warning Sign or radiation yellow tape identifying the workstation.
Inside a designated nuclear substance room, in a prominent location	Copy of the Internal Permit, CNSC safety poster which corresponds to the room classification, CNSC spill procedures poster, CNSC guidelines for handling packages containing nuclear substances
Specific storage location inside a designated nuclear substance room (i.e. fridge, freezer)	Radiation Warning Sign

2.4.17.2 Frivolous Posting

Radioactive warning signs must not be used frivolously and in a place where there is no radiation or nuclear substance present. Labs that are under dormancy status must also ensure that warning signs appear only where radiation or nuclear substances are stored. All permit postings must either be covered or be removed.

2.4.18 Classification of rooms (for unsealed nuclear substances only)

The area classification and room design for unsealed nuclear substances must follow the CNSC Regulatory Document REGDOC-2.5.6, 'Design of Rooms Where Unsealed Nuclear Substances Are Used.'. All locations for the use and store of nuclear substances must be pre-approved by the Radiation Safety Officer, identified and listed on the radiation permit. The area classification and room design for unsealed nuclear substances must follow the CNSC's radioisotope laboratory classification. See Appendix 13 for posters and more information. Intermediate Level Rooms and High Level Rooms require special permission from the CNSC. Please contact the RSO if unsure or you require more information.

Prior to making any changes to an Intermediate Level Lab (ILL) or higher please contact the Radiation Safety Officer (RSO) as the CNSC has to be notified. A submission of a design assessment form must be forwarded to the CNSC for approval by the RSO in order for changes to take place.

2.4.19 Internal Compliance/Laboratory Inspection

The University of Guelph assumes the responsibility of ensuring the safe use of nuclear substances and radiation devices on campus, as per CNSC guidelines and regulations. All University personnel shall give the RSO and CNSC inspector all reasonable assistance to enable the inspector(s) to carry out his/her duties under the NSCA.

Each Lab is audited **once per year**, as per the Laboratory Inspection Sheet as in Appendix 2. An inspection can be announced or un-announced. In an announced inspection, the checklist will be given to each Principal Investigator for completion and the RSO will perform the inspection after that. Any non-compliance items will be discussed and communicated with the Principal Investigator for corrective actions. All results will be communicated to the Principal Investigator.

2.4.20 General Guidelines for Handling Radioactive Materials

The most common way to minimized external exposures:

- Reducing the **TIME** of exposure
- Increasing the **DISTANCE**, from the source
- And by using correct **SHIELDING** materials, wherever possible.

The best way to minimize internal exposures:

- Prevent **INGESTION**, **INHALATION**, and **ABSORPTION** through the skin.
- Avoid Eating, drinking or smoking is strictly prohibited in areas where nuclear substances are used or stored at all times.
- Never pipette radioactive solutions orally.
- Use volatile nuclear substances in an approved ventilated area such as a non-recirculating fume hood.
- Wear PPE to prevent exposure through skin.
- Wear lab coats in radiation work areas.
- Sandals and open-toed shoes are not to be permitted when handling nuclear substances.
- Handling open sources in excess of 10 ALI (Annual Limit on Intake) must be done under a fume hood where feasible.

2.4.21 Radiation Safety Permit

2.4.21.1 New Permit

- Before a new permit is issued all applications are reviewed and approved by the Radiation Safety Officer and the Chair of the Radiation Safety Committee.

- A permit is issued to each Principal Investigator upon approval as per Appendix 1.
- To avoid a conflict of interest any permits that are held by the RSO, are approved by the Director of Health Safety & Wellness (or delegate) and the Chair of the Radiation Safety Committee.

Internal Principal Investigators are responsible for ensuring compliance to all CNSC regulatory and University requirements as well as permit conditions. Where a violation of any of the above has occurred the RSO will recommend suspension, cancellation or disciplinary action on any internal permit.

Written authorization must be obtained from the CNSC prior to issuing any internal authorization permit for any work requiring the use of more than 10,000 exemption quantities of a nuclear substance at a single time. Permit holders and researchers must contact the RSO prior to conducting such work as written approval is needed from the CNSC. Please plan in advance prior to conducting such work as the project also need approval from the Radiation Safety Committee.

Please refer to the Appendix 1 for information required and needed on the permit.

2.4.21.2 Amendments

The Radiation Safety Officer must be notified in writing of any amendments or changes to designated rooms, personnel, radioisotope limits, etc., by the Principal Investigator and approved by the RSO. An amended permit thereafter will be provided to the Principal Investigator for posting in all approved locations.

2.4.21.3 Permit Renewal

- All permits will be renewed as per CNSC guidelines.
- The Principal Investigator is responsible for the renewal of each permit.
- Principal Investigators must provide a renewal application to facilitate the review and evaluate their projects involving radioisotopes before permits are renewed. Any outstanding compliance concerns must be resolved prior to renewal.
- A revised permit will be provided to Principal Investigators upon renewal

2.4.21.4 Declaring Dormant Status

Principal Investigators that plan on leaving for an extended period (absence for more than 4 months) or wanting to stop radioisotope work temporality can do so upon approval from the Radiation Safety Officer. The Principal Investigator must communicate with the Radiation Safety Officer in writing, prior to leaving or stopping radioisotope work. The Principal Investigator must arrange for another Principal Investigator to assume the permit responsibilities if he/she will be absent from the University. The Radiation Safety Officer will confirm dormancy status only after the newly appointed Principal Investigator has been accepted in accordance with his/her Departmental Chair.

Prior to declaring dormancy of a permit, the Principal Investigator must resolve any non-compliances and follow the checklist for Dormancy in Appendix 3. Prior to declaring dormancy; the RSO will inspect the lab/designated space to ensure all radioisotopes have been stored safely with the checklist designed for dormancy. Once dormancy is declared radioisotopes cannot be purchased under the permit.

2.4.21.5 Permit Termination/Expiry

The Principal Investigator must terminate the Permit prior to leaving the University or when there are no further plans to continue working with radioisotopes. Written notice must be given at least 6 weeks prior to leaving the University of Guelph to ensure that the laboratories are decommissioned, and all the records are released to the Radiation Safety Officer. Records must be kept 3 years past termination/expiry of the Internal Permit. The Department Chair will be held responsible in the absence of the Internal Principal Investigator.

2.4.21.6 Permit Cancellation

An Internal Permit may be cancelled when the CNSC Regulations are violated or if the Principal Investigator fails to remain compliant according to the "Internal Review Policy". Suspension or cancellations will be at the discretion of the Radiation Safety Officer, the Radiation Safety Committee and Senior Management in charge of the Radiation Safety Program at the University of Guelph. Appeals will be reviewed by the Radiation Safety Committee.

