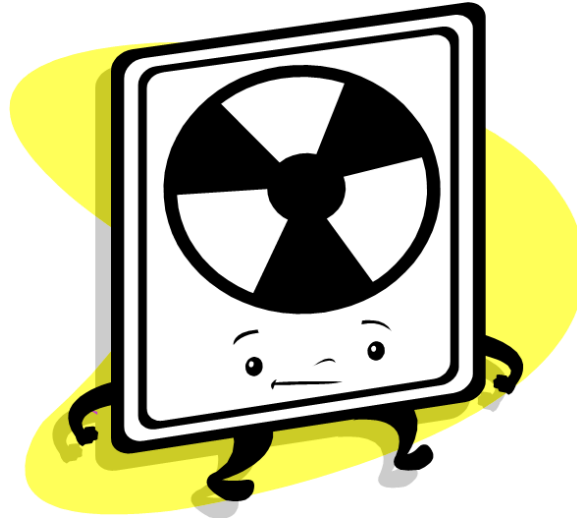


Radioactive Material Safety Manual



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THE
UNIVERSITY
OF RHODE ISLAND



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1. Introduction

Radiation Safety is the responsibility of all individuals at the University of Rhode Island (URI) including faculty, staff, students, researchers, and visitors. Those individuals using radioactive materials at URI must strictly comply to federal and state regulations, and university policies which is important for the safety and protection of all individuals at the University.

The Radiation and Laser Safety Committee (RLSC), under the functional authority of the President, is responsible for the Radiation Safety Program outlined in this manual and represents official university policy on radiation and radioactive materials. The purpose of the Radioactive Material Safety Manual (Separate manuals for X-ray Safety and Laser Safety) is to assist all individuals in complying with the Rhode Island Department of Health (RIDOH) radiation regulations and the URI Radiation Safety Program.

This Manual is not intended to be a fully comprehensive reference. Further advice concerning hazards associated with specific radioactive material and/or the development of new and unfamiliar procedures should be obtained through consultation with the Radiation Safety Office.

The Radioactive Material Safety Manual is an enforceable component of the URI's Radioactive Material Broad Scope License under which URI is authorized, and violations of its policies and procedures are citable as areas of non-compliance by the RIDOH.

Where existing or future federal, state, or local regulations and the University policies are found to be different from the requirements contained in this manual, those legally accepted regulations shall supersede this document.

This manual has been submitted and approved by the RLSC and the RIDOH to support the University's radioactive materials broad scope license and replaces all previous such documents.

The format and administrative content of the forms associated with this manual can be revised with pending approval of the RLSC. New forms may also be added as necessary. However, changes which would result in any condition of non-compliance with applicable regulations or license conditions shall not be approved.

The Radiation Safety Officer (RSO) will submit a copy of any revised manual to the RIDOH Radiation Control Program when the revised manual has substantial changes after the RLSC's approval.

2. Telephone Numbers and Information

Environmental Health and Safety	(401) 874-7993
Environmental Health and Safety (Emergency)	(401) 874-2121
Environmental Health and Safety (Fax)	(401) 874-9069
Radiation Safety Office	(401) 874-2600
Radiation Safety Officer	(401) 874-9439
Health Physicist	(401) 874-9451
URI Health Services	(401) 874-2246
URI Public Safety (Emergency)	(401) 874-2121
URI Public Safety (Non-Emergency)	(401) 874-4553
Medical Emergencies	
Kingston Campus	(401) 874-2121
Other Campuses	911

Radiation Safety Office hours are Mondays through Fridays, 8:30 a.m.-4:30 p.m.

For assistance with a radiation incident during normal office hours, call the Radiation Safety Office at (401) 874-2600. In the event of an after-hours radiation incident, contact the URI public Safety emergency line at (401) 874-2121.

Handling of radioactive material spills and other emergency information is available in the Spill and Emergency section of this manual.

3. Application, Application Amendment, and Decommissioning for the Use of Radioactive Materials

Radioactive Material Use Application

All radioactive material use at URI must be approved by the RSO and authorized by the RLSC.

New Authorized users (AUs) must submit an Application for Use of Radioactive Materials to the Radiation Safety Office, Rhode Island Nuclear Science Center, 16 Reactor Road, Narragansett Bay Campus, or by E-mail for the RSO's review. Application forms can be obtained by contacting the Radiation Safety Office or online. The application must be filled out completely and the radiation safety staff is available for assistance if necessary. All radiation workers must be listed on the application and anyone not listed on the form will not be allowed to work with radioactive materials for any reason.

The information provided on the application is very critical in that it will help the RSO to prepare necessary safety measures and assist the AU in implementing these measures. An inspection by the Radiation Safety Office will be performed prior to allowing radioactive material order and use.

If the RLSC determines that the training, facilities and safety precautions are adequate for the authorization requested, a formal written authorization to use radioactive materials will be issued. The authorized user must keep a copy of this authorization on file. In addition, The RSO may give temporary approval to AUs until the RLSC approves the application. The approval can be obtained electronically or at the RLSC meeting whichever comes first. All electronic approval will be re-visited at the following RLSC meeting.

Any new AUs planning to work with radioactive material with animals must be approved by the URI Institutional Animal Care and Use Committee (IACUC) or have submitted an application to use animals to IACUC before submitting the Application for Use of Radioactive Materials, and must attach an IACUC approval or a submitted IACUC application with the application. Details concerning the use of animals must be coordinated with animal care and approved by the IACUC.

Approved AUs will receive an Authorization Permit to work with radioactive materials, which is a proof of radiation authorization at URI and may be submitted with Grant Proposals. Once authorized, the AUs will remain authorized until either an authorization termination is requested by the AU or the authorization is revoked by the RLSC for noncompliance. Inactive AUs must follow the procedures in this section. After 6 years of inactive status, the RSO can request a meeting with inactive AUs to suggest decommissioning of their laboratory if applicable.

Radioactive Material Use Application Amendment Guidelines

AUs planning to make a change to their authorization must complete and submit a Radioactive Material Use Application Amendment Form. The form can be obtained by contacting the Radiation Safety Office or online. The form must include all the necessary information including additions and/or deletions of isotopes, procedures, active, and inactive request, etc. The RSO will submit all applications and amendments to the RLSC for approval. The RSO may give temporary approval to AUs until the RLSC approves the application. The approval can be obtained electronically or at the RLSC meeting whichever comes first. All electronic approval will be re-visited at the following RLSC meeting.

