This document was prepared for users of laboratories and facilities at Union College utilizing radioactive materials and/or equipment which can produce ionizing radiations.

Comments and suggestions for improving the document, as well as the procedures and regulations contained within, are welcome and may be sent to dobsonde@union.edu.

The New York State Department of Health’s State Sanitary Code, Chapter I, Part 16, titled “Ionizing Radiation” is accessible at www.health.state.ny.us/.

Elizabeth Dobson-Davis
Radiation Safety Officer
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Radiation Safety Committee

Lexie Bonitatibus, Director of Budgets and Risk Management
Michael Hilton, EHS Compliance Officer
John Garver, Professor of Geology
Scott LaBrake, Senior Lecturer for Physics & Astronomy
Elizabeth Dobson Davis, Director of EHS, RSO Elect, ex officio member

1.0 Introduction

This document was prepared for use as a manual of procedures for working with ionizing radiation at Union College. This document is revised periodically as regulations change or as better radiation safety criteria is developed. Comments and suggestions from faculty, staff, and students for improving this document should be directed to the chairperson of the Radiation Safety Committee.

The United States Environmental Protection Agency (USEPA) is responsible for establishing radiation protection standards. These standards are promulgated by the Nuclear Regulatory Commission (NRC) and in New York State, by the State Health Department (DOH). Risk evaluation for the exposure to ionizing radiation has been done by numerous bodies of scientists, most notably the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation.

People are exposed to ionizing radiation in the form of a natural occurring background radiation. Natural background radiation is derived from mainly cosmic and terrestrial radiation. Cosmic radiation originates from other galaxies and from the sun. Terrestrial radiation is given off from radioactive isotopes mainly in minerals that make up rock and soil. Radioactive elements such as uranium, thorium, and potassium may be taken up in the food chain, resulting in deposition in our bodies. They also decay into noble gases, such as radon, which can be inhaled. Naturally occurring radioactive materials can emit gamma rays that irradiate from the ground and from materials used in building structures. The total quantity of natural background radiation, on average, is about 360 milliREMS each year, but it can range from 1 to 2 times as much, depending on location. Natural background radiation is present when we make measurements in our laboratories and therefore should also be measured and quantified.
2.0 General Radiation Safety Policy

2.01 Introduction

The ionizing radiation dose received by any person from external or internal exposure from radioactive material or machines generating ionizing radiation must be held to the lowest possible value consistent with effective use of the material or installation and must never exceed the legally maximum permissible value. Union College’s radiation protection guidelines set forth a dose limitation system which is based on three principles:

**Justification**- Any occupational exposure of persons to ionizing radiation should be justified with an expected overall benefit from the activity causing the exposure.

**Optimization**- A sustained effort should be made to ensure that collective doses, as well as annual, committed, and cumulative lifetime individual doses, are maintained as low as reasonably achievable (ALARA), with economic and social factors being taken into account.

**Limitation**- Radiation doses as a result of occupational exposure should not exceed specified limiting values, contained in New York State Sanitary Code 10 NYCRR Part 16- Ionizing Radiation (Part 16), section 16.6, occupational dose limits.

Every effort should be made to avoid contamination of work areas, and, release of airborne or waterborne radioactivity should never exceed legal limits. Every effort should be made to avoid accidental releases. Disposal of all radioactive waste must be in accordance with procedures contained in Section 12. The radiation dose received by any person from external or internal exposure to ionizing radiation in a non-controlled, general public area must be held as close to natural background levels as possible and must not exceed the legal maximum permissible level of 100 mREMs per year, above the natural background level.

Legal maximum permissible dose levels are specified in the current edition of the New York State Department of Health Sanitary Code, Chapter I, Part 16, Ionizing Radiation; and in Title 10, Part 20, of the Code of Federal Regulations (10 CFR 20), Radiation Protection. These two documents contain definitions of terms used in this safety manual. Because of their size and frequency of changes, they are stand-alone documents.

Copies of these documents are available online at:


2.02 ALARA Program

Control of radiation exposure is based on the assumption that any exposure involves some risk. However, occupational exposure within accepted limits represents a risk that is very small compared to the other risks encountered in other work environments.

The policy of Union College is to maintain occupational exposures of individuals within allowable Radiation Exposure Guides and the individual and collective dose to workers As Low As is Reasonably Achievable (ALARA). Management at all levels, as well as each individual worker, must take an active role in minimizing radiation exposure.

2.03 ALARA Program Objectives

In accordance with Union College's commitment to keep occupational exposure as low as is reasonably achievable, the ALARA program will operate within the following guidelines:

1. The annual effective dose (rem) for whole body radiation exposure to individual workers shall not exceed 5 rems.
2. A reported radiation exposure in excess of 0.100 rem for one month shall be brought to the attention of the Radiation Safety Officer (RSO). The RSO shall investigate the source of the exposure; determine why the exposure occurred, and take steps to prevent its reoccurrence. The incident shall be brought to the attention of the Radiation Safety Committee (RSC) and be an agenda item at its next scheduled meeting.
3. This committee provides guidance to assure Union College's ALARA program is incorporated into work planning, design changes, and construction on campus.
4. The Radiation Safety Officer (RSO) has the authority and responsibility to coordinate the ALARA program consistent with Union College policies.
5. The RSO shall maintain the necessary records, procedures, and databases to document ALARA implementation.
6. The RSO shall be provided with the staffing necessary to support of the ALARA program.
7. ALARA considerations shall be incorporated into the normal work process, new work procedures and new design modifications, training and planning at Union College.
8. The RSO shall provide technical assistance to supervisors of radiation installations and users of ionizing radiation when requested for implementation of ALARA concepts and ALARA reviews.

2.04 ALARA Practices

1. Interpose shielding with permanent or temporary barriers as necessary to reduce radiation areas and exposure.
2. Minimize the amount of time in radiation areas.
3. Place as much distance between the user and the radiation sources as practical.
4. Decontaminate areas of radioactive contamination before proceeding to the next task.
5. Use engineering controls to maintain radiation exposures to low levels.
6. Use only the amount of radioactive materials necessary to perform experiments.
7. Require all individuals working with radioactive materials or installation to have proper training in their use and ionizing radiation safety.
3.00 Administrative Control

3.01 Introduction

The following delineates the responsibilities of various elements of the College as they relate to the Radiation Safety Program and the responsibilities of each of the groups to each other: Administration, Radiation Safety Committee (RSC), Radiation Safety Officer (RSO), and Principal Investigators (PI).

1. The Dean of the Faculty is the senior academic officer of the College.
2. The Radiation Safety Committee reports to the senior academic officer of the College.
3. The Director of Budgets and Risk Management is the management representative to the Radiation Safety Committee and will administer the budget for the Radiation Safety Program.
4. The Radiation Safety Officer is responsible for advising the Radiation Safety Program and reports to the Administration and Radiation Safety Committee.
5. The chain of command places the Dean of Faculty as the senior academic officer who represents the Administration and ultimately is responsible for the Radiation Safety Program of the College. The Administration will interact with the Radiation Safety Committee (RSC) and the RSC will report to the Administration of the College. The RSC will oversee the actions of the Radiation Safety Officer (RSO), and the RSO will report to the RSC. Principal Investigators (PI) are responsible to the RSO and can access the RSC, in those cases where there is a conflict between the PI and the RSO.
6. The Principal Investigators are responsible for the radiation safety procedures in their areas of responsibilities. The PI is responsible for adhering to safe practices, which are defined by the New York State Health Department and for generating various reports that are necessary to identify areas where materials generate ionization radiation. S/he is expected to notify the RSO of procedures or actions that he or she thinks may affect the safety of individuals who might come in contact with sources of ionizing radiation.
7. All Principal Investigators must articulate a radiation safety plan for the acquisition, use, and disposal of radioactive material, and this must be approved by the RSO.