2.4.21.7 Permit Records

Principal Investigator's need to keep records of any nuclear substance as per the following:

- The name, quantity, form and location of the nuclear substance,
- Model, serial number of a sealed source/where the nuclear substance is contained in radiation device, model and serial number of a radiation device and location of the sealed source/radiation device.
- The quantity of a nuclear substance used and the way the nuclear substance is used
- the name of each worker who uses or handles a nuclear substance;
- any transfer, receipt, disposal or abandonment of a nuclear substance, including - The date, name and address of the supplier or the recipient - The license number of the recipient - The name, quantity and form of the nuclear substance where the nuclear substance is a sealed source, the model and serial number of the source and where the nuclear substance is contained in a radiation device, the model and serial number of the device.
- All radiation training received by the workers under the permit
- Every inspection, measurement, test or servicing.

- All Records must be kept for 3 years after the expiry date of the last Internal Permit that was issued to the Principal Investigator.

2.4.22 Incident Reporting

All personnel who becomes aware of the becomes aware of any of the following situations shall immediately inform the RSO, who will make a preliminary report to the Commission of the location and circumstances of the situation and of any action that the University of Guelph has taken or proposes to take with respect to it:

a) the occurrence of an event that is likely to result in the exposure of persons to radiation in excess of the applicable radiation dose limits described in section 2.4.4 and 2.4.6.2 of the radiation safety manual. (prescribed by the *Radiation Protection Regulations*;)

b) any unauthorized release of a quantity of radioactive nuclear substance into the environment

c) radioactive material has escaped from a containment system, a package or a conveyance during transport;

d) fissile nuclear material is outside the confinement system during transport;

e) a situation or event that requires the implementation of a contingency plan;

f) an attempted or actual breach of security or an attempted or actual act of sabotage;

g) radioactive material is lost, stolen or no longer in the control of a person who is required to have control of it under the Act;

h) a radioactive material package shows evidence of damage, tampering or leakage of its contents;

i) information that reveals the incipient failure which could have a serious adverse effect on the environment or contribute to a serious risk to the health and safety of persons or the maintenance of security;

j) an actual, threatened or planned work disruption by workers;

k) death, serious illness or injury incurred or possibly incurred as a result of the radiation/radioactive material use;

l) a conveyance carrying radioactive material is involved in an accident;

m) the level of non-fixed contamination, during transport exceeds the following limits as applicable when averaged over any area of 300 cm^2 of any part of the surface of the radioactive material package or the conveyance:

   I. 4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or

   II. 0.4 Bq/cm^2 for all other alpha emitters;

n) there is a failure to comply with the applicable section of the NSCA Act, Regulations or licence or certificate conditions that is applicable to a radioactive material package that may lead to a situation in which the environment, the health and safety of persons or national security is adversely affected.

After making the preliminary report within 21 days the RSO shall file a full report of the situation and the report shall contain the following information:

a) a description of the situation, the circumstances and the problem, if any, with the radiation device;

b) the probable cause of the situation;

c) the nuclear substance, and if applicable, the brand name, model number and serial number of the radiation device involved;

d) the date, time and location where the situation occurred or, if unknown, the approximate date, time and location, and the date and time of becoming aware of the incident;

e) the actions that the licensee has taken or proposes to re-establish normal operations;

f) the actions that the licensee has taken or proposes to take to prevent a recurrence of the situation;

g) if the situation involved an exposure device, the qualifications of the workers, including any trainee, who were involved;

h) the effective dose and equivalent dose of radiation received by any person as a result of the situation; and

i) the effects on the environment, the health and safety of persons and the maintenance of security that have resulted or may result from the situation.

2.4.23 Records Retention

All records are to be maintained by the University of Guelph. Records should be available for inspection both by the CNSC and the RSO. Records to be maintained by the Permit holders include the following:

1) Names of persons involved in the handling of nuclear substances and radiation devices

2) Names and job categories of NEWs

3) Training for workers handling nuclear substances and radiation devices

4) List of locations of nuclear substances in possession

5) Dosimetry results of each worker

6) Inventory of unsealed sources in possession

7) Inventory of sealed sources and radiation devices

8) Details of incidents involving nuclear substances and radiation devices
9) Acquisitions and transfers of nuclear substances and radiation devices
10) Wipe-test monitoring results for unsealed substances
11) Fixed-contamination monitoring results
12) Decommissioning results
13) List of radiation-detection equipment
14) Radioactive waste disposal
15) Transport documents

Documents that are maintained at the RSO main office include:

1) Inventory of all devices and sources
2) Leak test analysis certificates for sealed sources
3) NEW acknowledgement forms
4) A copy of TDG training certificates
5) Reports of incidents, malfunctions, security breaches, etc.
6) Special form certificates
7) Transfer records
8) A list of authorized users and their training
9) Radiation dose results for authorized users
10) Copies of shipping documents
11) Current licence and emergency procedures
12) Type A packaging certifications
13) Complete copy of current CNSC licence

In order to dispose records the RSO shall send a written notification to the CNSC for authorization of the intended date of disposal and the nature of the records at least 90 days before the intended date of disposal. **Permit holders must seek approval from the RSO prior to disposal of any records**. The retention period the records mentioned above can be found at this link.

The retention period of all records pertaining to CNSC Licenses must be maintained for 1 year after expiry of the license. Training records are to be maintained for 3 years after termination of employment and servicing records for devices must be maintained for 3 years after expiry of license. Furthermore, the dosimetry records must be maintained for 5 years from the day the dose information is collected.

2.5 ADMINISTERING RADIONUCLIDES TO ANIMALS

Prior to using Radionuclides or isotopes on animals written permission is required from the Radiation Safety Officer. This policy and procedure is for permit holders under the consolidated license only. There are separate policies and procedures for use under the University of Guelph Veterinary Nuclear Medicine License. Please consult the Radiation Safety Officer if you any further questions or need clarification.

Animal housing:

Upon approval, permit holders need to ensure that animals used for research are housed with appropriate controls to ensure the dose received by any person handling the experiment that uses radioactive materials in animals follow the ALARA principle. Exposures from both external and internal sources should be assessed and evaluated prior to commencing any experimental work. When working with strong beta or gamma emitters, the permit holder should consult the RSO and if **required** dosimeters or area monitors will be issued during the period of the experiment.
Animals administered radioactive materials should be quarantined appropriately in designated locations only. If animals are caged after being treated with radionuclides a radiation warning sign must be posted on the cage itself to indicate that the animals are radioactive. The radiation dose rate in occupied areas should not exceed the regulatory limits and the permit holder should be able to demonstrate that dose rates will be kept ALARA. Radiation warning signs and CNSC spill posters should be posted in the room where the nuclear substances are used. The 24-hour emergency contact information should also be posted in the room.