Inactive AU Status

The Radiation Safety Office has an Authorized User classification of “Inactive User” Status for laboratories that currently do not have radioactive materials and will not for the predictable future. An inactive Authorized User is relieved of the active user requirements such as lab surveys performed by the Radiation Safety Office and attendance of annual retraining sessions.

To achieve “Inactive User” status:

1. Send an amendment form to the Radiation Safety Office.
2. Dispose of or transfer all radioactive materials in your possession using appropriate procedures.
3. Return all personnel dosimetry to the Radiation Safety Office if applicable.
4. Receive confirmatory survey by the Radiation Safety Office.
5. The Radiation Safety Office will cover or put an “Inactive” sign over the door signs and remove other radiation labels.
6. The RSO will report to the RLSC and notify the AU.

To regain “Active User” status:

1. Send an amendment form to the Radiation Safety Office requesting reactivation.
2. The RSO will review the amendment and will update if there are any changes such as updated room diagrams with survey locations, updated protocol for general radionuclide usage and other procedures, updated radiation worker lists, including verification of their training requirements, and requesting personnel dosimeters if needed.
3. The radiation safety personnel will visit the lab to confirm and remove the cover or inactive sign.
4. The RSO will report to the RLSC for approval and notify the AU.

The Radiation Safety Office will assist in the replacement of all required posting/labeling.

Laboratory Decommissioning

The Radiation Safety Office is responsible for the final survey of any area where radioactive materials were used or stored. These areas will be thoroughly checked by the Radiation Safety Office for radioactive materials and contamination prior to being considered general laboratory space. Once a thorough survey has been completed and confirmed to be below the regulatory release limits, the room is no longer a restricted area, and the laboratory is decommissioned and released for general public use. The Radiation Safety Office will maintain the records and the RSO will report to the RLSC. An example of the decommissioning process is below.

1. Send an amendment form to the Radiation Safety Office requesting decommissioning.
2. Dispose of or transfer all radioactive materials in your possession using appropriate procedures.
3. Return all personnel dosimetry to the Radiation Safety Office if applicable.
4. Receive confirmatory survey by the Radiation Safety Office.
5. The Radiation Safety Office will remove door signs and all other radiation signage and labels.
6. The RSO will report to the RLSC and notify the AU.
7. Release labs for the general public use.

4. Radioactive Material Receipt, Package Check-In, Inventory Number, Record of Use, Transfer, and Lab Storage Procedures

Package Receipt

There are two locations, the main campus and bay campus, where radioactive material packages are delivered. At the main campus, the packages are delivered to the shipping and receiving office at the Center for Biotechnology and Life Sciences (CBLS) building, 120 Flagg Road, Kingston, RI 02881. At the bay campus, the packages are delivered to the Radiation Safety Office, 16 Reactor Road, Narragansett, RI 02882. For the main campus, the shipping and receiving personnel contact the Radiation Safety Office when they receive any radioactive material labeled packages or packages indicating that they may contain radioactive materials. Radioactive material packages MUST NOT be accepted outside of normal business hours, on weekends, or holidays unless previously arranged with the RSO. The Radiation Safety Office will pick up the packages and deliver to the individual who ordered them.

Package Check-In

All radioactive material shipments are checked in and must be inspected within 3 hours of delivery by the Radiation Safety Office. The Radiation Safety Office must be notified as soon as the package is received and will conduct a survey of the package. Packages with evidence of degradation of package integrity, such as a package that is crushed, wet, or damaged, require terminating the package receiving process and notifying the carrier immediately. If the package is intact, the Radiation Safety Office will survey the package and confirm that dose rates are below the applicable limits. Packages with unacceptable levels of contamination or with external radiation levels exceeding applicable limits will be investigated and the final delivery carrier immediately notified. In addition, the RSO or his/her designee shall notify the RIDOH by phone when required. The Radiation Safety Office will deliver the package to the laboratory on the same day with the material tracking form when there are no issues with the package. If the package is delivered later on the day of scheduled delivery, the package can be delivered next business day to the individual who ordered it.

Inventory Number

Each radioisotope is assigned a specific inventory number by the Radiation Safety Office. This is recorded on the vial, and vial container to prevent isotope mix up, and the radioactive material tracking form. A radioactive material tracking form must be maintained while using the material and a copy of the form must be returned to the Radiation Safety Office when the material is no longer in use or is used completely. The form must be maintained by the AUs for their records and also by the Radiation Safety Office. Inventory of all radioisotopes is

electronically maintained by the Radiation Safety Office. A physical review of all inventoried radioactive material stock vials will be performed during the annual Radiation Safety lab audits.

Record of Use

The radioactive material tracking form must be kept up to date and filled out completely at each time of use. The form must indicate when the radioisotope is no longer in use or is completely used. If any activity remains, this must be indicated on the form as well. Upon receipt of the completed forms, the radioisotope will be deleted from the AU's radioactive material inventory. Failure to return the forms in a timely manner may cause the AU to exceed maximum possession limits and could prevent or delay approval of new radioisotope orders.

Transfer of Radioactive Material

All transfer of radioactive material between AUs within the University must be documented and approved by the RSO. The radioactive material tracking form will be used when the material is transferred. A new radioactive material tracking form and inventory number will be issued for the transferred radioisotope.

AUs leaving the university and transferring their radioactive material to another institution must arrange to properly ship their material in consultation with the RSO. A minimum of 2 weeks prior notification should be provided.

Lab Receipt and Storage of Radioactive Material

Radioactive material packages shall only be delivered by the Radiation Safety Office to approved laboratories and AUs. All radioactive materials shall be stored in a locked cabinet, refrigerator, freezer, or room, and when not in a locked device or room (such as during working hours), it shall be accompanied by a trained radiation worker at all times. All radioactive materials must be stored in secure areas to prevent unauthorized removal. Radioisotopes must also be stored behind sufficient shielding as necessary to reduce radiation exposures. Radiation Safety personnel will inspect all radioactive material labs to ensure that appropriate safety measures are in place and proper safety procedures and controls are being followed prior to work with radioisotopes.

