Radiation Safety

Procedures

Manual

October 31, 2018

Acknowledgements

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RADIATION SAFETY PROCEDURES MANUAL

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ABBREVIATIONS & ACRONYMS

ACT - Nuclear Safety and Control Act
ALARA - As low as reasonable achievable
ALI - Annual limit on intake
Bq – Becquerel
Ci – Curie
CNSC - Canadian Nuclear Safety Commission
CPM - Counts per minute dosimeter
CPS - Counts per second
DPM - Decays per minute
DPS - Decays per second
G – Giga μ - Micro
Gy – Gray
k - Kilo
IAEA - International Atomic Energy Agency
ICRP - International Commission on Radiological Protection
IP – Industrial package
LSA - Low specific activity
LSF - Liquid scintillation fluor
m - Milli
M- Mega
p – Pico
Pa - Pascal
NEW - Nuclear energy worker
R - Roentgen
RAD - Radiation absorbed dose
REM - Roentgen Equivalent to Man
Rn - Radon
Sv - Sievert
TI - Transport index
T - Tera
TDG - Transportation of dangerous goods
TLD Thermoluminescent Dosimeter
UN - United Nations

REVISION CONTROL SHEET
RADIATION SAFETY PROCEDURES MANUAL

Section:	Table of Contents	Date of Issue:	2007.01.27
		Issued By:	Safety Services
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Section / Part	Issue Date
1.3 Internal Compliance - added progressive warning procedure for non-compliance	March 9, 2008
4.1 Training Requirements – Lab Employee Training Record form updated	March 13, 2009
3.1 Radioisotope Laboratory Designation –Exemption Quantities revised to reflect changes to Nuclear Substances and Radiation Devices Regulations	June 22, 2009
1.2.3 Radiation Safety Committee membership updated	August 12, 2009
4.1 Radiation Safety Training – biannual refresher training required	June 24, 2009
8.1 Security, Storage, Labelling and Interlab Transport – revised to include requirements for maintaining security	September 24, 2011
9.1 Radioactive Waste Disposal – Radioactive Waste Disposal Form revised	September 24, 2011
10.2 Radiation Monitoring and Contamination Surveys –revised to reflect regulatory changes and to include new procedure and forms for documenting contamination surveys	November 9, 2011
Emergency Procedures – added procedures for Sealed Sources and Radiation Devices	January 24, 2012
Annual Compliance Report requirements moved from section 1.4 to section 1.1	January 24, 2012
1.4 Records and Reporting System – added records to be retained by permit holders	January 24, 2012
14.0 Sealed Sources and Radiation Devices - added	January 24, 2012
5.1 Personal Dose Monitoring – updated to reflect regulatory changes for internal monitoring; dosimetry badge and ring change period updated; Application for Dosimetry Service form changed to reflect use of Optically Stimulated Luminescence dosimeters	February 22, 2012
5.2.2 Internal Monitoring – updated to reflect regulatory changes for thyroid monitoring.	April 11, 2012
Appendix E: updated ALI/EQ Table	June 17, 2016
Updated department name and personnel titles throughout document. Replaced “policy” with “procedure”. Formatting changes (bullet form instead of paragraph).	January 31, 2017

Emergency Procedures: updated contact information; clarified process for reportable incidents	Feb 10, 2017
1.0 Clarified inspections and annual compliance report process; updated Committee terms of reference, responsibilities; added annual internal review process; clarified and updated records and reporting; added record retention information	Feb 10, 2017
2.0 Clarified decommissioning process and referenced form. Increased time required for review of permit application forms.	Feb 10, 2017
3.0 Referenced the latest version of GD-52 Design Guide information; added description of process for verification of doses around storage locations.	Feb 10, 2017
3.5 Clarified security measures to be implemented by Permit Holders and responsibilities.	Feb 10, 2017
4.1 Added requirement for verification of competency in addition to training.	Feb 10, 2017
5.2 Added use of optically stimulated luminescence dosimeters.	Feb 10, 2017
6.1.5 Clarified approval process for borrowing radioisotopes.	Feb 10, 2017
7.2.3 Clarified process for receiving radioactive packages	Feb 10, 2017
7.2.6 Clarified inventory verification	Feb 10, 2017
8.1 Moved detailed security information to section 3.5.	Feb 10, 2017
9.1.4 Updated PHAC information.	Feb 10, 2017
10. Clarified information regarding contamination survey requirements and frequency.	Feb 10, 2017
11. Clarified floor cleaning work procedure and scheduling.	Feb 10, 2017
15.1 Added requirement for University Contact/Project Manager to ensure contractor submits pre-qualification information prior to working on campus.	Feb 10, 2017
Appendices: reorganized the permit application form; added decommissioning form; updated dosimetry request form; updated acquisition form; revised inspection report form; clarified contamination criteria information	Feb 10, 2017
6.1.6 Nuclear Safeguards Added Appendix I detailing a safeguards program	Oct. 31, 2018
Updated CNSC posters in Appendix F	Oct. 31, 2018
3.5 Added reference to the Sealed Source Security Standard Operating Procedure (SOP) (included in Appendices)	Nov. 6, 2018

EMERGENCY PROCEDURES - RADIOACTIVE SPILLS AND DECONTAMINATION PROCEDURES

Section:	A	Date of Issue:	2007.01.27
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EMERGENCY TELEPHONE NUMBERS

Fire Department	**911**
Ambulance Service (EMS)	**911**
Security Services	**(403) 329-2345 (24 hours)**
Radiation Safety Officer	**(403) 329-2350 (office); (403) 332-2350 (cellular)**
Alternate Radiation Safety Officer	**(403) 332-4484 (office); (403) 915-7225 (cellular)**

Security Services maintains an emergency contact list for safety personnel

REPORTABLE INCIDENTS

The following require IMMEDIATE reporting to Campus Security and the Radiation Safety Officer (Safety Services) at any time.

- A spill of radioactive material outside of the radioactive work area
- Personal contamination (including clothing)
- Known or suspected internal contamination (inhalation, ingestion, injection)
- Known or suspected external exposure where person(s) may have received a dose in excess of 0.3 mSv
- Widespread contamination in the laboratory
- Loss or theft of any quantity of nuclear substance (radioactive material)
- A release of a quantity of radioactive nuclear substance into the environment not authorized by licensed activity
- An attempted or actual breach of security or sabotage at the site of the licensed activity
- A serious illness or injury incurred or possibly incurred as a result of the licensed activity
- The death of any person at a nuclear facility as a result of licensed activity

The following lists the situations when a report must be submitted to the CNSC, as outlined in Section 29 of the General Nuclear Safety and Control Regulations:

- Radiation dose exceeded
- Loss or theft of a radioactive substance
- Contravention of the Nuclear Safety and Control Act
- Unauthorized release of radioactive substance to the environment
- Security violation or sabotage

- Incipient failure of a system or component that may adversely affect health, safety, environment or security.
- Actual, threatened or planned work disruption by workers.
- Serious illness or injury incurred or possibly caused by the licensed activity.
- Death of any person at a nuclear facility
- Record deficiency that may adversely affect health, safety, environment or security.

The Radiation Safety Officer is responsible for reporting the incident immediately to the CNSC by phone and filing a written report within 21 days post incident.

The written report shall document the details of the incident, identify the root cause, and outline corrective actions to be implemented.

EMERGENCY RESPONSE TO A RADIOACTIVE SPILL

1. Notify all occupants in the area about the spill, if contaminate is volatile evacuate the area immediately.
2. Secure the area, keep all individuals from entering.
3. Ensure prompt first aid treatment is administered for injured personnel.
4. Remove all contaminated clothing and place in a plastic bag. Attempts must be made to remove all external contamination as soon as possible. Flush the area for a minimum of 15 minutes, if contamination is splashed in the eyes, mouth, or on skin.
5. Report the spill to Campus Security (403-329-**2345**) or Radiation Safety Officer (Safety Services) (403-329-2350) immediately.
6. Contain large volumes of non-volatile liquid spills to prevent further spreading. Ensure proper personal protective equipment is being worn.
7. Remain in the area to provide information and assistance in the clean up.
8. Ensure that all spilled and contaminated materials are properly packaged for disposal and are treated as hazardous wastes. Ensure that all other items in the clean up are decontaminated.

SPECIFIC PROCEDURES FOR MANAGING PERSONAL CONTAMINATION

- Immediate corrective actions should be taken if you know or suspect that you may have radioactive contamination on your clothing or skin.
- Prompt actions will minimize your exposure and will prevent a further spread of contamination.
- The primary concern regarding contamination on the clothing or skin is the increased probability of intake and resultant internal radiation exposure. Remember, radioactivity can enter the body by way of inhalation, ingestion, absorption, or through breaks in the skin.

GUIDELINES FOR CONTAMINATED WOUNDS

Minor wounds (puncture, scrape, and cut) while working with radioactivity require IMMEDIATE actions to limit any possible internal radiation exposure. Since minor wounds typically involve the hands, the following guideline is written for this situation.

1. Remove your gloves; turn them inside out, and DO NOT dispose.
2. Save the gloves and the object that caused the wound for monitoring and isotope identification. Information obtained from these items may help determine whether an internal exposure is likely.
3. Allow the wound to bleed and flush it gently with clean water. This will remove any radioactivity present in the wound and may prevent its absorption into the body.

4. Bandage or cover the wound, and seek medical attention if required.
5. Contact Campus Security Campus Security (403-329-**2345**) or Radiation Safety Officer (Safety Services) (403-329-2350) immediately.

   NOTE: For serious injuries or illnesses, always seek prompt medical attention first. Treatment and safety of the seriously injured person(s) ALWAYS takes precedence over radioactive contamination control. Emergency Services will only treat decontaminated individuals.

GUIDELINES FOR CONTAMINATED CLOTHING

1. Put on and wear a clean pair of gloves to carefully remove all contaminated clothing in such a way as to prevent a further spread of contamination, especially to the skin. Remove clothing inside out to contain the contamination.
2. Seal the contaminated clothing in a plastic bag. Write the following information on the bag: Name, telephone number of the owner of the clothing, and the radioisotopes involved.
3. After removal of contaminated clothing, carefully monitor all exposed skin areas. Monitor your hands. Follow the guidelines below if skin contamination is detected.
4. Contact Radiation Safety Officer (Safety Services) (403-329-2350) for cleaning of contaminated clothing. The clothing will most likely be stored until the radioactivity has decayed, if the clothing cannot be cleaned and the isotopes involved are short-lived.

GUIDELINES FOR PERSONAL CONTAMINATION

Radioactive contamination should be removed from the skin as soon as possible to reduce radiation exposure. Contamination deposited directly on the skin can cause intense irradiation of the skin as well as substantially increasing the risk for intake into the body.

1. Use mild hand soap or other appropriate solution for use on the skin. Some decontamination solutions and cleansers contain harsh chemicals and are not intended for use on the skin.
2. Water used for skin decontamination should be lukewarm in temperature. Water that is too hot or too cold will increase the blood flow to the area and increase the absorption of the contamination.
3. Gently wash or scrub the affected skin areas for about 2 to 3 minutes. Pay special attention to the fingernails if the hands are contaminated
4. Rinse with clean water and gently pat dry. Re-monitor the area with a contamination monitor.
5. Repeat this procedure as necessary. RUB, DO NOT SCRUB.

   NOTE: Gloves should be worn to prevent the spread of radioactive contamination to the hands during decontamination operations.
6. Work from the center of your body out (if your forearm is contaminated wash from the elbow towards the hand, hold your arm such that the water runs off your arm into the sink, not onto the floor or your body).
7. Monitor affected skin areas after every decontamination; attempt to determine effectiveness.
8. Stop cleaning immediately if contamination cannot be removed, or if the skin becomes irritated.
9. Rinse your eyes in an eyewash station for at least 15 minutes to flush foreign material out.
10. Rinse your mouth with water, but DO NOT swallow.
11. Blow your nose and keep the tissue, it will be analyzed for radioactive contamination. The nose filters approximately 50% of particulate matter.
12. Have someone absorb surface liquids, and liquids in the outer ear, lean to the side which has the liquid in it. Do not insert anything into your ear.

PROCEDURES FOR DECONTAMINATION OF EQUIPMENT AND AREAS

Tools, equipment, and work areas must be free of radioactive contamination whenever possible. All users are responsible for conducting surveys and promptly decontaminating all items and surfaces, if required.

1. Always wear protective clothing during decontamination operations. Minimum requirements include wearing a lab coat and two pairs of gloves (triple gloving is highly recommended).
2. There are several products commercially available for decontamination. Alternatively, two tablespoons of Alconox or Sparkleen can be dissolved in water to make a paste. Fantastik is also highly effective.
3. Methods used in decontamination include washing, scrubbing, abrasion, and corrosive methods. Always start with washing before progressing to more difficult decontamination methods.

4. DO NOT use methods such as grinding, sanding, scraping or chipping contaminated surfaces without the specific direction of Radiation Safety Officer (Safety Services).
5. Complex items should be disassembled as much as possible to allow sufficient cleaning of inner surfaces which may be contaminated. Do not disassemble if such action will jeopardize the operational integrity of the item or equipment.
6. Use disposable materials, such as paper towels.
7. Minimize the spread of contamination during decontamination operations. Avoid wiping a highly contaminated cleaning towel over a less contaminated surface. Generally, the best technique is to start at the edge of a contaminated area and work toward the area of highest contamination. The exception to this, however, would be to clean highly contaminated areas first if those areas were creating unacceptably high radiation exposure levels.
8. Frequently monitor surfaces during decontamination with either portable survey instruments or swipe tests to determine the effectiveness of the procedures being used. Continue decontamination as necessary.
9. Conduct SWIPE TESTS to confirm that there is no removable contamination.
10. Items and surfaces which cannot be successfully decontaminated must be identified and controlled as radioactive material. Such areas may also require shielding.
11. Ensure that all radioactive waste generated during decontamination is properly collected and disposed into the solid and liquid waste containers.
12. Once decontamination procedures are complete, remove gloves and wash hands thoroughly. Monitor hands, body, lab coat, clothing, etc., for radioactive contamination.

EMERGENCY PROCEDURES FOR SEALED SOURCES AND RADIATION DEVICES

- If leak tests are required and a positive leak-test result is reported, the leaking device must be taken out of use. The device should be properly packaged and sent to the licensed service provider for repair or disposal.

- Any loss of sealed sources and radiation devices must be immediately reported to the RSO (Safety Services). the CNSC must also be immediately notified, with a full report of the loss sent within 21 days of the incident
- It is advisable to notify the local fire department about the location of the radiation device and/or sealed source in advance of a fire. If a source or a device was involved in fire, place barriers at least 1 m around the device, if possible. Immediately contact the RSO, who will visually inspect the device and estimate the extent of damage.

- When appropriate, a radiation survey meter or contamination meter may be used to locate the sealed source or radiation device. In the case of little or no damage, a leak test (if applicable) must be performed before using the device or source. When the damage is extensive, the source or the device should be properly packaged and sent for disposal to the licensed service provider.

- Depending on the nuclear substance in the sealed source or radiation device, a complete radiation survey may be necessary to verify that there is no contamination of the area where the source or device was damaged.

ORGANIZATION & ADMINISTRATION OF RADIATION SAFETY

Section:	1	Date of Issue:	2007.02.01
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1.1 CANADIAN NUCLEAR SAFETY COMMISSION (CNSC) – LEGISLATED REQUIREMENTS

The Canadian Nuclear Safety Commission (CNSC) controls the development, application, and use of nuclear energy in Canada (Ref. 1). Control is achieved through a comprehensive licensing system that covers all aspects of nuclear facilities and nuclear substances (radioactive materials). The licensing system assures that all nuclear facilities and nuclear substances are utilized with proper consideration of health, safety, security, and protection of the environment.

The Canadian Nuclear Safety Commission has authority under the *Canadian Nuclear Safety Control Act and Regulations.* The CNSC provides policies, standards and guides for assessing licensees' capabilities to meet and maintain adequate radiation protection program requirements. Once a Nuclear Substance and Devices Licence is issued, the CNSC carries out compliance inspections to ensure that all regulatory and Licence requirements are met.

1.1.1 Risk Assessment

The CNSC has implemented a risk based regulatory assessment process to evaluate holders of a Nuclear Substances and Radiation Devices Licence. The Commission can potentially assess 13 different Safety Control Areas (SCA) (see table below) and grade the performance based upon the risk to health, safety, security and the environment. Not all aspects of the Safety Control Areas are checked for during the different Type I and Type II inspections; however licensees are required to be in compliance with all regulatory requirements. The requirements for each category of Nuclear Substances and Radiation Devices Licence are different.

1. Radiation Protection	2. Emergencies and Unplanned Events
3. Environmental Protection	4. Fire Protection
5. Training and Qualification	6. Operational Procedure
7. Organization and Management	8. Quality Management
9. Non-radiological Health and Safety	10. Public Information Programs
11. Security	12. International Obligation and Safeguards
13. Transportation	

Due to the inherent openness of the research environment and the large number of users of nuclear substances, universities, like the University of Lethbridge, are assessed as presenting a higher level of risk.

1.1.2 Licence Assessment & Inspections

CNSC will base their appraisal for Licence Renewal on three evaluation tools (annual compliance report and Type I audits and Type II inspections) for certain Safety Control Areas. The grading system is based upon certain expectations for documentation, control measures, worker performance, records management and reporting requirements.

Grading Systems for Safety Control Areas

Grade	Definition	Risk to Health, Safety, Security and the Environment
A	exceeds requirements	no unreasonable risk
B	meets requirements	no unreasonable risk
C	below requirements	no unreasonable risk but potential
D	significantly below requirements	high potential for unreasonable risk if not corrected
E	unacceptable	very high potential for unreasonable risk

1.1.2.1 Type I Inspection

Type I inspections (also known as audit) are in-depth examinations of a licensee's processes and operations and typically occur at the licensee's operational site(s). Compliance verification is done through direct observations of work activities, a comprehensive review of procedures and records, and staff interviews. This type of inspection will include the participation of several CNSC staff members, who may be onsite for a period of several days. At the end of the inspection, the licensee is presented with the preliminary findings, and a complete report is sent to the licensee within 60 days of the inspection. The licensee is given a list of non-compliances found, and must provide timelines for addressing these findings. Should something be found during the inspection that is an imminent threat to health, safety or the environment, the NSCA provides inspectors with the power to immediately order cessation of these activities.

1.1.2.2 Type II Inspection

A Type II inspection is an onsite snapshot of the licensee's operations. These inspections are typically shorter than Type I, since extensive interviews are not performed, and data is collected mainly through direct observations, measurements and reviews of onsite records. At the end of the inspection, the licensee is presented with a preliminary report, and a complete report is sent to the licensee within 30 days of the inspection. The licensee is given a list of non-compliances found and must provide timelines for addressing these findings. Should something be found during the inspection that is an imminent threat to health, safety or the environment, the NSCA provides inspectors with the power to immediately order cessation of these activities.
Reference: http://nuclearsafety.gc.ca/eng/nuclear-substances/licensing-nuclear-substances-and-radiation-devices/licensing-process/index.cfm

An inspection worksheet that lists the general expectations regarding regulatory requirements for a consolidated Licence, like the one issued to the University of Lethbridge, would be used. The worksheet listed columns are as follows;

- Description Column: provides a brief description of the regulatory requirements
- Regulatory Requirements Column: provides the source of the regulatory requirements
- Compliance expectation Column: provides a brief instructions to the Inspector on what to verify
- Information Gathering Methods: may be by interviews, observation, document review (policies and procedures), or records review (Authorized users, contamination records, inventory sheets, Waste disposal sheets, Dosimetry records).
- Risk Column: provides the SCA numbering and the level of risk associated with the listed requirement. Levels of Risk as High– immediate health safety or security risk, Medium– health, safety or security risk, but not immediate, Low– not health, safety or security risk, administrative issues.

Reference: http://nuclearsafety.gc.ca/eng/pdfs/nuclear-substances/Type-II-Inspection-815-eng.pdf

1.1.2.3 Annual Compliance Report

Completion of an Annual Compliance Report (ACR) is required by the CNSC. The ACR is a summary of

the licensee activities in the previous year. This keeps the CNSC advised of the status of the licensee's nuclear substances, prescribed equipment, locations and licence contact information. The Radiation Safety Officer will prepare the ACR on behalf of the Radiation Safety Committee. The ACR will be submitted within three months of the anniversary date of the licence.

Internal Permit Holders must maintain the following records to provide information required for annual reporting (ACR).

1. Receipt of radioactive material records
2. Inventory Records (accounting for stock materials, materials in use, disposal)
3. Contamination (swipe test) records
4. List of Authorized Workers
5. Incident reports
6. Leak Test records for sealed sources (if applicable)
7. Authorized Workers verification of competency and training records

- The above records shall be maintained in the format provided by the Radiation Safety Committee and kept in accordance with Radiation Safety & Procedures Manual.
- These records must be maintained up-to-date and available for inspection by radiation safety personnel and officers of the Canadian Nuclear Safety Commission at any time.

1.2 UNIVERSITY OF LETHBRIDGE RADIATION SAFETY PROGRAM

The University of Lethbridge considers health and safety to be a priority and is committed to providing a safe and healthy work and study environment for the entire University community. This is achieved by meeting or exceeding all regulatory requirements and ensuring that the University fully implements its Health and Safety Management System. The goal of the University of Lethbridge is to integrate health and safety into all aspects of University activities. All faculty members, employees, students, volunteers, contractors and visitors are required to comply with all University health and safety policies, procedures and rules, as well as all applicable legislation.

1.2.1 Support and Advisory Services

The University will provide support and advisory services in health and safety to assist those with responsibilities for health and safety through the Department of Campus Safety - Safety Services is responsible for identifying regulatory requirements, developing support and advisory services to assist University employees in carrying out their responsibilities and reporting regularly to the Senior Executive on the University's occupational health and safety status and performance.

1.2.2 Obligations of Licensees

The General Nuclear Safety and Control Regulations (Ref. 2) list the obligations of licensees (i.e. holder of a license issued by the Canadian Nuclear Safety Commission) as follows:
1) Ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the Nuclear Safety and Control Act, the regulations made under the Act and the license;
2) Train the workers to carry on the licensed activity in accordance with the Act, the regulations made under the Act and the license;
3) Implement precautions necessary to protect the environment and the health and safety of persons and to maintain security;
4) Provide the devices required by the Act, the regulations made under the Act and the license and maintain them within the manufacturer's specifications;
5) Require every person at the site of the licensed activity to use equipment, devices, clothing and procedures in accordance with the Act, the regulations made under the Act and the nuclear substances license;
6) Take all reasonable precautions to control the release of radioactive substances or hazardous substances within the site of the licensed activity and into the environment as a result of the licensed activity;
7) Implement measures for alerting the licensee to the illegal use or removal of a radioactive substance, prescribed equipment or prescribed information, or the illegal use of a nuclear facility;
8) Implement measures for alerting the licensee to acts of sabotage or attempted sabotage anywhere at the site of the licensed activity.
9) Implement measures necessary to facilitate Canada's compliance with any applicable safeguards agreement;

10) Instruct the workers on the physical security program at the site of the licensed activity and on their obligations under the program; and
11) Maintain a copy of the Act and the regulations made under the Act that apply to the licensed activity readily available for consultation of workers.

As the licensee, it is the responsibility of the University of Lethbridge to ensure that these obligations are met through the organizational structure outlined in the following section.

1.2.3 Applicant Authority: Vice-President, Research (VPR)

The VPR is the Applicant Authority for the licence issued to the University by the CNSC. The CNSC requires a member of senior management to sign a licence application to certify that he/she has been designated as the Applicant Authority and acknowledges that he/she has full legal and financial responsibility for the licence.

1.2.4 Radiation Safety Committee

The Radiation Safety Committee (RSC) is part of the Joint Biosafety/Radiation Safety Committee (JBRSC). The JBRSC acts on behalf of the University as an advisory committee for all activities within the University community involving biohazardous/infectious materials, nuclear substances, radiation devices, and designated radiation equipment capable of emitting x-ray or laser radiation. All activities must be conducted safely and in conformance with generally accepted standards as required by the University's defined safety programs. All activities must comply with applicable federal and provincial legislation along with relevant standards and guidelines.
The JBRSC is responsible for coordinating and controlling all activities related to radiation safety. The JBRSC advises on radiation safety matters in general and the effectiveness of radiation protection programs within the organization.

Membership

Potential members shall be recruited through nomination. Members shall be appointed to the JBRSC by the Vice-President Research following consult with the appropriate Faculty Dean. The guiding principle is to ensure that the membership is of adequate size and composition to effectively manage the JBRSC workload and to ensure a reasonable pool of expertise. The JBRSC will be a working committee representative of the University community and will be comprised of the following members:

- Six members (faculty or technical staff) one from each of the Departments of Biological Sciences, Chemistry and Biochemistry, Physics, Neuroscience, Kinesiology and Health Sciences. Members will be selected based upon their experience and knowledge in working with biohazardous materials and/or radioactive materials, radiation devices and designated radiation equipment.
- One member from an academic department whose work is unaffected by biohazardous/radioactive materials.
- Vice-President Research or Designate (ex officio)
- Biosafety Officer (ex officio)
- Radiation Safety Officer (ex officio)
- The JBRSC Chair will be selected from the committee members, excluding ex officio positions.

Note:

i. Ex officio members are voting members.
ii. The Office of Research and Innovation Services will provide a person to take minutes of the committee meetings.

Terms of Reference for the Radiation Safety Committee

To meet its responsibilities, the RSC has the following mandate and authority:

- To authorize and control, by the issue of internal permits, the use of radiation and emitting sources and materials within the limits of the relevant consolidated or individual licenses issued by the Canadian Nuclear Safety Commission.
- To suspend the use, at the University, of radiation emitting sources/materials and to regulate their use. The RSC determines the corrective actions to be implemented in the event of non-compliance by Internal Permit Holders.
- To inform the University community of the hazards associated with all radiation emitting sources/materials and to regulate their use.
- To provide advice on the safe use of radioactive materials and sources of ionizing radiation in all areas under the control of the University;
- To make recommendations on University governing documents relating to radiation safety;
- To produce and continually review the University radiation safety procedures and protocols.

The complete Terms of Reference are available on the Safety Services webpage.

1.2.4 Radiation Safety Officer

The University of Lethbridge is committed to allocating time and necessary resources so that the RSO's duties and responsibilities and the University's radiation safety program requirements are performed in accordance with all relevant regulatory requirements. The RSO's duties also include:

a) Administer, implement, and enforce the Radiation Safety Program.
b) The RSO has the authority to suspend any radioactive procedures which are considered unsafe, or that have the potential to cause harm to a member of the general public, or the environment.
c) Liaise with Provincial and Federal Government Radiation Safety specialists.
d) Investigates and reports to the Radiation Safety Committee any incidents which would result in contamination or exposure to personnel, or contamination to property.
e) Consult with researchers regarding the storage, use, and disposal of radioactive materials.
f) Consult with researchers regarding the use of ionizing radiation emitting devices.
g) Responsible to provide up to date materials and instruction of the Radioisotope Safety Course.
h) Liaise for licensing matters regarding the University's Radioisotope Consolidated Licence.
i) Designation as the Signing Authority for requesting changes to a license
j) Inform the CNSC of any changes in the RSO position, or any other of the licensee's representatives within 15 days, in accordance with paragraph 15 of the *General Nuclear Safety and Control Regulations (Ref. 2).*
k) Maintain a file on all active radioisotope projects. These shall include inventories of all radioactive sources under a permit holder's control, before the commencement of and after the completion of projects. Such files shall be considered active until all of the radioactive sources have been accounted for, either by disposal or by safe storage;
l) Maintain an inventory of all designated radiation equipment, in accordance with provincial regulatory requirements.
m) Organize and administrate a campus-wide radioactive waste collection and disposal service in accordance with established procedures.
n) Administer the Health Canada National Dosimetry Service on behalf of the users and to maintain all necessary records.

Permit holders (or designate) may act as site-specific (from radioisotope laboratories) assistant RSOs to provide initial assistance for radiation safety needs and initial response to emergencies (such as radioactive spills) under the direction of the RSO.

1.2.5 Internal Permit Holder (Radioisotope)

The Internal Permit Holder has the following responsibilities, in addition to the responsibilities of Authorized Workers in section 1.2.6 below:

a) Ensure that all Authorized Workers as listed on their Permit are aware of all radiation safety procedures;
b) Complete radiation safety training (including refresher training) provided by the University of Lethbridge.
c) Ensure that all Authorized Workers under their direction are trained to work safely with radiation. Internal Permit Holders must provide site-specific training in the safe use of radioactive materials and other sources of ionizing radiation;
d) Regularly assess and inspect their areas for compliance with radiation safety procedures;
e) ensure that any incidents that occur in their area are promptly reported to the RSO; and
f) adhere to all responsibilities and comply with all requirements listed on the Internal Permit and Permit Conditions.

1.2.6 Authorized Workers

Authorized Workers must know and comply with applicable policies, procedures, and regulations when working with nuclear substances, as outlined below:

- Complete radiation safety training (including refresher training) provided by the University of Lethbridge.
- Complete site-specific training provided by the Internal Permit Holder.
- Know the physical properties of the nuclear substances (radioactive materials) that are used in the lab. .
- Reduce the time, increase the distance, and use the correct shielding to reduce external radiation absorbed doses.
- Know what to do in case of a spill or accident with a nuclear substance.
- KEEP ALL FOOD, beverage containers or anything associated with food out of the laboratory.
- Wear dosimeters when required.
- Swipe checks incoming nuclear substances shipments.
- Place absorbent bench coat on the radioactive work surfaces.
- Label the radioactive work area on all four sides with radioactive warning tape.
- Label all equipment that is inside the radioactive work area.
- Conduct radioactive work procedures using good work practices.
- Conduct swipe checks post-procedure for contamination.
- Decontaminate when contamination is found.
- Keep the radioactive area as clean as possible! After an experiment all the areas must be checked for contamination. Contamination levels must be as low as possible, ideally at background levels.
- Record all usage, storage, and disposal of radioactive materials on Radioisotope Inventory Sheets.
- Conduct personal contamination surveys.
- Dispose of radioactive wastes from the laboratory as soon as possible.