Short-Lived Isotopes:

Animals injected with short-lived isotopes such as Iodine, should in-accordance with the RSO hold the animals before the decontamination process is started. It may be reasonable to secure the contaminated area and allow the radionuclide to decay to background radiation levels. The general procedure is to allow the isotope to decay for 10 half-lives. Therefore, with the use of certain isotopes with short half-lives it may be wise to delay-decay the animal or animal carcass prior to disposal or transfer.

Disposal of animal waste:
All animal waste is to be treated as radioactive waste and should be disposed of as radioactive waste. Please refer to RSM **section 2.4.13.1.7 (Radioactive Animal Carcasses and Tissues)** for more details on handling waste.

Monitoring and release of animal housing:

It is important to note and confirm that the housing for animals treated with isotopes will not be used for any other purposes unless the level of radioactivity is at or below background. Both the area and or housing should be monitored prior to release or re-use. Prior to release for normal use, the area and housing of animals should be cleaned, decontaminated, and monitored. The results should be recorded by the permit holder(s) and the RSO should be notified prior to release. During the experiment, the area should be restricted until decontamination is completed. If the delay-decay process is used, the area should have restricted access until radiation levels are at or below background. All radioactivity should be monitored, or wipe tested prior to cleaning and

releasing the cage, and or rooms. The radioactive contamination level must be reduced sufficiently so that it will not increase a person's effective dose by 500 μSv or more per year in excess of background radiation.

Transfer within the Institution

If the animals are to be transferred within the University of Guelph, it should be done with prior notification to the RSO. Extreme caution and care need to be taken to prevent any accidental exposure and transfer routes should be planned in advance.

Transfer outside the Institution

For offsite transportation of animals treated with radionuclides or its carcass, approval is needed from the RSO prior to conducting any transfers. A “Transfer of Radioactive Material” form must be completed prior to the transfer. If animals are transferred to an off-site location the permit holder or RSO must ensure that the receiving institution is licensed.

APPENDICES

APPENDIX 1 - SAMPLE INTERNAL PERMIT

University of Guelph Department of Molecular Biology	**RADIOISOTOPE USER PERMIT** **Permit Number: 303**
Permit Holder	
Dr. John Smith Department of Molecular Biology Rm S-4123 Building 30, Alexander Hall	
Permit Validity	
Effective Date:	July 31, 2019
Expiry Date:	July 31, 2022
Approved Nuclear Substances and Radiation Devices	
Unsealed Nuclear Substance and Possession Limit	^{125}I – 5 MBq ^{14}C 50 Mbq
Sealed source nuclear substance maximum activity in possession:	None
Radiation Devices in Possession (make and model):	None
Approved Locations	
Building, Building # & Room number:	Alex (30), 160, 163
Laboratory Designation	Basic Level Lab (BLL)
Approved Usage	
Research Analytical and diagnostic services	
Waste Disposal	
As per UofG Waste Policy on Radioactive Waste.	
Conditions of Approval	
As per Nuclear Safety Control Act, CNSC Regulations and UofG Policies and Procedures on handling of radioactive sources. Thyroid Bioassay monitoring may be required based on I-125 use.	
Types of Workers Authorized to Use Nuclear Substances under this permit	
1) Laboratory Personnel 2) Researchers 3) Students	
Dosimeters Issued Under this Permit	
☐ Yes	☐ No
Signature of Approval:	RSO RSC Chair

APPENDIX 2 - LABORATORY INSPECTION CHECKLIST

Laboratory Radiation Safety Inspection Checklist

Permit Holder: _____ Permit No._____ Permit Status_____

Building : _____ Department._____ Room(s)_____

Auditor: _____ Date._____ Signature_____

Laboratory Type: ☐ **Basic Level Laboratories** ☐ **Intermediate Level Laboratory**
☐ **Other** _____

Overall Grade*: A ☐ B ☐ C ☐ D ☐ E ☐

Radiation Safety Management	
1.1 Signs & Postings: There are appropriate & correct radiation warning signs in the designated room, including CNSC spill procedures and guidelines for handling radioactive packages.	
Compliant ☐ Non-Compliant ☐	Comments:
1.2 Food & Drink: There is no evidence of any food/drink consumption in designated radiation work areas or rooms	
Compliant ☐ Non-Compliant ☐	Comments:
1.3 Permit & Active Users: There is a valid permit posted in the lab. A list of authorized radiation users is available in the 'radiation folder'. If the permit is in 'Dormant Status', it is indicated in the 'radiation folder'. Radioisotopes in use in the designated lab are according to the valid permit.	
Compliant ☐ Non-Compliant ☐	Comments:
1.4 Dosimetry: All personnel handling high energy beta particles & gamma emitters are wearing their assigned TLD badges when applicable. The badges are stored in an appropriate location and manner.	
Compliant ☐ Non-Compliant ☐	Comments:
1.5 Dose Limit & Thyroid Screening: The PI is aware of Effective Dose limits and University of Guelph's Action level. Users of radioiodine such as I-125/I-131 are participating in thyroid screening if necessary.	
Compliant ☐ Non-Compliant ☐	Comments:
1.6 Fume Hood: Fume hoods have had their performance verified within one year.	
Compliant ☐ Non-Compliant ☐	Comments:
1.7 Radiation Instrument: Survey meters (portable) are in good condition and have been calibrated within one year.	
Compliant ☐ Non-Compliant ☐	Comments:
1.8 Area Posting: a) Active work stations, containers, storage areas, pipets, fridges etc. are labelled with appropriate radiation tape. b) There is no 'Frivolous Posting' of radiation warning signs on items, boxes, vials or areas where there is no nuclear substance or radiation device.	
Compliant ☐ Non-Compliant ☐	Comments:

1.9 Contamination: a) Contamination monitoring is performed and recorded in the 'Radiation Folder' using the U of G monthly monitoring form. Records are easily accessible in the designated labs. b) Contamination monitoring is recorded in Bq/cm² and is performed within **seven (7) days** after working with unsealed nuclear substances. If no work is performed it is clearly recorded in the form. c) Best practices such as contamination monitoring of work station and hands/clothing is performed immediately after working with isotopes.
Compliant ☐ Non-Compliant ☐ Comments:
1.9.1 Contamination Monitoring & Wipe Tests Records: a) Are Liquid Scintillation Counters (LSC) used: Yes: ☐ No: ☐ If Yes: Room Location for Counter:_____ Condition of Counter:_____ b) PI and radiation users are correctly and effectively conducting wipe tests as per the Radiation Safety Manual. c) Locations for contamination monitoring & wipe tests are clearly labelled on the map and the records are kept in the "Radiation Folder". d) Contaminated areas are cleaned and re-monitored.
Compliant ☐ Non-Compliant ☐ Comments:
Inventory
2.0 Inventory: All nuclear substances in storage or in use have inventory records. The total amount of activity for a radionuclides in use is tracked and known. If in 'Dormant Status' inventory is properly secured.
Compliant ☐ Non-Compliant ☐ Comments:
2.1 Fridges: There is an up to date inventory sheet for items in the fridge. If the fridge has a locking mechanism, it is kept locked when not in use. Items no longer in use are disposed.
Compliant ☐ Non-Compliant ☐ Comments:
Training and Awareness
3.0 EHS Radiation Safety Training: All workers including the PI and designated radiation users in the lab have completed the U of G EHS radiation safety training or refresher training in the last three (3) years.
Compliant ☐ Non-Compliant ☐ Comments:
3.1 Radiation Safety Awareness: Non-Radioactive workers in the lab are aware that radioactive sources are being used in their work area.
Compliant ☐ Non-Compliant ☐ Comments:
Purchasing
4.0 Purchase Records: a) All radioactive/nuclear substance purchasing is done in accordance with the RSO and purchasing department at the University of Guelph. b) PI has all purchase records available. Proper U of G purchasing methods are followed while ordering/cancelling purchase orders. c) PI is aware of their purchasing limits
Compliant ☐ Non-Compliant ☐ Comments:
Operations
5.0 ALARA: Radiation users are conducting experiments keeping the ALARA principle in mind. All users are operating equipment and using nuclear material using best practices. All users are using correct PPE.
Compliant ☐ Non-Compliant ☐ Comments:

5.1 Change Management: Change in operation including relocation or transfer of radioactive material is in consultation with RSO if applicable.	
Compliant ☐ Non-Compliant ☐	Comments:
Packaging	
6.1 Packaging: a) There is a valid CNSC poster with guidelines for handling packages containing nuclear substances in the lab. Users ensure that radioactive packages are delivered to them in good condition. b) Any shipping or transport of nuclear substances, radioactive materials, including devices such as LSC or ECD are done in consultation and approval from the RSO.	
Compliant ☐ Non-Compliant ☐	Comments:
Disposal & Decommissioning	
7.0 Disposal: PI and workers are using the proper SOP for radioactive disposal. Containers for disposal are clearly marked and secure. Proper wipe test procedure is followed before disposal. Proper Disposal forms are used.	
Compliant ☐ Non-Compliant ☐	Comments:
7.1 Decommissioning: Rooms that are no longer in use for radioactive work have been decommissioned or are in the process of decommissioning.	
Compliant ☐ Non-Compliant ☐	Comments:
Security	
8.0 Security: Rooms are locked when not attended. Radiation storage areas are secure and locked. Only authorized users are allowed in rooms designated for radioactive use or storage.	
Compliant ☐ Non-Compliant ☐	Comments:
Emergency Preparedness	
9.1 Emergency Info: a) Emergency contacts are current and listed clearly. All radiation users are aware of U of G Radiation Safety Officers' contact information. b) Laboratories have updated CNSC spill posters and they are clearly posted in the lab. c) Radiation users are aware and have adequate information on contamination, spill response and reporting procedures. The RSO has been notified of any major spills since the last auditing period. d) Radiation users are aware of U of G's incident and injury reporting process. The RSO has been notified of any other incidents such theft, lost/damage to radiation devices and or sources.	
Compliant ☐ Non-Compliant ☐	Comments:
Annual Radiation Safety Manual Review	
Compliant ☐ Non-Compliant ☐	Comments:
Nuclear Medicine Specific Procedures Review	
Compliant ☐ Non-Compliant ☐	Comments:

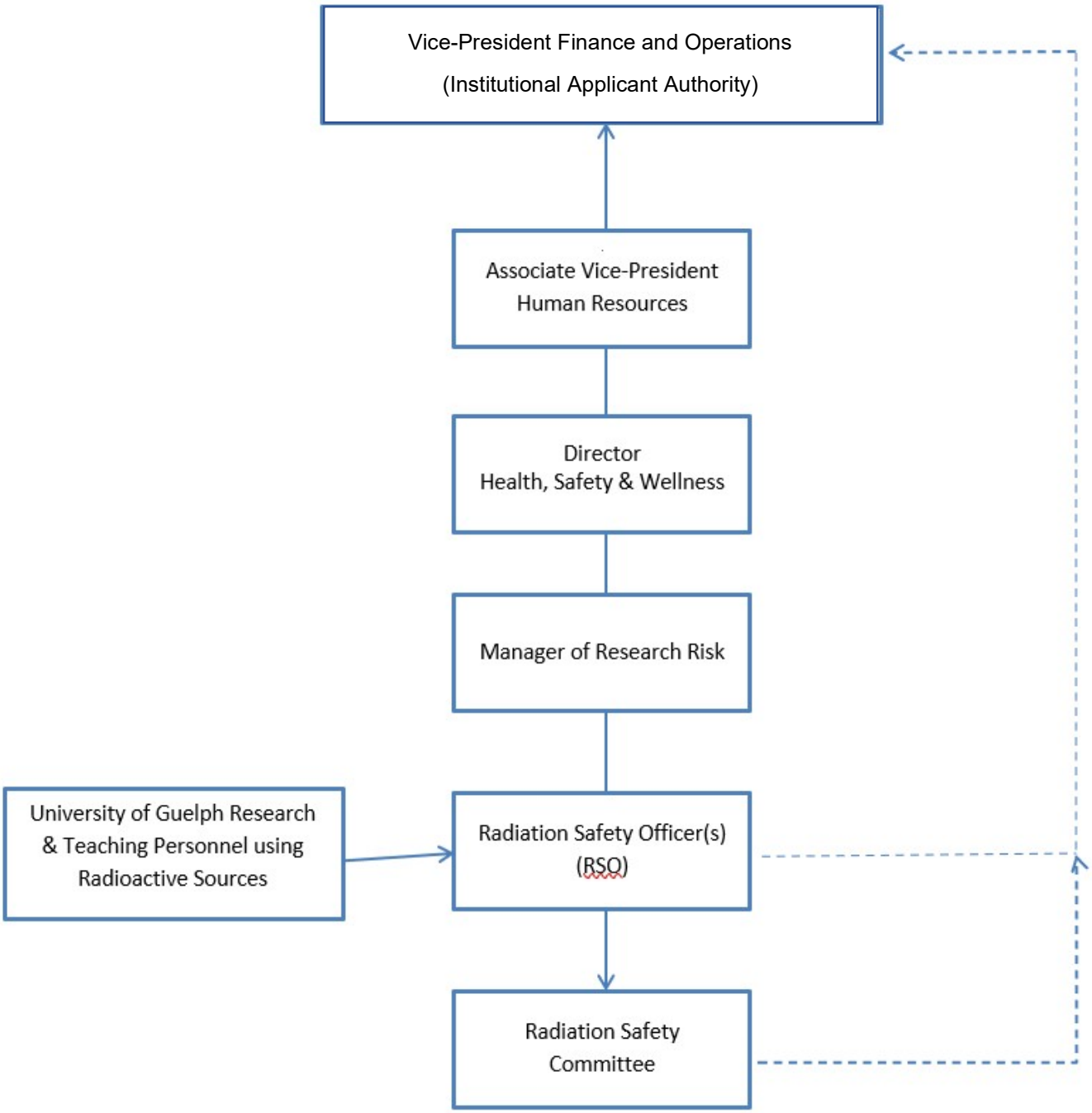
Grading System:

- A (Exceeds Expectations, Complaint)
- B (Meets Requirements, Complaint),
- C (Below Requirements, but low risk),
- D (Significantly below requirements, a follow up-audit will take place),
- E (Unacceptable, Radioactive work will be stopped immediately)

APPENDIX 3 - DORMANCY STATUS CHECK LIST

Refer to "Appendix 3 - Dormancy Status Check List"

APPENDIX 4 - RADIATION PROTECTION ORGANIZATIONAL AUTHORITY CHART (NUCLEAR SUBSTANCE AND RADIATION DEVICES)



Flowchart Overview:

The flowchart as the title suggests describes the organization authority chart and the reporting structure for CNSC licenses. The VP Finance and Operations is the applicant authority on all the CNSC licenses and the Radiation safety officer (RSO) acts as the liaison between CNSC on radiation safety matters pertaining to the University's CNSC issued licenses. The RSO is the subject matter expert on all aspects of radiation safety and provides day to day management and administration of the overall radiation safety program.

The Radiation safety committee along with the Manager of Research Risk maintains an oversight over the workings of the Radiation safety officer(s). The RSO reports to the Manager of Research Risk who reports to the EHS director and the director subsequently reports to the Associate vice-president of human resources.

APPENDIX 5 - CONTAMINATION MONITORING FORM

Refer to "Appendix 5 – Contamination Monitoring Form"

Sample Calculations for Contamination Monitoring

Indirect monitoring (using wipe tests and an LSC)

Contamination level (Bq/cm^2) is calculated using this formula:

$$\frac{Bq}{cm^2} = \frac{(Cpm - Bkg)}{E \times A \times T \times D}$$

Shown in an alternate format:

Bq/cm2 = (Cpm – Bkg) ÷ (E x A x T x D)

Where,

- **Cpm** = Sample count rate in counts per minute for the wipe
- **Bkg** = Background count rate in cpm or cps
- **E** = Detector efficiency (Scintillation counter efficiency). Please consult service manual. At 50%, E = 0.50
- **A** = Area wiped, i.e. 100cm^2
- **T** = 60 sec/min if count rate is cpm or 1 if count rate in cps
- **D** = 0.1; use 10% or 0.1 for wet wipes and 1% for 0.01 for dry wipes

Direct monitoring (using survey meters)

Contamination level (Bq/cm^2) is calculated using this formula:

$$\frac{Bq}{cm^2} = \frac{(Cpm - Bkg)}{E \times A \times T}$$

Shown in an alternate format:

Bq/cm2 = (Cpm – Bkg) ÷ (E x A x T)

Where,

- **Cpm** = Sample count rate in counts per minute for the wipe
- **Bkg** = Background count rate in cpm or cps

- **E** = Detector efficiency. Please consult user manual or calibration sticker
- **A** = Area wiped in cm^2. For pancake probe its 19.6 cm^2
- **T** = 60 sec/min if count rate is cpm or 1 if count rate in cps

Sample Problem and Solution

Sample Problem: Your lab is designated to use Tritium (^3H) and you have just taken a swipe of the Fume hood (in 100 cm^2) after your experiment. You have taken the wipe test according to standard procedure and use your liquid scintillation counter (LSC) for count rate of your sample. Your LSC printout shows 900 cpm, what is the contamination level in Bq/cm^2?

Solution: Assuming that the minimum detector efficiency is 50% (for LSC), the collection efficiency is 10% (for wet wipes) and background count rate is 40 cpm.

We have:

Contamination level (Bq/cm^2) = $\frac{900-40\ (cpm)}{0.5 \times 100cm^2 \times 60\ \frac{sec}{min} \times 0.1}$ **= 3 Bq/cm^2**

Shown in an alternate format:

Contamination level (Bq/cm^2) = (900 – 40 cpm) ÷ (0.5 x 100cm^2 x 60 sec/min x 0.1) = 3 Bq/cm^2

APPENDIX 6 - INVENTORY FORM FOR UNSEALED SUBSTANCES

Refer to "Appendix 6 - Inventory Form for Unsealed Substances"

APPENDIX 7 - FRIDGE INVENTORY FORM

Refer to “Appendix 7 - Fridge Inventory Form”

APPENDIX 8 - DOSIMETER APPLICATION

Refer to “Appendix 8 - Dosimeter Application”

APPENDIX 9 - DOSIMETER CARE & USE

Refer to the EHS Radiation Monitoring webpage and the Proper Care and Use of Personal Dosimeter Poster.

APPENDIX 10 - THYROID MONITORING & USE

Procedure: Medical Surveillance – Radioiodine Bioassay – Use of Equipment & Quarterly Reporting

Introduction

Use of volatile radioiodine such as I-125 or I-131 may occur within research and clinical activities at the University of Guelph as permitted by our Consolidated and Nuclear Medicine licenses issued by the Canadian Nuclear Safety Commission (CNSC). The University of Guelph uses a CAPTUS 700 T by Capintec (Thyroid uptake scanner) to conduct bioassay monitoring. The instrument is calibrated with phantoms provided by Health Canada and certified on an annual basis. As a condition of our licenses thyroid monitoring is required based on the following criteria,

a) Every person who in any 24-hour period uses a total quantity of Iodine 124, Iodine-125 or Iodine-131 exceeding:
    i. 2 MBq in an open room;
    ii. 200 MBq in a fume hood;
    iii. 20 000 MBq in a glove box; or
    iv. any approved quantity in any room, area or enclosure authorized in writing by the CNSC shall undergo thyroid screening within a period more than 24 hours after the last use that resulted in any of the above limits being exceeded and less than 5 days after the limit was exceeded.

b) Every person who in any 24-hour period uses a total quantity of Iodine-123 exceeding:
    i. 200 MBq in an open room;
    ii. 20,000 MBq in a fume hood;
    iii. 2,000,000 MBq in a glove box; or
    iv. any approved quantity in any room, area or enclosure authorized in writing by the CNSC shall undergo thyroid screening within a period more than 8 hours after the last use that resulted in any of the above limits being exceeded and less than 48 hours after the limit was exceeded.

c) Every person who is involved in a spill greater than 2 MBq of Iodine-124, Iodine-125 or Iodine-131 or on whom external contamination is detected, shall undergo thyroid screening within a period more than 24 hours after the spill and less than 5 days after the spill or contamination.

d) Every person who is involved in a spill of greater than 200 MBq of Iodine-123 or on whom external contamination is detected, shall undergo thyroid screening within a

period more than 8 hours after the spill and less than 48 hours after the spill or contamination (2046-17).