4.00 Radiation Safety Committee

4.01 Membership

The Radiation Safety Committee is appointed by and reports to the Dean of Faculty (or his or her designated representative). Members must have experience in the use of radiation and in some aspect of radiation safety. It is expected that committee members represent all departments with significant use of ionizing radiation. The Radiation Safety Office (RSO) is an ex-officio member of the Committee. The Chairperson is appointed by the Dean of Faculty. The Chairperson's responsibilities include:
1. Calling meetings of the Committee,
2. Making recommendations to the Dean of Faculty concerning the size and composition of the Committee,
3. Preparing reports of Committee activities for the Dean of Faculty.

Under recommendation of the Chairperson and approval of the Dean of Faculty, the Committee may seek the advice of a consultant having special expertise radiation safety. This consultant would normally be other members of Union College's faculty or staff, or emeriti, but consultants may be off-campus specialists.

4.02 Radiation Safety Committee Responsibilities

The Radiation Safety Committee (RSC) is charged with the primary responsibilities required for the College's Radiation License, and they include:

1. Set College policies for radiation safety,
2. Give approval to reactivate radiation installations or experiments if they were stopped by the RSO,
3. Review the activities of the RSO and the radiation protection program on an annual basis by completing the audit checklist provided as Form 4.1.
4. Based on findings from the annual review, provide a brief written annual report to the Dean of Faculty.

4.03 Meetings

The RSC meets quarterly and also may be called at any time during the calendar year whenever matters of urgency arise, as determined by the Dean of Faculty, the Chairperson, or the RSO. Guests may attend meetings at the invitation of the Chairperson. In the event that meetings are held in the absence of the Chairperson, a temporary chairperson will be selected from the attending members. Minutes of each meeting are distributed to the members, the Dean of Faculty (or his or her designated representative), and to the RSO.

4.04 Meeting Agenda

The meeting agenda shall include but not be limited to the following topics:

1. Old Business
   - Minutes of previous meeting
   - Outstanding regulatory inspection items

2. Regulatory Inspections since previous meeting
   - Recommendations
   - Violations

3. New Business Items
   - Audits by the RSO
   - New users (faculty or staff)
4. Current events affecting the Radiation Safety Program

5. Radiation exposures to Union College's faculty, staff, and students
   Quarterly Reports (ALARA)
   Annual Report (ALARA)

5.00 Radiation Safety Officer (RSO)

5.01 Introduction

The Radiation Safety Officer (RSO) position was established to facilitate implementation of the College's policy and procedures on radiation safety. The RSO has instrumentation for surveillance of sources of ionizing radiation and provides a periodic survey service for Union College's Radiation Installations.

The RSO is an individual engaged in the study of problems and practices of providing radiation protection. The RSO is concerned with an understanding of the mechanics of radiation damage, with development and implementation of methods and procedures necessary to evaluate radiation hazards, and with providing protection to people and their environment from unwarranted radiation exposures.

The RSO has the authority to stop an operation of any kind if a radiation hazard to personnel exists, if Union College property is endangered, or neglect of College policies is observed. The RSO is an ex officio member of the Radiation Safety Committee.

5.02 Responsibilities of the RSO

1. Assure that the radiation safety regulations set forth in these procedures are complied with.
2. Assure conformance to appropriate regulations of all government agencies concerned with radiation and nuclear safety, including fulfillment of reporting requirements.
3. Carry out the policies and recommendations concerning radiation safety established by the Radiation Safety Committee throughout the College.
4. Personally investigate any radiological incident or accident, prepare and submit a written report to the Committee, and to federal, state, or local agencies as required by regulation.
5. Maintain the College's personnel monitoring program.
6. Render assistance in obtaining registration of all radiation-producing machines.
7. Maintain a record of the registrations of all radiation-producing machines.
8. Maintain an inventory of all radioactive material purchases and shipments for the College, including disposal of all radioactive waste materials.
9. Perform periodic inspections of laboratories using radiation-producing equipment and/or radioactive nuclides and make recommendations for improvement of conditions to conform to College policies.
10. Oversee incoming and outgoing shipments of radioactive materials.
11. Approve or disapprove purchase orders for radioactive materials and/or radioactive

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generating devices. Submit an explanation to the requester in the event of disapproval of an order.

12. Report all regulation infractions to the Radiation Safety Committee for appropriate action.

13. Review the potential radiological hazards of proposed experiments for the Radiation Safety Committee and other Union College faculty and staff.


15. Prepare reports relative to his/her actions to the Radiation Safety Committee.

16. Inform the Radiation Safety Committee of all changes in government regulations on radiation safety, licensing and registration, and provide the RSC with copies of all relevant documents.

17. Inform the Radiation Safety Committee of any occurrence or situation requiring consideration of possible changes in the College's regulations and procedures for radiation safety.

18. Order the immediate shutdown of any operation that is hazardous or potentially hazardous.

19. Provide assistance with respect to radiation safety to any person working with a Radiation Installation or materials at the College.

20. Provide instructions for staff and students in the proper radiation safety procedures as requested by the Radiation Safety Committee or the associated College department.

21. Give written approval and provide specific procedures for each Radiation Installation before the Installation is placed into operation.

22. Serve as Radiation Safety Officer for the specific license issued by the New York State Department of Health under the State Sanitary Code, Chapter 1, Part 16, "Ionizing Radiation" and "Radiation Guide 10.2, Rev. 1, "Guidance for the Preparation and Application of Academic Programs of Limited Scope."

23. Provide supervisors of radiation installations with copies of all appropriate College and government regulations on radiation safety, licensing and registration.

24. Call a general meeting of all supervisors of radiation installations whenever he or she determines that such a meeting will be beneficial to the College's Radiation Safety Program.

25. Provide emergency radiation safety services.

26. Supervise disposal of all radioactive wastes.

27. Update and distribute revisions of Appendices of this document whenever there are significant changes in the information given therein and in any case review the information for accuracy at least once a calendar year.

28. Assure proper posting of radiation areas.

6.00 Radiation Installation

6.01 Definition

A radiation installation is any Union College facility where

1. Radioactive materials are stored or used, or
2. there is equipment for generating ionizing radiation, or
3. there is a combination of (1) and (2).
6.02 Initial Establishment

No radiation installation will be placed into operation before the RSO has given written approval. The supervisor in charge of the installation must submit a request for approval, together with a description of the facility to include controls for denying access to unauthorized personnel methods for continuous or periodic monitoring, and the instruments to be used. If radioactive materials are to be used, a description must be given for handling radioactive materials, shielding provided, radioisotopes to be handled in the facility, a list of the qualifications of the supervisor in charge of the installation, and a list of persons who may be exposed to ionizing radiation in the facility.

6.03 Modification of Facilities

Any proposed change in the installation, such as location or energy level or radiation operating equipment, the kind or amount of isotopes or personnel must be communicated to and approved by the Radiation Safety Officer.

6.04 Specific Radiation Safety Procedures

Each radiation installation must have a set of specific Radiation Safety Procedures as described in Section 14.

6.05 Requirements

1. Each radiation installation must have appropriate radiation monitoring and survey equipment available that is calibrated and maintained in operating condition.
2. Each installation using radioactive materials must have suitable means available for handling and storage of radioactive waste.
3. Posting, label and control access requirements specified in the New York State Department of Health Sanitary Code, "Ionizing Radiation," Chapter 1, Section 16.12, must be followed.

7.00 Supervisor of a Radiation Installation

7.01 Definition

The supervisor of a radiation installation is the employee (faculty member, staff member or research professor) of Union College having responsibility for the particular installation. For each radiation installation, the name of the supervisor must be on file with the Radiation Safety Officer and posted at the installation in a conspicuous location.
7.02 Supervisor Responsibilities

1. Assure that all users of the installation maintain a daily radiation safety program within their assigned spaces in compliance with applicable State regulations (NYSDOH Part 16) and College policies. Users refer to all persons who work in the installation and include the supervisor, undergraduate students, technicians and research professors. It applies to students using the Installation for a laboratory course or for a research project.