5. Radioactive Material Procurement Procedures

Radioactive material may be acquired only by an Authorized User (AU) or individuals specifically listed in the Authorized User's permit. All Purchase Requisitions for radioactive material must be approved by the RSO or designee before the order is processed through the Purchasing Department.

Note: Chemical compounds containing uranium or thorium must be purchased as radioactive material, because these compounds may be subject to radioactive waste disposal requirements.

The Authorized User must be approved to possess the isotope and activity ordered. The activity, when added to the current isotope inventory, must not exceed the AU's approved possession limit for that isotope. The Radiation Safety Office will review each request to ensure that orders are consistent with the user's authorization. If these conditions are met, the Radiation Safety Office will approve the acquisition the same day it is received.

Any acquisitions of radioactive materials from a vendor, collaborator or another institution require prior approval of the Radiation Safety Office. This includes but is not limited to replacement shipments, trial kits, and free samples.

When filling out a purchase requisition, the following information is required for processing by the Radiation Safety Office and must be clearly printed on the requisition:

1. Radioisotope, e.g. P-32, C-14, etc.
2. Maximum activity per vial, e.g. 500 microcuries (μCi), 0.5 mCi, etc.
3. Compound(s), e.g. DCTP, Thymidine, etc.
4. Total number of vials
5. Vendor and catalog number for the isotope ordered
6. Name and signature of the AU authorized for the order
7. Individual who placed the order if different from the AU
8. Location and phone number of the receiving laboratory approved for radioactive material use

6. Training

The Radiation Safety Office provides radiation safety training for individuals who work with or around radioactive materials or other generators of ionizing radiation. Authorized Users and workers using radioactive materials must have initial training before using radioactive materials. Annual refresher training is required for all active users to use and possess radioactive materials. Inactive users must have completed radiation safety training within a year to re-attain active status.

The user training will include basic radiation physics, radiation hazard, regulations, URI policies, safety procedures, package receiving, contamination survey, and waste disposal. Non user training will include radiation hazard, safety procedures, URI policies, and regulations.

All new radiation workers are recommended to review the Radiation Safety manual. Copies of the Radiation Safety manual can be obtained by direct request to the Radiation Safety Office or at the website <https://web.uri.edu/radiation/radioactive-materials-resources/>.

Each AU is responsible for training workers under his/her supervision on radiation safety procedures and practices specific to each particular laboratory.

Non-radiation workers (i.e., Maintenance, Custodial, and Public Safety) are retrained annually during safety training conducted by Environmental Health and Safety (EH&S) and the Radiation Safety Office, and as scheduled through the individual departments or EH&S. Additional training classes for administrative and secretarial staff are also available by request.

Special classes for groups may be given as needed if prior arrangements are made.

Call the Radiation Safety Office to sign up for a new training or retraining class.

7. Personnel Monitoring

Individuals likely to receive 1/10 of the maximum permissible exposure limits of 5 rem in a year per the RIDOH Regulations shall wear a radiation dosimeter (radiation badge). This includes all radioactive material users except low beta (ex. H-3, C-14, S-35) users. Other personnel may request dosimetry that will be provided at the discretion of the Radiation Safety Office.

Obtaining Dosimeters

The Radiation Safety Office issues personal radiation dosimeters to radiation workers who are likely to receive 1/10 of the maximum permissible exposure limits. Radiation workers must complete the Radiation Safety Training Class for users and fill out the Radiation Badge request form. If there is any doubt concerning the need for radiation dosimetry, contact the Radiation Safety Office.

Proper use of Dosimeters

The whole body dosimeter shall be worn between the neck and waist. If, however, one area of the body is more likely to be exposed than the rest, the dosimeter should be worn in that area. The front of the dosimeter must be exposed toward the source of radiation with no obstruction such that it correctly reads the exposure of the radiation worker. It is recommended that the dosimeter be worn inside of any personal protective equipment (PPE) such as gloves, apron or lab coat unless the user is wearing a shielded PPE. Please consult with the Radiation Safety Office as to where and how dosimeters should be worn when you use shielded PPE.

Extremity dosimeters (ring dosimeters) should be worn under any protective gloves on the hand most likely to receive the greatest exposure. The front of the ring dosimeter should face toward the radiation source.

Dosimeters are issued to a single user and shall not be shared. Dosimeters must be returned promptly at the end of each cycle to assure the Radiation Safety Office can take timely action, consistent with implementation of As Low Reasonably Achievable (ALARA), in the event any significant dose is measured.

Proper storage of dosimeters

Store dosimeters in a radiation-free area, such as a desk drawer, when not in use. Do not take the dosimeters out of the campus.

Lost or Damaged dosimeters

Report lost or damaged dosimeters such as crushed, broken, and melted to the Radiation Safety Office as soon as you are aware of the situation. Lost badges shall be documented at least with a name and date.

Pregnant Radiation Workers

A special situation arises when a radiation worker becomes pregnant. Under these conditions, radiation exposure could also involve exposure to the embryo or fetus. The State of Rhode Island also requires that the maximum permissible exposure for a declared pregnant worker during the gestation period is 500 mrem. Any radiation worker who is pregnant or thinks she may be pregnant may declare the pregnancy in writing in order for the prenatal exposure limits to take effect. The pregnant radiation worker will then meet with the RSO, and a complete assessment of her radiation exposure potential will be made. Additional counseling will be provided if necessary and a fetal badge will be assigned. The assigned fetal badge is normally worn on the abdomen and the badge will be exchanged on a monthly basis. Exposures should be maintained under 50 mrem per month generally. An individual may undeclare her pregnancy at any time, but this also should be documented.

8. Bioassay

Bioassays are required for radiation workers who are likely to receive a measurable internal radiation dose. Bioassay procedures include, but are not limited to, thyroid screening and urinalysis.

Radioactive Iodine

A bioassay is required any time more than 1 mCi of radioactive iodine in volatile form is used at once.

The Radiation Safety Office must be notified before handling more than 1.0 mCi of volatile radioactive iodine to make a plan to perform a bioassay for anyone involved in the procedure. The bioassay thyroid scan must be performed within 72 hours but no earlier than 8 hours. Generally the bioassay will be performed in approximately 24 hour periods.

Tritium (H-3)

The Radiation Safety Office must be notified before handling more than 10 mCi of H-3. Bioassays are required and background urinalysis will be performed before any procedure involving 100 mCi of H-3 or more. Tritium sources in metallic foils are exempt from bioassay requirements.