1.3 INTERNAL COMPLIANCE

The University of Lethbridge's RSO performs internal audits or inspections on all permit holders on a periodic basis in order to verify compliance with the regulations, licence conditions and internal permit conditions. The inspections are performed at authorized permit holder locations.

The frequency of the inspections is dependent upon room designation level, prior inspection results, frequency of purchases, number of workers, number of new workers, etc. The minimum frequency of performing audits is as follows:

- Basic-Level labs – annually
- Intermediate-Level labs – biannually
- Radioactive device users – annually

Incidences of non-compliance are documented and required to be corrected in a timely fashion. The corrective actions are verified. The results of monitoring and corrective actions are reported to the RSO. Inspection reports are reviewed internally and provide feedback on the effectiveness of the radiation protection program, and assist in identifying deficiencies in training, procedures, facilities and equipment. Appendix D contains an example of internal inspection report forms for:

The RSO will compile an annual internal review report summarizing licenced activities for the Radiation Safety Committee.

1.3.1 Internal Enforcement

The Radiation Safety Committee employs enforcement actions that will encourage compliance and prevent further non-compliance. Enforcement actions may include, but are not limited to:

- Temporary or permanent closure of a radioisotope laboratory
- Temporary suspension of radioisotope user permit and use of radioactive materials
- Revoking radioisotope permit indefinitely

The RSO and the Radiation Safety Committee determine what enforcement action to take, reflecting the severity and repetition of the incidents of non-compliance. A progressive warning procedure will be used when instances of non-compliance occur. Upon investigation, should the Radiation Safety Officer find any violations, the following guidelines will be utilized:

1. Verbal warning to user, outlining deficiencies found and how these deficiencies should be corrected.

2. Follow-up investigation to be conducted within 30 days of verbal warning. Failure to correct prior violations will result in a written warning, requiring the Principal User to provide a written response as to how the deficiencies have been corrected.

3. A follow-up investigation will be conducted within 30 days of the second inspection. Failure to meet conditions one and two which are previously listed will result in loss of user privileges.

The Radiation Safety Committee or the Radiation Safety Officer reserve the right to revoke the user's authorization, at any time, if in the Committee's opinion or the Radiation Safety Officers opinion, the health or safety of persons or property are placed in immediate danger.

Section:	1	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Records and Reporting System	Revision #:	1
		Revision Date:	Jan 24, 2012
Pages:	2	Revised By:	CCD

1.4 RECORDS AND REPORTING SYSTEM

The General Nuclear Safety and Control Regulations prescribe specific records and reports as well as the conditions for their retention and disposal. These records are used to evaluate the University's radiation safety program, maintenance of the ALARA principle and to demonstrate compliance.

Radioisotope Permit Holders shall maintain the following records for each permitted use and storage location. These records must be kept up-to-date and available for inspection by radiation safety personnel and officers of the Canadian Nuclear Safety Commission at any time:

This includes, but is not limited to:

- A copy of the nuclear substance permit;
- A copy of the CNSC licence (without appendices)
- Nuclear substance permit application documentation;
- Nuclear substance permit amendments;
- Research protocol(s);
- Work procedures;
- Authorized Radiation Worker records;
- Contamination monitoring records;
- Dosimetry records;
- Up-to-date inventory records of nuclear substances and radiation devices listed under the permit;
- Procurement records for nuclear substances and radiation devices;
- Transport and transfer records for nuclear substances and radiation devices;
- Equipment maintenance and certification records;
- Calibration records and instruction manuals for counting equipment (e.g. portable meters, liquid scintillation counters and gamma counters)
- Disposal of waste records;
- Decommissioning records; and
- Reported incidents.

Nuclear substance permit records may only be disposed of in consultation with the Radiation Safety Officer, and in accordance with applicable regulations.

The following is a summary of the records and reports that must be maintained and available, at the site where nuclear substances are used, for inspection by the CNSC. The RSO shall maintain copies of records associated with all nuclear substance permits at the university.

These records must be retained unless otherwise stated on the radioisotope licence conditions or until written permission to dispose of the records has been received by the CNSC.

1. Names of persons who use and handle nuclear substances (Authorized Worker Lists);
2. If applicable, the names and job categories of persons designated as NEWs;

3. Training program information for workers who handle nuclear substances;
4. Dosimetry records for authorized users;
5. If applicable, internal bioassay results;
6. Records of acquisitions, disposals and transfers of nuclear substances;
7. Inventory of unsealed sources;
8. Inventory of sealed sources and radiation devices;
9. List of laboratories, rooms and other locations designated for the use of nuclear substances;
10. List of storage locations of nuclear substances;
11. Inventory of radiation detection equipment;
12. Wipe test monitoring results;
13. Fixed contamination monitoring results, if applicable;
14. Decommissioning results;
15. Records of methods and characteristics of radioactive waste disposal;
16. Transfer and transport documents;
17. Leak test monitoring results;
18. Details of emergencies and other incidents involving nuclear substances;
19. Documentation related to the internal permit program.

Retention of Records

- Records shall be kept indefinitely, unless otherwise approved for disposition,
- All records must be transferred to the RSO. The RSO will forward the records to be archived to Records Management.
- Written notification to the CNSC for authorization of the intended date of disposal and the nature of the records must be sent at least 90 days before the intended date of disposal

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		Issued By:	Safety Services
Part:	Radioisotope Permits	Revision #:	1
		Revision Date:	Feb 10, 2017
Pages:	4	Revised By:	CCD

2.1 INTERNAL RADIOISOTOPE PERMITS

The University of Lethbridge currently possesses a Consolidated Nuclear Substances and Radiation Devices Licence issued by the Canadian Nuclear Safety Commission. A copy of the Nuclear Substances and Radiation Devices Licence must be posted wherever radioactive substances are stored, used or dispensed. The University Radiation Safety Committee authorizes the purchase, use, and storage of radioisotopes at the University of Lethbridge or at any location governed by this licence. Authorization will be given in the form of an Internal Radioisotope Permit issued under the University of Lethbridge Nuclear Substances and Radiation Devices Licence.

The University of Lethbridge's internal radioisotope permit system ensures the possession and use of any nuclear substance will be controlled within the licensee's operations. The University of Lethbridge is able to effectively coordinate and authorize all uses, quantities and locations of nuclear substances and devices containing nuclear substances through a documented internal radioisotope permit system.

Faculty members who want to purchase, use, or store radioisotopes may apply for a Radioisotope Permit. Non-faculty members cannot possess a Radioisotope Permit.

A Radioisotope Permit consists of the following:

> **Part A** states the name of the Permit Holder, approved radioisotopes, radioisotope possession limits, approved areas and maximum permissible quantity of radioactive material per vial in each type of laboratory
> **Part B** (Authorized Worker List) lists the individuals who are authorized to work under the internal permit, including training information and the date the individual was added to the list.
> **Appendix A-1** state the Conditions of Approval that the Radioisotope Permit Holder must comply with in order to maintain the Radioisotope Permit. The conditions of Approval depend on the type of procedures, radioisotopes, and quantity of radioactive materials used.

All parts of the Radioisotope Internal Permit (A, B and Appendix) must be posted in or near each room, area or enclosure where nuclear substances and radiation devices are used or stored. Internal permit conditions will be revised with new licence requirements and regulations, as appropriate.

2.1.1 Radioisotope Permit Application

The Application for Radioisotope Permit may be requested from the Radiation Safety Officer or downloaded from The University of Lethbridge website. The following is a summary of the permit application process:

1. The applicant requests and completes a permit application form and forwards the original document to the RSO (applicants are advised to retain a copy).
2. Upon receipt of completed application for Radioisotope Permit, the RSO will arrange a

meeting with the applicant to discuss the laboratory requirements and the University Policies and Procedures. An inspection of the proposed areas of use/storage may be required to determine if facilities are acceptable and meet the Design requirements of the CNSC. (The assessment and evaluation check list used in the evaluation of laboratory and premises can be found in the CNSC Design Guide R-52, Rev. 1, *Design Requirements for Radioisotope Laboratories.)*

3. Subject to 2.1.4, the RSO will forward the application to the University Radiation Safety Committee for approval.
4. If approved by the Radiation Safety Committee, the RSO prepares Radioisotope Internal Permit and permit conditions. The Radiation Safety Committee designate signs the approved permit.
5. Permit is issued and reviewed with the Radioisotope Permit Holder.

See Appendix A for samples of a permit application form, an unsealed source permit, a sealed source permit and conditions of permits.

2.1.2 Radioisotope Permit Amendment

The Radioisotope Permit Holder must request an amendment for any of the following:

- Addition or deletion of radioisotopes.
- Change in maximum vial size.
- Change in possession limit.
- Change in location of use and/or storage.
- Renovations to the laboratory space.
- Additions of Authorized Workers.

The Internal Permit Holder may forward a written memo (permit amendment request) to the RSO requesting any amendments to the internal permit.

Subject to 2.1.3, an amended Radioisotope Permit will be prepared by the Radiation Safety Officer and forwarded to the University Radiation Safety Committee for approval.

2.1.3 Radioisotope Permit Renewal

Radioisotope permits must be renewed at least 45 days in advance of the expiry date to ensure that all current conditions still address the radiation safety aspects of any potential changes in the research protocols. The Permit Application Form must be completed and submitted at least one month prior to expiry of the current Radioisotope Permit.

2.1.4 Application / Amendment Rejection

The Radiation Safety Officer will advise the Radioisotope Permit Holder requesting an application or amendment of the reasons why the application or amendment, was not recommended. The University Radiation Safety Committee will be requested to make the final decision if an understanding cannot be reached between the Radiation Safety Officer and Radioisotope Permit Holder.

The Radioisotope Permit Holder requesting an application or amendment may appear before the University Radiation Safety Committee to have the application reconsidered. Requests for reconsideration must be directed to the Chairperson of the University Radiation Safety Committee.

2.1.5 Temporary Transfer of Radioisotope Permit for Sabbatical or Extended Leave

Radioisotope Permit Holders who leave for an extended period of time (sabbatical or longer than a 4 week period) must advise the Radiation Safety Officer prior to leaving, and must arrange a temporary transfer of Radioisotope Permit.

The Radioisotope Permit Holder must arrange for the following:

- Another Radioisotope Permit Holder to assume responsibility for the Radioisotope Permit.
- Arrange for the Radiation Safety Officer to take a physical inventory of radioisotopes.

A Radioisotope Permit suspension may be imposed (see 2.1.6) if temporary transfer of the Radioisotope Permit is not arranged prior to leaving.

2.1.6 Radioisotope Permit Cancellation (Project and Lab Decommissioning)

The Internal Permit Holder may forward a written memo (permit cancellation request) to the RSO requesting that a permit be cancelled when employment is terminated or when there are no plans to continue radioactive work. The University Radiation Safety Committee may cancel a Radioisotope Permit if a Radioisotope Permit Holder cannot demonstrate the continued need for the Radioisotope Permit.

The Radioisotope Permit Holder will complete the following when a Radioisotope Permit is cancelled and the laboratory is decommissioned:

- Forward a written request for cancellation of a radioisotope permit.
- Complete a Hazardous Materials Close-out Form and arrange for decommissioning of the laboratory. The RSO will assist with disposal or transfer of radioactive material and devices/equipment containing radioisotopes.
- Remove radioactive warning tape/labels from all equipment, benches, refrigerators, freezers, and any other equipment that is labelled with radioactive warning tape.
- Complete a survey for removable contamination (swipe check or wipe test) of the laboratories and equipment, and decontaminate as required. Document the contamination survey as this will be required for final approval or for transfer of equipment to another user.
- Ensure all dosimeters, instruments, and other radiation safety equipment is available for collection.
- Contact the Radiation Safety Officer to make final cancellation arrangements.

The Radiation Safety Officer will ensure that all laboratories listed on the Radioisotope Permit are inspected prior to Radioisotope Permit cancellation.

Radioisotope Permit Holders will be responsible for decontamination if any contamination is found during the final inspection.

The Radioisotope Project and Lab Decommissioning Form is included in Appendix A.

2.1.7 Dormant Radioisotope Permit

A Radioisotope Permit Holder may request their Radioisotope Permit be placed into DORMANT status when there are no immediate plans to continue radioactive work. The Radioisotope Permit Holder must contact the Radiation Safety Officer to make arrangements for placing the Radioisotope Permit into DORMANT status.

The Radioisotope Permit Holder will complete the following:

- Dispose of all radioactive materials. Devices and equipment containing radioisotopes may be transferred to another Radioisotope Permit Holder through the Radiation Safety Officer.
- Remove radioactive warning tape/labels from all equipment, benches, refrigerators, freezers, and any other equipment that is labelled with radioactive warning tape.

- Complete a swipe check contamination survey of the laboratories and equipment, and decontaminate as required.
- Ensure all dosimeters, instruments, and other Radiation Safety equipment are available for pick up.
- Contact the Radiation Safety Officer to make final cancellation arrangements.

The Radiation Safety Officer will ensure that all laboratories stated on the Radioisotope Permit are inspected prior to placing the Radioisotope Permit into DORMANT status.

Radioisotope Permit Holders will be responsible for decontamination if any contamination is found during the inspection.

The Radiation Safety Officer may also recommend to the Radiation Safety Committee that a Radioisotope Permit be made DORMANT due to inactivity in ordering and using radioactive materials.

The Radiation Safety Committee may exercise the decision to cancel a DORMANT Radioisotope Permit after two years.

2.1.8 Radioisotope Permit Suspension

A Radioisotope Permit suspension may result when regulations or Radioisotope Conditions of Approval are violated.

a) The Radiation Safety Officer will notify the Executive Director, Campus Safety and the Radiation Safety Committee when violations warrant investigation for Radioisotope Permit suspension.

b) The results of the investigation will be brought before the Radiation Safety Committee.

c) The Radiation Safety Committee will exercise the decision to suspend the Radioisotope Permit or impose other disciplinary action.

2.1.9 CNSC Approval for Special Projects - Projects Using More Than 10,000 Exemption Quantities

The University of Lethbridge internal permit holders who require research projects involving the use of an unsealed nuclear substance in quantity of more than 10,000 times the Exemption Quantity for a radionuclide must contact the RSO for approval.

An application for permit amendment must be completed and forwarded to the RSO and Radiation Safety Committee for review and approval. The RSO must obtain written approval from the CNSC prior to issuing an internal authorization.

Section:	3	Date of Issue:	2007.02.01
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Part:	3.1 Radioisotope Laboratory Designation	Revision #:	1
		Revision Date:	June 22, 2009
Pages:	2		

3.1 RADIOISOTOPE LABORATORY DESIGNATION

Laboratories in which open sources of nuclear substances (radioactive materials) are used are designated as either Basic Level, Intermediate Level, or High Level laboratory. The level of the laboratory is based upon internal hazard potential of the nuclear substance. Limits for the internalization of various nuclear substances have been determined and are listed in Annual Limit of Intake Table (see Appendix E). The criteria for radioisotope laboratory designation are based upon the maximum activity in the stock vial of nuclear substance that will be used in that laboratory. The physical containment requirements are specified in Guidance Document GD-52 Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms. The use of a potentially volatile radioactive material will result in the laboratory being required to have a fume hood. Specific types of radioisotope work (for example, iodinations), may require the designation of a Laboratory as a High level. There may be additional restrictions or requirements based on the procedures being conducted or the total activity of the radioisotopes in use in a specific radioisotope laboratory. In most cases, all radioisotope laboratories at the University of Lethbridge are classified as Basic Level or Storage Rooms.

By definition, these rooms are described below:

CLASSIFICATION	**PURPOSE OF THE ROOM**
Storage Room	A room where any supplies of sealed or unsealed nuclear substances are kept without being handled. Examples include storage of waste and/or decaying radioactive material and supplies of nuclear substances held for future use.
Basic Level	A room in which an unsealed nuclear substance is used which is larger than one 'exemption quantity' as defined in section 1 of the *Nuclear Substances and Radiation Devices Regulations,* and where the largest quantity of each unsealed nuclear substance in one container does not exceed five (5) times its corresponding Annual Limit on Intake (ALI), as defined in section 12 (1) of the *Radiation Protection Regulations.*
Intermediate Level	A room where the largest quantity of each unsealed nuclear substance in one container does not exceed 50 times its corresponding ALI.

As a licence condition, licensees may be required to ensure that the design for every intermediate level room be approved in writing by the Commission prior to using it. The RSO shall refer to the Guidance Document GD-52 Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms for the construction or renovation of rooms designated for the use of unsealed nuclear substances.

The Radiation Safety Officer, based on the information stated on the Application for Radioisotope Permit or Application for Radioisotope Permit Amendment form, will determine laboratory designation and restrictions. Designation of a laboratory is be based upon the amount of radioactive material within a single vial, the types of procedures and the University of Lethbridge Licence conditions.

The Radiation Safety Officer will determine if there are any design inadequacies based upon Guidance Document GD-52 Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms. The Radioisotope Permit Holder will be notified, in writing, of the inadequacies.

The Radioisotope Permit Holder will be responsible for requesting alterations or additional equipment to meet design requirements. The Radioisotope Permit will not be approved if the design requirements have not been met.

Basic Level laboratory criteria are stated below:

Radionuclide	**EQ MBq**	**ALI MBq/yr**	**Basic Level MBq**	**Controlled Area Bq/cm^2**	**Public Areas Bq/cm^2**
H-3	1000	1000	5000	300	30
C-14	10	34	170	300	30
S-35	100	26	90	300	30
P-32	0.1	8	34.5	300	30
I-125	1	1	6.5	300	30

Note: The Annual Limit on Intake (ALI) is the intake in any year of a radionuclide which will result in a committed effective dose of 20 mSv during the 50 years after taking it into the body.

3.2 RADIOISOTOPE LABORATORY IDENTIFICATION (WARNING SIGNAGE)

All accessible entrances to a radioisotope laboratory are required to be posted with appropriate identification to ensure individuals are aware, prior to entering, that a radiation hazard may exist in the laboratory. Service and laboratory personnel are required to be informed of any restrictions on cleaning, maintenance, and service work associated with a particular radioisotope laboratory. The Permit Holder shall ensure that all warning signs and safety posters are correctly posted.

Section 21 of the *CNSC Radiation Protection Regulations* (Ref. 3) requires the posting of a durable and legible sign that bears the radiation warning symbol set out in Schedule 3 and the words "RAYONNEMENT—DANGER —RADIATION", at the boundary of and every point of access to:

- An area,
- A room,
- An enclosure or a vehicle,

If there is a nuclear substance, in a quantity in excess of 100 times the exemption quantity, or when there is reasonable probability that a person in the areas listed above would be exposed to a radiation dose rate greater than 25 uSv/h.

3.2.1 Radioisotope Laboratory Identification and Safety Rules Cards

Radioisotope Laboratory Identification and Safety Rules Cards (Appendix F) are available from the CNSC and will be supplied and posted adjacent to all radioisotope laboratory entrances. The card identifies the laboratory designation and outlines safety rules for working with radioisotopes.

Once the cards are initially posted, the Radioisotope Permit Holder will be responsible for notifying the Radiation Safety Officer if the Identification Cards are missing, defaced and/or if replacement is required. The Radioisotope Permit Holder will be responsible to ensure that all laboratory staff, students and authorized visitors are aware of the Rules. The Radioisotope Permit Holder must ensure the card remains conspicuously posted at all times.

Frivolous posting of signs is prohibited. Section 23 of the *CNSC Radiation Protection Regulations* (Ref. 3) states "No person shall post or keep posted a sign that indicates the presence of radiation, a nuclear substance or prescribed equipment at a place where the radiation, nuclear substance or prescribed equipment indicated on the sign is not present".

Decommissioning of facilities and locations require that all nuclear substances and related radiation warning signs and labels be removed.

Additional cards/posters for opening packages, responding to spills, and using dosimeters are also provided by the CNSC and must be posted, as required.

3.2.2 Posting of CNSC Licence and Internal Permit

A copy of the CNSC licence and internal permit must be posted in each radioisotope laboratory or storage room as indicated in section 14 of the CNSC *General Nuclear Safety and Control Regulations* (Ref. 2).

3.2.3 Emergency Contact Information

The Canadian Nuclear Safety Commission also requires emergency contact information to be available. Licensees are obliged to post the name or job title and telephone number of a person who, in case of an emergency, can initiate the appropriate procedures referred to in a licence and who can be contacted 24 hours a day in case of an emergency

The Radioisotope Permit Holder will be responsible for posting this information, maintaining up-to-date information, and ensuring that all laboratory staff and students are aware of the information on the posting. This shall include posting of the Campus Security 24 hour emergency number and the RSO contact information.

3.2.4 University of Lethbridge Radiation Safety and Procedures Manual

A copy of this manual must be accessible at all times within permitted laboratories. Authorized Workers must be made aware of the location of the manual (either hardcopy or online).

3.2.5 Verification of Doses Around Storage Locations

- Doses in occupied areas around storage locations are assessed using a calibrated and functioning survey meter.

- Doses must be kept below 2.5 uSv/hr. If doses greater than 2.5 uSv/hr are obtained, an investigation must commence and any necessary changes to reduce the radiation field must be made (e.g. installation of appropriate shielding).

- Measurements are made during inspections and when nuclear materials are added to storage locations.

Section:	3	Date of Issue:	2007.02.01
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Part:	Labelling Requirements for Work Areas	Revision #:	New
		Revision Date:	
Pages:	1		

3.3 LABELLING REQUIREMENTS FOR RADIOACTIVE WORK AREAS AND EQUIPMENT

Specific areas within a laboratory must be defined for handling radioactive open sources to protect University of Lethbridge staff, students, and the general public. Well defined areas and equipment alert people to the fact that radioactive contamination of the areas or equipment may exist. The radiation warning symbol is to be prominently displayed, of a size appropriate for the size of the container or area being labelled.

> ***Important Note:*** **Radiation warning signs and symbols must be removed when the area or equipment will no longer be used for radioactive work.**

3.3.1 Defining Radioactive Work Areas

The Radioisotope Permit Holder should choose low traffic areas as radioactive work stations. Bench areas next to a fume hood should be used if part of a procedure requires the use of a fume hood. The following guidelines will make the radioactive work area an easily identified and functional work space.

- Radioactive work areas are required to be made as small as possible, but still allow sufficient room to carry out procedures.
- Radioactive work areas must be defined by radioactive warning tape that displays the radiation warning symbol.
- The radioactive warning tape is required to be visible and fully enclose on all four sides the radioactive work area.
- Radioactive work areas and waste trays are required to be covered with appropriate ABSORBENT bench top covering. **The absorbent side is required to be facing up.**
- The absorbent covering should be changed at least once per week. Replace contaminated covering immediately.
- Work with radioactive liquids must be carried out in a tray if spills will not be completely absorbed by the bench covering.
- Sinks used for cleaning radioactive contaminated glassware should be located in or near radioactive work areas. Only one sink should be defined for this purpose. Radioactive warning tape must completely enclose the sink.
- Large equipment (water baths, centrifuges, incubators, etc.) used in conjunction with radioisotopes must be labelled with radioactive warning tape.
- Small equipment (micropipettes, glassware, etc.) within radioactive work areas must be labelled with radioactive warning tape. It is highly recommended that equipment and glassware be dedicated ONLY to radioactive work.

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Part:	Decommissioning	Revision #:	New
		Revision Date:	
Pages:	1		

3.4 DECOMMISSIONING OF RADIOISOTOPE LABORATORIES AND STORAGE ROOMS

The RSO is responsible for approving the decommissioning of all designated laboratories and storage rooms. Decommissioning of rooms shall be performed as follows.

To decommission a location, all nuclear substances or prescribed equipment and related radiation warning signs and labels are to be removed. A licensee must comply with all decommissioning requirements under the regulations by moving all nuclear substances and radiation devices, ensuring that contamination levels do not exceed the limits specified on the licence and removing all related radiation warning signs and labels. Decommissioning records must be kept for review by the CNSC.

Rooms can be decommissioned and released as needed and in accordance with licence conditions, as long as decommissioning records are kept on file and the list of Authorized Radioisotope Rooms and Classification is updated. Decommissioned rooms may be subject to a CNSC inspection prior to their release from regulatory control.

The CNSC suggests using a decommissioning plan for an authorized building or site, including the following:

1. Characterizing the licenced activities
2. Examining historical information, such as the following:
    - The length of time that nuclear substances and radiation devices were in use;
    - The location where they were used;
    - The specific type(s) and quantities of nuclear substance(s) which were used; and,
    - The information available by consulting previous licences.
3. Planning the processes of monitoring radiation contamination and decontamination
4. Preparing for the monitoring, dismantling and removal of associated equipment
5. Planning for the removal, transfer or shipment and disposal of nuclear substances and radiation devices.
6. Removing or defacing all signs, labels and nuclear substances packaging.
7. Conducting a final radiological survey and submitting a complete report to the CNSC, so that verification of the decommissioning can be completed.
8. Planning for a possible CNSC final inspection prior to releasing of the address from regulatory control.

The decommissioning form in Appendix A must be completed and approved by the RSO.

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		Issued By:	Safety Services
Part:	Access, Control and Security	Revision #:	1
		Revision Date:	September 24, 2011
Pages:	1		CCD

3.5 ACCESS, CONTROL AND SECURITY

Access to radioactive materials is to be controlled from the time of acquisition until disposal. When not in use or not under the direct supervision and control of an authorized worker, nuclear substances and radiation devices should be secured in a locked room, area, enclosure or vehicle.

Radioisotope users are responsible for ensuring that unauthorized personnel do not have access to radioisotopes or unattended radioisotope laboratories when radioactive materials are in use. Radioisotopes are required to be stored in a locked enclosure, fridge, or cabinet during storage or in a locked radioisotope laboratory if unattended by authorized radioisotope users. Radioactive waste must also be stored in a secure area to prevent unauthorized access. Only authorized trained personnel are permitted to have access to radioactive materials. These security measures are necessary to prevent the loss or theft of radioactive materials.

The permit holder shall implement and maintain security measures commensurate with the nuclear substance and/or radiation device in possession, and legislative requirements. This includes, but is not limited to:

• Physical protection of the permitted facility to minimize unauthorized access to work areas, rooms, and enclosures;

• Personnel authorization and clearance (e.g. criminal record check, if required) of Authorized Radiation Workers to work in the facility;

• Inventory management of nuclear substances and radiation devices (e.g. maintenance and verification of radioactive stock, sub-stock, waste and sealed source records)

• Incident reporting, response, and investigation into suspected criminal activity including the loss or suspected theft of nuclear substances and radiation devices under the nuclear substance permit.

NOTE: ***REGDOC 2.12.3: Security of Nuclear Substances: Sealed Sources*** sets out the minimum security measures that licensees must implement to prevent loss, sabotage, and illegal use/possession/removal of sealed sources during their entire life cycle, including while the sources are in use. **Information regarding Category 4 & 5 sources is provided in the UofL Sealed Source Security Standard Operating Procedure (Appendix J).**

3.5.1 Responsibilities for Maintaining Security:

- Access to radioactive materials is to be controlled from the time of acquisition until transfer or disposal. When not in use or not under the direct supervision and control of an authorized worker, nuclear substances and radiation devices should be secured in a locked room, area, enclosure (e.g. storage freezer) or vehicle.

- It is the responsibility of the Radioisotope Permit Holder to secure nuclear substances in their possession and ensure the materials are stored in a manner to prevent unauthorized access or removal. **Nuclear substances must be secured in such a manner that an individual with authorized access to the area (Caretaking, Maintenance, Materials Management staff) but who is not authorized to use or possess the materials cannot gain access or control of the materials.**
- It is the responsibility of the Radioisotope Permit Holder or his/her designated Authorized Workers to maintain surveillance over nuclear substances when in use. If constant surveillance of the nuclear substance cannot be maintained then the nuclear substances must be secured.

- Personnel authorization and clearance (e.g. criminal record check, if required) of Authorized Radiation Workers to work in the facility;

- Inventory management of nuclear substances and radiation devices (e.g. maintenance and verification of radioactive stock, sub-stock, waste and sealed source records).

- The Permit Holder or his/her designate must immediately any actual or suspected loss or theft. of a nuclear substance or radiation device to the RSO. An investigation must begin immediately.

- Radioisotope Permit Holders are to ensure that all authorized non-users that access the laboratory, review the radiation safety guidelines for non-users and maintain a record of the review. Alternatively, non-users can complete the online introductory radiation safety course.

3.5.2 Accessibility and Security of Nuclear Substances

- Radioisotope users are responsible for ensuring that unauthorized personnel do not have access to radioisotopes or unattended radioisotope laboratories when radioactive materials are in use.

- Radioisotopes are required to be stored in a locked enclosure, fridge, freezer, or cabinet during storage or in a locked radioisotope laboratory if unattended by authorized radioisotope users.

- Door keys for laboratories that store or use Nuclear Substances and for storage freezers or enclosures must be under strict control with a limited number of keys issued to authorized persons only.

- Each Radioisotope Permit Holder is required to maintain a record of all keys that are issued, date of issue and to who the keys are issued. The key records are to be stored in a lockable location, filing cabinet or secure drawer. When an individual leaves the employ of the Radioisotope Permit Holder the key or keys issued must be returned and the information documented.

- Radioactive waste must also be stored in a secure area to prevent unauthorized access. Only authorized trained personnel are permitted to have access to radioactive materials.

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

These security measures are necessary to prevent the loss or theft of radioactive materials. The theft or loss of any radioactive material shall be reported to the Radiation Safety Officer ((403)329-2350 or (403)332-2350) immediately and an investigation must commence.

Section:	4	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Training Requirements	Revision #:	1
		Revision Date:	June 24, 2009
Pages:	2	Revised By:	CCD

4.1 TRAINING REQUIREMENTS

Internal Permit Holders and Authorized Workers (Radioisotope Users)

No person shall be permitted to work with radioactive materials until they have received appropriate training and have been informed of the risks associated with exposure to ionizing radiation. A requirement of the University of Lethbridge's Radioisotope Licence is that only persons properly trained to work with radioactive material and informed of the hazards involved are allowed to handle radioisotopes. Section 12(1) (b) of the *General Nuclear Safety and Control Regulations* requires that every licensee shall "***"train the workers to carry on the licenced activity in accordance with the Act, the regulations made under the Act and the licence".***

The Radiation Safety Officer and the Permit Holder shall ensure that workers have appropriate radiation safety training and/or experience before authorizing the individual to use or handle radioactive materials. A properly trained person is defined as an individual who has successfully completed the University of Lethbridge Radioisotope Safety Course. Each Radioisotope Permit Holder is responsible for training each individual in radiation protection techniques **SPECIFIC** to each procedure. An individual may be exempt from some of the requirements for basic radiation safety training by virtue of past experience; however, all users shall have access and be familiar with the University's radiation safety policies and procedures. Individuals who have extensive experience in handling radioactive materials may challenge the Radioisotope Safety Exam. However, if the individual does not pass the exam they are required to attend the Radioisotope Safety Course prior to using any radioisotopes.