2. Assure that the legal exposure limits are not exceeded and that contamination (personnel, equipment, and facilities) is adequately controlled by requiring all users of the sources of ionizing radiation within the installation conduct radiation surveys and record the results of these surveys. These surveys shall include swipe test for radionuclides and survey meter readings for machines and radionuclides, as necessary.

3. Notify the RSO of any "reportable occurrences" immediately and provide a written report of the occurrence to the RSO within 3 days. Reportable occurrences shall include:
   a. any incident involving the use of radioactive materials exceeding 10 micro curies (µCi) beta-gamma emitters or 1 µCi of alpha emitters,
   b. any incident suspected of exceeding a radiation dose of 100 mRem in one week to any part of the body,
   c. any incident suspected of causing the release of radioactive material to the breathing environment of personnel,
   d. the accidental release of radioactive materials to the sanitary sewer, fume hoods, or exhaust duct system.

4. Maintain an inventory of ionizing radiation sources for the installation.

5. Assure that any person using material or equipment under her/his supervision is properly qualified and has received radiation protection training (see section 15.00). Supervisors for radiation equipment must provide training to students before they are allowed to operate equipment. This training should be done once per academic year and should include basic operation procedures, steps to reduce radiation exposure and emergency procedures. Training shall be documented and training records should be submitted to the RSO at the end of the academic year. Supervisors should use Form 7.1, Student Training Log, provided in the Forms section of this manual.

6. Assure that proper personnel monitoring equipment is worn as required in Section 8, "Personnel Monitoring."

7. Assure that the necessary appropriate survey and monitoring instrumentation (alpha, beta, and gamma) is functional and properly calibrated and is available to the research program.

8. Request from the RSO surveys be performed when special cases or problems exist.

9. Keep the RSO informed of the scope and proposed changes in his or her program.
10. Notify the Director of Physical Facilities by a note on the work order, when work is to be done in an area where radioactive materials or radiation generating equipment is stored or used. Notify the RSO when such a work order is submitted.

11. Maintain security of the radiation sources in his or her laboratory by controlling access to the laboratory or securing the radiation sources against unauthorized use.

12. Assure all personnel using radioactive materials in their laboratory monitor themselves for contamination before leaving.

8.00 Personnel Monitoring

8.0 Personnel Monitoring

An individual is monitored in order to determine the amount of ionizing radiation exposure he or she may receive over a certain time period. This is accomplished by wearing devices sensitive to potential radiation emitting from an installation or source where the individual has authorized access. The overall process includes monthly distribution and collection of the monitoring devices, analyzing the devices by a qualified laboratory to determine the radiation exposure or dose received by the wearer, interpretation and evaluation of the results, and maintenance of records. Any individual receiving an exposure of 100 mRem in any month will be notified and interviewed by the RSO, who may require a formal report from the supervisor of the radiation installation. The RSO will also notify the New York State Department of Health (NYSDOH) if an individual receives or exceeds dose equivalent values provided in Part 16.15(b).

8.01 Personnel Monitoring Devices

Devices used for personnel monitoring must be the integrating type, responsive to the radiation of interest and of sufficient sensitivity to record accurately exposure levels of 1/10 of the radiation protection guides. ("Accurately" should be a ±10% of calibration radiation.) These devices are obtained by completing Form 8.1, Request for Radiation Badge Service, and submitting it to the RSO. Prior radiation exposure history is required.

8.02 Declaration of Pregnancy

A declaration of pregnancy is a voluntary process that includes a written notification of the pregnancy by an employee who uses radioactive material or equipment as part of her job, see Form 8.2. A declaration of pregnancy must be made to the Radiation Safety Officer (RSO) in writing and can be made at any time during the pregnancy. Upon receiving the declaration of pregnancy form, the RSO will schedule an information session with the declared pregnant worker to review the worker's dose history, current job responsibilities, dose limits, and to determine methods for minimizing radiation exposure. The declaration of pregnancy can be revoked by the worker at any time by completing the revocation declaration of pregnancy form (See Form 8.3), or will
automatically end one year after submission. A separate written declaration should be submitted for each pregnancy.

The Nuclear Regulatory Commission (NRC) has published Regulatory Guide 8.13, which details potential health risks of prenatal exposures and suggests precautions and options for the pregnant worker. Copies of Regulatory Guide 8.13 may be obtained from the RSO and is available on the EHS website.

The licensee must retain the declaration form until the New York State Department of Health terminates each pertinent license.

**Regulatory Dose Limits to Declared Pregnant Workers**

The National Council on Radiation Protection and Measurement (NCRP) recommends the whole-body radiation dose received by a female worker during the nine months of her pregnancy must not exceed 500 millirem (mrem) (5 mSv). The NCRP concludes this provides an adequate margin of protection for an embryo/fetus. Efforts should be made to avoid substantial variation above a uniform monthly exposure rate of 0.1 rem (1 mSv) to a declared pregnant woman.

Federal and state regulatory agencies have adopted the NCRP recommendations. However, the regulations only apply when a worker voluntarily declares her pregnancy. If a declaration of pregnancy is made, the worker grants consent to her employer to limit her radiation dose to a total effective dose equivalent of 500 mrem (5 mSv) throughout the entire pregnancy. If no declaration is made to the employer, her occupational annual dose limits remains at 5 rems (50 mSv).

**Dose monitoring for Declared Pregnant Workers**

The Licensee is required to monitor the occupational dose to a declared pregnant woman using an individual monitoring device, if it's likely the declared pregnant worker will receive a monthly external deep dose equivalent in excess of 0.1 rem. Once a declaration of pregnancy form is completed and delivered to the RSO, the RSO will arrange for a fetal dose monitor to be worn by the pregnant worker, which should be worn any time the worker is using radiation equipment or sources during her pregnancy.

The licensee must retain the dose records until the New York State Department of Health terminates each pertinent license.

**8.03 Personnel Monitoring Wearing Criteria**

1. Each person who may expect to receive a dose equivalent in excess of 500 mRem per year must wear a personnel monitoring device. This device is assigned to an individual and shall not be worn by anyone else or used for any other purpose.
2. Any person who has occasion to enter a high radiation area (greater than 100 mRem in any hour) must wear a personnel monitoring device.
3. Personnel monitoring devices are changed on a monthly basis or as deemed necessary by the RSO.
4. Personnel monitoring devices recording whole body dose equivalent must be worn
between the waist and neck and on the front torso of the body.

5. Other regions of the body (i.e. the extremities) may be monitored only by devices explicitly designed for this purpose. Devices provided for whole body monitoring must not be used for this purpose. These devices will be supplied, upon request, by the RSO.

6. Personnel monitoring devices must be worn at all times when the individual is working with any radiation installation or source.

7. Personnel monitoring devices must be stored in a secure non-radiation area when not in use.

8.04 Personnel Monitoring Devices Maintenance

The RSO shall be responsible for supplying personnel monitoring devices to users, other employees of Union College. Visitors to Union College radiation installations at the request of the installation supervisor

Requests for personnel monitoring devices are made by the installation supervisor to the RSO using Form 8.1.

Personnel monitoring devices are exchanged on a monthly basis by the RSO or otherwise as deemed necessary by the RSO.

Records complying with existing regulations are prepared and maintained by the RSO.

Yearly radiation exposures shall be supplied to all authorized users.

8.05 Personnel Monitoring for Visitors

Visitors who meet the criteria in Section 8.02 are required to complete Form 8.1.

Results of visitor personnel monitoring readings are available upon request from the RSO.

9.00 Licenses and Registrations

Union College has been issued a specific license by the New York State Department of Health to cover the uses of radioactive materials on the Union College campus and satellite facilities. Copies of this license are available from the Radiation Safety Officer. Union College has also been issued a Certificate of Registration for machines that produce ionizing radiation. This registration is available from the Radiation Safety Officer.