Urine bioassays must be done for H-3 users in accordance with the following schedule:

1. Less than 100 mCi: bioassays are performed at the discretion of the RSO or when requested by the AU or the RLSC.
2. Greater than 100 mCi but less than 1.0 Ci: bioassays are performed weekly until results are in the normal range if necessary.
3. Greater than 1.0 Ci: bioassays are performed daily until results are in the normal range if necessary.

Following approval by the RSO, tritium users may perform their own bioassays and submit the results to the Radiation Safety Office. The bioassay procedure can be obtained from the Radiation Safety Office.

9. Laboratory Setup Guidelines for Radioactive Material Use

Radioactive material shall only be used in locations which have been approved and authorized by the RLSC. AUs wanting to add a radioactive material use location must submit a completed authorization amendment to the RSO. The RSO will review use protocol(s) in the application and/or amendment and classify each radioisotope procedure based on the guidebook Radionuclide and Radiation Protection Data Handbook. An application should provide details of the area and the proposed uses and receive approval by the RLSC. The adequate setup of the radioactive material work area will be assessed prior to the RLSC approval.

An on-site safety audit will be conducted by the Radiation Safety Office prior to any radioactive material use and annually thereafter. The Radiation Safety Office reserves the right to increase the on-site audit frequency.

All radioactive material labs must be properly posted with “Caution Radioactive Materials” and other applicable signage at each entrance including a copy of the “Notice to Employees” form RCA-1, from the RIDOH Radiation Control Program with the RIDOH required document location. In addition, emergency procedures and contacts are posted as well. This signage and postings will be provided and posted by the Radiation Safety Office and shall be visible at all times. Laboratory personnel should contact the Radiation Safety Office for a replacement sign if the one provided has been removed, defaced or damaged.

Access to all radioactive material laboratories should be restricted to authorized personnel only. Housekeeping or maintenance personnel may be allowed into these areas. Personnel monitoring badges are not assigned to housekeeping or maintenance personnel, but could be provided if necessary. Doors to all radioactive material laboratories must be securely closed and locked when no one is present. Radioactive material must remain secure at all times from unauthorized use and/or removal.

A survey meter which is appropriate to the type, energy and levels of ionizing radiation must be made available to users. Laboratories using low energy beta emitters such as H-3, C-14, and S-35 are not required to have survey meters. Analytical devices including a Liquid Scintillation Counter, a Planchette Counter, or a Gamma Counter must be available and in calibration for AUs and their radiation workers to use if necessary. Any survey meter that is used by any personnel on the campus (purchased or donated) must be registered with the RSO and will be added to the annual calibration schedule and calibrated at least annually. However, survey meters purchased for a personal use not related to the University work or research, are not required to be registered with the Radiation Safety Office.

Shielding materials appropriate to the type, energy and levels of radiation in all laboratories shall be made available. High energy beta emitters are recommended to be shielded with

Plexiglas (or plexiglass) to minimize the radiation exposure. In general, exposures shall always be kept ALARA. The ALARA program is set to keep occupational exposures under 1/10 of the allowable maximum permissible exposure limits. Shielding evaluations and design requires the RSO's pre-approval.

Tongs, forceps, or other remote handling tools are recommended. Liquid or loose radioactive material should be contained in a secondary, unbreakable and corrosive resistant container. Please consult with the RSO if additional training is needed.

Experiments that generate aerosols or use volatile radionuclide compounds must be performed in fume hoods with adequate flow rate. All iodination must be performed in a designated fume hood in an approved radioactive material use location without exception. If hoods are being used, hoods will be inspected at least annually by the EH&S personnel or EH&S contracted vendor, and also hoods will be tested by the Radiation Safety staff while conducting the annual audit. Additionally, experiments with such radionuclides should be performed in an area under negative air pressure.

10. Radioactive Material Laboratory Safety Guidelines

Basic laboratory safety guidelines are necessary to ensure personnel safety and prevent radioactive contamination or spills and ensure compliance. Consistent and active participation by all laboratory personnel including radiation workers is necessary.

The following set of guidelines is not comprehensive:

- Personnel without radiation safety training should not be near while radioactive procedures are in progress in laboratories.
- Radioactive material work area (hot work area) must be away from heavy traffic and doorways. AU must not change pre-approved work space without consultation with the RSO.
- Every container of radioactive material should be labeled for identification with the radiation warning symbol or “radioactive material” and pertinent information such as the radionuclide content, date and activity. The container does not need to be labeled if it holds radioactive material that is used that same day and solely by a user.
- Must use caution in handling radioactive materials and use double containers and shielded containers when transporting the material to protect against external radiation exposure and spills if necessary.
- Must wear laboratory coats and other recommended protective clothing including gloves at all times when working with radioactive materials.
- Must not handle food, drink, or personal items including cell phone while working with radioactive materials. Do not eat, drink, apply lip balm, or apply cosmetics in any area where radioactive materials are stored or used.
- Do not store food, drinks, or personal items within radioactive material labs.
- Dispose of radioactive wastes only in specially labeled receptacles.
- Never pipette by mouth.
- Absorbent paper shall be used to cover workbenches and other surfaces where radioactive materials are handled. In addition, absorbent materials should be used in trays if applicable.
- Survey hands and clothing for contamination after each procedure or before leaving the area. This is done using a survey meter with the exception of H-3 users.

- Survey all areas where radioactive materials are used in unsealed form after each procedure and/or at the end of the day. Decontaminate immediately if necessary.
- Work should be planned ahead and a practice run should be performed to test the procedure.
- The laboratory should be kept clean and orderly at all times.
- Radiation survey instruments should be checked prior to use to ensure proper operating conditions if possible. This includes a battery check to be performed before each use.
- Radiation badges, when assigned, shall be worn at all times while in areas where radioactive materials are stored or used. Assigned ring badges shall also be worn at all times when handling radioactive materials.
- All radioactive materials must be secured at all times to prevent unauthorized access and the laboratory must be locked when no one is present.

11. Radioactive Material Laboratory Survey and Wipe Test Procedures

AUs shall perform contamination surveys and document the results in appropriate units for all areas where radioactive materials are used or stored under their supervision. The Radiation Safety Office will conduct periodic surveys, generally quarterly, and audits to assure proper use of all radioactive material.