4.1.1 Training

The University of Lethbridge's Radioisotope Safety Course is offered by Safety Services dependent upon demand. Radioisotope Permit Holders are notified of course dates on a periodic basis.

Registration for the Radioisotope Safety Course is on a first come, first served basis. The Radioisotope Permit Holder will ensure that all individuals complete the Radioisotope Safety Course prior to using radioactive materials in any laboratory at the University of Lethbridge.

Individuals who require radiation safety training must receive instruction from a qualified Radiation Safety Specialist or attend an approved training course. Minimum training should include the following subjects:

1. Orientation Lecture
2. Regulatory Requirements
3. Structure of Matter
4. Radiation and Radioactivity/characteristics of radiation
5. Radiation Units
6. Radiation detection and measurement
7. Control of radiation exposure and basic principles of radiation protection

8. Contamination control and monitoring
9. Biological effects and risk
10. Operating and emergency procedures
11. Transportation requirements
12. Practical exercises

The CNSC Guide G-313 Radiation Safety Training Programs for Workers Involved in Licensed Activities with Nuclear Substances and Radiation Devices, and with Class II Nuclear Facilities and Prescribed Equipment and the REGDOC-2.2.2, Version 2 Human Performance Management – Personnel Training were reviewed and used to produce the University of Lethbridge's Radiation Safety Training.

Personnel making incidental contact with radioactive materials (Ancillary Workers) should also receive basic training to enable them to realize when they may be placing themselves at risk, whom to contact in the event of an emergency, and what simple steps to take to protect themselves and others until qualified radiation safety personnel arrive. These groups may include personnel in shipping/receiving, caretaking staff, contractor and maintenance staff, security and emergency personnel. For example, radiation safety seminars or video should be delivered to these groups on an "as required" basis.

Training Records shall be kept by the RSO, including the following information:

1. Course dates;
2. Names of the workers who attended each course;
3. The content of each course or level of training; and
4. The name of the instructor of each course.
5. The grade achieved by each worker who attended each course.

4.1.2 Authorized Workers

The Radioisotope Permit Holder must maintain a current list of personnel authorized to use nuclear substances in the laboratory. The names of the authorized individuals should be added or deleted from the internal permit "Authorized Worker and Training List". Radioisotope Permit Holder shall assist the RSO in maintaining this list and keeping it up to date. If applicable, radiation safety training certificates/documentation should be filed with the RSO and be available for inspection.

4.1.3 Authorized Workers – Confirmation Of Learning

The Permit Holder must evaluate new personnel no later than within one month of the worker's use nuclear substances.

Competent users must demonstrate the specific knowledge and skills as presented in the Radioisotope Safety Course during work procedures. The Radioisotope Permit Holder or designate must review and complete the Research Employee Training and Competency Record (Appendix G).

4.1.4 Refresher Training

Retraining of individuals may be required when there is a significant change in duties, equipment, procedures, radioisotope hazards, licence conditions and regulations. ALL Permit Holders and Authorized Workers are required to complete biannual refresher training in order to maintain their status as qualified authorized workers. This is typically done prior to internal permit renewal. The RSO shall determine when and if retraining is required.

Workers who do not complete the re-training or successfully demonstrate competency will be removed from the authorized worker list.

Refresher training will be offered through an interactive web-based computer program to allow individuals to complete at their own pace and time. Additionally, upon request the refresher presentation can be given in person by Radiation Safety Officer.

Section:	4	Date of Issue:	2007.02.02
		Issued By:	Safety Services
Part:	Designation of NEWs and Authorized Workers	Revision #:	New
		Revision Date:	
Pages:	1	Revised By:	

4.2 DESIGNATION OF NUCLEAR ENERGY WORKERS AND AUTHORIZED WORKERS

A Nuclear Energy Worker (NEW) is defined as a person who is required, in the course of the person's business or occupation in connection with a nuclear substance, to perform duties in such circumstance that there is a reasonable probability that the person may receive, a dose of radiation that is greater than the prescribed limit (1 mSv) for the general public. Nuclear Energy Workers are required to provide specific information under the CNSC Act and must be registered accordingly.

An **Authorized Worker is defined as "*a person who is not a NEW*"** who handles radioactive materials or works in an area where there is likelihood for accumulation of an annual radiation dose of not greater than 1 millisievert.

All users of nuclear substances (radioactive materials) at the University of Lethbridge are currently designated as Authorized Workers. There are no workers classified as Nuclear Energy Workers (NEW) at the University of Lethbridge

4.2.1 Pregnant Nuclear Energy Worker

Every Nuclear Energy Worker who becomes aware that she is pregnant must immediately inform the Radiation Safety Officer by completing Nuclear Energy Worker – Declaration of Pregnancy. The Radiation Safety Officer will meet with the individual to discuss work assignments, outline potential risks and answer any questions.

Section:	5	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	ALARA - Introduction and Justification	Revision #:	New
		Revision Date:	
Pages:	2	Revised By:	

5.1 ALARA - INTRODUCTION and JUSTIFICATION

Sources of ionizing radiation are potential hazards to workers who are occupationally exposed. The CNSC, through the authority of applicable acts and regulations, is responsible for the control, supervision of development, application and use of nuclear energy Compliance with legislation by applicable acts and regulations ultimately rests with the Internal Permit Holders and Authorized Workers, with oversight by the Radiation Safety Committee and the Radiation Safety Officer along with support from senior management.

The University holds a radioisotope licence(s) issued by the CNSC. To qualify for this licence, the University's radiation safety program must comply with the CNSC Act, Regulations and the licence conditions. Revocation or suspension of the University's licence may occur should the University not comply with these requirements.

The University is committed legally and morally to ensuring that radioactive materials are used and handled in accordance with conditions of their licence and federal regulations.

As Low As Reasonably Achievable (ALARA)

The current accepted regulatory guiding principles for radiological protection have been adopted from the International Commission on Radiological Protection (ICRP) Publication 60 ***"1990 Recommendations of the International Commission on Radiological Protection".*** The guidance document has three main foundations for radiological protection.

I. ***Justification*** - the need to justify any activity which involves radiation exposure on the basis that the expected benefits to society exceed the overall societal detriments.

II. ***Optimization*** - the need to ensure that the benefits of such justifiable activities or practices is maximized for the minimum associated societal detriment, economic and social factors being taken into account.

III. ***Dose and Risk Limitation*** - the need to apply dose limits to ensure that individuals or groups of individuals do not exceed acceptable levels of risk, and an appraisal of the steps taken to limit the probability of potential exposures.

The maximum permissible doses (also referred to as dose limits) is in no way to be referred to as "dose allotments" which can and should be used up. On the contrary, the guiding principle of all radiation work is: the dose should be **A**s **L**ow **A**s **R**easonably **A**chievable, economic and social factors being taken into account. This is called the "**ALARA**" principle and is central to all radiation safety. The University of Lethbridge expects workers to work with nuclear substances in a fashion that reflects this universally adopted radiation exposure control philosophy. The University is committed to keeping radiation exposures as low as reasonably achievable and will take all appropriate steps necessary to support the ALARA concept.

The Radiation Protection Regulations require all licencees to implement a radiation protection program to keep exposures “As Low as Reasonably Achievable (ALARA)”, through the management and control of:

- work practices;
- personnel qualification and training;
- occupational and public exposure to radiation; and
- planning for unusual situations.

5.1.1 Authorized Workers

Authorized Workers are obligated to take all reasonable precautions to ensure the worker’s own safety, the safety of the other persons at the site of the licenced activity, the protection of the environment, the protection of the public and the maintenance of security.

5.1.2 Radiation Safety Officer

The Radiation Safety Officer will review quarterly the occupational radiation exposures of all monitored workers and advise personnel of their recorded doses. An annual report is provided to the Radiation Safety Committee. The dose limits set by the CNSC apply to all users of nuclear substances.

Section:	5	Date of Issue:	
		Issued By:	Risk & Safety Services
Part:	Personnel Dose Monitoring	Revision #:	3
		Revision Date:	Feb 10, 2017
Pages:	4	Revised By:	CCD

5.2 PERSONAL DOSE MONITORING

Canada's Radiation Protection Regulations specify radiation dose limits for the possession and use of radioactive prescribed substances in Canada. These dose limits ensure the level or risk from working with radioactive materials is not greater than the risk experienced by other industries wit a high standard of safety. Individual users of radioactive material are responsible for keeping their occupational radiation exposures as low as reasonably achievable.

Canada's Radiation Protection Regulations specify that:

- personal monitoring is required for each NEW who is likely to receive more than 5 mSv/year;
- dosimeters must be worn properly to ensure that they accurately record the external doses received by the wearers;
- dosimeters must be exchanged at a predetermined frequency; and
- the licensee's dosimetry service must be licensed by the commission.

The RSO shall determine if an individual is required to participate in a bioassay program or wear a personal dosimeter (thermoluminescent (TLD) or optically stimulated luminescence (OSL)) dosimeter. This decision is based on the potential exposure of an individual and pursuant to CNSC's *Regulatory Document G-91 "Ascertaining and Recording Radiation Doses to Individuals".* Generally, personal monitoring shall be performed:

- For every "*Nuclear Energy Worker, including pregnant NEWs"*
- For "*a person who is not a NEW*" who handles radioactive materials or works in an area where there is likelihood for accumulation of an annual radiation dose of 1 millisievert (mSv).

All University of Lethbridge workers are classified as *"a person who is not a NEW*"; therefore, their annual whole body dose limit is 1 mSv. These workers are called, "Authorized Radioisotope Users" or "Authorized Workers". A NEW's maximum annual dose limit is 50 mSv (or 100 mSv over a 5 year period). A worker's dose is the total of the internal and external dose.

5.2.1 External Monitoring

Instruments that can measure radiation does from external radiation fields are called dosimeters. Dosimeters measure whole body, skin and extremity radiation dose equivalents and are commonly worn by individuals working around penetrating radiation. They are used to measure the accumulated dose to individuals over a period of time (one month: extremity; three months – whole body and skin).

Dosimeters are used to measure:

- Whole body deep dose – gamma; x-rays
- Whole body skin dose – gamma; x-ray; high energy beta
- Extremity (hand) dose – gamma; x-ray; high energy beta

Dosimeters typically do not detect radiation from low energy beta emitting (H-3, S-35, C-14) or alpha emitting radionuclides. These radioisotopes do not present an external hazard. If high energy beta emitters are utilized (P-32), whole body dosimeters must be worn. If the activity is in excess of 50 MBq, extremity dosimeters (finger or wrist) must be worn. Finger or wrist dosimeter should be worn when working behind bench shields.

A dosimetry service must be obtained from a CNSC approved agency such as Health Canada, Radiation Protection Bureau, in Ottawa, Ontario. The dosimeters must be worn and changed as required by the approved agency to ensure external does are accurately recorded. The RSO is responsible for issuing and changing the dosimetry badges. Proper care and use of personal dosimeters should be done in accordance with the information supplied on the CNSC's safety poster INFO-0742.

5.2.2 Internal Monitoring

Internal contamination monitoring is required under certain conditions with the use of some unsealed radioisotopes. Internal radiation exposures are to be measured using a screening or licenced bioassay procedure. Screening procedures must be submitted to the CNSC for approval. Tritium and radioiodine are the more commonly used radioisotopes that require internal monitoring.

Radioiodine:
Licence conditions may require that workers be monitored (thyroid monitoring for I-131 and I-125) for uptake. Every person shall undergo thyroid screening within five days who:
(a)uses in a 24-hour period a quantity of 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 other quantity in other containment approved in writing by the Commission or a person authorized by authorized by the Commission; or

(b) is involved in a spill of greater than 2 MBq of Iodine-125 or Iodine-131; or

(c) on whom Iodine-125 or Iodine-131 external contamination is detected.

Unless otherwise directed by a licence condition, all workers (NEWs and non-NEWs) who handle a quantity of volatile radioiodine at a single time that exceeds the amounts indicated above should be screened for I-125, I-131, or both if necessary. Workers should also be screened if they handle any other amount or type of volatile radioiodine in ways other than those listed above and for which written approval has been received from the CNSC.

Thyroid screening for workers using I-125 and I-131 who meet the screening participation guidelines listed above should be carried out between one and five days of the radioiodine handling or incident (Regulatory Document, RD 58 -Thyroid Screening for Radioiodine).

5.2.3 Application for Dosimetry Service

The University of Lethbridge uses "whole body" ooptically stimulated luminescent (OSL) dosimeters. These dosimeters contain crystals of aluminum oxide doped with carbon (Al_2O_3:C) that absorb radiation and store some of the energy in the form of excited electrons. The dosimeter is read by stimulating the sensitive elements using Light Emitting Diodes (LED), which releases some of the stored energy as light. The amount of released light is measured and used to determine the radiation exposure received by the dosimeter's user during the wearing period. Thermoluminescent dosimeters (TLD) "extremity" (ring) dosimeters may also be used. These contain lithium fluoride (LiF) crystals which measure whole body, skin and extremity radiation does equivalents.

a) A dosimetry application form (see Appendix B), is available from the RSO or the Safety Services webpage and must be completed for individuals that require a Dosimetry badge.
b) The dosimetry form must be returned to the RSO for processing.
c) The RSO will contact the recipient when the badge is ready for delivery or pickup.

The RSO must be advised immediately if any of the following occur:

- Loss of a dosimetry badge
- Contamination of a dosimetry badge
- A laboratory worker undergoes medical procedures that inject or require the consumption of radioactive material
- Change in dosimetry badge requirements
- Name change
- A change of Permit Holder
- An individual is no longer working in the laboratory

The Radioisotope Permit Holder will be responsible for all dosimetry badges issued under their Radioisotope Permit.

5.2.4 Dosimetry Badge Storage

The Radioisotope Permit Holder will ensure that dosimetry badges are stored in an area of low radiation field. Dosimetry badges must be kept away from the use, storage, and waste areas. Alternatively, a dosimetry badge storage board may be installed and used for storage of badges not in use.

5.2.5 Dosimetry Badge Change Periods

Whole body dosimetry badges and ring dosimeters are changed quarterly; approximately the 15th of February, May, August, and November.

The RSO will notify the Radioisotope Permit Holder of the exchange dates. The Radioisotope Permit Holder will collect all dosimetry badges for the laboratory and take them to the appropriate exchange area, as directed by the RSO.
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5.2.6 Dosimetry Reports

All dosimetry reports shall be routinely reviewed by the Radiation Safety Officer to ensure the exposures are as low as reasonably achievable (ALARA). Dosimetry records must be maintained and be available for inspection.

All individuals and the responsible Radioisotope Permit Holder will be notified of any dose estimate above background. Doses exceeding the annual dose limit for a *"NEW"* and *"a person who is not a NEW"* shall be reported to the CNSC and to the person monitored within 24 hours. The causes and circumstances contributing to the dosimetry results and a report on the investigation must be submitted to the CNSC within 10 days.

The RSO will investigate high dose estimate for individuals. An individual receiving a dose estimate exceeding the maximum permissible dose may result in suspension from radioactive work.

Radiation Dose Reports will be sent to each Authorized Worker. Each individual will receive their dose estimates in writing.

5.2.7 Previous Dose History

Health Canada - National Dose Registry (NDR) maintains a central database of occupational radiation dose received by individuals working with radioactive materials in Canada. This is tracked using individual social insurance numbers, thus ensuring readings are assigned to only one person.

Due to the privacy of individual dose records, only the individual can request a copy of their registered dose by completing the required application form and faxing it directly to NDR.

5.3 ACTION LEVELS

In order to retain control over the radiation safety program, and in accordance with the *CNSC Radiation Protection Regulations (sec. 6, SOR/2000-203)*, action levels are defined. "Action level" means a specific dose or other parameter that, if reached, may indicate a loss of control of part of licensee's radiation protection program and triggers a requirement for specific action to be taken.

5.3.1 Radiation Doses

The University of Lethbridge action level is one third the maximum allowed dose limit (see table below). These limits apply to combined external and internal exposures. Any accumulated doses approaching or over the action level will be investigated by the RSO. Hazard control measures will be implemented to prevent or minimize the potential reoccurrence of the exposure.

Type of Exposure	Exposure Period	Effective Dose Limit for General Public and Authorized Workers (mSv)	Action Level for Authorized Worker Exposures (mSv)	Effective Dose Limit for NEW (mSv)
Whole body exposure	1 year	1 mSv	0.3 mSv	50 mSv
Whole body exposure	5 year	------	------	100 mSv
Lens of an eye	1 year	15 mSv	5 mSv	150 mSv
Skin	1 year	50 mSv	16 mSv	500 mSv
Hands & feet	1 year	50 mSv	16 mSv	500 mSv

5.3.2 Radioactive Contamination

Permit Holders and Authorized Workers are required to measure the levels of contamination in laboratories that use nuclear substances and evaluate the levels of contamination (see table below, and Section 11). Licence conditions require that removable contamination does not exceed radionuclide-specific limits on any accessible surfaces within a radioisotope designated Laboratory or on equipment **after** working with nuclear substances.

Class C radionuclides are typically used at the University of Lethbridge. In keeping with the ALARA philosophy, contamination limits are set at or below regulatory limits; however, every effort should be made to maintain contamination levels at or as close to background levels as possible. Contamination limits are based on activity per square centimetre.

Class of Radionuclide	Regulatory Licence Limit		University of Lethbridge	
	Radioactive Control Area Limit	Public Areas / Decommissioning Limit	Limits for Radioactive Work area	Non-Radioactive Areas Decommissioning Limit
Class A - typically long lived and emit alpha radiation	3 Bq/cm^2	0.3 Bq/ cm^2	3.0 Bq/ cm^2	0.3 Bq/ cm^2
Class B - typically long lived and emit beta or gamma radiation	30 Bq/ cm^2	3 Bq/ cm^2	3.0 Bq/ cm^2	0.3 Bq/ cm^2
Class C - typically short lived and emit beta and gamma radiation	300 Bq/ cm^2	30 Bq/ cm^2	3.0 Bq/ cm^2	0.3 Bq/ cm^2

- **The Permit Holder or Radiation Lab Supervisor is responsible for notifying the RSO when contamination is found near or exceeding the UofL contamination action limits.**

- This is to ensure that contamination levels are appropriately mitigated and do not exceed the CNSC limits.

- Contamination exceeding the CNSC limits are reportable to the CNSC.

Section:	6	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	6.1 Acquisition and Control of Nuclear Substances	Revision #:	New
		Revision Date:	
Pages:	2	Revised By:	

6.1 ACQUISTION AND CONTROL OF NUCLEAR SUBSTANCES

There must be complete control of each nuclear substance from the time it is acquired to the time it is released.

"Acquisitions" include loans, purchase or transfers from other licensees or permit holders. The RSO, who must be familiar with the licence limitations and current inventories, must review and approve all acquisitions. Radioisotope possession limits are stated on the University of Lethbridge Consolidated Radioisotope Licence for various radioisotopes. The RSO maintains an inventory of all radioactive materials to ensure the University of Lethbridge does not exceed the Licence possession limits. All acquisitions whether purchased or free of charge must be approved by the RSO.

The Canadian Nuclear Safety Commission **must approve any protocol** that will use greater than 10,000 exemption quantities (see Appendix E). Approval must be received **prior** to the ordering of the nuclear substance for the protocol.

6.1.1 Purchasing Procedure for Radioactive Material

To acquire radioactive material, the permit holder must complete and sign a Radioisotope Purchase Authorization Form and forward it to the RSO. The permit holder is allowed to purchase only those radioisotopes listed on the internal permit. Permit Holders must also verify current inventory for the radioisotopes to be purchased. The RSO will use this information to ensure that the licence possession limits are not exceeded.

If approved, the RSO will enter the requisition into the University's purchasing system. The requisition must include the word "Radioactive" and the RSO's contact information. The RSO will forward confirmation of radioisotope order to Materials Management though the University's requisition system. A copy of all documents must be maintained. (See Appendix B for a copy of Radioisotope Purchase Authorization Form).

Materials Management shall provide suppliers with the RSO's contact information and instructions that no other individuals at the University are authorized to purchase radioactivity directly from the supplier. A copy of the licensee's CNSC licence (or licence number) must accompany the purchase order or transfer document for the nuclear substance or device being acquired.

The RSO shall ensure that the CNSC licence lists the radioisotope, possession limit for unsealed sources (if applicable), maximum activity of sealed source (if applicable) and the type (model and manufacturer) of device (if applicable). If the radioisotope licence does not list the appropriate information or exceeds the possession limits, the acquisition of the radioactive material must be suspended until an amended radioisotope licence has been received from the CNSC.

6.1.2 "NO Charge" Radioisotope Shipments

The Sales representative must supply a QUOTE number if arrangements have been made to receive a FREE sample of radioactive material.

A Radioisotope Purchase Authorization Form must be completed and must include the following information

- "FREE SAMPLE - NO CHARGE SHIPMENT"
- "QUOTE NUMBER – XXXXXXXXXX"

6.1.3 Radioisotope Shipments from Non-Commercial Vendors

Contact the RSO when radioisotopes will be received from another university or institution. The RSO must be contacted a minimum of fourteen work (14) days prior to the expected shipping date.

6.1.4 Spoiled Shipments / Incorrect Item Shipped

The Radioisotope Permit Holder or Designate must direct all enquiries regarding spoiled shipments, or the receipt of incorrect items, to the RSO who will contact Materials Management about replacement orders.

Important Note: **DO NOT CONTACT THE COMPANY DIRECTLY**.

Refer to Section 7 for completion of Radioisotope Inventory Sheets for spoiled shipments, and Section 10 for disposal and completion of Radioactive Waste Disposal Authorization form.

6.1.5 Borrowing Radioisotopes

Radioisotopes may be transferred internally between Radioisotope Permit Holders **ONLY** with approval of the RSO. This must only take place when the radioisotope is stated on the recipient's Radioisotope Permit and the possession limit will not be exceeded.

BEFORE TRANSFERRING THE RADIOISOTOPE a written request must be sent to the RSO for approval of transfer. This must include the following:

- Name and permit number of both permit holders
- Quantity of and type of radioisotope (e.g. 10 uCi 32P)
- Chemical form of radioisotope (e.g. ATP), if applicable
- Lot number, vial number, or other identification number

The RSO will provide written approval of the transfer to both Permit Holders. The transfer must also be documented by writing "Transferred to Dr...." on the lender's Radioisotope Inventory Sheet; and "Received by Dr. …" Note the volume, lot number, chemical form and activity transferred.

Refer to Section 12 if this transfer requires transportation by road.

6.1.6 NUCLEAR SAFEGUARDS

Canada has been a party to the *Treaty on the Non-Proliferation of Nuclear Weapons* (NPT) since 1972. Under the NPT, Canada has accepted International Atomic Energy Agency (IAEA) safeguards on all nuclear material. In addition, Canada is obligated to report to the IAEA on nuclear fuel cycle-related research and development activities and on certain nuclear-related manufacturing. These obligations are set out in the safeguards agreements between Canada and the IAEA. The Canadian Nuclear Safety

Commission (CNSC) has the mandate to implement these agreements.

WHAT ARE SAFEGUARDS

Safeguards are measures that provide confidence that nuclear material remains in peaceful use. In practice, safeguards measures include obligations to report nuclear material and activities. Under the safeguards agreements, the IAEA has the right to undertake verification activities to confirm declarations.

To ensure compliance with Canada's safeguards obligations, the CNSC requires that research institutions in Canada performing nuclear fuel cycle-related research and development and related activities make appropriate declarations.

The safeguards agreements define nuclear fuel cycle-related research and development activities as those that are specifically related to any process or system development aspect of any of the following: conversion of nuclear material, enrichment of nuclear material, nuclear fuel fabrication, nuclear reactors, critical facilities, reprocessing of nuclear fuel, and processing of intermediate- or high-level waste containing plutonium, high enriched uranium or uranium-233.

The possession of nuclear materials (uranium, thorium, plutonium), excluding ores, must also be declared and reported to the CNSC's International Safeguards Division (ISD).

HOW DO YOU MAKE A REQUIRED DECLARATION?

Researchers who would like to use safeguarded material are required to submit their request for review and approval by the Radiation Safety Officer and the Radiation Safety Committee.

If approved, a permit outlining conditions of use, etc. may be issued by the Radiation Safety Committee. General Safeguards Program requirements are provided in Appendix XX.

Section:	7	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Radioisotope Inventory Requirements	Revision #:	New
		Revision Date:	
Pages:	2	Revised By:	

7.1 RADIOISOTOPE INVENTORY REQUIREMENTS

"Inventories" of unsealed and sealed nuclear substances include any material in stock or storage, material in use and material waiting for disposal. Radioactive materials must be tracked from acquisition, during storage, use, and until final disposal ("cradle to grave inventory").

The Radioisotope Permit Holder is responsible for maintaining detailed inventory of all radioactive materials acquired under the Radioisotope Permit. These Radioisotope Inventories provide required information during an incident or an exposure investigation. Current inventory records shall be maintained in the areas where the nuclear substances are used or stored and be available for inspection by the RSO or the CNSC. Suspension of purchasing privileges or cancellation of the Radioisotope Permit may result from failure to maintain an up-to-date inventory.

7.1.1 Unsealed Nuclear Substance Inventory

Upon receipt of an approved unsealed radioactive shipment, a Radioisotope Inventory Record is required to be completed. A separate Radioisotope Inventory Record must be maintained for each shipment purchased and received. Radioisotope shipment information (including batch tracking), daily radioisotope usage, experimental product information, storage location and disposal/release activities are to be recorded on this form. (See Appendix C for copies of Original and Sub-Stock Radioisotope Inventory Record forms).

The information required to complete the first section of these forms (shipment information) can be obtained from the packing slip and/or the stock vial. The remaining information is to be filled in by the Authorized Worker as the material is used.

7.1.2 Sealed Source Inventory

Upon receipt of approved purchases of sealed sources, the RSO must be advised so the required information for the sealed source can be acquired and the appropriate sealed source inventory record(s) be amended. The information required is the supplier name, licence number (if applicable), manufacturer, model number, radionuclide, source size, calibration date, serial number, storage location and date of receipt.

7.1.3 Releases or Transfers

"Releases" of nuclear substances from a licensee's possession include transfers to another licensee and disposals as waste.

7.1.3.1 Internal Transfers

The transfer of radioactive materials to or from another location or permit holder within the University is prohibited without authorization from the RSO. Internal transfers should be treated as an acquisition or purchase. The Radioisotope Inventory Sheet must document the transfer as outlined in section 6.1.6 Borrowing Radioisotopes.

7.1.3.2 External Transfers

The transfer of radioactive materials to an external or an outside organization's radioisotope licensee is prohibited without authorization from the RSO. Nuclear substance and radiation devices can be transferred or accepted only if each material is specifically authorized in the recipient's current CNSC licence. The recipient may need to apply to the CNSC for a licence amendment before any transfer can occur. A copy of the recipient's valid radioisotope licence must be obtained before the transfer takes place and be available for inspection.

7.1.3.3 Disposal Activities

Permissible disposal methods of nuclear substances are outlined in internal radioisotope permits. The Sealed or Unsealed Radioactive Source Inventory records shall be amended and reflect the release, transfer or disposal of the material.

7.1.4 Records

Complete records of transfers, releases and disposals must be maintained that include:

- Date of transfer;
- Recipient's name, address and licence number;
- Name, quantity and form of the nuclear substance;
- Activity, manufacturer, model and serial number associated with the radiation device(s) and sealed sources;
- Copy of most recent leak test of devices or sealed sources of > 50 MBq;
- For sealed sources or devices a completed CNSC "Record of Disposition of Radioactive Material";
- A TYPE A or B transport container certificate, (if applicable) and
- A special form certificate (if applicable).

The RSO shall ensure appropriate transfer and release documentation is completed and radioisotope licences and transport regulations are complied with before the transfer takes place.

Section:	7	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Receiving Radioisotope Shipments	Revision #:	1
		Revision Date:	Feb 10, 2017
Pages:	5	Revised By:	CCD

7.2 RECEIVING RADIOISOTOPE SHIPMENTS

The handling, packaging, transport and receipt of radioactive material is governed by the requirements of the *Packaging and Transport Regulations* under the *Nuclear Safety and Control Act* and the *Transportation of Dangerous Goods Regulations* of Transport Canada. Only trained and authorized workers may receive deliveries of nuclear substances to ensure security of the material and safety of workers and the public.

Radioactive material shipments are delivered and accepted at the University only during normal working hours, unless other arrangements have been made. The shipments are to be made without delay to the shipping/receiving department and then delivered to the appropriate laboratory.

Primary shipping containers for radioactive material that have been packaged incorrectly or damaged during shipment are potential sources of radioactive contamination. Incoming radioactive shipments that are opened without due caution can lead to unnecessary personal radiation exposure and contamination. In order to reduce the risk from radiation exposure, incoming shipments must be inspected by Authorized Workers for evidence of damage, tampering, leaks and/or contamination. Authorized Workers should follow the procedures below in order to limit the spread of contamination in the event of a leaking package.

7.2.1 Procedures for Opening Packages Containing Nuclear Substances

- Only trained and authorized workers should open packages containing nuclear substances and radiation devices.
- Always wear suitable gloves, safety glasses and a lab coat when handling and opening a shipment of unsealed radioactive materials. When suitable, use remote handling tools for manipulation of the primary container to keep radiation doses to the hands ALARA.
- The University of Lethbridge typically receives only ‘excepted’ packages containing small quantities of unsealed and sealed sources. Contamination monitoring procedures for incoming packages are outlined in steps 1-8 below. Surface contamination monitoring of the outer package shall be performed if the package appears damaged (see step 1 below) or if contamination is found on the primary container (see step 5 below). In these cases, all packaging and areas coming into contact with the package shall be checked for contamination.
- Shipment of outgoing packages of unsealed sources is typically not required at the University of Lethbridge. When this is required, the inner primary container and the outer packaging shall be wipe tested for removable contamination. Measurement of radiation fields shall also be performed and documented, if required. The CNSC poster outlining guidelines for handling packages containing nuclear substances is also posted in each lab and outlines basic procedural requirements.