Individuals seeking approval to use radioactive material and/or radiation generating devices must apply to the Radiation Safety Officer by completing Form 9.1, Application for Use of Ionizing Radiation Source. The applications and registration requests must be signed by the Department Chairman, Center Director, or appropriate Dean. The RSO can provide assistance for all applications. The person responsible for the facility will serve as Radiation Installation Safety Officer. Copies of all applications, licenses (when
issued), registrations (when issued), feasibility reports, hazards analysis, etc., must be transmitted to the Radiation Safety Officer at the time they are submitted to or received from any outside agency.

10.00 Radioactive Materials at Union College

10.00 Radioactive Materials at Union College.

The following provides a comprehensive discussion of the regulatory control of radioactive materials at Union College.

10.01 Purchase of Radioactive Materials

Inventories of radionuclides are maintained by the Radiation Safety Officer and Radiation Installation Supervisors as required by the NYSDOH. The procedure for purchasing radionuclides is given below.

The Supervisor of a Radiation Installation in which radionuclides are used initiates a purchase order (PO) for the radionuclide(s) under Union College's Radiation License.

Before the purchase order is forwarded to the Purchasing Office, it must be approved by the Radiation Safety Officer.

If the current inventory allows purchase of the requested radionuclide(s) without exceeding the licensed quantity of the specific radionuclide(s), and if the requester has up-to-date training, the Radiation Safety Officer will sign for approval on the purchase order.

The purchase order is returned to the Requester to process with the Purchasing Office.

If the proposed purchase will result in a radioactivity amount that exceeds the license limit, or training is not up-to-date, the requisition is returned to the Requester with the reason why it is not approved. The Requester must revise the requisition or receive the required training and resubmit the requisition to the Purchasing Office. In addition, the RSO may submit an amendment to the NYSDOH for approval of adding an isotope or increasing the allowed total activity for a particular isotope listed on the license.

The Purchasing Office processes a purchase order after receiving approval and the signature of the Radiation Safety Officer.

10.02 Radioactive Materials from Offsite Sources

No sources of radiation (machines or radioactive materials) may be brought to the Union College campus without prior written approval of the RSO.
10.03 Opening Packages Containing Radioactive Materials

All packages received at Union College are delivered to Central Mail.

Central mail will notify the RSO or RSO designate to pick up the package. Before removal from the mail room, the RSO will inspect the package for any sign of damage (i.e. physical or water damage). If no damage is observed, The RSO will deliver the package to the designated recipient.

If the package shows signs of damage, the RSO is notified and will monitor the outer surface of the package to measure the radiation level before delivering the package to the designated recipient.

Opening of the package will occur at designated recipient’s lab room or work area. Only the RSO, or RSO designate, is allowed to transport packages containing radioactive materials on campus.

The following steps must be followed when opening a package containing radioactive material.

1. General procedure
   a. Wear gloves to prevent hand contamination.
   b. Visually inspect package for any sign of damage (i.e. wetness, crushed). If damage is noted, stop procedure and notify Radiation Safety Officer.
   c. Measure exposure rate at 3 feet (or 1 m) from package surface and record. If it is higher than the background level, stop and notify Radiation Safety Officer.
   d. Open package with the following precautionary steps:
      (1) Open the outer package (following manufacturer's direction, if supplied) and remove packing slip.
      (2) Open inner package and verify that contents agree with those on packing slip. Compare requisition, packing slip and label on container.
      (3) Check integrity of final source container (i.e. inspect for breakage of seals or vials, loss of liquid, or discoloration of packing material).
   e. If there is any reason to suspect contamination, wipe external surface of final source container and remove wipe to low background area. Check wipes with a thin-end window GM survey meter, and take precautions against the spread of contamination as necessary.
   f. Monitor the packaging material and packages for contamination before discarding.
      (1) If contaminated, treat as radioactive waste.
      (2) If not contaminated, remove radiation labels before discarding in regular trash.
   g. Maintain records of results on form 10.1, Radioactive shipment Receipt Record and Survey.
   h. Other procedures may be developed for special and unique packages.

10.04 Leak test procedures for sealed sources

According to 10 NYCRR Part 16.10(a)(4), semi-annual leak testing for a sealed source with a half-life greater than 30 days is required when the following conditions apply:
• Source contains greater than 100 micro curies of beta and/or gamma emitting material or greater than 10 micro curies of alpha emitting material, and:
  • Source is being used
  • Stored source will be used or transferred to another person, or:
  • Source is damaged

The RSO maintains a current list of Union’s sealed sources that require leak testing. Procedures are outlined in Appendix A.

11.00 Management and Disposal of Radioactive Waste

11.01 General Instructions

Radioactive waste may occur in solid, liquid, or gaseous form. It is imperative that the RSO be advised on the chemical, physical, and toxic hazards associated with these wastes, as well as the radioactive properties.

It is extremely important that effort be made to maintain the quantity of radioactive waste to a level as low as reasonably achievable (ALARA).

11.02 Management of Radioactive Waste

Each area that generates radioactive waste must have appropriate labeled containers (Caution, Radioactive Waste) and the containers must be stored in a secured area with sufficient shielding (see section 12.00, item 11). Solid and liquid wastes shall be stored separately and isotopes with a short half-life decay rate (<65 days) will be stored separately from isotopes with longer half-life decay rates.

The RSO will schedule pickup of radioactive waste as needed. The RSO will transport waste to the lead shielded storage receptacle, which is currently in S003 and will make arrangements for permitted disposal of isotopes with longer half-life decay rates.

11.03 Radioactive Waste Disposal Requirements

All radioactive materials placed in radioactive waste containers, both liquids and solids, must have waste information included with the container:
  a. Radionuclide name
  b. Quantity (μCi)
  c. Chemical Form
  d. Physical Form
  e. Accompanying Chemicals
  f. Laboratory of Origin

  The appropriate tag must be affixed to each container.
g. Only liquids containing Tritium (H-3) or Carbon-14 will be accepted by the RSO, and waste information must be provided.

h. Only stable radioactive materials will be accepted by the RSO for shipment to a permitted Waste Disposal Site. No pyrophoric materials, nitrates, strong acids or bases are acceptable. Consultation with the RSO is required.

11.04 General Guidance for Disposal of Radioactive Waste

1. Contact the RSO for assistance with radioactive waste disposal.
2. All Radioactivity labels must be defaced or removed from containers and packages prior to disposal in in-house waste. If waste is compacted, all labels that are visible in the compacted mass must be defaced or removed.
3. Remind employees that nonradioactive waste such as leftover reagents, boxes, and packaging material should not be mixed with radioactive waste.
4. Occasionally monitor all procedures to ensure radioactive waste is not created unnecessarily. Review all new procedures to ensure that waste is handled in a manner consistent with established procedures.
5. In all cases, consider the entire impact of various available disposal routes. Consider occupational and public exposure to radiation, other hazards associated with the material and routes of disposal (e.g., toxicity, carcinogenicity, pathogenicity, flammability).
6. In New York State, the Department of Environmental Conservation regulates releases to the environment and has enacted regulations on the transport of low-level radioactive waste in New York State (6 NYCRR Part 381). These regulations require that a properly executed manifest and a valid transport permit issued by Department of Environmental Conservation accompany all waste shipments. For further information, contact:

   New York State Department of Environmental Conservation
   Bureau of Environmental Remediation
   625 Broadway
   Albany, NY 12233-7015

11.05 Procedure for Disposal of Radioactive Liquids

1. Regulations for disposal of liquid radioactive waste in the sanitary sewer appear in 6 NYCRR Part 380-4.2 and 380-4.3. Consult with the RSO prior to disposal. Material must be readily soluble or dispersible in the water. There are daily and monthly limits based on the total sanitary sewerage release for Union College. Make a record of the date, radionuclide, estimated activity that was released (in millicuries or microcuries), and location of the sink or toilet where the material was released, and provide to the RSO.

2. Releases to the environment are regulated by the New York State Department of Environmental Conservation in 6 NYCRR Part 380. Be familiar with those regulations and possible permit requirements. For further information, contact New York State Department of Environmental Conservation.