Surveys must be conducted after each experiment using radioactive materials or at least at the end of the day when radioactive materials are used. Survey documentation shall include meter information such as model and serial number, etc. Wipe tests are strongly recommended to accompany the survey. All records require both count rate measurements with an appropriate calibrated survey meter and wipe tests performed to identify removable contamination. These checks are necessary to keep radiation exposures ALARA.

Listed labs with no use or storage must be reported to the Radiation Safety Office to be closed out. Quarterly surveys and wipes tests are conducted by the Radiation Safety personnel to verify compliance and to keep records for State inspections. Laboratories that use more than 1mCi at once or within a month will be surveyed monthly by the radiation safety personnel.

Inactive Radioactive Material AUs (AUs without any radioactive material stored or used and who have been granted inactive status by the RLSC) are exempt from the survey and wipe test procedures.

General Survey procedures

A survey must be performed using a survey meter on all labs using radioisotopes except for H-3 and may be performed for C-14 and S-35 (Low energy beta emitters) use labs. Before using any survey meter, check for current calibration and proper functioning. If the batteries are weak, contact the Radiation Safety Office to replace the battery and to perform a functional check before its use. Check that the meter is properly responding by holding the probe close to the radiation source, without touching it. Obtain background readings before surveys. Additional training on this procedure should be requested as needed.

Monitoring for contamination is performed by slowly moving the detector over all surfaces at a distance of approximately 1 to 2 centimeters. The survey meter should be turned on before entering any radiation area starting with the lowest setting for known radiation fields. The audio should always be "on" since small increases of radiation exposure are easily detected by listening to the audio and it is easier to pay attention to the surface being monitored. Make sure not to contaminate the probe by touching the surface being checked. Request assistance from the RSO if needed.

Any area with meter readings consistently above twice background or greater with the survey meter must be thoroughly investigated and immediately decontaminated if necessary. A resurvey should then be performed to confirm that the area is below twice background.

Calibrations of survey meters must be performed at least annually as coordinated by the RSO or the RSO's designee. Calibration is also required after a repair or the replacement of parts (e.g. probe). Calibrated meters will have a calibration label affixed to the side or bottom with the date of calibration, performed by, and serial number of the instrument. The calibration certificate will also be kept for records by the Radiation Safety Office.

Wipe Tests

If necessary, and mandatory for the use of H-3, cotton swabs or small filter paper discs are used for wipe tests. Either dry or wet wipe tests are acceptable. To perform a wipe test, wipe at least 100 cm² of the surface areas. Appropriate personal protective equipment must be worn when performing wipe tests.

Wipes are to be taken at locations around the laboratory based on knowledge of material use. Any area found with a wipe test resulting of 220 disintegrations per minutes (dpm) per 100 cm² or greater from a liquid scintillation counter, Planchette counter, or other applicable analytical equipment is considered contaminated. This area must be immediately decontaminated until the wipe test count is below 220 dpm.

Documentation

Lab surveys and wipe tests must be recorded with the locations of each survey and wipe test properly identified. Completed survey documentation must be kept for your records. The radiation safety quarterly survey will be kept in the Radiation Safety Office for URI records and for State inspections.

12. Radiation Safety Procedures for the Use of Radioactive Material in Animals

AUs planning to work with radioactive material with animals must be approved by the URI Institutional Animal Care and Use Committee (IACUC) or submit an application to use animals to IACUC before submitting the Application for Use of Radioactive Materials and must attach IACUC approval or submitted application with the application. The use of radioactive material in animals requires additional safeguards in the handling of affected animals. The information provided on the application will enable the Radiation Safety Office to formulate necessary safety measures and assist the AU in implementing these measures.

Details concerning the actual use of animals must be discussed with the Animal Care and the research protocol approved by the IACUC. No research activities using animals can be started without prior approvals.

The RSO will submit all applications to the RLSC for review and approval. However, the RSO may also grant temporary approval to AUs if necessary. Approved AUs will receive an Authorization Permit to work with radioactive material in animals at URI and this may be submitted with Grant Proposals. The IACUC will be notified and provided with a copy of the approved application.

The AU is responsible for the overall radiation safety of the project, including radiation exposure monitoring of the animals, cages, and procedures; analytical determination of radioactivity in urine, feces, and bedding; and labeling of all cages containing radioactive animals. Consultation and assistance will be provided upon request. Tags for this purpose must indicate the radioisotope, the activity (in μCi or mCi) and the date. Animal Care must be notified per terms of the IACUC protocol prior to housing animals with radioactivity in their facility. Such notification may not be necessary for animal use within the AU's authorized laboratories.

All animal remains containing radioactive material [except H-3 and C-14 as described below] are to be disposed of as follows:

- Place the remains in a (preferably yellow) radioactive materials waste bag. Secure the bags closed with tape and indicate the radioisotope, the activity (in μCi or mCi) and the date on the tags. Submit a waste request to the Radiation Safety Office. The bag will be collected by the radiation safety personnel and stored in the radioactive material labeled freezer at the Radioactive Waste Facility for future disposal.
- All animal wastes with short half-life isotopes (≤ 90 days) will be placed in a clear bag or red biohazard bag, securely shut with tape, and marked on a radioactive material sticker with the radioisotope, the activity (in μCi or mCi) and the date. Store the waste in a freezer for

at least 10 half-lives. After 10 half-lives, the waste will be surveyed and collected by the radiation safety office and transferred for disposal as animal wastes.

- Animal remains containing H-3 and/or C-14 in quantities less than 0.05 μCi per gram, may be disposed of as non-radioactive waste. The RSO must be consulted before disposal of animal wastes. The AU must maintain inventory records with the date, activity, and radioisotope used in the animal and provide a copy to the RSO.

From RIDOH regulation 216 RICR 40 Subchapter 20:

1.15.5 Disposal of Specific Wastes

For the purpose of this Part, disposal of specific wastes is defined by 10 CFR 20.2005.

1.16.8 Records of Waste Disposal

For the purpose of this Part, requirements for maintenance of records of waste disposal are defined by 10CFR 20.2108.

13. Gauges

Gauges are designed and licensed to do specific measuring tasks, (e.g., measure moisture and density of soils). These devices may contain one or two radioactive sources, (e.g., an Americium-241: Beryllium (Am-Be) source and a Cesium-137 source). Any gauge containing radioactive materials will be operated and maintained in accordance with its manufacturer's manual of operation and instruction.