As soon as practicable upon receipt of the package and before opening the radioactive material:

Step 1: Visually inspect the outer package(s) for damage and leakage immediately upon receipt. If the package does not appear damaged, proceed to step 2. If the package appears damaged, isolate the package to prevent further contamination and notify the lab supervisor and the RSO. Notify the delivery person and request that he/she remain on site (in a confined area) until the exterior and interior surface of the package is checked for contamination. It may be necessary to check the delivery vehicle for contamination.

Step 2: Using an appropriate and calibrated radiation survey meter, measure the radiation fields at one meter from the outer surface of the package and compare these values with the Transport Index stated on the package safety marks. (Note the value on the package is the Transport Index (TI). The TI is the maximum radiation field in microsieverts per hour at 1 meter from the exterior surface of the package divided by 10). Take readings on contact with the surface of the package and confirm that the appropriate safety marks have been attached to the package. Note any discrepancies.

Step 3: If the radioactive material is volatile or a powder, place the package in a fume hood. A suitable containment area (tray or glove box) may be adequate if the material does not have a high toxicity rating.

Step 4: Open the outer package and check for possible damage to the contents, broken seals or discoloration of package materials. If the package appears damaged, isolate it to prevent further contamination and notify the supervisor and the RSO. Wipe test the interior packaging and record the results.

Step 5: If no damage is evident, remove inner package or primary container and wipe test the container. If contamination is detected, monitor all packaging and if appropriate, all areas coming into contact with the package for contamination. Contain the contamination, decontaminate, and document the results.

Step 6: Avoid unnecessary direct contact with unshielded containers.

Step 7: Verify the radioisotope, activity, calibration date and any other details with the information of the packaging slip and with the purchase order or transfer document. Place the radioactive material in a secure area and log the source in the inventory record.

Step 8: Report any anomalies (radiation levels in excess of the package labelling, incorrect TI, incorrect safety marks, contamination, leakage, short or wrong shipment, etc.) to the Permit Holder in charge for notification of the consignor, supplier, RSO and the CNSC (if applicable).

7.2.2 Maximum Allowable Wipe Test Levels

When performing a wipe test on “excepted” and “other than excepted” package surfaces, the maximum allowable levels of non-fixed radioactive contamination **must not exceed 0.4 Bq/cm^2 and 4.0 Bq/cm^2,** respectively.

7.2.3 Procedures upon Receipt of Sealed Radioactive Packages

As soon as practicable on receipt and before opening the radioactive material:

Step 1: Visually inspect the outer package(s) for damage and leakage. If the package does not appear damaged or leaking, go to Step 2.
If the package is damaged or leakage of contents is evident, go to Step 6.

Step 2: If there is no visible damage to the package or leakage of the contents, confirm that the information on the package safety marks are in agreement with the information on the shipping document.

Note any discrepancies.

Step 3: Using an appropriate and calibrated radiation survey meter, measure the radiation fields at one meter from the outer surface of the package and compare these values with the Transport Index stated on the package safety marks. *(Note the value on the package is the Transport Index (TI). The TI is the maximum radiation field in microsieverts per hour at 1 meter from the exterior surface of the package divided by 10).* Take readings on contact with the surface of the package and confirm that the appropriate safety marks have been attached to the package, taking into account if the package was for exclusive use. Note any discrepancies. If there are any discrepancies in Step 2 or 3 contact the shipper. If the package contains a sealed source, go to Step 4; if it contains an unsealed source, go to the section entitled "Procedures for opening packages containing unsealed sources".

Step 4: For sealed sources, there should be a valid leak test certificate, TYPE A or B transport container certificate (if applicable) and a special form certificate (if applicable) provided with sealed source shipments. The certificate(s) may be attached to the shipping document or to the source container. If no leak test certificate is provided, carry out a leak test on the sealed source container. Maintain a copy of the leak test certificate for a minimum of three years. If no TYPE A or B certificate is provided, contact the shipper or manufacturer to obtain a copy.

Step 5: Open the outer container and visually inspect the source holder for damage and to ensure that the shutter mechanism (if applicable) is locked in the closed position. Verify the source holder manufacturer, model number, serial number, radioisotope, source size, manufacture date and any other details with the information on the packaging slip and with the purchase order or transfer document. Place the sealed source in a secure area and log it in the radioactive source inventory.

Step 6: *If the outer package appears damaged* the delivery person shall be notified and requested to stay on site until the package is opened and the radioactive source is checked for potential leakage. If there is evidence of leakage above 200 Bq, the delivery person and the transport vehicle shall be checked for radioactive contamination and the delivery employer notified. The consignor should also be notified.

Step 7: if there appears to be damage to the package or leakage of the contents, measure:

i. The radiation level at the surface of the package. It should not exceed 2000 uSv/hr (Yellow III label).
ii. The radiation level at 1 meter from the surface of the package. It should not exceed 100 uSv/hr (Yellow III label).
iii. The activity of any non-fixed radioactive material on the external surface of the package. It should not exceed 0.4 Bq/cm^2 and 4.0 Bq/cm^2 for beta-gamma and all alpha emitters respectively over an area not exceeding 300 cm^2 .

Determine whether the measurements referred to in Step 7 are within applicable limits imposed by the Packaging and Transport Regulations under the Nuclear Safety and Control Act, and the Transportation of Dangerous Goods Regulations of Transport Canada, taking into account the safety marks borne by the package and whether it was exclusive use.

Step 8: Any anomalies (contamination, leakage, short or wrong shipment, wrong safety marks, etc.) shall be reported to the Permit Holder and the RSO.

<u>The consignor and CNSC shall be informed immediately if</u>:

i. The discovery of any crack, split, wasting of material due to corrosion, or other defect which calls into question the integrity of the packaging or source holder.
ii. The radiation field on contact with the outer package exceeds 2000 uSv/hr (or 10, 000 uSv/hr for an exclusive use package) and/or the radiation field at 1 meter exceeds 100 uSv/hr (or the TI is greater than 10).
iii. The activity of any non-fixed radioactive material on the external surface of the package exceeds 0.4 Bq/cm^2 and 4.0 Bq/cm^2 for beta-gamma and all alpha emitters respectively over an area not exceeding 300 cm^2

iv. Applicable limits set out in the Packaging and Transport Regulations under the Nuclear Safety and Control Act were exceeded.

Should the CNSC be notified, one must provided full particulars of the packaging and the manner in which the package failed to satisfy any applicable requirements of the Packaging and Transport Regulations under the Nuclear Safety and Control Act. These records shall be retained for inspection for minimum of 2 years.

As described in the Packaging and Transport Regulations:

a) Records of all radioactive packages received and their shipping documents are to be retained for inspection by the "Commission; and
b) **Prescribed reports to the consignor and to the Commission are mandatory, within 21 days** of discovering any damage to or tampering with, a package containing radioactive material.

For more information, refer to CNSC poster *Guidelines for Handling Packages Containing Nuclear Substances INFO-0744* (current version).

7.2.4 Documentation for Received Materials

Trained individuals who receive the radioactive materials in the laboratory must enter the following information on the appropriate "Radioisotope Inventory Sheet" (Appendix C):

- date received
- reference date*****
- activity on reference date*****
- volume received*****
- lot number*****
- concentration on reference date*****
- swipe test results
- room number of storage location
- fridge or freezer number

* This information is stated on the vial and/or technical data sheet.

An inventory sheet number may be written on the lid of the vial, outer vial or on the label of each vial. This facilitates tracking the amount of material in each vial when multiply vials are received with the same lot information.

7.2.5 How to Maintain Radioisotope Inventory During Use, Storage and Disposal

- Each Radioisotope Permit Holder will maintain a Radioisotope Inventory Logbook.
- A "Radioisotope Inventory Sheet" (Appendix C) will be completed for each vial of radioisotope acquired.
- Every Radioisotope Inventory Sheet must be placed in the Radioisotope Permit Holder's Radioisotope Inventory Logbook.

7.2.5.1 Use and Storage

The following must be noted on the inventory sheet each time radioactive material is used:

- Room where material is used
- Procedure name (a brief description of use)
- User name
- Date
- The volume used
- The volume remaining in the stock vial
- Volume of waste disposed of into each container (solid, liquid, LS vial, carcass)
- Container number where the waste was placed (solid, liquid)

- Stored * product **MUST be noted**
- Contamination surveys must be completed as per Section 10.2 after procedures are complete, Indicate on the inventory sheet the date swipe checks were done.

Important Note:
"Stored" refers to radioactively labelled materials that at the end of a procedure are not placed in the waste container immediately, but are kept in the laboratory, for further use i.e. to expose a gel to a film.

The isotopic distribution of the radioactive components in the waste stream being generated must be known. This information is required for waste disposal.

7.2.5.2 Disposal

Disposal of the stock vial does not necessarily mean a balance of zero in the Laboratory. If there is material left in the stock vial for disposal, record the information in the box "Activity in Stock Vial Disposed". Record the "ACTIVITY REMAINING IN THE LABORATORY" on the Radioisotope Inventory Sheet for any stored materials that have not been removed form the laboratory. Due to the long half lives of such isotopes as Na-22, H-3, and C-14, and the nature of I-125, accumulation of end product cannot be allowed to go unaccounted for in the laboratory. The isotope must be tracked until it is disposed of entirely.

When the waste is to be removed **FROM** the laboratory, the date of removal, container number, and the activity on that date must be calculated and recorded on the Radioisotope Inventory Sheet in the waste disposal section.

Keep a photocopy of the Radioisotope Inventory Sheet and notify the RSO when wastes are ready for disposal.

The Radioisotope Inventory Sheet must be available for inspection at all times. A physical inventory may be requested during an inspection. A physical radioisotope inventory will be required prior to laboratory relocation, when there are discrepancies in the inventory, and prior to a cancellation of a Radioisotope Permit.

Radioisotope Permit Holders upon termination will NOT remove any radioactive materials from University property, unless arrangements have been made in advance with the RSO.

7.2.6 Annual Radioisotope Inventory Verification

The RSO will send out a request to each Radioisotope Permit Holder for updating the current radioisotope inventory.

The Radioisotope Permit Holder or designate will note any discrepancies on the inventory and return the updated form to the RSO within the deadline provided.

The RSO may request more frequent verification of inventory, as required.

Section:	8	Date of Issue:	2007.02.01
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Part:	Storage, Labelling, and Interlab Transport	Revision #:	1
		Revision Date:	September 24, 2011
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8.1 STORAGE, LABELLING, AND INTERLAB TRANSPORT

Radioactive materials must be stored in such a manner so as to prevent unauthorized access and removal to facilitate the protection of the University of Lethbridge employees, students, and the general public.

- Individuals must be made aware of potential radiation hazards through the use of signs and labels.
- Radioisotope users are responsible for ensuring that unauthorized personnel do not have access to radioisotopes or unattended radioisotope laboratories when radioactive materials are in use.
- Radioisotopes are required to be stored in a locked enclosure, fridge, or cabinet during storage or in a locked radioisotope laboratory if unattended by authorized radioisotope users.
- Radioactive waste must also be stored in a secure area to prevent unauthorized access.
- Only authorized trained personnel are permitted to have access to radioactive materials.

These security measures are necessary to prevent the loss or theft of radioactive materials.

8.1.1 Storage and Labelling of Radioactive Materials

Radioactive materials will be stored in the following locations only:

- Laboratories as stated on Radioisotope Permits. Laboratories with radioactive materials must be secured when not occupied.
- Other areas as stated on the Radioisotope Permit Conditions of Approval.
- A locked container during field studies.
    - All refrigerators and freezers are required to be locked at all times, except when removing or replacing items. All storage areas (e.g. refrigerators, freezers, cabinets, cupboards, etc.) must be secured with a quality security lock. The maximum number of keys for storage areas should be kept to a minimum (no more than three), not be marked or labelled in any way and must remain with the key holder (keys are not to be left out in plain sight with labels indicating location).
    - When a room containing nuclear substances is unoccupied for any period of time such as lunch, lab meetings, etc. the room must be locked.
    - Counting rooms must be secured if nuclear substances are present.

Note: It is recommended that radioactive materials **NOT** be stored in a fridge/freezer located in hallways or interlabs. However, if such storage is necessary then fridge/freezer are required to be locked at all times, except when removing or replacing items.

All storage areas must be labelled with a radiation warning symbol, and a label indicating the isotopes that may be stored in the area. Examples of storage areas are refrigerators, freezers, lead castles, and

cupboards.

All storage containers must be labelled with the radioactive warning symbol, the isotope, the activity, and the reference date. Examples of storage containers are:

- Original shipping containers
- Lead pigs
- Test tubes, beakers, etc.

Where a radiation field exceeds 2.5 µSv/h within a storage area, a sign must be posted stating the radiation field on contact with the isotope(s) and the radiation field on the outside of the storage area. The radiation field on the outside of the storage area should not exceed 2.5 µSv/h. Shielding is required to reduce the field to below 25 µSv/h. In most cases it will be practical and advisable to shield radioactive material such that radiation fields to which workers are exposed are less than 2.5 µSv/h (0.25 mR/h).

The Radioisotope Permit Holder must notify the Radiation Safety Officer if a radiation field is suspected to be above 2.5 µSv/h. The Radiation Safety Officer will take the necessary measurements and advise on the appropriate shielding.

8.1.2 Movement of Nuclear Substances between Laboratories

Radioactive materials are required to be moved or transported in a sealed and unbreakable secondary container to prevent contamination of personnel and any publicly accessible areas.

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9.1 RADIOACTIVE WASTE DISPOSAL REQUIREMENTS

- The Radioisotope Permit Holder must dispose of all radioactive waste generated according to the procedures set out by the University of Lethbridge. Radioactive waste generated at the University of Lethbridge will be transferred to a CNSC licensee authorized to accept the specific waste.
- Release to the atmosphere, municipal garbage and sewer system are also possible waste disposal methods that may be utilized by the University of Lethbridge. Disposal limits are determined by the CNSC and are provided in the University's CNSC licence.
- Materials will be considered radioactive wastes when solids, liquids, animal carcasses, animal tissue, and equipment contaminated with radioisotopes are disposed.
- Sealed sources for disposal are considered to be radioactive waste
- Contact the RSO for disposal/transfer of radiation devices,
- Disposal activities are coordinated and approved by the RSO.

Note: Disused Nuclear Sources

- Disused sources are defined any source that is no longer required for academic, research or administrative purposes or will not be used again within a reasonable time frame will be considered unused/disused.
- Unused/disused sources can be identified at any time, in addition to annual inventory.
- The Radiation Safety Committee reserves the right to request that any nuclear source meeting the definition above be identified as disused and sent for disposal.

9.1.1 Radioactive Waste: Handling and Disposal

Radioactive waste materials must be handled and disposed of in a way that prevents unreasonable risk to the public or the environment. Disposal records must be retained. Records should indicate the name of nuclear substance; quantity; form; origin; volume of any waste; disposal method. To reduce the volume of disposed matter, workers should segregate radioactive waste based on half-life and levels of contamination.

The licensee may be required to dispose of each radionuclide differently and according to specifications set out as conditions of a licence.

Below are the different possible methods of disposal. The acceptable characteristics and limits of each method of disposal will be specified as conditions of a licence.

a) Release through the municipal garbage system.

This method is for nuclear substances which are in solid form and uniformly distributed in the waste, with a concentration by weight less than the prescribed limit. This method may be authorized if the applicant's total amount of waste is less than three tonnes per year per licensee address.

b) Release through the municipal sewage system.

This method maybe authorized for nuclear substances which are in water soluble liquid form, and if the applicant's total annual quantity of waste is less than the prescribed limit for each building.

c) Release into the atmosphere.

This method may be permitted for nuclear substances which are in gaseous form and which are incidental to the applicant's normal operations. This method is limited to the applicant's disposal of less than three million cubic metres per year. It is not permitted as a deliberate means of disposal unless the applicant obtains prior approval in writing from the Commission.

d) Transfer to a CNSC licensee authorized to accept the specified waste.

e) Transfer/return to the supplier.

All other waste disposal methods will require specific and prior written approval from the CNSC.

9.1.2 Waste Disposal Containers

Radioisotope Permit Holders will determine approximate quantities of waste generated per week or per project, and contact the RSO to confirm that the proper type of container is used.

9.1.3 Storage of Radioactive Waste Containers

Waste containers will be securely stored away from frequently used work areas, and TLD badge boards.

Waste containers must be readily accessible for removal. Any containers that may pose a risk of spillage or injury will be rejected.

Radioactive liquid and radioactive solid waste containers should be stored in a spill tray. Liquid waste containers that contain volatile radiocompounds must be stored in a fumehood. The lid of a liquid waste container must not be left open.

Waste storage in the laboratory must not result in laboratory personnel being subjected to radiation levels of 2.5 µSv/h (0.25 mRem/h) or greater (refer to Section 8.1.1).

9.1.4 Segregation of Radioactive Waste for Disposal

Any radioactive waste, which contains a Risk Group 1-4 Agent as defined in the Public Health Agency of Canada's, "Canadian Biosafety Standard", is required to be chemically "disinfected" before disposing as radioactive waste.

Solid waste:

- Items that are contaminated or possibly contaminated (scintillation vials not containing liquids, gloves, paper, small disposable equipment, gels, Eppendorf tubes with small volumes < 2 ml) must be placed a solid waste container.
- **Liquids must NOT be poured in the solid waste containers.**
- The container must have a clearance of eight (8) centimetres from the top.
- The material contents must be recorded on the Radioactive Waste Disposal form (Appendix C).

Radioactive contaminated sharps (syringes, needles, scalpels, and blades) must be disposed of in the following manner:

- Needles must not be clipped.
- Needles must not be removed from syringes; syringe and needle should be disposed of as a unit.

- Needles must not be re-sheathed.
- All sharps must be placed in a puncture resistant container such as a metal can with a plastic or a metal lid or a plastic jar with a lid.
- **DO NOT USE GLASS CONTAINERS FOR SHARPS.**
- Puncture resistant containers left on the bench for extended use must be labelled with radiation warning tape and the word "SHARPS" on the exterior of the container.
- Once sealed, the puncture resistant container must be placed in the radioactive solid waste container. The container must be sealed shut or taped in such a way to prevent opening.
- The material contents must be recorded on the Radioactive Waste Disposal Authorization form and the words "**SHARPS**" (see Appendix C).

Liquid waste:

- Must be poured into **appropriate** liquid waste container.
- The liquid waste container must not be filled above the useable capacity (allow room for expansion).
- The chemical constituents must be recorded on the Radioactive Waste Disposal Authorization form (see Appendix C).

Stock vials:

- Must be defaced prior to disposal in solid waste and kept out of the solid waste for separate pick-up.
- Place the stock vial in its original outer container, or **IN A LEAD PIG IF IT ARRIVED IN ONE,** and place in a small sealable clear plastic bag beside your radioactive solid waste container for pick-up.
- Calculate the activity remaining in the stock vial, based upon the volume remaining in the vial.
- If the vial is empty (all of the liquid has been pipetted out of the vial) the activity for disposal is 1% of the original activity decayed to the day of pick-up from the laboratory.
- The stock vial number must be recorded on the Radioactive Waste Disposal Authorization form (see Appendix C).

Spoiled shipments - place the stock vial in a plastic bag and complete a waste disposal authorization form. Write the inventory number for the vial and the words "Spoiled shipment" on the form. The stock vial number must be recorded on the Radioactive Waste Disposal Authorization form (see Appendix C).

Liquid scintillation vials are segregated by the type, size of vial, and radioisotope used. Vials that are counted without using any liquid must be placed in the solid waste containers. Ensure the lids on LS vials are on tight to prevent leakage.

Plastic liquid scintillation vials containing LS fluid must be placed in heavy duty plastic bags for disposal. DO NOT MIX WITH GLASS VIALS.

Glass liquid scintillation vials containing LS fluid must be placed in heavy duty plastic bags for disposal. DO NOT MIX WITH PLASTIC VIALS.

Radioactive gases collected or generated during an experimental procedure must be released into a fumehood. Refer to licence conditions for discharge quantity concentrations and contact the RSO.

Important Note: all labels must be defaced. This includes labelling tape with the trefoil symbol. Waste containing labels that have not been defaced will be rejected and returned to the originating laboratory.

9.1.5 Preparation of Waste for Pick-Up

Radioactive Waste Disposal Authorization forms (see Appendix C) or the disposal section of the inventory record must be used to record the disposal information for liquid waste, solid waste, stock vials, and carcasses. A **SEPARATE FORM** IS REQUIRED FOR **EACH CONTAINER** or **BAG OF WASTE.**

The Inventory Sheet Number, Isotope and Activity must be recorded on all Radioactive Waste Disposal forms.

Prior to waste pick-up:

- Seal the bag in the solid waste container with unlabelled (no radiation warning symbol) tape.
- Swipe check the outside of the liquid, solid waste containers, and any other containers which are to be picked up; decontaminate as required. Attach swipe results to ONE of the completed Radioactive Waste Disposal forms.
- Attach Radioactive Waste Disposal forms to corresponding liquid and solid waste containers, stock vial bag, and carcass bags.
- Contact the RSO to arrange for disposal

9.1.6 Disposal of Shipping Containers and Packaging

Plastic wrapping around the stock vial must be disposed of into the solid radioactive waste container.

Styrofoam inserts that are **free of detectable radioactive contamination** may be recycled directly through the suppliers of radioactive materials or other University recycling program.

Shipment boxes that are **free of detectable radioactive contamination** may be disposed of into the normal garbage, once the Radiation and Transportation of Dangerous Goods markings and/or labels on the shipment boxes have been defaced and the box is collapsed.

Lead containers used for shipping the product should be used as shielding while storing the radioactive materials in the laboratory. The stock vials and the lead container should be disposed of as a unit. If the Laboratory has empty lead containers for disposal, the containers must be collected in a small box for recycling. Ensure the removable contamination does not exceed 0.3 Bq/cm^2. Contaminated containers will not be collected.

Note: Lead containers must NOT be disposed of into the Radioactive Solid waste container.

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10.1 RADIATION DETECTION INSTRUMENTS

In order to facilitate a thorough contamination control program, Radioisotope Permit Holders must maintain and use laboratory based and portable radiation detection instrumentation. Portable survey instruments are required for Radioisotope Permit Holders using gamma or moderate to high beta emitters. These must be used and maintained according to manufacturer's instructions. Operator's manuals for all instruments must be retained.

Radioisotope Permit Holders are required to purchase their own radiation detection instruments and are responsible for all calibration costs and quality control. Portable meters must be calibrated at least every 12 months in accordance with the methods approved by the Canadian Nuclear Safety Commission.

Contamination meters need to be provided wherever there are unsealed nuclear substances other than S-35, C-14, and H-3. A calibrated dose survey meter must be available at all sites of licensed activity. Under section 20 of the Nuclear Substances and Radiation Devices Regulations, no person shall use a survey meter unless it has been calibrated within the last 12 months.

Not all meters are suitable for or sensitive enough to detect all types of radiation. Contact the RSO for advice on the suitable radiation detection instruments before purchasing.

10.1.1 Acquiring and Maintaining Radiation Detection Instruments

Upon submission of a new Application for Radioisotope Permit, the Radiation Safety Officer will assess the need for a radiation detection instrument and advise the Radioisotope Permit Holder of the specific type and make of instrument to be purchased. The Permit Holder and RSO will advise laboratory personnel on the proper use of the instrument. The cost of purchasing the specific instrument, including annual calibration and repairs, will be the responsibility of the Radioisotope Permit Holder.

There are several categories of radiation detection equipment including equipment used for measuring radiation dose and equipment used for measuring radioactive contamination.

a) Radiation dose measuring equipment

Survey meters are specifically designed for the measurement of radiation dose rates. Usually, they are not as sensitive as contamination meters and are therefore not able to detect surface contamination.

- The equipment must measure either radiation dose or dose rate and be calibrated in the appropriate units for these quantities (e.g. mR/h, uSv/h).
- Equipment used for measuring dose rate must be calibrated at least every 12 months in accordance with the methods approved by the Canadian Nuclear Safety Commission.
- Calibration records must be retained on file by the Permit Holder and a copy sent to the RSO.
- Radiation dose measuring equipment must be used in accordance with the guidelines provided by the manufacturer.

b) Contamination monitoring equipment

Contamination meters are specifically designed to measure surface contamination (contamination surveys). The detector is usually far more sensitive to radiation than a conventional dose rate meter. Its thin entrance window makes it appropriate for monitoring contaminated surfaces, but not for surveying radiation dose rates. A common thin window detector is a "15 cm^2 pancake detector" connected to a meter. This equipment includes Geiger counters and scintillation detectors. The following guidelines must be followed for this type of equipment;

- The equipment must measure radioactivity and be calibrated in contamination units (e.g. cpm, cps or dps).
- **Equipment used for measuring radioactive contamination must be calibrated at least every 12 months** by a company approved by the RSO and in accordance with the methods approved by the Canadian Nuclear Safety Commission
- (Note: a maximum of up to 24 months may be permitted at the discretion of the RSO to prevent interruption of research projects and only if an alternative instrument is unavailable and source response checks are maintained within expected range of values). Instrumentation may also be sent for recalibration after extended periods of not being used.
- Calibration records must be retained on file by the Permit Holder and a copy sent to the RSO.
- Contamination monitoring equipment must be operated in accordance with manufacturer's specifications.

10.1.2 Pre-operational Meter Checks

Before each use, workers must verify that a portable contamination or dose survey meter is properly functioning by conducting an examination for:

1. Physical inspection for damage
2. Battery/power check
3. Calibration date (within 12 months)
4. Source/radiation response *(within 20% of expected value)*

Instrumentation not functioning properly cannot be used and must be sent for repair. The RSO must be notified when an instrument requires repair. A replacement, if available, may be supplied by the RSO. Laboratory personnel **MUST NOT** adjust or attempt to make repairs to instruments.

10.1.3 Liquid Scintillation Counters and Gamma Counters

Liquid scintillation counters are lab based equipment used for counting scintillations produced by ionizing radiation. Liquid scintillation counting is the measurement of activity of a sample of radioactive material in which the radioactive material is combined with a liquid scintillation cocktail (Fluor), and the resultant photon emissions are counted. The purpose is to allow more efficient counting due to the direct interaction of the radioactivity with the cocktail. It is generally used for alpha and beta particle detection. **Gamma Counters** are used for measuring gamma radiation.

The following must be adhered to when using counting equipment:

- Permit Holders are responsible for following the manufacturer's requirements for proper functioning and methodology to verify the accuracy of contamination measuring equipment.
- Reference standards must be used to calibrate the equipment and be analyzed with samples to confirm that the equipment is properly functioning. These must be analyzed according to manufacturer's specifications, typically once during each 24 hour period (equipment can be programmed to do this automatically) and can alert the operator with warning messages if problems occur. Calibration records must be maintained by the Permit Holder.
- Equipment must be maintained and kept in working condition. Records of maintenance and repair must be kept.
- Malfunctioning equipment must not be used and shall be taken out of service until repaired. The RSO must be advised of malfunctioning equipment.

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10.2 RADIATION MONITORING REQUIREMENTS

Laboratory personnel must conduct contamination monitoring to ensure radiation doses, both internal and external, are **AS LOW AS REASONABLY ACHIEVABLE (ALARA)**. Radiation monitoring is used to detect the presence of radioactive contamination from open source work, to detect the presence of radioactive leakage from sealed sources, and to detect the presence of exposure fields from radioactive materials. Failure to routinely monitor work areas can result in the build up an uncontrollable spread of radioactive contamination to the workplace thus leading to contamination of personnel.

Types of Radioactive Contamination Monitoring

There are two possible methods for detecting and measuring radioactive contamination:

- *Direct* – involves using appropriate portable radiation contamination instruments in areas with low background radiation, to measure removable and fixed contamination
- *Indirect* – involves systematically collecting and counting wipe samples from workplace surfaces and measuring removable contamination.

10.2.1 Surveys for Detecting Surface Contamination

The method and instrumentation chosen to complete a contamination survey must readily detect the radioisotope(s) in use.

- Laboratory personnel may conduct a direct survey when gamma or moderate to high-energy beta emitters are in use.
- Laboratory personnel may conduct an indirect survey (swipe check) when surveying for any radioisotope.
- The Permit Holder is responsible for obtaining the required materials and instrumentation to conduct contamination surveys.
- The Permit Holder shall ensure that all contamination surveys are performed, documented and available for inspection. For indirect surveys, the print out from the liquid scintillation and/or gamma counter must be kept to document the survey and the results must be recorded on the **Contamination Monitoring Record Form**.
- The frequency of surveying must be adequate to detect the presence of contamination,
- The areas to be surveyed depend upon the number of users, the frequency of use and the number of areas where nuclear substances are manipulated.
- Daily indirect surveys (wipes) of immediate work areas during and after use of radioisotopes, especially after stock solution transfers, should be performed by workers.

- **<u>A general laboratory indirect survey must be conducted a minimum of once per week</u> when radioisotopes are in use; the results must be logged in the contamination logbook. This is a CNSC licence requirement**.

- Weekly surveys are not required when radioisotopes have not been used in any given week. Inventory records should indicate if radioisotopes have or have not been used in any given week.

The following types of surveys must be completed when working with *gamma or moderate to high energy beta emitters:*

- A **personal survey** must be conducted when leaving the immediate work area lab coats must be included; and when the procedure is complete; or when personal contamination is suspected.
- A **survey of the immediate work area** must be conducted prior to beginning a procedure.
- **An indirect survey of the immediate work area must be conducted upon completion of all procedures.**
- Direct Monitoring of work areas with a survey meter may be used. An operational check, background check, and measured count rates must be documented.