3. Liquid scintillation-counting media containing 0.05 micro curie per gram or less of Tritium (H-3) or Carbon 14 (C-14) may be disposed of without regard to its
radioactivity. Make a record of the date, radionuclide, estimate activity (in millicuries or micro curies), calculated concentration in micro curies per gram, method of material disposal, and provide to the RSO.

11.06 Procedure for Disposal by Decay-In-Storage (DIS)

Short-lived material (physical half-life less than 65 days) may be disposed by Decay-In-Storage (DIS). If you use this procedure, keep material separated according to length of half-life.

1. Because the waste will be surveyed with all shielding removed, the waste containers must not provide any radiation shielding for the material.

2. When a container is full, seal it with string or tape and attach an identification tag that includes the date sealed, the longest half-life radioisotope in the container, and the initials of the person sealing the container. The container may then be transferred to the DIS area.

3. Decay the material for at least 10 half-lives.

4. Prior to disposal as in-house waste, monitor each container as follows:
   a. Check your radiation detection survey meter for proper operation;
   b. Plan to monitor in a low-level (less than 0.05 millirem per hour) area;
   c. Remove any shielding from around the container;
   d. Discard as in-house waste only those containers that cannot be distinguished from background. Record the date when the container was sealed, the disposal date, and type of waste material.
   e. Remove all radiation labels.
   f. Containers that can be distinguished from background radiation levels must be returned to the storage area for further decay or transferred for permitted disposal.

11.07 Disposal of Solid Radioactive Waste

Except for material suitable for DIS, solids must be transferred to a permitted disposal facility. Follow the packaging instructions you received from the disposal broker. File the manifest from the disposal broker. Compliance with regulations issues by the New York State Department of Environmental Conservation (6NYCRR Part 381) relating to waste manifests and transport permits is required.

12.00 General Procedures for Radiation Safety

Rules for safe use of sealed and unsealed radioactive materials are summarized in Appendices B & C, and must be posted in the work area.
12.01 Radioactive Materials
1. High standards of cleanliness and good housekeeping must be maintained in all laboratories and areas where radioactive material is present. Eating, drinking, and smoking in such work areas is prohibited.
2. Hands and fingernails must be washed carefully and monitored after working with radioactive materials. Always use rubber gloves and laboratory coats when handling more than ten micro curies (10μCi) of material.
3. Surveys should always be made with a suitable meter before and during work with beta and gamma and/or neutron emitting materials. Appropriate time limits must be established for personnel to assure the maximum permissible dose limits are not exceeded. Beta, gamma, and alpha surveys shall be obtained with a suitable meter during the course of such work.
4. Personnel shall monitor themselves with a suitable instrument (GM Type for beta/gamma emitters and/or sensitive alpha meter for alpha emitters) before leaving the laboratory or work area. No person or object shall leave the laboratory without being monitored and properly decontaminated, if necessary, to prevent spread of contamination or personnel radiation exposure.
5. No radioactive solution is ever to be pipetted by mouth. Suitable pipetting devices must be available and used.
6. Whenever practical, operations with radioactive materials should be conducted in a hood, dry box, or other type of closed system. Operations with materials susceptible to atmospheric contamination such as boiling, evaporating, distilling, or ashing must be done in hoods with an air flow of approximately 100 linear feet per minute and approved by the RSO. Work with powders should be done in a dry box. Work with unsealed radioactive materials should be done over a tray.
7. It is recommended working surfaces be covered with absorbent paper.
8. Each container in which radioactive materials are transported, stored, or used shall be labeled "Caution, Radioactive Materials."
9. Any contamination of the body or clothing by radioisotopes must be immediately reported to the RSO. Accidental contamination of any working area must be clearly marked as to the radioisotope, the area, and the survey meter reading. Decontamination shall proceed as soon as possible.
10. When work is completed, each person must survey and clean up his or her work area and apparatus, and arrange for waste disposal, or proper storage of all radioactive material and equipment.
11. All radioactive materials should be stored in locked or otherwise secure areas, with sufficient shielding to reduce the radiation below 2 mRems/hr at the surface of the shield. The area must be properly posted.
12. All radioactive samples, including calibration sources and sealed sources, regardless of strength, should be clearly labeled or tagged at all times with the activity, isotope, date of measurement, and the name of the responsible person.
13. Sealed sources or other material and/or devices generating radiation must be used in a manner such that exposure to oneself and others is minimized. Consideration must be given to other persons in the room, behind walls or obstructions, and in other rooms.
14. A high radiation area (greater than 100 mRem/hr) must never be left unattended in such a manner that persons may unintentionally enter. If a high radiation area is accessible, the person responsible for this area must maintain continuous surveillance to prevent such entry, remove the radiation source, or lock the area to prevent any access.
15. Whenever air concentrations exceed, or are expected to exceed, 10% of the values
specified in Appendix A (New York State Sanitary Code, Chapter 1, Part 16, Appendix 1, Table 4), suitable respiratory protection must be worn.

16. Appropriate labeled containers shall be used for storage of radioactive waste. Short-lived and long-lived waste shall be separately stored. Additional precautions shall be taken in the storage of radioactive waste that is also toxic and/or flammable, e.g., waste from liquid scintillation counting.

17. Rooms and work areas shall be properly posted with warning signs and apparatus shall be properly labeled with warning labels or tags. The telephone number of the RSO shall also be posted.

12.02 Installations that Generate Ionizing Radiation

1. For x-ray, electron microscope, and particulate accelerator facilities, a visual check must be made to assure safety controls are functioning before the equipment is energized.

Entrance to the accelerator room, x-ray room, etc. must be equipped with a functional interlock which de-energizes the unit if the door to the facility is accidentally opened, or if failure of the interlock occurs ("Fail Safe").

The interlock must not be bypassed without the explicit approval of the Installation Supervisor. A sign must be posted indicating the bypass condition in an appropriate location.

2. An appropriate radiation survey must be made when entering an accelerator or x-ray room after operation to determine if it has produced radioactivity.

3. When possible, x-ray installations shall be operated remotely, i.e., behind specifically designed barriers.

4. When the ionizing radiation equipment operation necessitates occupancy of the room, radiation surveys shall be obtained during all operating conditions at all personnel stations. Time limits for personnel must be set to assure that personnel exposure is a minimum and in no case exceeds the legal maximum permissible limits. Shielding must be used, where necessary, to assure conformance with exposure limits.

5. Rooms and work areas where ionizing radiation is generated must be properly posted with warning signs and the telephone number of the RSO should also be posted.

6. All installations that produce ionizing radiation shall have a posted listing of the interlocks. These interlocks shall be checked at a frequency not to exceed three months and shall be entered into the operation log.
13.00 Emergency Procedures

13.01 Objectives

1. To minimize personnel exposure to ionizing radiation.
2. To assure immediate medical attention for injured personnel.
3. To mitigate the consequences of the spread of radionuclides to the environment.
4. To enable the Departmental facilities to return to normal operation.

13.02 Spills of Radioactive Liquids

1. Individuals working in the area where radioactive liquid is spilled are responsible for cleaning the spill or calling the RSO.

2. The RSO must be notified immediately of all accidents involving possible body contamination or ingestion of radioactivity by personnel, excessive exposure to radiation, contamination of equipment, spread of contamination or difficulty in cleaning up a contaminated area. The RSO must be notified immediately in the event of loss of radioactive material.