Operation

Gauges may be operated only by (or under the direct supervision of) a properly trained operator. The gauge operator will maintain constant surveillance of the gauge during operation and restrict access to the immediate area of the gauge. Students may operate the gauge only under the supervision of a properly trained gauge operator.

Storage

Gauges shall be secured against unauthorized removal of the sealed source from its fully shielded position when in storage or transit. They shall also be secured against unauthorized removal from their storage areas when not in use.

Stuck Source

If the operator is unable to retract a source, he/she should immediately notify the Radiation Safety Office to receive further assistance. Areas around the gauge must be secured to prevent unauthorized personnel from entering the area to prevent access to where the sources are pointing. The operator should remain on the site and maintain surveillance of the gauge.

The gauge manufacturer should be consulted if repeated attempts to retract the source are unsuccessful. The Radiation Safety Office will notify the Department of Health if it becomes apparent that attempts to recover the source will be unsuccessful.

If the source is successfully retracted, the Radiation Safety Office should conduct a radiation survey using appropriate radiation detection instrumentation to verify that the source is properly stored.

Transport

Most gauges are certified with the US Department of Transportation (DOT) special form or come with a DOT certified storage and shipping container.

The DOT¹ has determined that transporting radioactive materials in a state vehicle for non-commercial purposes such as research, training, etc. is not subject to the Hazardous Materials Transport Act (HMTA) regulations. However, if the gauge is transported to a field location off campus, HMTA regulations apply.

Traffic Accidents

If a gauge is involved in a traffic accident, follow the instructions provided by the gauge manufacturer in their manual and notify the Radiation Safety Office. If the gauge can be readily seen, visually inspect it for signs of damage. If one or more sources have been ejected from the gauge, secure the area and prevent unauthorized personnel from accessing it. Emergency responders such as police and fire fighters must be notified. Emergency response actions² may be performed prior to any measurement of radiation. Limit entry into the immediate area of the gauge to the shortest time possible.

Leak Tests

Only qualified personnel, such as radiation safety personnel, should test the sealed source(s) in any device for leakage. In general, beta and gamma emitting sealed sources with activity of more than 100 uCi are leak tested and physically inventoried at least every six months (alpha emitting sources more than 10 uCi are tested every 3 months). If gauges are not in use and in storage they are exempt from leak tests, however physical inventory will be performed as scheduled (at least every six months).

¹ Hazardous materials transported by a state employee in a state-owned vehicle for non-commercial purposes are not subject to the HMTA regulations. The US DOT's Office of Hazardous Materials, chief of Regulatory Review and Reinvention provided the interpretation in a letter to Mr. David Wiik; USDOT dated November 19, 2004., Reference No.: 04-0256

² Removal of injured personnel – Advise medical personnel that the victim may be contaminated with radioactive material.

14. Radioactive Waste Disposal Procedures

Radioactive waste requires the same safety and security measures similar to radioactive materials. The AU is responsible for the safe, secure, and proper storage of radioactive wastes generated until removed by the radiation safety personnel. This manual establishes guidelines to ensure compliance with the required procedures for collection, packaging, labeling, transport and disposal of radioactive wastes generated under licensed activities conducted at URI.

The AU is responsible for obtaining all containers and shielding required for his/her waste management program, as well as for maintaining written inventory records of the activity of all contaminated wastes in storage and those removed from the laboratory on the Radioactive Waste Disposal Form. This form can be obtained by contacting the Radiation Safety Office or online at <http://web.uri.edu/radiation/radioactive-materials-resources/>.

Radioactive waste should not be stockpiled in the lab. A radioactive waste area should be located away from heavy traffic or high use areas. Adequate space for shielding should be considered if needed. Plan to contain liquid waste in the event of a spill or failure of the liquid waste container. Containment can be easily achieved by placing the waste container in a secondary container or by placing plastic backed absorbent paper beneath them.

Do not place radioactive waste where it might be picked up by housekeeping personnel and be disposed of as ordinary waste. Accidental and improper radioactive waste pick-up and/or disposal must be reported immediately to the RSO.

The Radiation Safety Office is responsible for the pickup and disposal of all radioactive wastes from the laboratories. Radioactive waste management including segregation, direct handling, repackaging, and physical disposal will be conducted by trained and authorized personnel only under the direction of the RSO. Poor radioactive waste disposal practices including sharps in the dry waste container can lead to a higher threat of radioactive material contamination and personnel health hazards. Non-compliance items are expected to be addressed immediately by means of wastes handling retraining and discussion to prevent recurrence.

Before requesting a radioactive waste pickup, please make sure the containers are properly sealed and the Radioactive Waste Disposal Forms are completely filled out and ready to provide to the radiation safety personnel. Full waste containers that require shielding should not be left outside of shields while awaiting pickup. All requests for radioactive waste pickups in the labs or other special areas will be completed by contacting the Radiation Safety Office.

Specific information such as AU, location, waste type, number of containers, etc. must be provided before pickup. The waste will be picked up by the radiation safety personnel per a waste pickup schedule unless there is inclement weather or other special circumstance. Contact the Radiation Safety Office for questions and assistance with the waste pickup request and documentation.

Waste Segregation and Minimization

Waste segregation by form and isotope is an effort to minimize the volume of radioactive waste disposed in licensed land disposal facilities. For this initiative to succeed, it is necessary that all AUs and laboratory personnel follow proper radioactive waste procedures.

Radioactive waste must be segregated by radioisotope and physical form. The only general exceptions are the radioisotopes H-3 and C-14 which can be stored together. Any other exception must be pre-approved by the RSO. The basic physical forms are: solids, glass, sharps, liquid, liquid scintillation vials (LSV), biological, animal remains, source vials, lead pigs, and sealed sources.

Solid

Solid radioactive waste is comprised mostly of solid disposable items that have been contaminated with radioactive material including absorbent work surface coverings, gloves, tubing, etc. The plastic waste bag, preferably yellow bags, must be placed in waste receptacles that remain closed at all times. Deface or remove all radioactive labels before placing waste into the bags if possible. Do not place anything in the bags in such a way that they may tear. Inspect the plastic waste bag for tears prior to removal from the container if possible. Use a secondary bag to contain the waste if needed. Do not mix liquid scintillation vials, lead pigs, and stock vials with the solid waste, **especially sharps**. Plastic source vial containers, but not the lead impregnated type, may be disposed in the solid waste after being defaced of all radioactive labels. Every waste container must have a completed Radioactive Waste Disposal Form attached prior to pick up.