The following types of surveys must be completed when working with *low energy beta emitters, and all alpha emitters:*

- A **personal survey** must be conducted when personal contamination is suspected.
- **An indirect survey of the immediate work area must be conducted upon completion of all procedures.**

The Radioisotope Permit Holder or designate must conduct an indirect contamination survey of the area if a **radioactive work area, including any fume hood,** requires any **maintenance work** (refer to Section 11).

An indirect contamination survey must be conducted on all equipment that was used for radioactive work prior to the equipment being removed from the radioactive work area.

Contamination surveys must also be performed:

- After spills or incidents;
- Before equipment is released for non-radioactive use; and
- Before a decommissioned room is released for non-radioactive use.

10.2.2 Maximum Permissible Levels of Radioactive Contamination

Surface contamination is a quantity of radioactivity over a defined area which is usually expressed in Becquerels per square centimetre (Bq/cm^2). Based on the guidelines established by the CNSC, the maximum permissible levels for removable radioactive contamination are described in the table below.

Class of Radionuclide	**Regulatory License Limit**		**University of Lethbridge**	
	Radioactive Control Area Limit	Public Areas / Decommissioning Limit	Limits for Radioactive Work area	Non-Radioactive Areas Decommissioning Limit
Class A - typically long lived and emit alpha radiation	3 Bq/cm^2	0.3 Bq/cm^2	3.0 Bq/cm^2	0.3 Bq/cm^2
Class B - typically long lived and emit beta or gamma radiation	30 Bq/cm^2	3 Bq/cm^2	3.0 Bq/cm^2	0.3 Bq/cm^2
Class C - typically short lived and emit beta and gamma radiation	300 Bq/cm^2	30 Bq/cm^2	3.0 Bq/cm^2	0.3 Bq/cm^2

Note: contamination may be averaged over an area of not greater than 100 cm^2
Prior to releasing a room for general use, all fixed contamination must be approved by the CNSC, as per licence conditions.

It is good practice to keep contamination levels ALARA. If the contamination measurement shows that the level of contamination exceeds limits, corrective actions must be taken.

Surface Contamination

Using the following equation, the removable activity (Bq/cm^2) can be calculated

$$\text{Bq/cm}^2 = \frac{CPM - Bkg}{E_c \times 60 \times A \times E_w}$$

where:

CPM = total count rate in counts per minute (cpm) measured.
Bkg = normal background count rate from the survey instrument.
60 = seconds/minute (Bq = 1 dps)
E_c = efficiency factor of the counter for the radioisotope being measured.
A = area wiped in cm^2 (100cm^2)
E_w = collection efficiency factor for the wipe (0.1 or 10%)

10.2.3 Corrective Action

- Any areas found with contamination above the limits specified above are required to be decontaminated to acceptable levels (at minimum) and target decontamination efforts should be background levels.
- Decontamination results must be documented. Investigation and corrective actions taken to prevent a reoccurrence must also be recorded.
- Contamination and decontamination results must be communicated to appropriate persons working in the area.
- **The Permit Holder or Radiation Lab Supervisor shall advise the RSO when action limits are exceeded.**

Contamination Level	**Action Required**
< 0.3 Bq/cm^2 for Class A, B, or C radionuclides	Record result as 'no contamination'
Work surfaces > 3.0 Bq/cm^2 for Class A, B, or C radionuclides	Clean area immediately. Re-monitor and repeat cleaning until all contamination is removed or further cleaning does not reduce contamination levels. Record contamination levels before and after clean up. **Advise the RSO if action limits are exceeded.**
All other surfaces > 0.3 Bq/cm^2 for Class A, B, or C radionuclides	

10.2.4 Determined Instrument Sensitivities to Detect Contamination Limits

Using the formula above (section 10.2.2), one can calculate the net CPM (counts per minute) above background values that are equivalent to the maximum contamination limit for each radionuclide. Performing these calculations proves that the instruments used are sensitive enough to detect the maximum permissible contamination levels.

The detector efficiency can be determined by counting a standard source of known activity with your detector.

Efficiency = (detector count rate - background count rate)
known activity of standard source

The equivalent net CPM value contamination limits are in the tables below.

Beckman 6500 Liquid Scintillation Counter

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
H-3	60%	0.3 Bq/cm^2	108	3.0 Bq/cm^2	1080
S-35, C-14	95%	0.3 Bq/cm^2	171	3.0 Bq/cm^2	1710
P-32, P-33	95%	0.3 Bq/cm^2	171	3.0 Bq/cm^2	1710

Perkin Elmer TriCarb (Model 2800 TR, 2810 TR and 2910 TR) Liquid Scintillation Counter

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
H-3	60%	0.3 Bq/cm^2	108	3.0 Bq/cm^2	1080
S-35, C-14	95%	0.3 Bq/cm^2	171	3.0 Bq/cm^2	1710
P-32, P-33	95%	0.3 Bq/cm^2	171	3.0 Bq/cm^2	1710

Perkin Elmer Wizard 1470 Automatic Gamma Counter

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
I-125	78%	0.3 Bq/cm^2	140	3.0 Bq/cm^2	1404

Portable Meters:

Ludlum Model 3 and Model 2241-2 (3) Meter with 44-9 G-M Pancake Probe

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
P-32, P-33	32%	0.3 Bq/cm^2	58	3.0 Bq/cm^2	580

WB Johnson GSM 500 Meter and HP-265 G-M Pancake Probe

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
P-32, P-33	45%	0.3 Bq/cm^2	81	3.0 Bq/cm^2	810

Berthold Model LB124 Meter

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
P-32, P-33	30%	0.3 Bq/cm^2	54	3.0 Bq/cm^2	540

10.2.5 Surveys for Detecting Airborne Contamination

Work with dry powders and volatile substances must be performed in a fumehood. If a concern with airborne contamination is suspected, the Radiation Safety Officer must be notified **prior** to the start of the procedure.

10.2.6 Contamination Logbook

A Contamination Logbook must be maintained for each laboratory. Small inner laboratories and equipment rooms do not require individual logbooks, but must be included in the Contamination Logbook for the main laboratory. Contamination Logbooks must be organized so that anyone reviewing the logbook will know who has done the contamination surveys and when the surveys were done.

The Contamination Logbooks must have the following:

- A floor plan of the laboratory layout
- A list of the areas to be swipe checked weekly and monthly
- A summary sheet
- Notation of the following is required: date of the entry or date of swipes; name of the individual who conducted the survey; no contamination found or contamination found and removed with comments on actions taken; or no radioactive work done (if applicable)
- Completed Radioactive Contamination Monitoring Record forms
- The printout results must be dated and placed behind the summary sheet in chronological order.
- Post decontamination printout results are to be placed immediately behind the contaminated printout results.

Note: Swipe checks are unnecessary if radioactive materials have not been used for one week, however it is still necessary to make a **weekly** notation of the date and “No Radioactive Work Done”.

10.2.7 Evaluating Contamination

In keeping with the ALARA philosophy contamination limits are set at or below regulatory limits, however every effort should be made to maintain contamination levels at or as close to background levels as possible.

Personal Contamination

- All personal contamination including contamination of clothing must be reported immediately to the RSO at 329-2350.
- Treat personal injuries first; then follow the appropriate decontamination procedures.
- Appropriate decontamination procedures must be taken immediately, if there is not any personal injury.

Area Contamination

- The Radioisotope Permit Holder must ensure that the levels of loose (removable) radioactive contamination must not exceed 3.0 Bq/cm^2 on all labelled areas or equipment. Contamination on unlabelled areas must not exceed 0.3 Bq/cm^2. The area of each swipe check must not exceed 100 cm^2.
- Appropriate decontamination procedures must be initiated if the contamination is localized. Ensure the information is recorded in the Contamination Logbook.
- Personnel must be warned, and RSO (332-2350) must be notified **immediately** if:
  - action limits are exceed, or
  - contamination is widespread or in public access areas. Provide as much pertinent information as possible when reporting contamination.
- The RSO will initiate appropriate assistance.

Refer to "EMERGENCY RESPONSE TO RADIOACTIVE SPILL" at the beginning of this manual.

10.2.8 Monitoring Radiation Levels

The Radioisotope Permit Holder should be aware that there is a potential for high radiation levels when gamma or moderate to high beta emitters are in use or are not stored appropriately. The Radioisotope Permit Holder must contact Radiation Safety Officer if radiation levels above 25 µSv/h (2.5 mRem/h) are suspected.

10.2.9 Acceptable Liquid Scintillation Fluids

Environmentally friendly liquid scintillation fluid must be used. Acceptable LS fluids include:

Supplier	**Cocktail Name**
Perkin Elmer	Ultima Gold
MP Biomedical	Ecolite

Note: *Contact the RSO if a liquid scintillation fluid not listed above is required.*

Section:	10	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Sealed Source Leak Tests	Revision #:	1
		Revision Date:	Feb 10, 2017
Pages:	3	Revised By:	

10.3 SEALED RADIOACTIVE SOURCES

Sealed radioactive sources may be used in teaching and research. Requirements for leak testing are provided below.

10.3.1 SEALED SOURCE LEAK TESTS

Leak tests must be performed on sealed sources for leakage. Sealed sources containing radioactive material of less than 50 MBq, or krypton-85 or tritium that is in a gaseous form do not require leak tests to be performed.

Sealed sources containing radioactive material greater than 50 MBq must be leak tested at the following intervals:

- Every 6 months for regular sealed sources
- Every 12 months on each sealed source in a self shielded irradiator, gas chromatography, moisture-density gauge, or other radiation device
- Every 24 months for a sealed source in storage
- Before using a sealed source removed from 12 months of storage; and
- Immediately following any incident where sealed sources could have been damaged as a result of the incident.

Radioisotope Permit Conditions of Approval indicate the frequency of leak tests.

10.3.2 Purpose of Sealed Radioactive Source Leak Testing

Leakage and dispersal of radioactive material from a sealed radioactive source may be the result of a number of contributing factors, such s manufacturing defects, corrosion, abrasion, extreme temperatures, impact and mechanical abuse and the involvement in an accident or fire. Regularly performed leak test by an approved method will detect leakage of material so that prompt measures can be taken to control dispersal and contamination.

10.3.3 Performance of Leak Test Procedures by Qualified Persons Only

Only qualified persons are permitted to perform sealed radioactive source leak testing. The RSO will conduct the leak tests and courier the samples to an approved agency for testing.

10.3.4 General Description of Leak Testing Methods

Performance of a leak test involves taking a moistened (water/alcohol) wipe sample (q-tip or filter paper disk) and wiping the exterior surfaces of a sealed source housing or the immediate environment of the

radioactive source. The collected wipe sample is then measured for radioactivity, by a CNSC approved agency, to determine if the measured radioactivity exceeds the maximum allowable limit (200 Becquerels). The collection and measurement of the leak test may be performed in whole or in part by the licensee (written procedures must be approved by the CNSC) or by a CNSC approved agency.

The Radiation Safety Officer will notify the Radioisotope Permit Holder of any leakage. The sealed source holder and/or sealed source will be isolated and the use will be immediately discontinued if the removable radioactive contamination is in excess of 200 Bq.

When leak testing of a radioactive sealed source detects a leakage of 200 Bq or more of radioactivity, the following actions shall be taken:

1) Use of the radioactive sealed source or radiation device containing the sealed source shall be discontinued.
2) Efforts shall be made to prevent the spread of contamination from the leaking sealed source, and
3) After complying with steps (1) and (2) the **CNSC must be immediately notified** of the leaking sealed source **and a full written report must be submitted to the CNSC within 21 days**.

10.3.5 Leak Test Sampling Procedure

Pre-test Procedure

1. Prior to collecting a leak test sample, obtain and review wipe sampling procedures and operating instructions for each source or device.
2. Ensure that sufficient leak test wipe sampling materials and containers are available.
3. Complete all information on the Leak Test Sampling Certificate and assign a number to the sample containers.

Leak Test Instructions

1. Perform a visual check on the nuclear source or device to ensure that it is in good condition. If applicable, before taking the leak test sample, ensure the source/device is in the shielded position.
2. When nuclear devices are equipped with shutter mechanisms, the movement of the shutter from the open to closed position may not always be a reliable indication that the shutter is in fact closed. Due to corrosion and mechanical failure, shutter mechanisms have been known to fail. If the device or source employs a shutter mechanism, use a radiation survey meter to confirm that it is in the closed position.
3. **Radiation Hazard Warning**: wipe samples are not to be taken directly from the radioactive source capsule. This practice will result in an unnecessary and potentially hazardous radiation dose being receive by the leak test sampler. Locate yourself at the backside of the device when performing leak tests and/or if possible, shield yourself from the spruce. Caution must be used to ensure that no body parts are placed in front of the primary radiation beam. Familiarity with the device being tested is essential.
4. Moisten the Q-tip wipe sample (or filter disk) with water or alcohol and perform wipe with reasonable pressure.
5. Wipe the following locations on the different types of nuclear devices:

a) Fixed Nuclear Gauge – wipe seams of source holder, source housing interfaces, around radiation label, exit beam port and shutter mechanism.
b) Portable Nuclear Gauge p wipe gauge housing, exterior of exposed source rod (while in shielded position), shield entrance for source rod on gauge base and if applicable, remove top gauge shell cover and wipe the radiation warning label covering Am241-Be source in base.
c) Electron Capture Detectors – wipe detector entrance and exit ports, exterior and interior (if possible) of detector housing.
d) Self-shielded Irradiators – wipe the exterior (top and bottom) of the stationary shield, exterior of rotating shield, interior of sample chamber.

e) Nuclear Medicine Calibration and Flood Sources – wipe all external surfaces of the source including the source seal area.

Place the leak test wipe in the labeled sample container (envelope) and seal it. Ensue the container number corresponds to the sample container number indicated on the certificate. **Caution:** treat used leak test sample wipes as being potentially contaminated with radioactivity until proven otherwise.

10.3.6 Shipping Instructions for Collected Leak Test Samples

If a radiation monitor is available, check the wipe samples for gross radioactive contamination (greater than 2x background). If gross contamination is evident, contact the approved testing agency that the samples will be shipped to for further instruction. If gross contamination is not evident, courier the samples to the approved testing agency. Sending leak test samples via Canada Post is prohibited.

10.3.7 Licensee Leak Test Record Keeping Requirements

Section 39 of the *Nuclear Safety and Radiation Devices Regulations* (Ref. 4) requires that complete records of all leak test results be maintained for a minimum of 3 years. Records of leak tests will be maintained by the RSO.

Section:	11	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Requirements for Floor Cleaning	Revision #:	1
		Revision Date:	Feb. 10, 2017
Pages:	2	Revised By:	CCD

11.1 REQUIREMENTS FOR FLOOR CLEANING OF RADIOISOTOPE LABORATORIES

All radioactive areas are to be surveyed for contamination prior to floor cleaning to minimize the potential exposure to the Caretaking staff. Laboratory personnel must perform swipe checks and decontaminate when necessary prior to floor cleaning to ensure safe working conditions. This will be conducted and accessed by those most familiar with and responsible for the work being carried out within a laboratory (i.e. Radiation Lab Supervisor and/or Permit Holder). The Radiation Safety Officer will monitor these procedures and carry out surveys, as required, to ensure that clearance requirements are met.

11.1.1 Floor Clearance

Radioisotope Laboratories are required to follow the procedures below and will be identified by a warning label (Figure 1- a) affixed to the radioactive laboratory card located adjacent to laboratory entrances. Radioisotope Laboratories will be placed on a schedule by Caretaking Services. Radioisotope Laboratories identified by Figure 1- b will require clearance and authorization by Safety Services.

Figure 1- a

Figure 1 - b

a) The cleaning schedule and any changes to it will be communicated by Caretaking Services to the laboratories.

b) Laboratory personnel will perform a floor swipe check survey for radioactive contamination the day floor cleaning is scheduled. The weekly laboratory survey, if performed the day of cleaning and **includes multiple floor area locations**, is acceptable.

c) All work with radioactive materials will be restricted from the time the laboratory has been surveyed until after floor cleaning. "Restricted" means that any manipulation with open sources must cease. Procedures such as incubations where no manipulation is required can continue.

d) Applicable sections of the Clearance to Work form (see Appendix G) must be completed by authorized laboratory personnel.

e) Radioactive Contamination Logbooks will be available in each laboratory for the Caretaking Supervisor's review. If inner laboratories exist, only one contamination logbook is required.

f) The Caretaking Supervisor will visit the laboratories scheduled for cleaning to obtain the completed Clearance to Work form and inspect the laboratory for accessibility and service details.

g) Caretaking personnel **WILL NOT** clean floors on the scheduled day if any one of the following occurs:
- Survey results for radioactive contamination are not available.
- The Clearance to Work form is not available.
- Inconsistency between survey results and Clearance to Work form.
- Biohazardous wastes are not removed from floors.
- Laboratory personnel have not cleared obstructions or vacated the laboratory.

h) Contact Caretaking Services if there are questions as to why the floor was not cleaned.

i) If the laboratory was not cleaned, it will be cleaned on the next cycle, provided the required procedures are completed.

j) Caretaking Services will arrange for annual floor cleaning and sealing. Permit Holders are required to maintain clean floors on an ongoing basis by either their staff or by entering a work request with Caretaking Services.

k) The RSO will perform random checks of laboratories and notify the appropriate individuals if an inconsistency exists between the radioactive contamination surveys and Clearance to Work form (see Appendix G).

Section:	11	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Requirements for Service Work	Revision #:	New
		Revision Date:	
Pages:	1	Revised By:	

11.2 REQUIREMENTS FOR SERVICE WORK IN RADIOISOTOPE LABORATORIES

All service personnel are considered members of the general public and as such must receive minimal exposure when in a radioisotope laboratory. Requirements associated with maintenance and repair of areas or equipment that may be contaminated with radioactive material have been developed to ensure minimal exposure. The following procedures have been developed with the goal of reducing the potential for exposure or contamination for all service personnel.

11.2.1 Service and Maintenance Clearance

Laboratory personnel will ensure that work areas and equipment are free of detectable radioactive contamination and other hazards in the area are controlled in Radioisotope Laboratories **PRIOR** to service work being conducted. A “Clearance to Work form” must be completed (see Appendix G).

Laboratory Personnel will ensure that service personnel are aware of an area or equipment (i.e. internal workings of pumps) that is not free of detectable radioactive contamination and cannot be decontaminated or any other hazards that are uncontrolled.

It is recommended that service personnel be supervised and are provided with an orientation and hazard review. Service personnel must follow their department’s safe work procedures for working in laboratories and wear appropriate personal protective equipment.

Section:	12	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Transportation and Shipping Policy	Revision #:	New
		Revision Date:	
Pages:	3	Revised By:	

12.1 TRANSPORTATION AND SHIPPING POLICY

Any nuclear substance with an activity greater than 70 kBq/kg (2 µCi/kg) is considered radioactive for the purposes of transportation. The packaging and transportation of radioactive materials must comply with the Canadian Nuclear Safety Commission Regulations, the Transportation of Dangerous Goods Act and Regulations, and the International Air Transport Act and Regulations.

All transportation of nuclear substances must be directed through the Radiation Safety Officer who will arrange for transport through the University's Materials Management department. The shipper is responsible for ensuring the transport of radioactive materials conforms to pertinent regulations and the radioactive shipment shall be in accordance with regulations. All personnel who offer dangerous goods (the radioactive shipment) for transport or transport dangerous goods shall be trained and the training documentation maintained on file as per the Transportation of Dangerous Goods Regulations.

Canada Post does not permit the shipment of nuclear substances (radioactive materials) through the mail.

12.1.1 Packaging of Radioactive Materials for Transport

Packaging requirements vary depending on the radioisotope, the form, and the activity. The Radioisotope Permit Holder must contact the RSO for packaging information at least three weeks in advance of the actual shipment date. The Radioisotope Permit Holder will be responsible for obtaining and covering the cost of the appropriate packaging and labels.

12.1.2 Transportation On Campus

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

- Materials Management will be responsible for transportation of routine shipments arriving on campus.
- Materials Management must be contacted to arrange for the transport of the materials, if a Radioisotope Permit Holder requires transportation services between buildings

12.1.3 Shipping Off Campus

The Radioisotope Permit Holder will be responsible for obtaining a copy of the current CNSC Radioisotope Licence of the recipient institute, company, etc. and forwarding to the Radiation Safety Officer. Please note that the CNSC licence is required, NOT a radioisotope permit issued under the licence.

The Radioisotope Permit Holder must forward a written request to the RSO for approval of the shipment. The following information must be provided:

- Radioisotope and activity in µCi or equivalent S.I. units.
- Physical form (solid, liquid, gas).

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

The request for shipping must be forwarded to the RSO at least three weeks prior to the shipment date. The RSO will make arrangements with Materials Management to set up a time to pick-up the materials when the shipping documents are complete.

There may be research projects that require transportation by the Radioisotope Permit Holder or laboratory personnel. The Radioisotope Permit Holder must contact the RSO at least (4) four weeks prior to the commencement of the project to arrange for training in Transportation of Dangerous Goods. Once trained, the Radioisotope Permit Holder and the individuals involved will be responsible for ensuring the Transportation of Dangerous Goods Regulations are followed.

In all cases where radioactive materials are intended to be transported, appropriate arrangements must first be made with the intended recipient. Nuclear substances and radiation devices can only be delivered to the locations specified. The building name and street address of delivery locations should be forwarded to each supplier with every initial purchase.

In cases where nuclear substances are shipped off site, the following may apply:

- The sender should verify the safe arrival of each shipment.
- In the case of transferring radiation devices, the recipient is to be given instructions to deal with emergencies, such as fires and spills.
- Nuclear substances and radiation devices can only be shipped to and accepted at locations specified by a licensed recipient. The building name and street address for the receipt of deliveries should be forwarded to each supplier of radioactive materials, with every acquisition.
- For unsealed radioactive material transfers, a survey for removable radioactive contamination must be performed on the exterior surface of shipping container, documented and be kept on file. The amount of removable radioactive contamination found on the exterior surface should be as low as practicable and must be below the criteria set out in the transport regulations.
- To transport nuclear substances, licensees must comply with CNSC’s *Packaging and Transport of Nuclear Substances Regulations* and *Transport Canada’s Transportation of Dangerous Goods Regulations.*

If any nuclear substances are required to be transported in a TYPE A Package, the licensee will contact the manufacturer (or obtain through another source or internal testing and documentation) for the following information.

1. Package design specifications;
2. Package design compliance information, for example, test reports, calculations, quality assurance program;
3. Instructions for packing; and
4. Transporting, receiving, maintaining, and unpacking the packages.

The licensee is required to maintain current records of the following, for all nuclear substances prepared in TYPE A, and IP-2 or an IP-3 package. Before transport of nuclear substances, the following records and procedures must be approved by the CNSC:

1. The types, quantities and physical forms of the radioactive materials to be transported;
2. The packages and package types used, including applicable package certificates and user registrations. Most radioactive materials will be excepted packages. If a TYPE A package is to be transported the above certificates and registrations must be obtained before transport.

3. The annual number of shipments for various categories of radioactive materials and packages;

   It is not anticipated that more than 2 annual shipments be made for low level radioactive waste to an authorized CNSC recipient. It is not anticipated that any sources > 37 MBq will be transported.

4. Marking, labelling and placarding of shipments shall be in accordance to CNSC's Packaging and Transport Regulations and Transport Canada's Transportation of Dangerous Goods (TDG) Regulations.

5. Transport documents and instructions to carriers;

6. All transport documents must comply with pertinent regulations. Instruct carriers of special transport conditions and emergency procedures.

7. Shipment notifications and confirmations;

8. Carriage, stowage and segregation, and storage in transit of nuclear substance;
   Carriers will be instructed to segregate the packages from occupants in the vehicle and ensure the package is securely stowed during transport.

9. Receipt and opening of packages; (refer to section 7.2, as well as section 21 of the CNSC Packaging and Transport of Nuclear Substance Regulations).

10. Handling of undeliverable consignments;
    If a consignment is undeliverable to the consignee, the carrier shall
    - Notify the consignor, consignee and the CNSC
    - Place the consignment in an area to which access is controlled by the carrier and keep it there until it can be delivered to the consignor or consignee.

11. Inspection of packaging (see section 7); and

12. Names of contact persons for the applicant's packaging and transport operations; RSO: (403) 329-2350 or (403) 332-2350.

All records must be available for inspection upon the request of the CNSC.

12.1.4. Transportation Incidents

The CNSC Packaging and Transport of Nuclear Substances Regulations, requires that every consignor, carrier, consignee or holder of a license to transport radioactive material who becomes aware of any of the following incidents shall **immediately make a preliminary report** to the Canadian Nuclear Safety Commission CNSC) and to the holder, if any, of a license to import the radioactive material that is involved in any of the following occurrences:

1) Conveyance carrying radioactive material is involved in an accident;
2) Package shows evidence of damage, tampering or leakage of its contents;
3) Any failure to comply with the CNSC Nuclear Safety and Control Act or the Packaging and Transport of Nuclear Substances Regulations, or any license or certificate applicable to a package that may reasonably be expected to lead to a situation in which the environment, the health and safety of persons or national security is adversely affected;
4) Radioactive material is lost, stolen or no longer in control of a person who is required to have control of it by the CNSC Nuclear Safety and Control Act or regulations made under the Act; or
5) Radioactive material has escaped from a containment system, package or conveyance during transport.

6) Accidental Release has occurred.

The preliminary report referred to above must include information on the location and circumstances of the incident and on any action that the consignor, the carrier and the consignee has taken or proposes to take with respect to it.

After a transportation incident involving radioactive material occurs, the consignor, the carrier and the consignee **shall provide a full written report to the CNSC within 21 days**, and the report shall contain the following information about the dangerous occurrence:

1) Date, time and location;
2) Probable cause;
3) Names of the persons involved;
4) Circumstances;
5) Effects on the environment, the health and safety of persons, and national or international security that have resulted or may result;
6) Doses of radiation that any person has received or is likely to receive; and
7) Actions taken by the consignor, the carrier and the consignee.

Section:	12	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Classifying Nuclear Substance Packages	Revision #:	New
		Revision Date:	
Pages:	2	Revised By:	

12.2 CLASSIFYING NUCLEAR SUBSTANCE PACKAGES

The packaging and labeling of nuclear substances is regulated by the Canadian Nuclear Safety Commission's Packaging and Transport of Nuclear Substances Regulations. Nuclear substances may be shipped as "Excepted Packages", "Low Specific Activity (LSA)", "Type A", or "Type B" packages. It is the package design that makes nuclear substances safe for transportation and ensures only an acceptable amount of radiation is released. Therefore, the design and construction of the packaging is very strictly controlled.

On Excepted Packages, the safety mark "Radioactive" must be visible upon opening the package and the radiation level at any point on the external surface of the package must not exceed 5 uSv/h. All other packages must be categorized by radiation level and display the corresponding radiation warning labels as follows:

Category I - White

Does not exceed 5 uSv/h at any location on the external surface of the package.

Category II - Yellow

Does not exceed 500 uSv/h at any location on the external surface of the package and the transport index does not exceed 1.

Category III - Yellow

Does not exceed 2 mSv/h at any location on the external surface of the package and the transport index does not exceed 10.

12.2.1 Transport Index

The **Transport Index** (TI) for a package is the maximum radiation level in microsieverts per hour at one meter from the external surface of the package, divided by 10.

Example: 1 uSv/h at 1 m equals a TI = 0.1.

TRANSFER OF NUCLEAR SUBSTANCES AND RADIATION DEVICES

Section:	13	Date of Issue:	2007.02.01
		Issued By:	Safety Services
Part:	Collaborative Research	Revision #:	New
		Revision Date:	
Pages:	1	Revised By:	

13.1 Transfer of Nuclear Substances and Radiation Devices

Radioisotope Permit Holder considering the transfer of nuclear substances and/or radiation devices must forward a written request to the RSO for approval of the transfer. The following information must be provided to the University of Lethbridge Radiation Safety Officer **and** the Radiation Safety Officer at the collaborating institution or external agency:

- Copy of the current CNSC Radioisotope Licence of the recipient
- Radioisotope and activity in µCi or equivalent S.I. units.
- Physical form (solid, liquid, gas).
- Full chemical name.
- Weight or volume.
- Lot number
- Special handling requirements (dry ice, perishable, etc.).
- "No Commercial value" if the shipment is for a collaborative project.
- Make, model and serial number for radiation devices
- Reason for the transfer
- Location where material will be used and/or stored.
- Intended use.
- Authorized signature - signature of individual authorized to acquire and handle radioisotopes.
- The name and telephone number of the Radiation Safety Officer of the recipient institute, company, etc.

A transfer of nuclear substances and radiation devices must not occur until written approval is acquired from both the University of Lethbridge Radiation Safety Officer and the Radiation Safety Officer at the collaborating institution.

Note: Approval must be obtained for ALL transfers, including activity below exemption quantities.

Refer to Sections 8 and 12 for transfers of radioisotopes to a laboratory located in another University building and for proper packaging of material for shipment.

13.1.1 Collaborative Work with External Agencies

The University of Lethbridge recognizes that collaborative research involving the use of radioactive materials can be beneficial for all parties involved. Activities carried out at the respective institutions must take place under the applicable licence and comply with all applicable policies and procedures.

13.1.2 External Personnel Working at University of Lethbridge Licensed Locations.

All individuals who will be working with radioisotopes at the University of Lethbridge shall conduct the work under a University of Lethbridge Radioisotope Permit Holder. It is the responsibility of the individual to solicit a Radioisotope Permit Holder.

The individual or Radioisotope Permit Holder must ensure that the University of Lethbridge Radiation Safety Officer **and** the Radiation Safety Officer at the collaborating institution is notified of the arrangement prior to the commencement of work.

The Radioisotope Permit Holder must ensure the individuals become approved University of Lethbridge Authorized Workers and must apply for an amendment to add the new Authorized Worker to their Internal Permit (see Section 4 – Training).

Authorized Workers must know and comply with applicable policies, procedures, and regulations. All Authorized Workers are required to use the University of Lethbridge dosimetry service while working under the University's licence.

Section:	14	Date of Issue:	2007.01.27
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Part:	Industrial Radiography Policy	Revision #:	1
		Revision Date:	January 24, 2012
Pages:	1	Revised By:	CCD

14.1 SEALED SOURCES AND RADIATION DEVICES

Sealed sources are radioactive materials that are encapsulated or encased in such a way that they are extremely unlikely to be absorbed into the body and therefore present only an external radiation hazard (e.g. small calibration sources, check sources).