A summary of spill cleanup procedures is provided in Appendix D, which must be posted in the work area. The following procedures shall be followed. (In both cases, notify the RSO):

a) Minor Spills (less than 100 µCi of beta/gamma emitters or 10 µCi of alpha-emitters)
   i. Notify all persons not involved in the spill to vacate the room at once.
   ii. Permit only the minimum number of persons necessary to deal with the spill in the area.
   iii. Confine the spill immediately and notify the RSO.
   iv. Put on protective gloves and drop absorbent paper on the liquid spill.
   v. Decontaminate, using appropriate radiation monitors to check the progress of the work.
   vi. Monitor all persons involved in the spill and the cleaning.
   vii. All cleanup material shall be considered to be contaminated and held for disposal as radioactive waste.

b) Major Spills (greater than 100 µCi of beta/gamma emitters or 10 µCi of alpha-emitters)

   i. Notify all persons not involved in the spill to vacate the room at once and notify the RSO.
   ii. Use gloves to right the container of the spilled liquid.
   iii. If the spill is on clothing, discard outer clothing at once before vacating the room.
   iv. Vacate and secure the room. Post the room "Contaminated. Do Not
Enter.”

v. Take immediate steps to decontaminate involved personnel. (Use soap and water and shower if possible.)

vi. All cleanup material shall be considered to be contaminated and held for disposal as radioactive waste.

13.03 Radiological Emergencies

A radiological emergency is either the uncontrolled release of radioactive material or exposure that exceeds the NYSDOH established guidelines of personnel to ionizing radiation. These emergencies will include but are not limited to:

1. Personnel exposure (or suspected exposure) to possible internal deposition of radionuclides. This could be from airborne concentrations of radionuclides, body contamination, or inadvertent ingestion.

2. Uncontrolled release of radionuclides to the building, premise, neighborhood, or sewers.

3. Accidental contamination of on-site areas or equipment.

13.04 Administrative Authority Under Emergency Conditions

Most accidents can be divided into two phases: 1) the emergency phase, where the nature of the problem is being ascertained; and 2) the recovery phase, which commences during or immediately following the emergency.

1. Any radiological emergency action shall include immediate notification of the Laboratory Supervisor, the Department Chairman, and the RSO.

   Under no circumstances shall the facility involved be reactivated without the explicit approval of the RSO.

13.05 Guidelines for Laboratory Supervisor

The following guidelines are established for use by the laboratory supervisor:

1. Medical assistance should be obtained for
   a. all injured personnel,
   b. all exposures that exceed 25 Rems.

2. Emergency radiological assistance may be requested as deemed necessary only by the RSO or by the chairman of the Radiation Safety Committee. [Nuclear Regulatory Commission 24-hour emergency operation center: (301) 816-5100, NYSDOH Radiological Health: (518) 402-7570.]

3. Notification of outside agencies is required in some cases. This notification shall be made only by the RSO or the Office of News and Communication.
4. The RSO (388-6340) MUST be notified of all radiological emergencies. (Off hours, call Union College Campus Safety, 388-6911.)

13.06 Injured Personnel Involved in a Radiation Accident

1. Request for an ambulance or for assistance from the Schenectady Fire Department or Police Department shall be made through the Union College Campus Safety (Ext. 6911).
2. The Laboratory Supervisor shall be notified immediately.
3. In the case of injured personnel requiring transportation to the hospital (Ellis Hospital), the procedure is as follows:

**Ambulance required.** If, in the judgment of the responsible person present, an ambulance is required, Campus Safety (ext. 6911) will call an ambulance immediately upon request and will provide the ambulance service with directions for reaching the scene of the accident. A Campus Safety Officer will be sent to the accident scene to assist.

**Ambulance not required** in accordance with Union College policy, injured personnel are taken to Ellis Hospital (or to the infirmary) by a Campus Safety Officer in a Union College vehicle. (On arrival at the scene, if the Campus Safety Officer determines the injured party cannot be safely transported in a sitting position, an ambulance will be called.)

4. Injured personnel should not be permitted to drive.

5. Union College employees shall not use their privately owned vehicles to transport injured persons to Ellis Hospital.

6. The Laboratory Supervisor must file a report with the Radiation Safety Office as soon as possible and preferably within 24 hours. If the RSO is not available, the Laboratory Supervisor must file a report with Campus Safety as soon as possible.

7. A Departmental report may also be required.

14.00 Radiation Safety Procedures for Radiation Installations

For each Radiation Installation at Union College, there must be Radiation Safety Procedures that apply specifically to the installation. Specific procedures must be prepared by the Supervisor of the Radiation Installation, who will consult with the RSO. Procedures contained in Section 12.00, General Procedures for Radiation Safety, should be incorporated in the Specific Procedures. Specific procedures must be approved by the RSO.
After approval, copies must be distributed as follows:

1. One copy to the RSO;
2. One copy to the Chairman of the Department (or the Director of the Center);
3. One copy to be posted at the Installation;
4. One copy to each person authorized to work in or have access to the Installation.

Specific procedures must be revised whenever the facilities or operations in the Installation change, or whenever there is a change in supervisory personnel. In any case, the procedures must be reviewed annually for possible revisions. In addition to the Specific Procedures, a copy of this document must be readily available at all times to all persons having access to the Installation.

15.00 Radiation Safety Training

Radiation safety training provided by the Radiation Safety Officer ensures users of ionizing radiation have the knowledge and skill to work efficiently and effectively in a radiation environment, with a minimum of radiation exposure to themselves and other workers in the laboratory. The safety training supplements the education and experience laboratory personnel have received, and amplifies on-the-job training they are receiving.

15.01 Safety Training Topics and Requirements

Personnel will be instructed:

1. Before assuming duties with, or in the vicinity of, radioactive materials.
2. During annual refresher training.
3. Whenever there is a significant change in duties, regulations, or the terms of the license.

Instruction for individuals in attendance will include the following subjects:

1. Applicable regulations and license conditions.
2. Areas where radioactive material is used or stored.
3. Potential hazards associated with radioactive material in each area where the employees will work.
4. Appropriate radiation safety procedures.
5. License’s in-house work rules.
6. Each individual’s obligation to report unsafe conditions to the Radiation Safety Officer.
7. Appropriate response to emergencies or unsafe conditions.
8. Worker's right to be informed of occupational radiation exposure and bioassay results.
9. Locations where the licensee has posted or made available notices, copies of pertinent regulations, and copies of pertinent licenses and license conditions (including applications and applicable correspondence).

15.02 Training requirements for Student Operators of Radiation Equipment

Supervisors for radiation equipment must provide training to students before they are allowed to operate equipment. This training should be done once per academic year and should include basic operation procedures, steps to reduce radiation exposure and emergency procedures. Training shall be documented and training records should be submitted to the RSO at the end of the academic year. Supervisors should use Form 7.1, Student Training Log.

Records of initial and refresher training will be maintained for five years and will include:

1. The name of the individual who conducted the training;
2. the names of the individuals who received the training;
3. the dates and duration of the training session; and
4. a list of the topics covered.

16.00 Posting and Labeling Requirements

16.01 Notices to Workers

Certain documents must be conspicuously posted in each room, laboratory, or area in which radiation sources are present. These documents include the State of New York Notice to Employees (form GEN 301), Part 16 of the State Sanitary Code.

16.02 Radiation Warning Signs for Rooms and Areas

1. Each entrance to a radiation area must be posted with a "Caution Radiation Area" sign. A radiation area is defined as an area where the level of radiation could cause a major portion of such individual's body to receive a dose equivalent from external exposure that exceeds 2.0 millirems/hour.

2. Each entrance to a high radiation area must be posted with a "Caution High Radiation Sign" sign. A high radiation area is defined as an area where the level of radiation could cause a major portion of such individual's body to receive a dose equivalent from external exposure that exceeds 100 millirems/hour.
Each airborne radioactivity area must be posted with a "Caution Airborne Radioactivity Area" sign. An airborne radioactivity area is defined as an area where the airborne radioactive materials exceed the Derived Air concentrations (DAC) Appendix 16C, Table 1, Column 3.

There are two exceptions to the room posting requirements:

1. Rooms containing only sealed sources do not have to not be posted if the radiation level at 30 cm from the sources does not exceed 5 mrem/hr.

2. Rooms do not have to be posted if the radiation source is in use for eight hours or less and if the source is constantly attended by someone properly instructed in radiation safety, who will prevent exposure to individuals in excess of 500 mrem.