Sharps

Sharps are defined as anything that could tear the yellow radioactive material bag including needles, razor blades, capillary tubes, broken glass, etc. This waste type must be disposed of in puncture resistant plastic containers. Make sure that all sharps are dry before placing them into a container. When full, securely close the container and have a completed Radioactive Waste Disposal Form attached prior to pick up.

Liquid

Radioactive liquid waste can be further divided into aqueous, acids and bases, and pump oils. Aqueous liquids are water-based liquids with a pH between 5.5 and 9, such as saline and buffer solutions and weak acids and bases. No radioactive liquid is to be poured down the sink. Sinks will be checked during routine lab surveys and wipe tests performed by the Radiation Safety Office. Pipettes and other such items must not be placed in the container. All biological

material in the containers must be properly deactivated or neutralized such as by using a bleach solution. Do not mix liquid waste types in the container.

Double containment in a tray or pan that will adequately contain the liquid is recommended as a precaution against leakage or spills. This will also control accidental overflow and drips due to pouring. At a minimum, plastic backed absorbent paper shall be placed under all liquid waste containers. Containers should be kept as free of contamination as possible.

Liquid waste should be placed in recyclable containers that can be returned to the laboratory by the Radiation Safety Office. These containers should be made of heavy gauge plastic with no more than a 5 gallon capacity. Judgment should be used in the selection of plastics since many organic chemicals will dissolve them.

The Radiation Safety Office will not accept liquid waste that has been placed in glass containers. Contact the Radiation Safety Office if you have any questions about the type of container to use for your liquid waste or if the liquid waste contains any regulated chemicals. Every container must have a completed Radioactive Waste Disposal Form attached prior to pick up.

Liquid Scintillation Vials

Liquid Scintillation Vials are glass or plastic vials containing organic or aqueous based liquid scintillation fluid. This waste can be disposed of as non-radioactive material wastes if below the regulatory limits. For more information, contact the Radiation Safety Office. The AU must know what is in the liquid scintillation vials and the activity. The Radiation Safety Office strongly recommends the use of a biodegradable scintillation cocktail unless another chemical based cocktail is necessary. Liquid scintillation waste with short half-life (less than 90 days) isotopes will be picked up by the Radiation Safety Office and held for at least 10 half-lives, surveyed, and disposed of as regular trash if biodegradable or disposed of as chemical waste if non-biodegradable. The disposal records must be maintained at the Radiation Safety Office.

Biological

The Radiation Safety Office will not pick up any radioactive waste containing biological waste unless it is properly deactivated or neutralized. Liquids must be absorbed into some absorbent material such as paper towels, sponges, gauze, etc. prior to being placed into bags. Pathogenic and infectious waste must be sterilized by chemical treatment. Do not autoclave radioactive contaminated biological waste unless the autoclave is only dedicated for such waste.

Animal Remains

This category covers radioactive animal carcasses and animal research by-product waste. Animal remains containing radioactive material are subject to handling according to the guidelines stated in the Radiation Safety Procedures for the Use of Radioactive Material in

Animals section. Every waste bag must be securely sealed with a tag attached indicating the AU, the date, radioisotope, and total activity. Liquids must be absorbed into some absorbent material such as paper towels, sponges, gauze, etc., prior to placing into bags.

Source Vials

These are the original vials that the radioactive material was shipped in to a lab and which are waiting for disposal. All source vials are considered wastes. A copy of the Radioactive Material Tracking Form must be returned along with the source vial.

Lead Pigs

The inner lead lining of a lead pig must first be removed from the plastic container. The plastic container should then be surveyed to make sure it is not contaminated. Any radiation labeling must be completely defaced before the plastic container is disposed of as regular trash. Lead is a regulated material and cannot be disposed of as trash. It must also be surveyed and free of contamination before the Radiation Safety Office will pick it up. Lead pigs and lead impregnated shielding containers must be kept separate from the solid waste.

Other Wastes including Sealed Sources

These wastes include calibration sources, check sources, quenched standard sets, electron capture gas chromatograph detectors, etc. Final survey and/or leak tests are required to be performed on all sealed sources prior to disposal. All sealed sources must be turned in to the Radiation Safety Office for proper disposal even if they are decayed. AUs and radiation workers must check for broken or crushed sources and handle these damaged sources with extreme care. Notify the RSO immediately if a source breach or contamination is found or suspected. Sealed sources must be kept separate from the other wastes for disposal. A Radioactive Waste Disposal Form is not required. Segregation by radioisotope does not apply to sealed sources.

15. Emergency Response, Radioactive Material Spill, and Accident

Radioactive material incidents may involve three levels of response due to severity: spills, accidents, and emergencies. All these events may raise exposure and contamination concerns with potentially increased dose both internally and externally to the lab personnel, the environment and members of the public. Each incident must be carefully evaluated before proceeding and approached properly to prevent additional hazards and personnel exposure. Contact numbers are listed below for assistance.

Radiation Incident & Emergency Phone Numbers

Working Hours:

Radiation Safety Office	(401) 874-2600
Radiation Safety Officer	(401) 874-9439
Health Physicist	(401) 874-9451

After Hours:

Environmental Health and Safety (Emergency)	(401) 874-2121
URI Public Safety (Emergency)	(401) 874-2121
URI Public Safety (Non-Emergency)	(401) 874-4553
Medical Emergencies (Must go to Rhode Island hospital for any radiation injuries)	911

Basic Radioactive Material Spill Kit Items

Every radioactive material laboratory using open sources must have a radioactive material spill kit designed to handle a minor spill (as defined below). A spill kit should contain the following at the minimum:

Radioactive decontamination reagent, paper towel, plastic backed absorbent materials, radioactive waste bag, disposable gloves, shoe covers, and sealable plastic bags (gallon size Ziploc bag).

Radioactive Material Spill

A radioactive material spill may be in the form of liquid, powder, mist, fume, organic vapor, or gas. The spill may pose cross-contamination concerns to the lab and adjacent areas, as well as personnel.