Devices containing integrated sealed sources that are not normally removable. Examples are moisture density gauges, liquid scintillation counters, electron capture chromatographs, and X-ray fluorescence equipment. Sealed radioactive sources and radiation devices may be used in teaching and research with the requirements listed below.

14.1.1 Sealed Source Permits, Acquisition and Record Keeping

Sealed Source Permits are internal radioisotope permits specifically authorizing the use of sealed source radioactive materials and the conditions of that use. All documents required by the condition of a Sealed Source permit are maintained to ensure compliance with regulations and licence requirements.

The purchase and acquisition of all sealed sources, including exempt material, must be approved by the RSO to ensure regulatory compliance.

An inventory record of sealed sources must be kept. This must included the type of radioisotope, activity, manufacturer name, serial number, calibration date, and storage location. The inventory must be updated at least annually.

Internal Permits are issued authorizing the use of sealed source radioactive materials to ensure compliance with regulations and licence requirements.

Permit Holders must ensure that users of sealed sources and radiation devices receive lab specific radiation safety training and are competent.

14.1.2 Procedures for Working with Sealed Sources

The principle of ALARA and appropriate radiation safety practices must be followed whenever Sealed Source radioactive materials are handled or stored to ensure that unnecessary exposures do not occur.

Measures to ensure security of sealed sources must also be maintained. Sealed sources must be kept in locked storage and usage must be supervised.

1. Prior to beginning work with sealed sources or devices containing sealed sources it is important to be familiar with the specific hazards of the radioactive material present.

2. All radioactive material shall be attended by an authorized user or must be locked (secure) when not attended by a person listed on the Internal Radioisotope Permit.

3. Radioactive sealed sources or equipment containing radioactive materials are to be stored and used in a way that ensures that radiation fields in accessible operating areas do not exceed 25mSv/hr and in areas adjacent to radioactive working areas do not exceed 2.5mSv/h.

4. Preplan procedures to minimize the time spent in close proximity to the radioactive material to reduce the time of exposure.

5. Utilize procedures that maximize the distance between people and the source.

6. Follow the manufacturer's directions for storage, leak testing procedures and manipulation of the source. Additional shielding may be required.

7. All incidents (damage, theft, loss) involving sealed sources must be immediately reported to the RSO.

14.1.3 Sealed Sources Requiring Leak Tests

See Section 10.3 for sealed source leak test requirements.

14. 1. 4 Sealed Sources Security – Standard Operating Procedure

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		Issued By:	Safety Services
Part:	Industrial Radiography Policy	Revision #:	NEW
		Revision Date:	
Pages:	1	Revised By:	

15.1 INDUSTRIAL RADIOGRAPHY PROCEDURES

Industrial radiography, a form of non-destructive testing, uses x-ray machines, or encapsulated radioactive materials to produce radiation. The radiation penetrates the object being studied (pipelines, floors, concrete walls) and exposes x-ray film placed behind the object. The location of flaws, conduits, etc., can be determined. At the University of Lethbridge, industrial radiography is performed by qualified contractors.

The Canadian Nuclear Safety Commission regulates industrial radiography. The following procedures describe the minimum requirements for ensuring safety of staff, students and the public.

15.1.1 Contracted Radiography Company

The contracted company must be informed of the following when initially contacted:

- The company must be in compliance with Canadian Nuclear Safety Commission Regulations. Failure to be in compliance will result in the work being postponed until the company is in compliance.
- Prior to hiring a radiography company, the University Contact responsible for project coordination shall advise the RSO and ensure that the contractor submits the required pre-qualification information to Safety Services for review.
- The University of Lethbridge will not accept a qualified operator with a record of malpractice that suggests disregard for radiation safety.
- An inspection by the University of Lethbridge Radiation Safety Officer and/or the Canadian Nuclear Safety Commission may occur while the radiographers are on site.

15.1.2 Scheduling Work

Scheduling of the work will proceed when:

a) The Radiation Safety Officer must be notified at least two weeks before the scheduled project date.

b) The Radiation Safety Officer requires the following information:
- name of contractor,
- isotope and activity of source, and
- time, location, and details of project.

c) The exposure rate from the unshielded source when x-raying objects or structural elements is very high. Before the source is exposed the contractor will set up a perimeter around the source using

radiation-warning signs. The area within this perimeter must be vacated. The vacated area can be quite large and may include several offices, classrooms, etc., on more than one floor.

d) The department requesting this service must provide sufficient staff to man the perimeter. To establish the number of staff required to secure the area, the Radiation Safety Officer or Safety Services designate must conduct a walk through of the area with the project co-ordinator.

REFERENCES

1) Canadian Nuclear Safety Commission, Nuclear Safety and Control Act, Ottawa, 1997, www.nuclearsafety.gc.ca

2) Canadian Nuclear Safety Commission, General Nuclear Safety and Control Regulations, SOR/2000-202, Ottawa, 2000, www.nuclearsafety.gc.ca

3) Canadian Nuclear Safety Commission, Radiation Protection Regulations, SOR/2000-203, Ottawa, 2000,
www.nuclearsafety.gc.ca

4) Canadian Nuclear Safety Commission, Nuclear Substances and Radiation Devices Regulations, SOR/2000-207, Ottawa, 2000, www.nuclearsafety.gc.ca

5) Canadian Nuclear Safety Commission, Packaging and Transport of Nuclear Substances Regulations, SOR/2000-208, Ottawa, 2000, www.nuclearsafety.gc.ca

6) Canadian Nuclear Safety Commission, Design Guide for Basic and Intermediate Level Radionuclide Laboratories, R-52, Ottawa, 1999, www.nuclearsafety.gc.ca

7) Canadian Nuclear Safety Commission, Regulatory Guide, G 58 -Thyroid Screening for Radioiodine, Ottawa, 2002, www.nuclearsafety.gc.ca

8) Government of Alberta, Freedom of Information and Protection of Privacy Act, Edmonton, 1994, www.gov.ab.ca

9) Government of Canada, Transportation of Dangerous Goods Regulations, SOR/2002-306, 2002, www.canada.gc.ca

10) International Atomic Energy Agency, Regulations for the Safe Transport of Radioactive Material, 1996, Vienna, www.iaea.org

11) International Commission on Radiological Protection, ICRP Publication 60, 1990 Recommendations of the International Commission on Radiological Protection, Pergamon Press, Oxford, 1990, www.icrp.org

12) International Commission on Radiological Protection, ICRP Publication 61, Annual Limits on Intake of Radionuclides by Workers Based on the 1990 Recommendations, Pergamon Press, Oxford, 1991, www.icrp.org

PART B

GLOSSARY OF TERMS

Absorbed Dose

Energy absorbed per unit mass (1 Joule per kg). The energy imparted to matter by ionizing radiation per unit mass of irradiated material.

$$1\ Gy = \frac{1\ Joule}{kg} \qquad 1\ rad = 0.01\ Joule/kg.$$

Absorption

The process by which radiation transfers some or all of its energy to any material through which it passes.

Absorption Coefficient, Linear (μ)

A factor expressing the fraction of a beam of x or gamma radiation absorbed in unit thickness of material. In the expression $I = I_0 e^{-\mu x}$, I_0 is the initial intensity, I the intensity of the beam after passage through a thickness of the material x and μ is the linear absorption coefficient.

Activity

The rate of disintegration (transformation) or decay of nuclear substances. The SI unit of activity is the becquerel (Bq).

ALARA

(acronym for "as low as reasonably achievable") Making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

Alpha Particle

A positively charged particle emitted from the nucleus of an atom having a mass and charge equal in magnitude of a helium nucleus; i.e. two protons and two neutrons.

Annual Limit of Intake (ALI)

The derived limit for the amount of nuclear substance taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a *committed effective dose equivalent* of 50 mSv or a *committed equivalent dose* of 50 mSv to any individual organ or tissue.

Atom

Smallest particle of an element that cannot be divided or broken up by chemical means. It consists of a nucleus, which contains protons and neutrons and electrons orbiting the nucleus.

Atomic Number (Z)

The number of protons in the nucleus of a neutral atom. The atomic number determines the chemical properties of the element.

Atomic Weight (A)

Expressed in terms of "atomic mass units". The number of neutrons and protons in the nucleus of an atom.

Attenuation

The process by which a beam of radiation is reduced in intensity when passing through some material.

Avogadro's Number

Number of atoms in a gram atomic weight of any element. It is numerically equal to 6.023×10^{23} on the unified mass scale.

Background Radiation

Radiation from cosmic sources, naturally occurring nuclear substances, radon and global fallout as it exits in the environment from the testing of nuclear explosive devices.

Basic Level Laboratory

A room where nuclear substances are used and where the total quantity of each nuclear substance used at one time does not exceed five (5) times its corresponding Annual Limit of Intake (ALI).

Becquerel

A unit, in the International System of Units (SI), of measurement of radioactivity. It is equivalent to 1 disintegration per second.

Beta Particle

A negatively charged particle emitted from the nucleus of an atom, with a mass and charge equal in magnitude to that of the electron.

Bremsstrahlung

Secondary photon radiation produced by sudden deceleration of charged particles passing through matter.

Contamination (fixed)

Contamination that can not be readily removed from the surface. Depending on the radioisotope and activity, fixed contamination may pose an external radiation hazard.

Contamination (removable)

Contamination that can be readily removed from the surface. Removable surface contamination is of the greatest concern as it is transferable to other surfaces. This can result in widespread surface contamination and lead to internal contamination due to the intake of nuclear substances into the body.

Contamination (Radioactive)

Deposition of nuclear substances in any place where it is not desired.

Critical Organ

The body organ receiving a radionuclide or radiation dose that results in the greatest overall damage to the body. For example, ^{125}I and ^{131}I, the critical is the thyroid due to the preferential uptake of iodine by that gland and its susceptibility to radiation damage.

Curie (Ci)

A unit of activity. One Curie equals 3.70×10^{10} nuclear transformations per second, which is approximately the rate of decay of 1 gram of radium.

Decay Constant (λ)

The fraction of the number of atoms of a radioisotope which decay in unit time. It is expressed as the reciprocal of time (e.g. seconds^{-1}) and is related to the half life by the following equation: $\lambda = 0.693/T_{1/2}$.

Decay, Radioactive

The decrease in the activity of any nuclear substance with the passage of time, due to the spontaneous emission from the atomic nuclei of either alpha, beta particles, or gamma radiation.

Deterministic Effects

Effects characterized by a severity that increases with dose above some clinical threshold. The severity of the syndrome that occurs following the administration of the radiation will depend on the number of cells damaged and the total equivalent dose received by the individual.

Dose

A generic term denoting the quantity of radiation or energy absorbed.

Dose Rate

The absorbed dose delivered per unit time.

Dosimeter

A portable device used to measure and record the total exposure to ionizing radiation.

Effective Dose

Effective Dose is the sum of the doubly weighted absorbed dose in all the tissues and organs of the body. The weighting factors for this purpose are called the radiation weighting factor and tissue weighting factor. This unit is in joules per kilogram with the special name Sievert.

1 Sv = 100Rem

Equivalent Dose

Equivalent Dose is the absorbed dose averaged over a tissue or organ and weighted for the radiation quality that is of interest. The weighting factor for this purpose is called the radiation weighting factor. This unit is in joules per kilogram with the special name Sievert.

Electromagnetic Radiation

Traveling waves of radiation resulting from changing electric and magnetic fields.

Electron Volt (eV)

A unit of energy equivalent to the energy gained by an electron in passing through a potential difference by one volt.

Energy

Capacity for doing work. “Potential energy” is the energy inherent in a mass because of its spatial relation to other masses.

Exposure

A measure of ionization produced in air by gamma or x-radiation. The unit of exposure is coulombs per kilogram of air.

Gamma Ray (γ)

High energy, short wavelength, electromagnetic photon emitted from the nucleus.

Genetic Effect

An effect in a descendant resulting from the modification of genetic material in a parent.

Geometry Factor

The fraction of the total solid angle about the source of radiation that is subtended by the face of the sensitive volume of a detector.

Gray

The International Systems of Units (SI) unit of absorbed dose. This is the energy absorbed per unit mass. 1 Gy = 1 J/kg = 100 Rad

Half Life, Biological

The time required for the body to eliminate half of the nuclear substance taken in by natural biological means.

Half Life, Effective

Time required for a radionuclide in a body to reduce its activity by half as a result of the combined action of radioactive decay and biological elimination. The effective half life is a mathematical combination of the physical and biological half lives of the particular radionuclide.

Half Life, Radioactive

Time required for a nuclear substance to lose 50 percent of its activity by decay. The time in which half the atoms of a nuclear substance disintegrate to another nuclear form. Each radionuclide has a unique half life.

Half Value Layer

The thickness of a specified substance which, when introduced into the path of a given beam of radiation, reduces the exposure rate by one half.

Ion

An atom that has too many or too few electrons, causing it to be chemically active.

Ionization

The process by which a neutral atom or molecule acquires a positive or negative charge. The process of adding one or more electrons to, or removing one or more electrons from, atoms or molecules, thereby creating ions.

Intermediate Level Lab

A room where the total quantity of a nuclear substance used at one time does not exceed 50 times its corresponding ALI.

Isotopes

Nuclides having the same number of protons in the nuclei, and hence the same atomic number but differing in the number of neutrons; therefore, in the mass number.

Linear Energy Transfer (LET)

A measure of the ability of biological material to absorb ionizing radiation; specifically, for charged particles traversing a medium. The energy lost per unit length of path as a result of those collisions with electrons in which the energy loss is less than a specified maximum value. A similar quantity may be defined for photons.

Neutron

A nuclear particle having a mass similar to a proton but having no electrical charge.

Nuclear Energy Worker (NEW)

A person who is required, in the course of the person's business or occupation in connection with a nuclear substance, to perform duties in such circumstance that there is a reasonable probability that the person may receive, a dose of radiation that is greater then the prescribed limit (1 mSv) for the general public.

Nuclide

A general term referring to all known isotopes, both stable and unstable of the chemical elements.

Open Source

An open source is any unsealed nuclear substance. This could be in the form of a liquid, gas, or solid. Such a source is most likely to cause contamination.

Photon
A quantum of energy emitted in the form of electromagnetic energy. Gamma rays and x-rays are examples of photons.

Radiation
Energy in motion, in the form of waves or particles.

Radiation, External
Radiation from a source outside the body--the radiation must penetrate the skin.

Radiation, Internal
Radiation from a source within the body (as a result of deposition of radionuclides in body tissues).

Radiation Weighting Factor (RWF)
A modifying factor used in the derivation of equivalent dose. This factor if selected for the type and energy of the radiation incident on the body. Used to allow comparison of different types of radiation.

Radioactive Decay
The decrease in the amount of any nuclear substance with the passage of time, due to the spontaneous emission from the atomic nuclei of either alpha, beta particles, or gamma radiation.

Radioactivity
Spontaneous emission of radiation, generally particles or gamma radiation from the nucleus of an unstable isotope.

Radioisotope
An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. Approximately 5000 natural and artificial radioisotopes have been identified.

Radionuclide
A radioisotope.

Radiotoxicity
The term referring to the potential of a radioisotope to cause damage to living tissue by the absorption of energy from the disintegration of the nuclear substance that is within the body.

Radon
A radioactive element that is one of the heaviest gases known. Its atomic number is 86, and its mass number is 222. It is a daughter of radium.

Roentgen
The amount of x or gamma radiation required to produce a specific amount of ionization in 1 cc of air. One roentgen equals 2.58×10^{-4} coulomb per kilogram of air.

Sealed Source
A nuclear substance in a capsule that is sealed or in a cover to which the nuclear substance is bonded, where the capsule or cover is strong enough to prevent contact with and dispersion of the nuclear substance under the conditions of use.

Sievert (Sv)
The (SI) unit for equivalent dose. See equivalent dose. 1 Sv = 100 rem

Somatic Effect
Effects of radiation limited to the exposed individual. Somatic injury affects the current generation but is not passed on to future generations.

Specific Activity

Total activity of a given nuclide per gram of a compound, element or radioactive nuclide.

Stochastic Effects

Health effects that occur randomly and for which the probability of the effect occurring, rather that its severity, is assumed to be a linear function of dose without a threshold. Hereditary effects and cancer incidences are examples of stochastic effects.

Tissue Weighting Factor

Tissue Weighting Factor represents the relative contribution of that organ or tissue to the total detriment due to the effects resulting from uniform irradiation of the whole body.

Yield

The percentage of radiation emitted from a radioisotope with a particular energy. Example for Iodine 125 35% of the radiation is 35 keV gammas. 93% is internally converted.

PART C

APPENDICES

APPENDIX A

A.1 Radioisotope Permit Application
A.2 Permit Conditions of Approval A-1
A.3 Radioisotope Permit – Open Source
A.4 Radioisotope Permit – Sealed Source
A.5 Radioisotope Project and Lab Decommissioning Form

RADIOISOTOPE INTERNAL PERMIT APPLICATION
Part A

Revision #: Revision Date:	NEW	Date of Issue: Issued By:	2007.02.22 Safety Services
Revised By: Revision #:	CCD 2		
Revision Date:	Feb. 10, 2017	Pages	4

INSTRUCTIONS:

a) *All persons planning to use Radioactive Materials at locations controlled by the University of Lethbridge are required to apply and obtain an approved Internal Radioisotope Permit*

b) All new Authorized Workers and Permit Holders must be registered with the Radiation Safety Office. Complete answers to the following questions are required to assess your application and implement appropriate safety procedures. Attach additional pages if required.

c) **Return completed application to:** Radiation Safety Officer, Safety Services, Markin Hall M4145. safety.services@uleth.ca

1. Applicant/Responsible User:

Name: _____

This is an application for: ***Renewal*** of existing Permit ____ **OR** ***New*** Internal Radioisotope Permit ____

Current or previously assigned Permit Number(s):_____

Anticipated start date for working with radioisotopes_____ (Allow up to four weeks for processing.)

Department: _____

Office (Room #Bldg):_____

Phone (office): _____ **(lab):**_____

Fax number: _____ **email:** _____

Summary of training and experience working with radioisotopes (include radioisotopes, training dates, course duration and location; date and length of time which you last did work with radioisotopes:

_____
_____
_____
_____

2. Intended Use of Radioactive Materials

a) **Statement of Intended Use of radioisotopes** (Describe the radioisotopes and experimental protocols. Include the quantity of each radioisotope that will be used in each procedure (attach additional pages, if necessary):

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

b) Waste Disposal: list the form of waste materials that will be produced and the proposed method of disposal (attach additional pages, if necessary).

Radioisotope	Type of Waste	Proposed Method of Disposal

3. Radioisotopes: List all isotopes that you are applying to be permitted to use or store. There are two types of permits - sealed source or open source. *List activities in MBq (1 mCi = 37 MBq).*

a) Sealed Source Permits allow the purchase, use and storage of radioactive materials that are encapsulated or encased in such a way that it is extremely unlikely to be absorbed into the body. Sealed Sources may be in the form of calibration sources, moisture density gauges, electron capture chromatographs, X-ray fluorescence equipment, etc. This includes exempt quantities. (Attach additional sheets if required.)

Radioisotope	Activity and Calibration date	Source Serial Number	Complete this section for Sealed Sources incorporated into Devices. Device Manufacturer	Device Model #	Device Serial #

Note: Leak testing of SEALED SOURCES containing more than 50MBq (1.35mCi) is mandatory.

b) Open Source Permits allow the purchase, use and storage of radioactive materials in the form of a solid, liquid or gas. These sources are provided in a container designed to allow the removal or extraction of some or the entire radioactivity such as a vial, ampoule or bottle. The information supplied by the applicant will be used to assess the containment level of the laboratory as per CNSC regulations. ***Maximum activity in storage and requested possession limit include the <u>total activity of all stock solutions, samples and waste</u> in the possession of the Permit Holder (Attach additional pages, if required).***

Radioisotope	Maximum activity in use at a single time	Maximum activity per vial/container	Maximum activity in storage	Requested Possession Limit	Approved Possession Limit (this column is for RSO use only)

4. Locations (Room & Building) where radioactive materials will be stored and/or manipulated:

Locations for storage and manipulation:
Locations for storage only:
Locations for manipulation only:

5. Instruments for Contamination Monitoring and Sample Counting: (List all instruments that may be used (purchased or borrowed) – The Permit Holder MUST demonstrate that access to appropriate instruments for monitoring is available.

a) Bench Top Counters (beta or gamma counters)

Make and Model of counter	Counter Serial #	Source	Activity / Date	Source Serial #	Location (Room & Bldg)

b) Portable Survey Meters

Make and Model of meter	Make and model of probe (s)	Location (Rm & Bldg)	Check Source			Ownership
			Radioisotope	Activity / Date	Serial #	

6 a) Radiation Laboratory Supervisor (RLS) *The RLS must indicate their agreement to act on behalf of the Permit Holder by completing the RLS declaration at the end of this form.*

First Name:	Surname:	Office Phone #:	Room # & Building:
		:	

Summary of training and experience using radioisotopes (include radioisotopes, training dates, course duration and location; date and length of time which you last did work with radioisotopes:

_____

_____

_____

_____

b) Authorized Workers: Complete **"*Part B List of Authorized Workers"*** on page 4 by listing all personnel who, in addition to the Permit Holder and LRS, may be working with radioactive materials.

Declarations

I, the nominated Radiation Laboratory Supervisor (RLS), accept the responsibilities to act as the designate of the applicant in accordance with the procedures outlined in the University of Lethbridge "Radiation Safety Manual".

Date: _____ Name: _____ Signature of nominated LRS: _____

I, the Applicant, warrant the statements contained herein to be true and agree that the radioisotopes supplied against this application shall be used for the purpose and in the manner authorized by the University of Lethbridge Safety Committee. I hereby agree to comply with the rules and procedures outlined in the University of Lethbridge "Radiation Safety Manual".

Date: _____ Name: _____ Signature of Applicant: _____

Department Head Approval: I, the supervisor of the Applicant, approve of the applied for activities including the use of the locations listed in Section 4) and I am aware that the cancellation of the Applicant's Internal Radioisotope Permit requires the completion of a ***Radioisotope Permit Decommissioning Form*** and decommissioning of these areas.

Date: _____ Name: _____Signature of Department Head: _____

Related notes:

- **Requests for amendment of the following information should be submitted in writing to the RSO, Safety Services for subsequent approval by the Radiation Safety Committee.**
- **Records required as outlined within the conditions listed on the Internal Radioisotope Permit and the Internal Radioisotope Permit itself are the property of the University of Lethbridge and must be returned to Services upon request.**
- **If the Permit Holder wishes to cancel a permit they are required to indicate such intent to the RSO, Safety Services as soon as possible, and submit a completed "Radioisotope Permit Decommissioning Form".**

List of Authorized Workers

First Name	Surname	Job Title	Date Added/ Deleted	Radionuclides Used and Length of Experience	Radiation Safety Training	
					Date	Location

APPENDIX A **RADIOISOTOPE PERMIT NO. _____**

RADIATION SAFETY CONDITIONS

NUCLEAR SUBSTANCES & RADIATION DEVICES

RESPONSIBILITIES

1. The recipient of this Radioisotope Permit shall comply with the radiation protection responsibilities and requirements outlined in the University of Lethbridge Radiation Safety and Procedures Manual. Authorized users under this permit shall have access and be familiar with the Radiation Safety and Procedures Manual.

TRAINING

2. The Radioisotope Permit Holder shall ensure that only authorized personnel who have received appropriate radiation safety training and who are aware of the hazards involved are allowed to use nuclear substances without supervision.

   Individuals with limited or no training in the use of nuclear substances shall be required to complete a radiation safety course approved by the Radiation Safety Officer.

3. Copies of training certificates/documentation shall be submitted to the Radiation Safety Officer.

SIGNAGE

4. Appropriate radiation warning signs shall be posted whenever and wherever nuclear substances are used or stored. Signage must display the nature of the radiation hazard present. Contact the Radiation Safety Officer for signage details.

   Radioisotope laboratories or storage enclosures (e.g. refrigerator) must display: radiation warning symbol, the words “Caution Radiation Area”, nuclear substances and possession limit and emergency contact name(s) or job titles and 24hr. emergency telephone numbers.

LICENCE AND PERMIT POSTING

5. A valid copy of this Radioisotope Permit and University of Lethbridge Radioisotope Licence shall be conspicuously posted at all locations where nuclear substances are used or stored.

USAGE

6. The handling of nuclear substances covered by this Radioisotope Permit shall be in accordance with these permit conditions and all radiation safety practices/procedures outlined in the University of Lethbridge Radiation Safety Procedures Manual.

7. Nuclear substances shall only be handled or stored in an approved radioisotope laboratory as specified in this Radioisotope Permit.

8. A calibrated contamination survey meter must be available to radioisotope users to monitor radioactive contamination from Iodine-125, and Phosphorus-32. Calibration requirements outlined in the University of Lethbridge Radiation Safety Procedures Manual must be followed.

9. An Emergency Spill Kit shall be available in each radioisotope laboratory listed under this Radioisotope Permit.

10. Radioactive prescribed substances authorized by this permit are not to be used in or on humans or animals.

11. Radiation intensity levels in nuclear substance usage and storage areas, normally occupied by any other person, other than a Nuclear Energy Worker, shall not exceed 2.5 microsieverts per hour.

12. Individuals working with radioiodine should follow the radiation safety procedures outlined in the University of Lethbridge Radiation Safety and Procedures Manual.

13. Sealed sources shall be leak tested, if required, following procedures in the University of Lethbridge Radiation Safety Procedures Manual. Records of leak tests shall be maintained.

PERSONNEL MONITORING

14. If applicable, individuals working with radioiodine in excess of the quantities listed in the University of Lethbridge Radiation Safety Procedures Manual shall be required to participate in an in vivo or bioassay monitoring program. For additional information concerning monitoring schedules contact the Radiation Safety Officer.

15. All personnel who work in an area, room or enclosure where tritium is stored, or used without containment in the form of:

    a) a gas, Tritiated water or nucleic acid precursor in quantities of 200 Megabecquerels (5.4mCi), or more, or;

    b) tritium labeled compounds in quantities of 2 Gigabecquerels (54mCi), or more;

    shall be monitored for internal tritium contamination. Information on the bioassay method to be used can be obtained from the Radiation Safety Officer.

16. Whole body dosimeters shall be worn by personnel working with Phosphorus-32, Iodine-125, Iodine-131, and Chromium-51. Extremity dosimeters shall be worn by personnel working with Phosphorus-32 in excess of 50 Megabecquerels. The use of personnel radiation dosimeters is not required for the use of Tritium (^{3}H) and Carbon-14.

INVENTORY

17. Up-to-date inventories shall be maintained for all nuclear substances acquired under this permit. A separate inventory record is required for each open source vial. Inventory information for radiation devices and sealed sources may be kept together on a sealed source inventory record. University of Lethbridge "Radioisotope Inventory and Usage Record" forms must be used and are available from Radiation Safety Officer.

EMERGENCIES, THEFT, LOSS OR SPILLS

18. The Radiation Safety Officer must be notified immediately if any nuclear substance has been involved in an accident or fire.

19. The theft or loss of any nuclear substance shall be reported to the Radiation Safety Officer (329-2350 or 332-2350) immediately.

20. The Radiation Safety Officer shall be notified of any occurrence of a radioactive spill. Spill procedures outlined in the University of Lethbridge Radiation Safety Procedures Manual shall be followed.

SECURITY

21. Nuclear substances must not be accessible to unauthorized workers or the general public. Nuclear substance must be locked within a secure storage unit in a secure area or enclosure. Each radioisotope laboratory must not be left unattended – an authorized radioisotope user must supervise the area if the nuclear substance is not in a secure area or enclosure.

TRANSFER AND TRANSPORT OF NUCLEAR SUBSTANCES (RADIOACTIVE MATERIAL)

22. Transfer or transport of nuclear substances to another organization is prohibited without prior approval from the Radiation Safety Officer.

PURCHASES

23. All purchase requisitions for nuclear substances shall include:

    a) University of Lethbridge CNSC Radioisotope Licence number
    b) Radioisotope Permit holder name or number
    c) Authorized Permit holder or designate signature
    d) The words “Radioactive Material”
    e) Authorization from the Radiation Safety Officer

RECEIPT OF RADIOACTIVE SHIPMENTS

24. A copy of each radioactive shipment packing slip shall be submitted to the Radiation Safety Officer.

25. Radioactive shipments must be put in a secure area ASAP after delivery. “Procedures Upon Receiving Radioactive Materials” in the University of Lethbridge Radiation Safety Procedures Manual must be followed.

PERMIT AMENDMENTS

26. Request for amendments to this Radioactive Permit shall be submitted in writing to the Radiation Safety Officer.

GENERAL SAFETY

27. Appropriate hand washing facilities (i.e. sink and soap) must be maintained.
28. Personal protective equipment (lab coat, safety glasses, and gloves) must be worn.

University of Lethbridge Open Source Radioisotope Permit

RADIOISOTOPE USER PERMIT NUMBER: RS 2016 – 10

DATE OF ISSUE: 30 January 2016
EXPIRY DATE: 31 January 2018

NAME AND ADDRESS OF PERMIT HOLDER:

DR. X
Room B-xxx,
University Hall Building
University of Lethbridge
4401 University Drive
Lethbridge, Alberta T1K 3M4

PHONE: (403) XXX - XXX
E**mail: x.x@uleth.ca**

NAMES OF PERSONS DESIGNATED AS AUTHORIZED USERS UNDER THIS PERMIT:

See attached Authorized Worker & Training List

RADIOISOTOPES	**OPEN SOURCE POSSESSION LIMIT**
^{125}I	< 37 MBq

LOCATIONS WHERE RADIOISOTOPES ARE AUTHORIZED TO BE USED OR STORED:

USAGE & STORAGE:
Room Cxxx– Basic Level Laboratory
University Hall Building
University of Lethbridge
4401 University Drive
Lethbridge, Alberta T1K 3M4

RADIATION SAFETY CONDITIONS (SEE APPENDIX A)

RADIOACTIVE WASTE MANAGEMENT INSTRUCTIONS:

The Radiation Safety Officer must authorize the disposal of radioactive material.