16.03 Radiation Warning Labels for Containers

Containers in which radioactive materials are used, stored, or transported must be labeled with a "Caution, Radioactive Materials" label. For storage, the label must also identify the radionuclide, quantity, and date of measurement. There are exceptions:

1. Container with quantities less than those listed in Table 9 of 10 NYCRR Part 16 Appendix 16A (10 times this quantity for natural uranium or thorium).

2. Containers with concentration less than those listed in 10 NYCRR Part 16 Table 3, Appendix 16C.

3. Containers used transiently in laboratory work (e.g. beakers, flasks, and test tubes) for a period of a few hours and in the presence of an authorized user.

4. Containers in areas with restricted access, such as storage vaults or hot cells, if a written record is readily available to identify the radionuclide, quantity, and assay date of each container. Although the regulation provides exceptions, safety is increased by labeling all containers holding radioactive materials. Attention is drawn to the presence of the materials and helps prevent inadvertent contamination of coworkers and experimental data.

16.04 Removal of Radiation Warning Signs and Labels

Radiation labels must be obliterated or removed from containers and packages when they no longer contain radioactive materials. Labels and markings should be promptly removed from apparatus that are not contaminated and will no longer be used with radioactive materials. After a final survey of rooms and areas formerly used for radiation work, all signs and labels must be removed.
Appendix A

Union College In-House Leak Testing Procedures

According to 10 NYCRR Part 16.10(a)(4), semi-annual leak testing for a sealed source with a half-life greater than 30 days is required when the following conditions apply:

- Source contains greater than 100 micro curies of beta and/or gamma emitting material or greater than 10 micro curies of alpha emitting material, and:
- Source is being used
- Stored source will be used or transferred to another person, or:
- Source is damaged

The RSO maintains a current list of Union’s sealed sources that require leak testing. If leak testing is required, complete the following steps:

Contact PI who operates Canberra Gamma Ray Detector located in ISEC 072 to make a leak test appointment.

All personnel who are involved with the leak testing must wear their personal dosimeter badge.

Place a GM survey meter near the leak test site to monitor exposure rate.

Using tongs, wipe the entire accessible surface area of the sealed source with filter or tissue paper. Pay attention to seams and joints.

Calculate the estimated activity in micro curies for wipe sample.

If the wipe sample is 0.005 micro curies or greater, notify the RSO. The source must be withdrawn from use to be repaired or disposed, and the Health Department must be notified.

Sign and date the leak test sample results and file with the RSO.
RULES FOR SAFE USE OF SEALED SOURCE RADIOACTIVE MATERIAL

Introduction: Because radioactivity is encapsulated or plated onto a surface, sealed sources do not present a significant contamination hazard under normal conditions. However, sealed/plated sources may present an external exposure hazard depending on the properties of the radioisotope or the amount of activity present.

Inverse square law- The intensity of radiation emitted by a radioactive source follows the inverse square law: As distance from a point source increases, the intensity decreases proportionally to the square of the changes in distance.

\[ \text{Intensity} = \frac{1}{d^2} \]

Handling the source

- Minimize the time spent handling a source, or being in the vicinity of a source
- Handle high activity sources with handling tools such as tongs or remote handling tools
- Do not touch the active surface of a plated source with your fingers
- Wash hands after handling a plated source

Eating & Drinking

Do not eat or drink in rooms where sealed/plated sources are used or stored.

Labeling Sources

Sealed/plated sources must be labeled with a “Caution-Radioactive Materials” label that lists the radioisotope, the amount of radioactivity, and the date of fabrication/calibration.

Shielding and Radiation Surveys

Use appropriate shielding. Gamma and x-ray emitters should be shielded with lead. Because bremsstrahlung production is a concern with beta emitters, beta sources should be shielded with a primary shield of plexiglas or similar low atomic number (low-Z) materials. If sufficient bremsstrahlung is produced in the low-Z primary shield, a secondary shield of lead should be placed outside the primary shield.

High activity sources must be shielded appropriately when in use or storage

Sources should be stored away from normally occupied areas

If you are uncertain whether a source should be shielded or is sufficiently shielded, contact the Radiation Safety Officer for information at 518-388-6340.

Cloud Chamber Sources
Appendix B

Radioactive sources used in cloud chamber experiments are typically rods or needles plated with very small amounts of Sr-90 (for beta activity) or Po-210 or Pb-210 (for alpha activity). The activity of these sources is low enough that shielding is not necessary. However, it is important to handle the source by holding the cork, rather than the needle, on which the radioactivity is plated.

Security

Sealed sources are typically small in size and are readily portable. It is important to pay extra attention to ensure that sealed/plated sources are secured. Sealed sources should be locked in a secured container or secured storage area when not in use. Any room where sealed sources are used must be locked when unattended.

Leak Testing

Under the terms of Union’s Radioactive Materials license, leak tests must be performed on sealed sources prior to initial use and every 6 months thereafter. For those sources that emit alpha particles, leak test shall be conducted every 3 months. Leak tests are not required for sealed sources with 100 microcuries or less of beta and/or gamma emitting material or 10 microcuries or less of alpha emitting material. If beta and/or gamma emitting sealed sources are being stored and not used, leak tests are not required. Any sealed source that will be used or transferred to another person must be leak tested, unless they have been leak tested within 6 months prior to the date of use or transfer.

If there is a reason to suspect that a sealed source may have been damaged, or might be leaking, notify the RSO and do not use the sealed source until it is leak tested.

Missing Source

If a sealed or plated source is missing, notify the RSO promptly at 388-6340. If a sealed or plated source is suspected to be missing, it is reasonable to take a short time to attempt to find it, but do not delay more than a few hours to notify the RSO.

Overexposure to a Source

If you suspect you have received a significant exposure to a radioactive source, contact the RSO at x6340 or Campus Safety at x6911.

(Reference: University of Washington, Module 7-Working Safely with Sealed Sources)
RULES FOR SAFE USE OF UNSEALED RADIOACTIVE MATERIAL

These rules must be posted as required by Section 16.13(b), New York State Sanitary Code (10 NYCRR 16).

Rules

1. Prior to performing operations with quantities of radioactive material that may produce significant external or internal exposure, attention shall be given by the user to precautionary measures including the use of remote handling devices, hoods, shielding, etc. The Radiation Safety Officer must be consulted before beginning any new use of radioactive material.

2. There shall be no eating, drinking, applying cosmetics or preparation of food in any location where unsealed sources of radioactive material are used or stored.

3. Smoking is prohibited in locations where unsealed sources of radioactive materials are used or stored.

4. Do not store food, drink, or personal effects with radioactive material.

5. Pipetting of radioactive solutions by mouth is prohibited.

6. Segregate pipetting devices used with radioactive materials from those used with non-radioactive solutions.

7. Lab coats and disposable gloves shall be worn during operations involving the handling of unsealed sources of radioactive material. The lab coat and gloves should be removed before leaving the laboratory. Care must be taken such that other items (e.g. pens, pencils, notebooks, door knobs, telephones, etc.) are not handled with gloves used during work with radioactive materials.

8. Work that may result in contamination of work surfaces shall be done over plastic-backed absorbent paper. Trays made of impervious materials (i.e., stainless steel, porcelain-coated, etc.) and lined with absorbent paper provide excellent work arrangements to help prevent the spread of contamination.

9. Work surfaces and personnel should be monitored after working with radioactive materials.

10. Where there has been a spill of radioactive material (see posted Spill Procedures) that may have produced contamination of the person or clothing, both the person and the clothing shall be monitored. Personnel contamination shall be removed as soon as possible. Where contamination
Appendix C

above action levels is noted during a laboratory survey, decontamination must be immediately initiated by the user.

11. After working with unsealed sources of radioactive material, hands should be monitored and washed before leaving the laboratory.

12. Objects and equipment that may have been contaminated with radioactive material shall be surveyed and demonstrated to be free of contamination prior to their removal from a laboratory, or transferred to other laboratories, repair shops, surplus, etc. If found to be contaminated, such items must be decontaminated as soon as practical.