Two types of spills are possible in a lab situation depending on the volume and activity:

Minor Spill

A minor spill is a spill that remains contained, can easily and effectively be cleaned up without assistance from the Radiation Safety Office, does not involve personnel contamination, and is typically less than 100 uCi of activity and/or a small volume of liquid within a small area. The Radiation Safety personnel will provide assistance with small spills whenever requested.

1. Notify others in the area of the minor spill.
2. Survey hands and surrounding areas; remove gloves if required and replace gloves.
3. Remove contaminated bench paper and dispose of as radioactive waste.
4. Decontaminate and verify that all contamination is removed.
5. Re-survey immediate and surrounding areas.
6. Dispose of all spill clean-up material as radioactive waste. This includes any contaminated brooms, mops, dust pans, etc.
7. Report to the Radiation Safety Office and do not resume work in the area until the Radiation Safety Office has cleared the area.

Major Spill

A major spill involves typically large amounts of radioactivity greater than 100 uCi, high radiation exposures at the surface (> 2 mR/hr), a large volume of fluid, and/or a large surface area of contamination, involves personnel contamination, and results in contamination outside of the intended work area. The RSO or other Radiation Safety personnel must be contacted immediately for major spills to take charge of clean-up operations and follow up to verify decontamination to acceptable levels. Personnel are expected to use sound judgment in initiating cleanup efforts.

1. Notify others in the area of the major spill.
2. Have somebody not involved in the incident (if practical) call the Radiation Safety Office for assistance and guidance.
3. Check shoes for potential contamination.
4. Have unaffected personnel (if available) survey the area for contamination boundary.
5. Barricade the area at the boundary of the contamination to prevent any spreading of the contamination.
6. With assistance and replacement items, remove contaminated clothing or footwear.
7. Do not leave the area until the initial investigation by the Radiation Safety Office has been completed.

If you need assistance with a major spill after normal working hours, please call the URI Public Safety Emergency line at (401) 874-2121 and the RSO will be notified.

Decontamination

Decontamination is the removal of unwanted radioactive materials. Contamination can be to an area, on personnel, and in some cases, involves injury to personnel. Major personnel injuries take priority over decontamination, which can be performed at a later time.

Personnel Decontamination

Clothing Decontamination:

1. Remove the contaminated clothing carefully to avoid or minimize contaminating the skin.
2. Check the skin for possible contamination; decontaminate the skin as indicated below before continuing with clothing decontamination.
3. Determine approximate activity on the clothing.
4. The clothing material will be labeled and held in storage by the Radiation Safety Office until the activity is decayed, it is decontaminated, or it is disposed of as radioactive.

Skin Decontamination:

1. Contact the Radiation Safety Office for assistance.
2. Wash with mild soap and running water (or wetted towels).
3. Do not abrade skin or scrub raw.
4. Survey after each washing and drying for cleaning efficiency.

Personnel Injury

For serious injuries involving radioactive material, such as a life-threatening situation, immediately call 911 (must go to the Rhode Island Hospital). Minor cuts should be allowed to bleed, thereby reducing absorption. First aid of major cuts or abrasions, lacerations, etc., should be considered before decontamination. Proceed with personnel decontamination if possible. Contact the RSO for assistance. Please note the following:

- Treatment of a serious injury should take precedence over almost all concern for contamination control and radiation exposure.
- No transport restrictions should be imposed that would seriously compromise the patient's medical care.
- When transporting a contaminated patient to a hospital emergency room or the designated emergency receiving point, the following procedures should be followed:
 - Contaminated clothing should be removed if possible.
 - If skin decontamination is necessary, wash the patient thoroughly with soap or detergent and water.

- Wrap the patient in a clean sheet or blanket.
- A representative from the Radiation Safety Office should accompany the patient, but do not delay transport if Radiation Safety personnel are not present.

- External contamination is not immediately harmful to the patient unless the skin is badly punctured or wet.
- Minor injuries can usually be treated at the scene and can usually wait until after an initial radiation survey has been completed.

All radiation accidents (wound, overexposure, ingestion, and inhalation) must be reported to the RSO as soon as possible since this may require regulatory notification. No one involved in a radiation injury will be permitted to return to work without the approval of the RSO.

Area Decontamination

All persons not involved and not contaminated should leave the area.

1. Put on appropriate personal protective equipment (double gloves, booties, etc.) before entering areas where there may be contamination.
2. Define an outer boundary of contamination.
3. As soon as possible clean from the outer edge of the contamination and work inward.
4. Use a spray solution and wipe up with paper towels or other absorbent material to remove as much removable contamination as possible.
5. Low activity spills not containing hazardous materials can be cleaned up by using mild soap with running water.
6. While cleaning towards the center area, check newly cleaned areas for loose contamination before walking or kneeling in these areas. Absorbent paper may be placed over these areas to prevent recontamination.
7. Mark any areas where the contamination cannot be easily removed for further decontamination efforts or shielding.
8. Re-survey the area.
9. Using filter paper or a cotton swab, wipe the area. Count the wipe using a scintillation counter, a Planchette counter or a gamma counter as appropriate. If the count is greater than 220 dpm, repeat area decontamination until the count is below this level of contamination.
10. Dispose of all radioactive waste properly according to the radioactive waste procedures.

Accident/Incident

Accidents may involve a release of radioactive material into the air, water system, or outside the lab. In case of an accident involving radioactive material, notify all personnel to leave the area immediately. Notify the RSO for immediate response.

An accident/incident report should be filled out by the AU and sent to the Radiation Safety Office as soon as possible. The report must include basic information such as the name of the AU, the date and time of the incident, the date and time it is reported to the Public Safety/Radiation Safety Office, the location of the incident, any personnel involved, and the isotopes and activities involved. The second part of the form consists of a written description that includes: how the incident occurred; what caused the incident; the areas, personnel, and/or equipment that were contaminated, if any; the current status; and any procedural changes required to prevent a recurrence of the incident. If the incident involved contamination of an area, equipment, or personnel, a copy of the contamination survey should be attached. This survey should include a diagram of the affected area or equipment and the results of meter and wipe tests indicating contamination levels in dpm or μCi . The original surveys should be placed in the AU's file with laboratory survey records. Do not re-enter the room until approval of the RSO is obtained.

If the accident occurs after hours, please call the URI Public Safety Emergency line at (401) 874-2121 and the RSO will be notified.