This Permit is issued by the Radiation Safety Committee on behalf of the University of Lethbridge under the authority granted by the Canadian Nuclear Safety Commission through Nuclear Substances and Radiation Devices Licence Number: 07961-1-07.0

Carolin Cattoi-Demkiw .
Chair, Radiation Safety Committee Signature

University of Lethbridge Sealed Source Radioisotope Permit

RADIOISOTOPE USER PERMIT NUMBER: RS 2016 – 14

DATE OF ISSUE: 30 January 2016
EXPIRY DATE: 31 January 2018

NAME AND ADDRESS OF PERMIT HOLDER:

DR. X
Room B-xxx,
University Hall Building
University of Lethbridge
4401 University Drive
Lethbridge, Alberta T1K 3M4

TEL: (403) XXX - XXX
E**mail: x.x@uleth.ca**

NAMES OF PERSONS DESIGNATED AS AUTHORIZED USERS UNDER THIS PERMIT:

Dr. X

Device Description: PORTABLE GAUGE, MISCELLANEOUS CHECK SOURCES

Manufacturer	Model	Serial No.	Radioisotope	Serial No.	Activity	Calibration Date
Campbell Pacific	503	H31073899	Am-241/Be	H3107389	1850 MBq	May 1981

LOCATIONS WHERE RADIOISOTOPES ARE AUTHORIZED TO BE USED OR STORED:

USAGE & STORAGE:
Room Cxxx– Storage Room
University Hall Building
University of Lethbridge
4401 University Drive
Lethbridge, Alberta T1K 3M4

RADIATION SAFETY CONDITIONS (SEE APPENDIX A)

RADIOACTIVE WASTE MANAGEMENT INSTRUCTIONS

Arrangements for disposal or transfer of the sealed radioactive materials covered by this permit shall be made through the Radiation Safety Officer.

This Permit is issued by the Radiation Safety Committee on behalf of the University of Lethbridge under the authority granted by the Canadian Nuclear Safety Commission through Nuclear Substances and Radiation Devices Licence Number: 07961-1-07.2

Carolin Cattoi-Demkiw
Chair, Radiation Safety Committee

Signature _____

RADIOISOTOPE LAB/PROJECT DECOMMISSIONING FORM

INSTRUCTIONS:

Radioactive material may not be transferred to the possession of any person nor used for any purpose in any location other than originally authorized without prior approval of the Radiation Safety Officer and the Radiation Safety Committee.

Refer to the checklist on page 2 for further information on decommissioning requirements.

Permit Holders planning to discontinue the use of Radioactive Materials at locations authorized by the University of Lethbridge must contact the RSO to initiate the decommissioning process.

Return completed form to: *Radiation Safety Officer, Campus Safety - Safety Services, University of Lethbridge, Markin Hall M4145. Phone: 329-2350 (office) or 332-2350 (cellular)*

1. Permit Holder/Radiation Lab Supervisor:

Radioisotope Internal Permit Number: _____ Lab Location (Bldg. /Room #): _____

Name: _____

Department: _____ Office (Room #, Bldg.): _____

Phone (office): _____ (lab): _____

Email: _____

2. Comments/additional information:

_____

_____

_____

_____

DATE OF TERMINATION: _____

PERMIT HOLDER: _____ _____
Print Name Signature

RADIATION SAFETY OFFICER: _____ _____
Print Name Signature

Laboratory Decommissioning Procedure Checklist

☐ **Radioisotope Inventory**

All radioactive stocks and/or sealed sources must either be transferred to another authorized permit holder or disposed as per the UofL authorized disposal procedure for radioisotopes. The University Radiation Safety Officer (RSO) must authorize the transfer to another permit holder.

☐ **Decontamination**

A thorough contamination survey (swipe tests) must be completed. All bench tops, floors, storage areas and equipment must be surveyed. Areas that exceed the criteria in the Radiation Safety and Procedures Manual must be decontaminated and re-swiped. Records, including scintillation counter printout must be forwarded to the RSO.

☐ **Equipment**

Prior to disposal, surplus or transfer to another user all equipment that had been used with radioisotopes must be thoroughly decontaminated, as described in the Radiation Safety and Procedures Manual. Records, including the scintillation counter printout, must be forwarded to the Radiation Safety Officer. Note, liquid scintillation counters typically contain a radioactive source and are listed on the University's inventory of radiation devices. As such, moving a LSC to another location, or transfer to another user must be approved and authorized the RSO.

☐ **Waste**

All radioactive waste must be disposed of as per disposed as per the UofL authorized disposal procedure for radioisotopes.

☐ **Signage**

All radioactive warning signs must be removed (including door signs, storage/work area stickers).

Note: Decommissioning of a building that is listed on the University's licence requires a more in depth process. The CNSC recommends using a decommissioning plan for an authorized building or site, including the following:

a) Characterizing the licenced activities.
b) Examining historical information, such as the following:
- The length of time that nuclear substances and radiation devices were in use;
- The location where they were used;
- The specific type(s) and quantities of nuclear substance(s) which were used; and,
- The information available by consulting previous licences.

c) Planning the processes of monitoring radiation contamination and decontamination.
d) Preparing for the monitoring, dismantling and removal of associated equipment.
e) Planning for the removal, transfer or shipment and disposal of nuclear substances and radiation devices.
f) Removing or defacing all signs, labels and nuclear substances packaging.
g) Conducting a final radiological survey and submitting a complete report to the CNSC, so that verification of the decommissioning can be completed.
h) Planning for a possible CNSC final inspection prior to releasing of the address from regulatory control.

APPENDIX B

B.1 Dosimetry Service Request Form
B.2 Radioisotope Purchase Authorization Form

UNIVERSITY OF LETHBRIDGE
APPLICATION FOR DOSIMETRY SERVICE

(N.B. The National Dosimetry Service charges additional fees for ad hoc dosimeter requests. Please allow a minimum of 2 weeks for order processing.)

PLEASE PRINT CLEARLY

PERSONAL INFORMATION

Name:
_____
(Surname) (Given Names)

Date of Birth: _____ (Year/Month/Day)

Male _____ Female _____ Job Title: _____

Place of Birth: Province: _____
Country: _____
Social Insurance Number: _____
(Note: The National Dose Registry maintains records by S.I.N.)

Lab Phone #_____ Email: _____
Radiation Safety Training Course Date: _____

DOSIMETER TYPE

Please indicate type of dosimeter(s) you are applying for. If you will be ordering P-32 stock solution of greater than 50 MBq (1.35 mCi) you are required to wear an extremity dosimeter, wrist **or** ring. Indicate S, M, or L, for ring.

_____ Whole Body/Torso _____ Left Wrist _____Right Wrist
_____ Left Ring _____ Right Ring

DOSIMETER USE Radioisotope _____ X-ray equipment _____

Please list the maximum activity that you will be **using at any one time in a procedure** for the isotopes you will be using:

Isotope	Max. Activity	Isotope	Max. Activity	Isotope	Max. Activity	Isotope	Max. Activity
P-32		P-33		I-125			

DOSIMETER STORAGE
Storage location: _____
Building Room #

PRIOR DOSIMETRY SERVICE

Have you participated in a dosimetry program before? (If yes, please indicate where you lived and dates when the dosimeter was worn.)
Yes ___ No ____ Province: _____ Date: _____

If outside Canada, please indicate the country: _____

AUTHORIZATION

Radioisotope Permit Holder Name: _____
Department: _____
Radioisotope Permit Number: _____

Signature of Radioisotope Permit Holder: _____
Signature of Registrant: _____

Name of Responsible Authority for X-ray Unit: _____
Location of X-ray equipment _____
Building Room

Signature of Responsible Authority for X-ray Unit: _____
Signature of Registrant: _____

THE PERMIT HOLDER IS RESPONSIBLE FOR THE COST OF UNNECESSARY, LOST, DAMAGED, OR LATE DOSIMETERS

****

For Safety Services Use Only:

Date of training: _____ Verified by: _____

Date dosimeter issued: _____

The information on this form is collected under the authority of the Freedom of Information and Protection of Privacy Act. It is required for the acquisition of a dosimeter to measure personal radiation dose estimates. This information will be provided to the dosimetry service provider, National Dosimetry Services (Health Canada). If you have any questions about the collection or use of this information, contact the University of Lethbridge FOIP Coordinator at 403-332-4620 or foip@uleth.ca.

University of Lethbridge
RADIOISOTOPE PURCHASE AUTHORIZATION FORM

INSTRUCTIONS:

1. The Radiation Safety Officer (RSO) must approve and place all radioactive purchases.
2. Complete all sections of this order form. Requests will be delayed if the form is not complete. Attach any supporting documentation (e.g. vendor quote and contact information)
3. Email the completed form to the RSO: safety.services@uleth.ca
4. ***Please allow a minimum of 2 weeks for order processing.***

Permit Holder			**Permit Number**	**Date**
Department	**Phone**		**Email**	
Contact Person	**Phone**		**Email**	
Delivery location				
Budget Code				
Permit Holder Signature				

Vendor	
Quote Number (if applicable)	
Vendor Contact Person (if applicable)	
Vendor Phone Number	
Catalog Number	
Isotope	
Chemical Form	
Activity (Curies)	**Activity (Becquerels)**
Cost	
Requested Delivery Date	
Quantity of isotope currently on inventory	
Requisition #	***(do not write in this area)***
Date approved:	***RSO signature:***

Radioisotope Procurement Procedure:

a) The Permit Holder submits completed Radioisotope Purchase Request Form to the Radiation Safety Officer (RSO). The form must be signed by the Permit Holder.
b) If the request is approved, the RSO enters the requisition with Materials Management. The approved request form will be attached to the requisition.
c) The Permit Holder approves expenditure from the designated account.
d) Materials Management processes the order with the Supplier (RSO contact information must be recorded on the Supplier's order form. Supplier must contact RSO regarding any changes to the order.)
e) Materials Management contacts the RSO when order is received.
f) The Permit Holder confirms that the order has been received as requested and completes a vial swipe and the inventory record documenting the purchase. The shipping document must be filed in the records binder with the corresponding inventory sheet.
g) Any discrepancies regarding the order must be immediately reported to the RSO.

Ordering Requirements

- Only individuals who are approved Permit Holders can order radioactive material.
- The Permit Holder may only order the specific isotopes for which they are approved.
- The Permit Holder may not exceed the possession limit indicated on their permit.
- ALL radioactive material purchase requests (even exempt quantities) must be approved by the Radiation Safety Officer (RSO).

Training Requirements

- A requirement of the University of Lethbridge Radioisotope License is that only persons properly trained to work with radioactive material and informed of the hazards involved are allowed to handle radioisotopes.

- A properly trained person is defined as an individual who:
    - has successfully completed the University of Lethbridge Radiation Safety Course; and
    - has received training from the Permit Holder in radiation protection techniques **SPECIFIC** to each procedure that will be conducted.

- Individuals who have extensive experience in handling radioactive materials must provide a copy of their previous training certificate and may challenge the Radiation Safety Exam. However, if the individual does not pass the exam they are **required** to attend the Radiation Safety Course. I**ndividuals not properly trained as defined above are not authorized to use radioactive materials**.

- The Radioisotope Permit Holder will supply the Radiation Safety Officer with a current list of personnel authorized to use radioactive materials in the laboratory.

- NOTE: Summer students cannot challenge the exam; they must complete the Radiation Safety Course.

APPENDIX C

C.1 ACR Inventory and Purchases Form - Open Source
C.2 ACR Inventory and Purchases Form – Sealed Source
C.2 Original Stock Vial Inventory Form
C.3 Sub-stock Vial Inventory Form
C.4 Radioactive Waste Disposal Form

UNIVERSITY OF LETHBRIDGE

ACR Open Source Radioisotope Purchases & Inventory Report

Permit Holder: _____
Permit Number: _____

January 1 – December 31, _____
Other date: _____
(*e.g. Jan. 1, 2014 – June 30, 2014)*

See instructions on page 2

Date Received DD/MM/YY	**Order Person**	**Supplier**	**Radio-isotope**	**Chemical**	**Lot # & Vial #**	**Original Activity μCi**	**Cal. Date** DD/MM/YY	**Activity in stock as of Dec. 31** ***Or end of reporting period above (enter date)*** _____	**Storage Location**	**Requisition or Packing Slip #**	**In Stock (Y/N) Dispo Date**

UNIVERSITY OF LETHBRIDGE

ACR Open Source Radioisotope Purchases & Inventory Report

Indicate the radioisotope used below.

1. **Record the activity remaining in each stock vial, sub-stock, liquid waste, solid waste and LSV waste.**
2. **If there is radioactivity left in stock vials and sub-stocks, indicate "Yes" in the last column. If "No", record the date the stock vial or sub-stock was disposed.**
3. **Confirm your inventory to ensure that all radioactivity used balances in the inventory (I.e. total radioactivity used equals sum of each disposal activity. Total in stock equals disposals plus activity remaining in stocks/sub-stocks. Indicate zero activity remaining in your inventory if the stock/sub-stock has been used.**
4. **If you use more than two radioisotopes, add additional pages as necessary.**
5. **Report all inventory discrepancies immediately to the RSO.**

Radioisotope: ☐ **14-C** ☐ **3-H** ☐ **I-125** ☐ **32-P** ☐ **35-S**

Activity in liquid waste as of December 31, _____ = _____
Activity in solid waste as of December 31, _____ = _____
Activity in Liquid Scintillation Vial (LSV) waste as of December 31, _____ = _____

Activity in Stock as of December 31, _____ = _____
Activity in sub-stock as of December 31, _____ = _____

TOTAL Activity per radioisotope of December 31, _____ **=** _____

Radioisotope: ☐ **14-C** ☐ **3-H** ☐ **I-125** ☐ **32-P** ☐ **35-S**

Activity in liquid waste as of December 31, _____ = _____
Activity in solid waste as of December 31, _____ = _____
Activity in Liquid Scintillation Vial (LSV) waste as of December 31, _____ = _____

Activity in Stock as of December 31, _____ = _____
Activity in sub-stock as of December 31, _____ = _____

TOTAL Activity per radioisotope of December 31, _____ = _____

Inventory completed by: _____ _____
(Print Name) (Signature)

UNIVERSITY OF LETHBRIDGE

ACR Sealed Radioactive Source/Calibration Standard Inventory

January 1 – December 31, _____
Other: _____
(*e.g. Jan. 1, 2014 – June 30, 2014)*

Permit Holder: _____

Permit Number _____

Manufacturer	Description	Quantity	Serial No.	Radioisotope	Activity/ Calibration Date	EQ	Location (Room/Bldg)	Date of Receipt

TOTAL NUMBER OF SOURCES = _____

DATE: _____

Inventory completed by: _____ _____
(Print Name) (Signature)

ORIGINAL STOCK VIAL – RADIOISOTOPE INVENTORY

PERMIT HOLDER: _____ **RADIONUCLIDE & COMPOUND:** _____ **LOT/BATCH NUMBER:** _____

DATE RECEIVED: _____ **SUPPLIER:** _____ **ACTIVITY (mCi or MBq):** _____ **CALIBRATION DATE:** _____
(DD/MM/YY) **(DD/MM/YY)**

VIAL SWIPE RESULTS: _____ **VOLUME: (ul or mL):** _____ **STORAGE LOCATION:** _____

RECORD OF USE						PRODUCT INFORMATION				DISPOSAL ACTIVITES				
Date Used	Usage Location	Survey Date dd/mm/yy	Volume &/or Activity Used	Name of User	Volume &/or Activity Remaining	Experimental Procedure	Substock # or Storage Location	Volume &/or Activity Stored as Experimental Product	Product Disposal Date dd/mm/yy	Solid Waste Form and Amount	Liquid Waste Form and Amount	Aqueous Sewer	Other	Lab Container Disposal Date dd/mm/yy
Comments:									**Legend:** A = Aqueous S = Solid G = Glass/sharps O = Organic B = Biohazardous LSV = Liq. Scint. vials					

Date Stock Vial Disposed: _____ **Activity of Stock at time of Disposal:** _____
(DD/MM/YY)

UNIVERSITY OF LETHBRIDGE
SUBSTOCK VIAL – RADIOISOTOPE INVENTORY

PERMIT HOLDER: _____ **RADIONUCLIDE & COMPOUND:** _____ **LOT/BATCH NUMBER:** _____

SUB-STOCK NUMBER: _____ **DATE:**_____ **ACTIVITY (mCi or MBq):** _____ **STORAGE LOCATION:** _____
(DD/MM/YY)

_____

RECORD OF USE						PRODUCT INFORMATION				DISPOSAL ACTIVITES				
Date Used	Usage Location	Survey Date dd/mm/yy	Volume &/or Activity Used	Name of User	Volume &/or Activity Remaining	Experimental Procedure	Substock # or Storage Location	Volume &/or Activity Stored as Experimental Product	Product Disposal Date dd/mm/yy	Solid Waste Form and Amount	Liquid Waste Form and Amount	Aqueous Sewer	Other	Lab Container Disposal Date dd/mm/yy

Comments:

Legend: A = Aqueous S = Solid G = Glass/sharps
O = Organic B = Biohazardous
LSV = Liq. Scint. vials

Date Sub Stock Vial Disposed: _____ **Activity of Stock at time of Disposal:** _____
(DD/MM/YY)

RADIOACTIVE WASTE DISPOSAL FORM

INSTRUCTIONS:

- Complete this form for **each** Radioactive Waste Disposal Container used in the laboratory.
- Complete the unshaded columns **each time waste is added the container** (i.e. record the lot/vial number, activity and the date waste was added to container.
- **Record the total weight for solid waste, the total volume for liquid waste or the total volume of scintillation fluid in the container** (i.e. volume per vial x # vials: this will be used to calculate the specific activity).
- **Record the 'TOTAL ACTIVITY' for the lab container disposal date (including decay).**
- This form and the current Radioisotope Inventory Form will satisfy the CNSC's requirement of tracking radioactive materials from "cradle to grave".

N.B. Perform a swipe check on each waste container that will be removed from the lab to ensure that no contamination is present. Attach a copy of the completed contamination survey form to this one.

PERMIT HOLDER _____	**PERMIT NUMBER**_____
CONTAINER ID _____	**RADIOISOTOPE** _____

RADIOACTIVE WASTE TYPE	
❑ **Liquid (total volume:)**	❑ **Solid (total weight:)**
LSV (liquid scintillation vials) ***Do not overfill LSV pails– leave a minimum of 2" of space at top of container***	
❑ **Plastic vials**	❑ **Glass vials**
❑ **Other – specify:**	
Total volume of scintillation fluid in container:	***Scintillation fluid type:***

Lot OR Vial #	Lab Container Disposal Date	Activity (uCi or MBq)	Radiation Safety Pick Up Date	Final Disposal Method / Date
	TOTAL			

APPENDIX D

D.1 Inspection Report Form

Radioisotope Laboratory Inspection Report

Permit Holder:		**Inspection date:**	
Permit Number:		**Inspector:**	
Lab Supervisor:		**Inspection Type:**	
Building:		**__ Routine __ Permit Renewal __ Compliance Verification**	
Room:		**Nuclides used:**	

C = Compliance
N = Non-compliance

Canadian Nuclear Safety Commission Regulations - General Nuclear Safety & Control Regulations (**GN)**; Radiation Protection Regulations (**RP)**; Nuclear Substances and Radiation Devices Regulations (**NSRD)**; Packaging and Transport of Nuclear Substance Regulations (**PTNS);** Licence Condition **LC;** Design Compliance Guide RD-52 **(DC); U of L Lab Safety Manual (UL);** Radiation Safety & Procedures Manual - **Section #;** Permit **, Lab Rules**

C	N	GENERAL SAFETY	Regulation Reference	Radiation Safety Manual
		Radioisotope Lab Sign posted at each entrance to the lab.	RP 22; LC	Section 3
		Lab security (Lab doors locked and secured when lab is unoccupied).	GN 12	Section 3,6
		Permit and Licence Posted - inside the lab (clearly visible).	LC	Section 3
		Lab Rules (CNSC Posters) Posted - inside the lab (clearly visible).	LC	Section 3
		Radiation Safety & Procedures Manual available in the lab.	LC	Section 3
		Emergency procedures available (Radiation Safety & Procedures manual).	LC	Emergency
		Food and beverages prohibited in lab	LC	Lab Rules
C	**N**	**PERSONNEL**		
		Authorized Worker List is posted in the lab (clearly visible).	RP 24; GN 28	Section 3
		Procedures for visitors and Facilities staff (e.g. Building Maintenance) are in place.	LC	Section 11
		Training records for Authorized Workers available.	NSRD 36; LC	Section 4
		Lab coats worn when in the lab.	LC	Lab Rules
		Safety glasses and protective gloves worn when handling radioactive materials.	LC	Lab Rules
		Dosimeters worn when working with radioactive materials (if required).	LC	Section 5
		Bioassay performed when required (I-125).	LC	Section 5
C	**N**	**USAGE, STORAGE AND DISPOSAL**		
		Nuclear substance storage area labeled (rad warning symbol and listed isotopes stored inside).	LC	Section 3
		Nuclear substance storage area secured (fridge/freezer is lockable and is locked at all times).	LC	Section 3
		Nuclear substances not left unsupervised, unless room locked.	LC	Section 3
		Radiation warning symbol on containers of radioactive materials.	LC	Section 3
		Clearly identified working surfaces for handling radioactive materials (warning tape on 4 sides).	LC	Section 3
		Radiation warning symbol on equipment within the radioactive work area.	LC	Section 3
		Radioactive work surfaces covered with disposable absorbent covers.	LC	Section 3
		Spill trays and containment are used.	LC	Section 3
		Radiation warning signs are not posted (where there are no nuclear substances or plans to use)	LC	Section 3
		Up-to-date inventory, usage (room, procedure, user name, date, amount, disposal).	NS 39(1a); GN 28	Section 7
		Radioactive waste disposal authorization forms available (copies available - 3 years).	NS 39(1a); GN 28	Section 9
		Work conducted in fume hood as required by Internal Permit Conditions of Approval.	LC	Section 2
		Fume hood is properly functioning with adequate flow; not over crowded; containers sealed.	LC	Section 2
		Dose rate in occupied areas outside of storage area < 2.5uSv/hr.	LC	Section 5
C	**N**	**CONTAMINATION CONTROL**		
		Portable contamination monitor operational – batteries ok; response checks completed; calibrated within past 12 months.	RP 23	Section 11
		Contamination instrumentation (LSC) operational and verified	RP 23	Section 10
		Monitoring/swipes of packages of incoming nuclear substances (recorded on inventory sheet).	PTNS	Section 7
		Contamination logbook (includes floor plan, list of areas to be checked).	LC	Section 10
		Contamination logbook entries at least weekly.	LC	Section 10
		Liquid scintillation printouts records kept (3 years in chronological order).	LC	
		Monitoring of radioactive equipment after use to ensure contamination criteria not exceeded (less than action limits).	LC	Section 10
		Removal of lab coat and washing of hands before leaving laboratory (handwashing supplies i.e. soap and paper towels, must be available for hand washing).	LC	Lab Rules

COMMENTS:

Radiation Safety Officer:	**Written Notification of Corrective Action Sent:**	**Permit Holder's Response Received:**

Regulatory Exemption Quantities, ALIs, & Basic/Intermediate Limits

Radioisotope	EQ (MBq)	ALI (MBq/y)	Basic Level Lab (MBq) open container limit	Intermediate Level Lab (MBq) open container limit
Am-241	0.001	0.03	-	-
Ba-133	0.1	20	100	1000
C-14	**10**	**34**	**170**	**1700**
Ca-45	1	20	100	1000
Cd-109	1	9	45	450
Ce-141	1	20	100	1000
Co-57	0.1	95	475	4750
Cr-51	1	530	2650	26500
Cs-137	0.1	1	5	50
Fe-55	1	100	500	5000
H-3	**1000**	**1000**	**5000**	**50000**
I-125	**1**	**1**	**5**	**50**
I-131	0.01	1	5	50
In-111	0.1	70	350	3500
Na-22	0.01	6	30	300
Nb-95	0.1	30	150	1500
Ni-63	10	100	500	5000
P-32	**0.1**	**8**	**40**	**400**
P-33	**1**	**80**	**400**	**4000**
Ra-226	0.01	0.07	0.35	3.5
S-35	**100**	**26**	**130**	**1300**

Contact the RSO or refer to CNSC Nuclear Substances and Radiation Devices Regulations SOR 2000/207 for further information on exemption quantities.

Updated June 17, 2016

APPENDIX F

F.1 CNSC ROOM ID CARD – BASIC
F.2 CNSC ROOM ID CARD – INTERMEDIATE
F.3 CNSC DOSIMETERS CARD
F.4 CNSC SPILLS CARD
F.5 CNSC PACKAGES CARD

Canada's Nuclear Regulator

BASIC LEVEL

Use of Unsealed Nuclear Substances

This room has been classified as basic level for the use of unsealed nuclear substances in accordance with Canadian Nuclear Safety Commission requirements. Below is a list of safe work practices to be followed when working in this room.

24-hour emergency contact (name and phone number)

Room identification

- Do not eat, drink, store food, or smoke in this room.
- Use protective clothing and equipment when working with nuclear substances.
- Clearly identify work surfaces used for handling nuclear substances.
- Check all packages containing nuclear substances for damage upon receipt.
- Store nuclear substances in a locked room or enclosure when not in use.
- In case of a spill or incident involving a nuclear substance, inform others in the area, follow emergency procedures and notify the radiation safety officer immediately.

Notes

A room is classified as basic level for the use of unsealed nuclear substances where more than one exemption quantity is handled and where the largest quantity (in becquerels) of a nuclear substance handled by any worker does not exceed five times its corresponding annual limit of intake (in becquerels). Contact your radiation safety officer for a list of annual limits of intake.

For more information, contact:
Directorate of Nuclear Substance Regulation
Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
Ottawa, ON K1P 5S9
Telephone: 1-888-229-2672
Fax: 613-995-5086

nuclearsafety.gc.ca

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Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

Canada

ISBN: 978-0-662-03915-0, Cat. No.: CC172-127/1-2016E-PDF

DECEMBER2016

Canada's Nuclear Regulator

INTERMEDIATE LEVEL

Use of Unsealed Nuclear Substances

This room has been classified as intermediate level for the use of unsealed nuclear substances in accordance with Canadian Nuclear Safety Commission requirements. The following is a list of safe work practices to be followed when working in this room.

24-hour emergency contact (name and phone number)

Room identification

- Do not eat, drink, store food, or smoke in this room.
- Wear dosimetry as required by your radiation protection program.
- Wear appropriate protective clothing and equipment when working with nuclear substances.
- Clearly identify work surfaces used for handling nuclear substances.
- Wash hands regularly and monitor them for contamination frequently.
- Monitor work area for contamination after working with nuclear substances.
- Check all packages containing nuclear substances for damage upon receipt.
- Store nuclear substances in a locked room or enclosure when not in use.
- In case of a spill or incident involving a nuclear substance, inform others in the area, follow emergency procedures and notify the radiation safety officer immediately.

Notes

A room is classified as intermediate level for the use of unsealed nuclear substances where the largest quantity (in becquerels) of a nuclear substance handled by any worker does not exceed 50 times its corresponding annual limit of intake (in becquerels). Contact your radiation safety officer for a list of annual limits of intake.

For more information, contact:
Directorate of Nuclear Substance Regulation
Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
Ottawa, ON K1P 5S9
Telephone: 1-888-229-2672
Fax: 613-995-5086

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Canada

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Canada's Nuclear Regulator

PROPER CARE AND USE OF PERSONAL DOSIMETERS

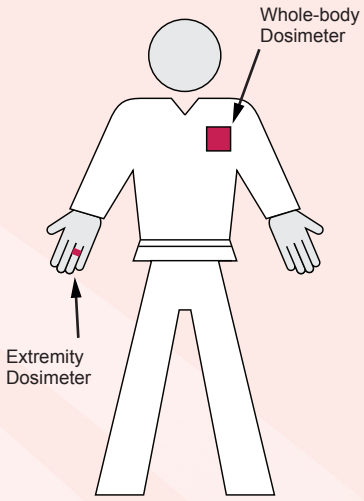
This poster gives useful tips for the proper handling, wearing and storage of whole-body and extremity dosimeters. These are commonly referred to as thermoluminescent dosimeters (TLDs) or optically stimulated luminescent (OSL) dosimeters. Your dosimeter measures the amount of radiation to which you are exposed.

Handling

1. Follow manufacturer recommendations for the care and use of your dosimeter. Do not expose the dosimeter to high temperatures, water, direct sunlight or fluorescent light.
2. Change the dosimeter plaques in a clean, dry area away from direct light, and avoid direct skin contact, if necessary.

Wearing

3. Clip your whole-body dosimeter firmly to your clothing between your waist and neck.
4. Extremity dosimeters should be worn facing the source of radiation.
5. If necessary, wear a second dosimeter on the area of your body most likely to receive the highest dose. In these cases, special arrangements must be made with the dosimetry service provider to ensure doses are assigned properly.
6. If you lose or damage your dosimeter, you should stop working with radiation until you receive a replacement.
7. Do not share your dosimeter.



Storage

8. Store your dosimeter in a manner recommended by the manufacturer when not in use.
9. It is good practice to keep extra dosimeters as replacements for lost or damaged ones and for visitors.
10. When not in use, dosimeters are best stored in a low-radiation background area. Dosimeters should be protected from direct light and heat.

For more information, contact:
Directorate of Nuclear Substance Regulation
Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
Ottawa, ON K1P 5S9
Telephone: 1-888-229-2672
Fax: 613-995-5086

nuclearsafety.gc.ca

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

Canada

APRIL 2018

Canada's Nuclear Regulator

SPILL PROCEDURES

Name and telephone number of the person responsible for enforcing safe work practices with nuclear substances in this work area:

Radiation safety officer	**Telephone number**

24-hour emergency contact	**Telephone number**

General precautions

1. Inform people in the area that a spill has occurred. Keep them away from the contaminated area.
2. Cover the spill with absorbent material to prevent the spread of contamination.

Minor spills (typically less than 100 exemption quantities of a nuclear substance)

1. Wear 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 radiation safety officer or the person in charge.
6. Record spill details and contamination monitoring results. Adjust inventory and waste records appropriately.