Monitoring is required for every person who in any 24 hour period,

a) uses a total quantity of I-125 or I-131 (Gases, volatile liquids and powders) exceeding,
   - 2 MBq in an open room
   - 200 MBq in a fume hood
   - 20,000 MBq in a glove box
   - Any approved quantity in any room, area or enclosure authorized by the CNSC

b) Is involved in a spill of greater than 2MBq of I-125 or I-131

c) Is found to be externally contaminated with I-125 or I-131 or

d) Worked within two meters of a person whose screening measurement results are equal to or greater than 1 kBq, if they were working within one hour after the time of the suspected exposure.

e) Other persons who regularly work close to a worker handling more than 2 MBq of volatile I-125 or I-131 on an open bench or in an open area should be screened for the relevant radioiodine.

Procedure

All radio-iodine bioassays will be performed in Occupational Health & Wellness (OHW) by either OHW trained personnel or the Radiation Safety Officer. As part of the process any inquiry will be made and recorded as to whether the person on whom the bioassay is being completed has been exposed to I-125 or I-131 in the previous eight (8) days.

Calibration of Machine

The machine is to be calibrated once on each day of use.

1. Turn the machine ON using the switch in the back
2. Check the date and time displayed and ensure they are correct (if the date & time are not correct contact the RSO and/or the Service Provider). Servicing may be required.
3. On the main screen press “Continue”
4. Press “Auto Calibrate”
5. The message “calibrate with Cs137” should come up on the screen
6. Tilt the arm of the machine up to about 90° and insert the white holder
7. Insert the Cs-137 check source, black tip down, into the holder.

8. Press “Cal with Cs-137”. Machine will start to auto calibrate. Once the red peak is displayed on the screen the calibration with Cs-137 is completed.
    - DO NOT press “Accept” this will cause the calibration with Eu-152 to be bypassed
9. Remove the Cs-137 check source from the holder and return to the storage container
10. Insert the Eu-152 check source, black tip down, into the holder
11. Press “Linearity Correction with Eu-152”. The calibration will begin. Once the results of the calibration are displayed, the machine calibration has been completed.
12. Remove the Eu-152 check source from the holder and return to the storage container
13. Press “Accept”. Main screen will be displayed.
14. Remove the white holder.
    - **The white holder is open at the bottom, NEVER pull it out of the machine with a source still in situ.**
    - Ensure the Printer is turned ON prior to beginning the Background & Bioassay Measurements

Determining the Background Reading

For each instance that a bioassay is going to be performed a background reading must be done. Background measurements are done without the person in the room.

1. From the main screen press “Bioassay”
2. Select “Staff Screen”
3. From the staff roster, Select the individual’s name for which the background will be performed
4. Ensure arm of the machine and probe are in a horizontal position
5. Verify that 60 seconds is displayed on the screen (if less than 60 sec are indicated contact the RSO who will adjust the time of the measurement)
6. Press “Measure” - will measure background for 60 seconds.
7. When the measurement is completed, press “Accept”. The background measurement value will be auto populated in the background display window.

Performing the Bioassay

1. Ensure the probe is at a distance of 25 cm, if not adjust to 25 cm.
2. Have the person sit with the probe touching their Adam’s apple

3. Verify that 60 seconds is displayed on the screen (if less than 60 sec are indicated contact the RSO who will adjust the time of the measurement)
4. Verify person's name on the screen (if the incorrect person is shown on the screen, need to perform background for correct person then proceed to completing the bioassay)
5. Press "Neck Measurement"
6. Press "Measure"
7. When the bioassay is completed, machine will beep and indicate FINISH on the screen
8. Press "Accept"
9. In comment box input your initials (person performing the bioassay), comment on results and that they were reviewed with the individual
10. Select "Save + Print"
11. Review the results with the individual and compare them to the baseline results on file. Have the individual initial that the results were reviewed. With them. Initial the results yourself.
12. Please include the following in the results page:
    a. Highlight the isotope being tested (i.e. I-131 r 1-125)
    b. Input date of when the client last used radio-iodine.
    c. Insert comments on the "Action Taken"
    d. The input page should already contain device name, date and client's name.
    e. **Note**: The RSO shall be immediately notified of any results that exceed the internally set allowable limit.
13. File the results
14. Return to main menu
15. Turn off the machine.

Reports

On a quarterly basis OHW will issue a report to the RSO listing all the bioassays performed.

1. Go to Main screen
2. Select "Reports"
3. Select "Bioassay Report"
4. Input calendar dates for the quarter.
5. Select names of clients/staff members

6. Ensure Printer is on and press print.
7. Please highlight which isotope was tested (Majority being I-131), it is important to sort I-125 users as well.
8. Forward report to RSO.

Performing Baseline Measurements

Baseline measurements will be performed on an annual basis on all individuals identified as having the potential to be exposed to I-125 or I-131. The above procedure will be followed when performing baseline measurements. All results will be maintained by OHW.

Instrument Details

Model: CAPTUS 700 T by Capintec

Calibration Schedule: Annually as part of Health Canada's Calibration program.