13. If personnel monitoring devices (whole-body or ring badge) have been issued to you for your work with radioactive material, they must be worn at all times in areas where these materials are used or stored. These devices should be worn as prescribed by the Radiation Safety Officer. Personnel monitoring devices should be stored in a designated low background area when they are not being worn to monitor occupational exposures. They should not be left on your lab coat or shared by another individual.

14. Dispose of radioactive waste only in the manner designated by the Radiation Safety Officer and maintain records as instructed.

15. Store radioactive materials in covered containers plainly identified and labeled with name or compound, radionuclide, date, activity, and radiation level, if applicable.

16. Always transport radioactive material in shielded containers.
Appendix D

SPILL PROCEDURES

These procedures must be posted as required by Section 16.13(b), New York State Sanitary Code (10 NYCRR 16).

Minor Spills – Spills that are less than "100 microcuries of beta/gamma emitters or less than 10 microcuries of alpha emitters"

1. NOTIFY: Notify persons in the area that a spill has occurred.

2. PREVENT THE SPREAD: Cover the spill with absorbent paper.

3. CLEAN UP: Use disposable gloves and remote handling tongs. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose of in the radioactive waste container. Also insert into the plastic bag all other contaminated materials such as contaminated gloves.

4. SURVEY: With a low-range thin-window GM survey meter, check the area around the spill, hands, and clothing for contamination.

5. REPORT: Report incident to the Radiation Safety Officer.

Major Spills – Spills that are greater than "100 microcuries of beta/gamma emitters or more than 10 microcuries of alpha emitters"

1. CLEAR THE AREA: Notify all persons not involved in the spill to vacate the room.

2. PREVENT THE SPREAD: Cover the spill with absorbent pads, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.

3. SHIELD THE SOURCE: If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure.

4. CLOSE THE ROOM: Leave the room and lock the door(s) to prevent entry.

5. CALL FOR HELP: Notify the Radiation Safety Officer immediately.

6. PERSONNEL DECONTAMINATION: Contaminated clothing should be removed and stored for further evaluation by the Radiation Safety Officer. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water.

7. The Radiation Safety Officer will supervise the clean-up of the spill and will complete a report.

RADIATION SAFETY OFFICER: Elizabeth Dobson-Davis

OFFICE PHONE: 388-6340    CELL PHONE: 925-2753
## Annual Review Checklist for RSO Duties & Radiation Protection Program

**Reviewer(s) names:**

**RSO name:**

**Date of review:**

<table>
<thead>
<tr>
<th>Review of Radiation Materials License 443</th>
<th>Yes</th>
<th>No</th>
<th>NA</th>
<th>Notes</th>
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<tbody>
<tr>
<td>a) Are amendments &amp; conditions to license present</td>
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<tr>
<td>b) Does list of radioactive materials in Conditions 6, 7, 8 of license include all types used or stored on campus?</td>
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<td>c) Is list of users in Section 10.A accurate? Deviations noted in a, b or c above have been corrected.</td>
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**Training-Initial & annual training records include the following information:**

- **Name of individual who provided training**
- **Name of individuals (employees & students) who received training**
- **Dates & duration of training**

**List of topics covered**

- Training topics are relevant & follow requirements provided in NYSDOH BERP Radiation Guide 10.2, Rev. 1, Appendix B

**Storage**

- Radioactive materials are stored in a locked facility
- Radioactive materials are not stored in same location as flammable materials.

**Survey Meters**

- Survey meters are calibrated annually, calibration records for past 5 years are on file.

**Physical Inventory**

- A quarterly (every 3 months) physical inventory record is on file for all sealed sources possessed under license. Inventory records for past 5 years are on file.

**Leak Tests**

- Sealed sources that require semi-annual leak tests as specified in 10 NYCRR Part 16.10(a)(4) are identified on inventory sheet.
- Procedures for conducting in-house leak tests follow those outlined in Radiation Safety Manual
- Leak test results are recorded in microcuries

**General Surveillance of radioactive materials**

- Monthly monitoring records of radiation materials use areas are present.
- Quarterly inventory records of radioactive materials used or stored on campus are present.

**Personnel Monitoring**

- Dosimeter badge reports for present & past authorized users are on file.
- Badge storage locations are not near radiation sources when not in use.
- Evidence of RSO review of reports & follow up on high or unusual readings.

**Received Radioactive Shipments**

- Records of Form 10.1, Radioactive Shipment Receipt Record & Survey are on file.

**Radioactive Waste Disposal**

- Manifests of radioactive waste disposal are on file.
- A LLRW report was submitted to NYSERDA for the previous year, if radioactive waste disposal occurred.

**Reviewer Signature(s):**

**Date:**
Form 7.1 Training Log for Student Operators of Radiation Equipment

Date:

Instructor name:

List training topics reviewed with students:

<table>
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<th>Name (Print Clearly)</th>
<th>Signature</th>
<th>Union College ID #</th>
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Form 8.1

Request for Radiation Badge Service

Name

Address (Union or Home)

Birthdate

Have you worn a radiation badge before? □ Yes □ No

If yes, please provide reports that document your previous exposure to radiation to the Union College Radiation Safety Officer. Reports may be sent to Elizabeth Dobson-Davis, RSO: dobsonde@union.edu.
Union College

Form 8.2

Declaration of Pregnancy

Name_________________________________

College ID #_________________________________

Telephone #___________________________

College email address_____________________________________________________

Date of Conception (Mo/Yr)__________________________________________

I am submitting this Declaration of Pregnancy to inform my Supervisor and the Radiation Safety Officer (RSO) that I am pregnant as of the above listed date.

I understand the radiation dose to my embryo/fetus during my entire pregnancy will not be allowed to exceed 0.5 rem (5 millisievert) (unless that dose has already been exceeded between the time of conception and submittal of this form). I also understand that meeting the lower dose limit may require a change in job or job responsibilities during my pregnancy.

Signature ________________________________________________________

Date________________________________________
Union College
Form 8.3
Revocation of Declaration of Pregnancy

Name______________________________

College ID #________________________

Telephone # _________________________

College email address_____________________

Date_______________________________

I am submitting this Revocation of Declaration of Pregnancy to inform my Supervisor and the Radiation Safety Officer (RSO) that I revoke my previous Declaration of Pregnancy as of the above date.

I understand my occupational annual radiation dose rate will revert to 5 rems for the remainder of the year.

Signature _______________________________

Date_______________________________
Form 9.1
Application for Use of an Ionizing Radiation Source

1. ____________________________
   User and Office               Location of Source

2. ____________________________
   Department                   Signature of Department Chair

3. Source of Radiation
   A. Machine description/output or sealed source type and activity:
      ____________________________
      USE:
      ____________________________

4. Radiation monitoring instrument(s) available:
   ____________________________

5. Include a description of safety controls and procedures that will be implemented to minimize exposure from the radiation source.
   ____________________________
   ____________________________
   ____________________________
Form 10.1
Radioactive Shipment Receipt Record and Survey

1. Shipment No. ________________ Union College
   ID _______________________
   Surveyor Name ________________ Date ______________________

2. Package Condition Acceptable? ___Yes ___No
   If no, please describe condition ________________________________
   Radiation units of label ______________________

3. Measured Radiation Levels
   (Background __________ mR/hr)
   a. Package surface __________ mR/hr
   b. 3 feet or 1 meter from package surface __________ mR/hr

4. Do Packing Slip and Contents Agree?
   a. Radionuclide ___Yes ___No
   b. Amount ___Yes ___No
   c. Chemical Form ___Yes ___No
   If no, provide description ________________________________________

5. Wipe Results
   a. Outer Package Surface _____ CPM - _____ (efficiency) = _____ DPM
   b. Final Source Container _____ CPM - ____ (efficiency) = _____ DPM

6. Disposal Method of Package After Inspection
   ______________________________________

7. If Department/Carrier Notification Required, Give Time, Date, and Persons Notified:
   Time __________
   Date __________
   Person Notified ________________
   Signature & Title _______________________________
   Date __________________________