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

Major spills (Major spills involve more than 100 exemption quantities, or significant contamination of personnel, or release of volatile material)

1. Clear the area. Persons not involved in the spill should 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. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and mild soap.
7. Follow the procedures for minor spills or proceed in accordance with authorized procedure.
8. Record the names of all persons involved in the spill. Note the details of any personal contamination.
9. If required, 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 days.

If an exposure may have occurred that is in excess of applicable radiation dose limits, the CNSC shall be notified **immediately** as required by section 16 of the *Radiation Protection Regulations*.

For more information, contact:
Directorate of Nuclear Substance Regulation
Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
Ottawa, ON K1P 5S9
Telephone: 1-888-229-2672
Fax: 613-995-5086

nuclearsafety.gc.ca

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Canadian Nuclear Safety Commission
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INFO-0744

GUIDELINES FOR HANDLING PACKAGES CONTAINING NUCLEAR SUBSTANCES

Identifying Packages Containing Nuclear Substances

The packaging and labeling of nuclear substances is governed by the Canadian Nuclear Safety Commission's *Packaging and Transport of Nuclear Substances (PTNS) Regulations*. Nuclear substances may be shipped in "Excepted Packages", "Type A" or "Type B" packages, "Industrial Packages I, II, III", and packages for "Fissile Material". The "radioactive" category labels also show radiation dose rates.

On Excepted Packages, no external labeling is required, and the safety mark "RADIOACTIVE" must be visible upon opening the package. The radiation level at any point on the external surface of the package must not exceed 5 µSv/h. All other packages must be categorized by radiation level and display the corresponding radiation warning labels as follows:

Category 1-WHITE
Does not exceed 5 µSv/h at any location on the external surface of the package

Category II-YELLOW
Does not exceed 500 µSv/h at any location on the external surface of the package and the transport index does not exceed 1.

Category III-YELLOW
Does not exceed 2 mSv/h at any location on the external surface of the package and the transport index does not exceed 10.

The transport index is the maximum radiation level in microsieverts per hour at one metre from the external surface of the package, divided by 10.
Example: 1 µSv/h (0.1 mrem/h) at 1 m equals a TI = 0.1.

Upon receipt of a package containing nuclear substances, keep your distance. Examine the package for damage or leakage. If the package is damaged or leaking, contain and isolate it to minimize radiation exposure and contamination, and comply with Section 19 of the PTNS *Regulations*.

Opening Packages Containing Nuclear Substances

Radiation Safety Officer	**Phone Number**

1. If an appropriate survey monitor is available, monitor the radiation fields around the package. Note any discrepancies.
2. Avoid unnecessary direct contact with unshielded containers.
3. Verify the nuclear substance, the quantity, and other details with the information on the packing slip and with the purchase order. Log the shipment details and any anomalies in the inventory record.
4. Report any anomalies (radiation levels in excess of the package labeling, incorrect transport index, contamination, leakage, short or wrong shipment) to the Radiation Safety Officer.

When opening packages containing unsealed nuclear substances, additional steps should be taken:

5. Wear protective clothing while handling the package.
6. If the material is volatile (unbound iodine, tritium, radioactive gases, etc.) or in a powder form, open the package in a fume hood.
7. Open the outer package and check for possible damage to the contents, broken seals, or discoloration of packing materials. If the contents appear to be damaged, isolate the package to prevent further contamination and notify the Radiation Safety Officer.
8. If no damage is evident, wipe test the inner package or primary container which holds the unsealed nuclear substance. If contamination is detected, monitor all packaging and, if appropriate, all locations in contact with the package, for contamination. Contain the contamination, decontaminate, and dispose in accordance with the conditions of the Nuclear Substances and Radiation Devices licence.

For more information, contact: Directorate of Nuclear Substance Regulation, Canadian Nuclear Safety Commission, P.O. Box 1046, Station B, Ottawa, ON K1P 5S9. Telephone: 1-888-229-2672. Fax: (613) 995-5086.

APPENDIX G

G.1 Clearance to Work Form
G.2 Hazardous Materials Closeout Form
G.3 Authorized Worker Training and Competency Verification Record

University of Lethbridge

FIAT LUX

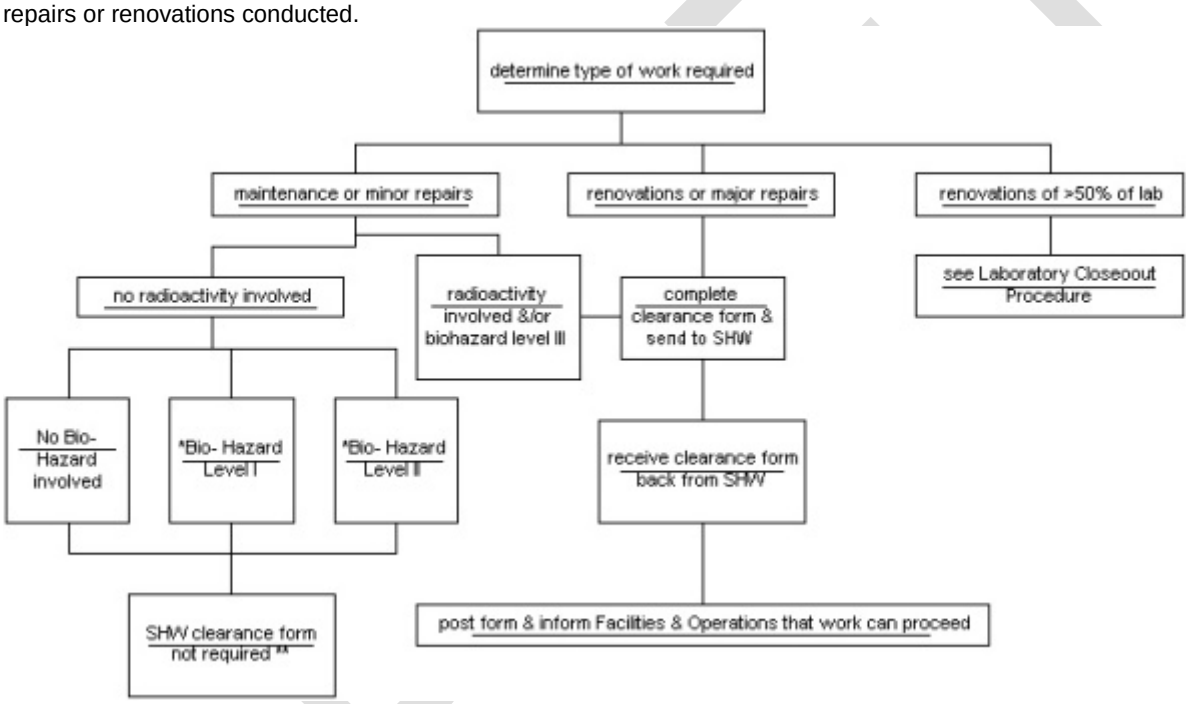
CLEARANCE TO WORK IN LABORATORIES

The **Clearance to Work in Laboratories procedure** is to be used whenever maintenance, repairs or renovations are required in a laboratory. The purpose of this is to ensure a safe environment for maintenance/construction workers. A review by Safety Services office is required when: (1) there is possible radioactive contamination; (2) if the renovation causes a significant disruption in the laboratory; and (3) for all work in Level 3 Biohazards labs (for work in biohazard lab up to Level 2, designated lab personnel must accompany maintenance workers). Some **typical examples** of renovations include:

- Repair/replacement of large areas of flooring
- Removal of a single laboratory bench
- Removal of fumehood

For renovations involving all of or a significant portion (>50%) of the lab, the **Laboratory Closeout Procedure** must be followed.

This form is to be completed by the Person in Charge of the laboratory at the same time that work is requested through Facilities. The decision chart below indicates the sequence of actions that must be taken in order to have maintenance, repairs or renovations conducted.



***If biohazard level 1 or 2 – person in charge or designate must accompany maintenance workers, during regular hours.**

Step 1. Determine what work needs to be preformed.

Step 2. If the area does not involve possible radioactive contamination or require renovations, arrange to have The requested work completed in accordance with Facilities & Operations procedures. Ensure area is clear of chemicals, surfaces are free of residues, experiments have been stopped and obstructions have been removed to allow access. See *Clearance to Work in Laboratories Checklist* on page 2.

Step 3. If the area is possibly contaminated with radioactivity or if renovations or major repairs are required, complete the *Clearance to Work in Laboratories Checklist* and send it to Safety Services for clearance check. When SHW signed and returned the *Clearance to Work in Laboratories Checklist*, post a copy and arrange to have the requested work completed in accordance with Facilities & Operations procedures.

****Facilities staff performing the work must follow appropriate safe work procedures e.g. the Guideline for Maintenance/Minor Repair Work in Laboratories. If there are any questions or if clarification is required, contact immediate supervisor, Facilities, or Safety Services.**

Clearance to Work in Laboratories Checklist

Principal Investigator/Person in Charge: _____

Contact Name: _____ **Phone#:** _____ **Department:** _____

Laboratory/Rm#: _____ **Building Name:** _____

Type of Lab: ☐ Radioisotope ☐ Biosafety ☐ Chemical

Scope of Work:

Request Date: _____ **Requested by:** _____

The following refers to the area that will be disturbed by the repair or renovations	Date Complete/NA
All chemical containers and laboratory apparatus have been removed	_____
All residues on surfaces in the area have been cleaned	_____
All surfaces have been tested and are free of radioactive contamination	_____
All experiments in the area have been stopped	_____
Obstructions have been removed from the area to allow access	_____

Principal Investigator/Person in Charge sign-Off:
"The area is free of chemical or radioactive contamination and is now safe for renovation or repair work to proceed".

Principal Investigator/Person in Charge: _____ (Signature) _____ (Date)

Safety Services Sign-Off required for situations mentioned on Page 1:

Radiation Safety Officer	_____ Signature	_____ Date	_____ N/A
**Safety Advisor	_____ Signature	_____ Date	_____ N/A
Biosafety Officer	_____ Signature	_____ Date	_____ N/A

**Required when there are significant renovations

UNIVERSITY OF LETHBRIDGE

HAZARDOUS MATERIALS CLOSE-OUT PROCEDURE CHECK LIST

Building and room number _____

Please choose one

____Vacating Lab ___ Renovations-Full Lab ___ Renovations –Partial (attach plan)

Hazardous Material/Procedure

Chemicals	**Date Completed or N/A**
Determine if chemicals are for transfer or waste disposal	_____
Ensure all containers have WHMIS labels	_____
Dispose of chemical waste through OHS	_____
Return gas cylinders to supplier	_____
OR transfer responsibility (within U of L) to: _____ Name/Room	_____
Radioactive Material	
Contact OHS	_____
RSO walkthrough	_____
Biohazards, Human Body Substances & Transgenics	
Send notice of de-registration or relocation to OHS	_____
Send Biosafety Cabinet decontamination notice to Biosafety officer	_____
Dispose of tissues & transgenics by autoclaving or incineration	_____
Dispose of preservative (consult Safety Services)	_____
Apply for Canadian Food Inspection Agency off-campus transport permit	_____
Apply for Health Canada off-campus transport of biohazards permit	_____
Transfer responsibility of biohazards (within U of L) to: _____ Name/Room	_____
Obtain Biosafety clearance for Laboratory Decontamination Safety Services	_____
Equipment & Laboratory Surfaces	
Clean and/or decontaminate laboratory surfaces (benches, fume hoods, sinks)	_____
Clean and/or decontaminate equipment	_____
Contact OHS regarding disposal of surplus equipment	_____
Mixed Hazards	
Identify mixed hazards: _____	
Contact OHS for information on disposal	_____

ACKNOWLEDGMENT AND APPROVALS

Department Sign-Off

Submit completed check list to department head for signature Department: _____

Researcher _____ **Date:** _____
Signature Print Name

Researcher _____ **Date:** _____
Signature Print Name

Department Head _____ **Date:** _____
Signature Print Name

Safety Services Sign-Off

Biosafety _____ Date: _____
Signature Print Name

Safety Advisor _____ Date: _____
Signature Print Name

Radiation Safety _____ Date: _____
Signature Print Name

Project Manager Sign-Off

Project Manager_____ Date:_____
Signature **Print Name**

COMMENTS

Renovations may <u>not</u> begin, nor a new researcher take possession of the lab until the closeout has approved by Safety Services and this form returned to the originating department.

University of Lethbridge
Authorized Worker Confirmation of Lab-specific Radiation Safety Training

Authorized Worker Name:	**Date:**
Radioisotope Permit Holder Name:	**Permit #**
Supervisor Name:	
Supervisor Signature:	

Radioisotopes Used	**Experimental Procedure (Name or description)**	**Activity Used in Experimental Procedure**

Radiation Awareness Training only	☐ **Check if individual is not working with radioisotopes (complete items 1-6 below)**

Competency Requirements	**Competent Authorized Workers must demonstrate specific knowledge, understanding and skills in the following areas:**	**COMPETENT**		**Initials**	
		YES	**NO**	**Authorized Worker**	**Reviewer / Supervisor**
1. Hazard Assessment	Understands the hazards associated with each radioisotope used in lab and all lab procedures (review hazard assessment)				
2. Spill Response Procedures	Understands the following: • Spill kit location and spill cleanup procedures • Reporting requirements, contact numbers • Contamination surveys and waste management				
3. Security	Understands measures to be taken by staff: • Keep door locked and closed when lab vacant, question strangers, etc. • Sources locked when not in use (i.e.do not leave sources unattended)				

University of Lethbridge
Authorized Worker Confirmation of Lab-specific Radiation Safety Training

Competency Requirements	Competent Authorized Workers must demonstrate specific knowledge, understanding and skills in the following areas:	COMPETENT		INITIALS	
		YES	NO	Authorized Worker	Reviewer / Supervisor
4. ALARA	Conducts procedures in manner to reduce exposures: • Demonstrates use of increased distance from the source, minimized time around radioactive materials, use of correct shielding				
5. Dosimetry	• Understands wearing requirements, storage location/requirements and dosimeter exchange procedure				
6. PPE	• Demonstrates the proper use of personal protective equipment (PPE) - safety glasses, lab coats, gloves, appropriate clothing				
7. Contamination Monitoring	• Demonstrates correct procedure for using portable contamination monitoring meters (operational checks – battery, source response), measure background, documentation of results) • Demonstrates correct procedure for using liquid scintillation/gamma counter (calibration and verification of accuracy, swipe test procedure, documentation of results) • Understands UofL action limits for contamination and CNSC licence contamination limits • Understands reporting requirements				
8. Purchasing and Acquisition	• Understands required information on all orders - review example of completed form (i.e. chemical name, isotope, activity, cat #, Permit holder name and signature, Permit Number, inventory on hand) • All purchases of radioisotopes, check sources, radiation devices (and transfers) require RSO approval • How to swipe test incoming shipments • Recording of contamination monitoring results (attach to inventory form) • Proper disposal of packaging				

University of Lethbridge
Authorized Worker Confirmation of Lab-specific Radiation Safety Training

Competency Requirements	Competent Authorized Workers must demonstrate specific knowledge, understanding and skills in the following areas:	COMPETENT		INITIALS	
		YES	NO	Authorized Worker	Reviewer / Supervisor
9. Inventory	Demonstrates the following: • Complete inventory record when procedure is complete ("cradle to grave") • Sealed source sign out procedure and record keeping (if applicable)				
10. Waste Disposal	Demonstrates the following: • Prepare waste for disposal • Complete paper work (disposal form) and verify activity is correct • Swipe check waste container prior to removal; record kept in contamination monitoring binder				
11. Resources	• Copy of Radiation Safety and Procedures manual available in lab • Risk and Safety Services webpage – information, questions, forms • Radiation Safety Data Sheets				
12. Other:					
13. Other:					

Comments:

Retain a copy of completed form and forward a copy to Radiation Safety Officer.

University of Lethbridge
Authorized Worker Confirmation of Lab-specific Radiation Safety Training

All personnel handling open and/or sealed radioactive sources must have BOTH generic and site-specific training documented below.

I have read carefully and understand all of the safety requirements and procedures for working safely with radioisotopes in the lab. I also agree to read all procedures for specific experiments contained in the Radiation Safety and Procedures Manual and/or laboratory manuals. I recognize that it is my responsibility to strictly follow these procedures.

I understand that I am required to wear personal protective equipment, such as safety glasses, lab coat, gloves etc., at all times when directed to do so in the laboratory.

If I am unsure of the potential hazards related to lab procedures, I will discuss this with my supervisor prior to undertaking the procedure in question.

LABORATORY PERSONNEL:

Authorized Worker (print name)	Generic Radiation Safety Training Date	Job-specific Training Date	Authorized Worker Signature	Principal Investigator/ Supervisor Initial

Retain a copy of completed form and forward a copy to Radiation Safety Officer.

APPENDIX H

H.1 Radioactive Contamination Criteria
H.2 Radioactive Contamination Monitoring Record

University of Lethbridge Radioactive Contamination Action Limits (14-C, 3-H, 125-I, 32-P, S-35)	
Non-radioactive Areas / Decommissioning Limit	**Designated Radioactive Work Areas/Equipment**
0.3 Bq/cm^2	**3.0 Bq/cm^2**

Contamination Level	Action Required
< 0.3 Bq/cm^2	Record result as '**no contamination'**
Work areas > 3.0 Bq/cm^2	***Clean area immediately***. Re-monitor and repeat cleaning until all contamination is removed or further cleaning does not reduce contamination levels. ***Record contamination levels before and after clean up.***
All other areas > 0.3 Bq/cm^2	

Beckman 6500 Liquid Scintillation Counter

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
H-3	60%	0.3 Bq/cm^2	108	3.0 Bq/cm^2	1080
S-35, C-14	95%	0.3 Bq/cm^2	171	3.0 Bq/cm^2	1710
P-32, P-33	95%	0.3 Bq/cm^2	171	3.0 Bq/cm^2	1710

Perkin Elmer TriCarb (Model 2800 TR, 2810 TR and 2910 TR) Liquid Scintillation Counter

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
H-3	60%	0.3 Bq/cm^2	108	3.0 Bq/cm^2	1080
S-35, C-14	95%	0.3 Bq/cm^2	171	3.0 Bq/cm^2	1710
P-32, P-33	95%	0.3 Bq/cm^2	171	3.0 Bq/cm^2	1710

Perkin Elmer Wizard 1470 Automatic Gamma Counter

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
I-125	78%	0.3 Bq/cm^2	140	3.0 Bq/cm^2	1404

Portable Meters:

Ludlum Model 3 and Model 2241-2 (3) Meter with 44-9 G-M Pancake Probe

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
P-32, P-33	32%	0.30 Bq/cm^2	58	3.0 Bq/cm^2	580

WB Johnson GSM 500 Meter and HP-265 G-M Pancake Probe

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
P-32, P-33	45%	0.30 Bq/cm^2	81	3.0 Bq/cm^2	810

Berthold Model LB124 Meter

Radionuclide	Detection Efficiency	Non-Radioactive Areas Contamination Limit	Equivalent Net CPM Value	Radioactive Work Areas Contamination Limit	Equivalent Net CPM value
P-32, P-33	30%	0.30 Bq/cm^2	54	3.0 Bq/cm^2	540

Calculation for determining removable contamination (Bq/cm^2) = $\dfrac{\text{(CPM - BKG)}}{\text{Ec x Ew x 60 x A}}$

Where:
CPM= total count rate in counts per minute (CPM)
BKG= normal background count rate measured by the survey instrument (CPM)
Ec= detection efficiency of the counter for the radioisotope measured
Ew= collection efficiency factor for the wipe test (10%)
60 = conversion from minutes to seconds (Bq = 1 disintegration per second (DPS))
A= area wiped (10cm x10cm = 100cm^2)

RADIOACTIVE CONTAMINATION MONITORING RECORD

Date:	**Name:**	**Location:**	**Radioisotope(s) used:**

Type of Contamination Survey and Counting Instrument Used: record the type of contamination survey (direct or indirect) and the make/model of the counting instrument used in the appropriate section below: (i.e. contamination meter, liquid scintillation counter, or gamma counter; *e.g. Ludlum Model 3 meter and 44-9 pancake probe; Beckman 6500 LSC)* and if this is a ***post-procedure*** or ***weekly survey***.

DIRECT SURVEY	**Check one:**	**INDIRECT SURVEY**	**Check one:**
Contamination Meter : Berthold LB-124 Detector: Geiger-Mueller	❑ **Post-procedure** ❑ **Weekly**	Liquid Scintillation Counter: _____ Gamma Counter: _____	❑ **Post-procedure** ❑ **Weekly**

Record the background, measured and net counts per minute for each surveyed location. Compare the net CPM with the appropriate contamination limit chart. If the contamination is found, decontaminate immediately, re-swipe and record the results.

Sample #	Description	CPM (Measured)	CPM (Net)	Contamination Found (Yes/No)	Decontamination Results	Comments
BKG						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

RADIOACTIVE CONTAMINATION MONITORING RECORD

Record the background, measured and net counts per minute for each surveyed location. Compare the net CPM with the appropriate contamination limit chart. If the contamination is found, decontaminate immediately, re-swipe and record the results.						
Sample #	**Description**	**CPM (Measured)**	**CPM (Net)**	**Contamination Found (Yes/No)**	**Decontamination Results**	**Comments**
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						

BKG: Background

CPM: Counts Per Minute

Net CPM = Measured CPM – Background CPM

Safeguards Program

Scope

As per section 4 of REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*, all licensees categorized as "other licensees" for safeguards purposes are required to have a documented safeguards program that provides for the fulfillment of applicable safeguards requirements. Section 3.3 of REGDOC-2.13.1 defines "other licensees" as those who do not possess Group 1A material (i.e. uranium, plutonium-239 and thorium that are sufficiently pure to be used for fuel fabrication or for isotopic enrichment and that are subject to full-scope safeguards), and who:

a) possess Group 1B material (i.e. material that would be categorized as Group 1A material if not formally approved for exemption by the International Atomic Energy Agency (IAEA) from some reporting and verification obligations) or Group 2 material (e.g. uranium and thorium ore concentrates), and/or
b) carry out specified nuclear-related manufacturing activities as defined in REGDOC-2.13.1 Appendix A: List of Declarable Nuclear-Related Manufacturing Activities, and/or
c) conduct nuclear fuel cycle-related research and development activities as defined in REGDOC-2.13.1 Appendix B: List of Nuclear Fuel Cycle-Related Research and Development Activities

For "other licensees", the safeguards requirements considered in the safeguards program include the following:

a) IAEA Access
b) Nuclear Material Accountancy
c) Information Required by the Additional Protocol
d) Provision of Information
e) Retention of Records

Safeguards Program Requirements

IAEA Access	The licensee contact is responsible for providing access to IAEA inspectors upon notification by the CNSC in order to enable the IAEA to verify declarations made by Canada to the IAEA in relation to: a) Group 1B material (i.e. material exempted from safeguards), and or b) specified nuclear-related manufacturing activities, and/or c) nuclear fuel cycle-related research and development activities **Note:** Access may need to be provided on notice as little as 24 hours. The CNSC will seek to participate in all IAEA access requests.
Nuclear Material Accountancy	The licensee contact is responsible for the following activities in order to establish the quantities of Group 1B material present and to report the changes in those quantities as required: a) ensuring that instruments used to make measurements will be maintained and calibrated b) ensuring submission of Inventory Change Document (ICD) to the CNSC by the next business day following an inventory change c) ensuring submission of an updated List of Inventory Items (LII) to the CNSC upon request d) ensuring submission of an Obligated Material Inventory Summary (OMIS) to the CNSC annually by January 31st for any year in which foreign-obligated material was possessed **Note:** Reporting forms can be found on the "Forms" page of the CNSC website (http://nuclearsafety.gc.ca/eng/resources/forms/nuclear-materials-accountancy-reporting.cfm).
Information Required by the Additional Protocol	The licensee contact is responsible for ensuring submission of information to the CNSC annually by March 15th on: a) specified nuclear-related manufacturing activities b) nuclear fuel cycle-related research and development activities

Safeguards Program cont'd

Provision of Information	The licensee contact is responsible for ensuring measures are in place to prevent the compromise of systems used to generate, store and transmit safeguards-relevant information. The licensee contact is responsible for ensuring that information supplied to the CNSC will be transmitted using the CNSC's Nuclear Materials Accountancy Reporting (NMAR) e-business system. Alternate arrangements will be made with the CNSC for files that cannot be submitted via NMAR. **Note:** An NMAR access code can be obtained by emailing the CNSC at cnsc.safeguards-garanties.ccsn@canada.ca
Retention of Records	The licensee contact is responsible for ensuring that copies of records will be retained: a) for the period specified under applicable CNSC regulations, or b) as long as Group 1B material relevant to the records remains in the licensee's possession, or c) as long as the licensee continues to perform declarable nuclear-related manufacturing activities relevant to the records, or d) as long as the licensee continues to perform nuclear fuel cycle-related research and development activities relevant to the records, or e) for a minimum of five years, whichever is longer

APPENDIX J

Sealed Source Security Standard Operating Procedure (SOP)

Radiation Safety – Standard Operating Procedure

Title: Security Measures for Sealed Nuclear Sources

Revision #: new

Review Period: 3 years

Prepared By: Carolin Cattoi-Demkiw (RSO) **Date: June 26, 2017**

Reviewed By: Joint Biosafety & Radiation Safety Committee **Date: July 5, 2017**

Approved By: Joint Biosafety & Radiation Safety Committee **Date: July 6, 2017**

Purpose

Access to radioactive materials is to be controlled from the time of acquisition until disposal. This SOP outlines security requirements for controlling unauthorized access to sealed sources as required by Canadian Nuclear Safety Commission *REGDOC-2.12.3, Security of Nuclear Substances: Sealed Sources*.

Scope

The permit holder shall implement and maintain security measures commensurate with the nuclear substance and/or radiation device in possession, and legislative requirements. This SOP shall apply to the use and storage of Category 4 and 5 sealed sources, and radiation devices (i.e. liquid scintillation counters).

Responsibility

It is the responsibility of the Radioisotope Permit Holders, Radioisotope Lab Supervisors and Authorized Workers to secure nuclear substances in their possession and ensure that radioactive materials are used and stored in a manner to prevent unauthorized access or removal.

Definitions

Category 4 source: sources that are very unlikely to permanently injure anyone. However, this amount of unshielded radioactive material, if not safely managed or securely protected, could possibly – although it is unlikely – temporarily injure someone who handled it or was otherwise in contact with it, or who was close to it for a period of many weeks.

Category 5 source: sources that could not permanently injure someone.

Radiation Device: a device that contains more than the exemption quantity of a nuclear substance and that enables the nuclear substance to be used for its radiation properties; a device that contains a radium luminous compound.

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

Storage The holding of radioactive sources in an area that provides for their containment with the intention of retrieval.

Training

a) Radiation Safety Training (Part 1 – Theory and Part 2 – Practical) provided by Safety Services. Note: at the discretion of the Radiation Safety Officer, Part 2 training may not be required for workers who only use Category 5 sealed sources.
b) Lab specific radiation safety training provided by the Radioisotope Permit Holder and/or Radioisotope Lab Supervisor is required prior to working with radioactive materials.
c) Radiation Safety Awareness training will be provided to Facilities staff (Caretakers, Utilities, etc.) by Safety Services.

Safety

The Radioisotope Permit Holder shall conduct a hazard assessment that identifies hazards and mitigating controls for the use and storage of sealed sources. A copy of the hazard assessment shall be available to Authorized Workers.

A copy of the following shall be available to Authorized Workers:

- UofL Radiation Safety and Procedures Manual
- Radiation Safety Data Sheets
- Manufacturer's safety information
- Any other relevant safety information

Material and Equipment

- Lockable enclosures
- Shielding (if required)
- Record keeping systems (see Records section below)

Procedure

The security of sealed sources shall be maintained by implementation of the following:

1. **Access Control and Authorization:**
   - Access to sealed sources is to be controlled from the time of acquisition until transfer or disposal.

a) Physical Security (locked storage)
- When not in use or not under the direct supervision and control of an authorized worker, sealed sources shall be secured in a locked room, area, enclosure (e.g. storage freezer).
- A method of key control shall be implemented by the Radioisotope Permit Holder.

b) Authorization
- Only trained Authorized Workers are permitted access to sealed sources.

- Sealed sources must be secured in such a manner that an individual with authorized access to the area (Caretaking, Maintenance, Materials Management staff) but who is not authorized to use or possess the materials cannot gain access or control of the materials.

2. **Training:**
   - Radioisotope Permit Holders shall ensure that all Authorized Workers are trained and competent in application of required security measures.
   - Authorized non-users that access the laboratory shall receive radiation safety awareness training.
   - Records of training/review must be maintained.

3. **Inventory Management:**
   - Inventory management of nuclear substances and radiation devices (e.g. maintenance and verification inventory records and sign-out log books) must be maintained by the Radioisotope Permit Holder.
   - Individual sealed sources must be identified with a unique inventory number.
   - Regular inventory verification checks must be conducted by the Radioisotope Permit Holder and at the request of the RSO.
   - A log book entry must be made each time a sealed source is removed from and returned to storage. The entry must include the date, the Authorized Worker's name, the identity of the source, the location the source will be used and the date the source was returned to storage.

4. **Incident Reporting:**
   - The Permit Holder or his/her designate must immediately report any actual or suspected loss or theft of a nuclear substance or radiation device to the RSO and an investigation must begin.

Review Period

- This SOP must be reviewed every three years by the Radiation Safety Committee and the Radiation Safety Officer.
- This SOP must be immediately revised if errors are identified or if procedures change.

Records

The Permit Holder must maintain the following records:

- Inventory records documenting purchases, transfers and disposals
- A log book to record the use of sealed sources
- Training records
- Key control records

References

CNSC Regulatory Document 2-12-3, Security of Nuclear Substances – Sealed Sources: http://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/REGDOC-2-12-3-Security-of-Nuclear-Substances-Sealed-Sources.pdf

University of Lethbridge Radiation Safety and Procedures Manual: http://www.uleth.ca/risk-and-safety-services/sites/risk-and-safety-services/files/UofL%20Radiation%20Safety%20and%20Procedures%20Manual_02.10.2017.pdf