APPENDIX 11 - SKIN CONTAMINATION (DNSR ARTICLE)

Refer to: "DNSR article – CNSC Expectations for Licensee Response During Skin Contamination Events"

APPENDIX 12 - CLASSIFICATION OF RADIONUCLIDES

The most commonly licensed radionuclides have been grouped into Class A, Class B, Class C, based upon their radiological properties as shown in the table below:

Class	Radionuclide
Class A	All alpha emitters and their daughter isotopes Ag-110m, Bi-210, Co-56, Co-60, Cs-134, Cs-137, I-124, Lu-177m, Mn-52, Na-22, Po-210, Pu-238, Pu-239, Pu-240, Sb-124, Sc-46, Sr-82, U-234, U-235, U-238, V-48, Zn-65
Class B	Au-198, Ba-133, Br-82, Ce-143, Co-58, Cu-67, Fe-59, Hg-194, Hg-203, I-131, Ir-192, La-140, Mo-99, Nb-95, Pa-233, Ra-223, Re-186, Re-188, Ru-103, Sb-122, Sm-153, Sr-90, Xe-127, Y-86, Y-90, Yb-169, Zr-89, Zr-95
Class C	C-11, C-14, Ca-45, Cd-109, Ce-141, Cl-36, Co-57, Cr-51, Cu-60, Cu-61, Cu-64, F-18, Fe-55, Ga-67, Ga-68, Ge-68, H-3, I-123, I-125, In-111, In-113m, In-114, K-42, Kr-85, Lu-177, Mn-52m, Mn-56, N-13, Na-24, Nb-98, Ni-63, O-15, P-32, P-33, Pd-103, Pr-144, Pu-241, Rh-106, S-35, Sc-44, Sn-113, Sr-89, Tc-94m, Tc-99, Tc-99m, Te-127, Tl-201, V-49, W-181, W-188, Xe-133, Zn-63

APPENDIX 13 - SIGNAGE AND POSTING

Please refer to Section 2.3.17 of the RSM for policy on posting of radiation warning signage. Downloadable posters are available through the following links:

- Room Designation
  - Basic Level Laboratory
  - Intermediate Level Laboratory
  - High Level Laboratory
- Containment Level
- Guidelines for Handling Packages Containing Nuclear Substances
- Spill Procedures
- Responding to Accidents Involving Portable Gauges

APPENDIX 14 - NUCLEAR ENERGY WORKER (NEW) NOTIFICATION FORM

Notification of Nuclear Energy Worker Status

Surname: _____ **Given Name(s):** _____

Department: _____ **Sex:** M ☐ F ☐

As required by the Canadian Nuclear Safety Commission, in accordance with the Nuclear Safety and Control Act (NSCA) and its regulations, this is to inform you that you are a Nuclear Energy Worker (NEW). As defined in the NSCA, a NEW is 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 dose limit for the general public.

The University of Guelph however stresses adherence to the ALARA policy of maintaining doses: As Low as Reasonably Achievable.

Our procedures and policies are directed towards your safety, ensuring that the potential for exposure is minimized. The University of Guelph notifies users of radioactive materials of their classification as "Nuclear Energy Workers" if there is a reasonable probability of receiving an effective dose greater than that allowed to members of the general public (i.e. 1 mSv per annum whole body).

The following documents are provided for your information:

1. The risks associated with radiation to which you may be exposed during your work, including the risk associated with the exposure of an embryo and fetus,
2. The applicable dose limits as specified in the regulations,
3. Your radiation dose levels, received on an annual basis,
4. The rights of a pregnant nuclear energy worker and rights of a breastfeeding nuclear energy worker (section 4).

I have read the above documents and I understand the risks, my obligations and the radiation dose limits that are associated with being a NEW.

Signature of Worker: _____

Signature of Radiation Safety Officer: _____

Date: _____

1) RISKS ASSOCIATED WITH RADIATION

Health Physics Society Statement*:

In accordance with current knowledge of radiation health risks, the Health Physics Society recommends against quantitative estimation of health risks below an individual dose of 50 mSv in one year or a lifetime dose of 100 mSv above that received from natural sources. Doses from natural background radiation in Canada & the United States average about 3 mSv. A dose of 50 mSv will be accumulated in the first 17 years of life and about 250 mSv in a lifetime of 80 years. Estimation of health risk associated with radiation doses that are of similar magnitude as those received from natural sources should be strictly qualitative and encompass a range of hypothetical health outcomes, including the possibility of no adverse health effects at such low levels.

There is substantial and convincing scientific evidence for health risks following high-dose exposures. However, below 50-100 mSv (which includes occupational and environmental exposures), risks of health effects are either too small to be observed or are nonexistent.

In part because of the insurmountable intrinsic and methodological difficulties in determining if the health effects that are demonstrated at high radiation doses are also present at low doses, current radiation protection standards and practices are based on the premise that any radiation dose, no matter how small, may result in detrimental health effects, such as cancer and hereditary genetic damage. Further, it is assumed that these effects are produced in direct proportion to the dose received, that is, doubling the radiation dose results in a doubling of the effect. These two assumptions lead to a dose-response relationship, often referred to as the linear, no-threshold model, for estimating health effects at radiation dose levels of interest. There is, however, substantial scientific evidence that this model is an oversimplification. It can be rejected for a number of specific cancers, such as bone cancer and chronic lymphocytic leukemia, and heritable genetic damage has not been observed in human studies. However, the effect of biological mechanisms such as DNA repair, bystander effect, and adaptive response on the induction of cancers and genetic mutations are not well understood and are not accounted for by the linear, no-threshold model.

Radiogenic Health Effects Have Not Been Consistently Demonstrated Below 100 mSv Lifetime

Radiogenic health effects (primarily cancer) have been demonstrated in humans through epidemiological studies only at doses exceeding 50-100 mSv delivered at high dose rates. Below this dose, estimation of adverse health effect remains speculative. Risk estimates that are used to predict health effects in exposed individuals or populations are based on epidemiological studies of well-defined populations (for example, the Japanese survivors of the atomic bombings in 1945 and medical patients) exposed to relatively high doses delivered at high dose rates. Epidemiological studies have not demonstrated adverse health effects in individuals exposed to small doses (less than 100 mSv) delivered in a period of many years.

Limit Quantitative Risk Assessment to Doses at or Above 50 mSv (5 Rem) per Year or 100 mSv (10 Rem) Lifetime

In view of the above, the Society has concluded that estimates of risk should be limited to individuals receiving a dose of 50 mSv in one year or a lifetime dose of 100 mSv in addition to natural background. In making risk estimates, specific organ doses and age-adjusted and gender adjusted organ risk factors should be used. Below these doses, risk estimates should not be used. Expressions of risk should only be qualitative, that is, a range based on the uncertainties in estimating risk (NCRP 1997) emphasizing the inability to detect any increased health detriment (that is, zero health effects is a probable outcome).

Impact on Radiation Protection

Limiting the use of quantitative risk assessment, as described above, has the following implications for radiation protection: (a) The possibility that health effects might occur at small doses should not be entirely discounted. The Health Physics Society also recognizes the practical advantages of the linear, no-threshold hypothesis to the practice of radiation protection. Nonetheless, risk assessment at low doses should focus on establishing a range of health outcomes in the dose range of interest and acknowledge the possibility of zero health effects. These assessments can be used to inform decision making with respect to cleanup of sites contaminated with radioactive material, disposition of slightly radioactive material, transport of radioactive material, etc. (b) Collective dose (the sum of individual doses in a defined exposed population expressed as person-rem) has been a useful index for quantifying dose in large populations and in comparing the magnitude of exposures from different radiation sources. However, collective dose may aggregate information excessively; for example, a large dose to a small number of people is not equivalent to a small dose to many people, even if the collective doses are the same. Thus, for populations in which almost all individuals are estimated to receive a lifetime dose of less than 100 mSv above background collective dose is a highly speculative and uncertain measure of risk and should not be used for the purpose of estimating population health risks.

* Feinendegen, Ludwig E. "Radiation Risks in Perspective." *Health Physics*93.4 (2007): 329-30. Web: http://hps.org/hpspublications/positionstatements.html. The Health Physics Society is a nonprofit scientific professional organization whose mission is excellence in the science and practice of radiation safety. Since its formation in 1956, the Society has grown to approximately 6,000 scientists, physicians, engineers, lawyers, and other professionals representing academia, industry, government, national laboratories, the Department of Defense, and other organizations. Society activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. Society members are involved in understanding, evaluating, and controlling the potential risks from radiation relative to the benefits. Official position statements are prepared and adopted in accordance with standard policies and procedures of the Society. The Society may be contacted at 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101; phone: 703-790-1745; fax: 703-790-2672; email: HPS@BurkInc.com.

2) APPLICABLE DOSE LIMITS AS PER REGULATIONS

Annual Exposure Limits

Tissue or Organ	Nuclear Energy Worker (NEW) (mSv)	Non-Nuclear Energy Worker (mSv)
Whole Body	20**	1
Extremities	500	50
Skin	500	50
Pregnant Workers	4	1

** NEWs may receive up to 50 mSv in a year and total dose of 100 mSv in a five-year dosimetry period. The average annual dose limit in the 5-year period is 20 mSv.

3) EXPECTED RADIATION DOSE LEVELS

All NEWs will be monitored with TLD/OSL monitors from a *CNSC approved dosimetry service provider*. All exposures must be reported to the RSO. Dosimeters will only be issued upon the completion of radiation safety training.

All records of dosimetry are reviewed by the Radiation Safety Officer. Records are maintained at the EHS office.

The University of Guelph radiation safety program follows the ALARA principle and is designed to ensure workers are continuously protected and are properly trained. Even though the annual dose limit for Nuclear Energy Workers is 50 mSv per year in Canada and an average of 20 mSv over five years, we try to maintain an annual dose for each user that is a fraction of that.

The University of Guelph sets ‘Action levels’ as per the ‘*Radiation Protection Regulations’*. The action level set is at 2 mSv year. Once the action level is reached the RSO will investigate the causes of exposure and may modify work patterns to keep doses ALARA.

4) PREGNANT AND BREASTFEEDING NUCLEAR ENERGY WORKERS

A pregnant nuclear energy worker must not receive an effective dose of greater than **4 mSv** for the balance of the pregnancy.

The balance of the pregnancy is defined as "the period from the moment the RSO is informed, in writing, of the pregnancy to the end of the pregnancy".

As soon as a female Nuclear Energy Worker is aware of her condition, she is encouraged to inform Occupational Health and Wellness and/or the RSO of her condition.

The University of Guelph Pregnancy Protocol will be followed. All pregnant and breastfeeding NEWs will be monitored with an appropriately modified schedule using TLD/OSL monitors from a CNSC approved service provider. The University may also make any reasonable accommodation to maintain effective doses As Low as Reasonably Achievable.

It may be pertinent to note that a female Nuclear Energy Worker (NEW) is encouraged to inform Occupational Health and Wellness and/or the RSO in writing of being pregnant or breastfeeding immediately upon becoming aware of the fact. When a state of pregnancy is established the RSO along with the supervisor may modify work patterns to keep doses ALARA and well below the regulatory limit.

Similarly, the RSO along with the supervisor will review the breastfeeding NEW's work practices, including the nuclear substances handled, so that appropriate accommodations can be made to limit intakes of nuclear substances by the breastfeeding NEW. This will ensure that the dose to the breastfed infant along with the breastfeeding NEW remains ALARA.

Radiation Risk and Pregnancy

A worker who becomes pregnant will naturally wonder how their work around radiation might affect their developing baby. The dose limit for pregnant Nuclear Energy Workers is lower than for other Nuclear Energy Workers. From the moment a worker informs the University (either through Occupational Health and Wellness or notifying the Radiation Safety Officer), that worker's effective dose limit becomes 4 mSv for the duration of the pregnancy. This lower dose limit is an extra precaution, but the goal as always is to keep the developing baby's dose as low as reasonably achievable.

A great resource is provided by the Centers for Disease Control. Just watch out, they use rad as their unit! Remember, 100 rad = 1 Gy = 1 mSv for photons.

Radiation Risk to the Developing Embryo

Early in pregnancy, the embryo is developing. There is rapid cell division, but the cells have not specialized yet. During this phase, high dose of radiation, on the order of 100 mSv or higher, may start to slightly increase the risk of miscarriage. There are no effects to a surviving embryo.

Radiation Risk to the Developing Fetus

Following the embryonic stage in pregnancy, the developing cells specialize to create organs and tissues. This is thought to be the highest risk phase of pregnancy. Radiation doses on the order of 100 mSv and higher may result in growth restrictions. High radiation doses, on the order of 500 mSv and higher, may increase the risk of miscarriage or development of neurological and motor deficiencies.

In the late stage of pregnancy, the main concern is increasing the risk of cancer that would develop during childhood, up to about 10 years of age. This risk is very hard to quantify and is not expected to be observable at doses below 100 mSv.

Radiation Risk to Breastfeeding Baby

If a worker is breastfeeding their baby, there can be a risk to the baby if that worker is handling open sources of radiation and may ingest or inhale the radiation source. In that case, it is possible for the radiation source to make its way to the breastmilk and be passed along to the baby. This could cause the baby to receive a radiation dose. The main sources at the University that could be of concern are radioiodine's. If you are working with radioiodine's or any other open source and may start to breastfeed or are breastfeeding, please contact the RSO. The RSO can evaluate the quantity of radiation source that you are working with and determine if there is a cause for concern.

There is no risk to a breastfeeding baby if only sealed sources are being used.

Rights of a Pregnant or a Breastfeeding Worker

Pregnant and breastfeeding workers who have informed the University of their status have rights under the Radiation Protection Regulations.

In the case of a pregnant worker, the University must make accommodations to limit the worker's radiation dose to 4 mSv for the duration of the pregnancy from the time the worker informs the University of the pregnancy.

APPENDIX 15 - RADIATION SAFETY DATA SHEETS FOR COMMON RADIOISOTOPES

Refer to the "Radionuclide Information Booklet"