

RADIONUCLIDE USERS ANNUAL REFRESHER TRAINING GUIDE

RADIATION SAFETY SERVICE

Radiation Safety Service
Campus Safety Service Bldg.
1239 Kipke Dr. 48109-1010
Office Hours: Mon thru Fri
7:30am - 4:30 pm
Phone: 764-4420
Emergency (After Hours) Phone:
Call Public Safety at 763-1131 or 911

INSTRUCTIONS

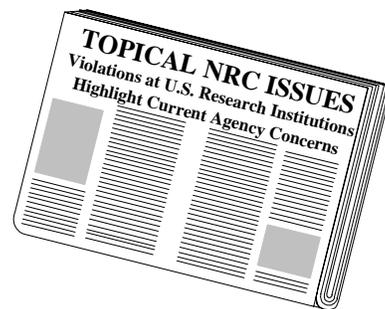
How to Use this Guide

Annual refresher training is intended for those persons who had attended the [Radiation Safety Service Orientation Course](#) prior to the start of the current calendar year. It serves to update and inform users about current radiological safety requirements and concerns. Those users **MUST** review the annual *Refresher Training Guide* at least **ONCE EVERY CALENDAR YEAR**. Alternatively, groups of users or departments may prefer to arrange for an in-house refresher training lecture conducted by a Radiation Safety Service Health Physicist. These can be arranged on a case-by-case basis by calling RSS offices at 764-4420.

Refresher training **MUST** be documented for each person in your laboratory who uses radioactive materials except for staff members who have attended the Radiation Safety Orientation Course in the current year. That documentation must be retained by Authorized Users and is **subject to inspection** by the Nuclear Regulatory Commission and Radiation Safety Service. *After reviewing the information in this document, sign the attached [acknowledgement page](#) and keep it in the Radiation Safety Records Binder in your laboratory.*

When approved by RSS, this guide can also be used as *interim* initial training for new staff who have never attended the RSS Orientation Course but who need to commence working with radioactive materials before they can attend the RSS Orientation Course. Contact RSS for more information at 764-4420.

Topical Issues and Concerns



SECURITY OF RADIOACTIVE MATERIAL IS MAJOR NRC CONCERN

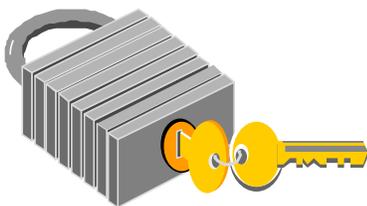
The NRC expects vigilant adherence to rules requiring security of radioactive materials. It has stepped up its efforts to enforce those rules and will cite licensees for violations of those rules. **NOTE:** these rules are viewed so seriously that at some institutions, inspectors have taken to visiting laboratories in the late afternoon or early evening hours to ensure facilities are secure during times of reduced occupancy.

What does this mean to you?

PHYSICAL SECURITY

All radioactive material MUST be secured from unauthorized use, removal and vandalism at all times.

Secure stock solutions of radioactive material and sealed/plated sources in a locked storage area and/or locked lab room when left unattended. Unsecured radioactive materials must **NEVER** be stored or used in an unrestricted and unposted room, area or facility. Unsecured material **MUST** never be left unattended. **REMEMBER**, the key is to restrict radioactive material access from anyone not authorized to use those materials under your UM-issued Authorization to Use Radioactive Materials.



INVENTORY CONTROL

Inventory control serves many purposes--one such purpose is for security of materials. An accurate "in-lab" inventory is an essential element of security. It is difficult if not impossible to identify missing radioactive material when users are unsure as to the proper amount that is supposed to be present in the laboratory. *Maintain an accurate, documented inventory of materials received, used and disposed.* OSEH-RSS can supply [forms](#) to assist in keeping a documented inventory.



AVOIDING INADVERTANT DISPOSAL OF RADIOACTIVE MATERIALS

Many laboratories purchase or fabricate shielded boxes made of plexiglass or other appropriate material as interim waste containers. This is a good safety practice permitting users to conveniently collect routine solid wastes at their work stations and then later transfer them to OSEH-supplied waste drums stored in another area.

However, there have been some infrequent instances where in-house shielded waste containers were not clearly labeled and custodial staff nearly mistook the items as garbage for disposal as ordinary trash. Disposal of radioactive materials as ordinary trash is a serious violation of safety and anti-pollution laws and regulations. Radiation Safety Service provides routine training to custodial staff that work in or around radioactive material laboratories. Custodial staff are instructed to avoid items, containers, equipment and wastes labeled with radioactive material warning labels.

What does this mean to you?

- Make sure that radioactive warning labels are blatantly affixed to all visible sides of any container used for radioactive specimens, wastes, sharps containers, etc. RSS supplies labels for in-house waste containers that instruct custodial staff to avoid disposal of the contents.

Notify RSS immediately if you suspect that radioactive material is missing from your lab. RSS can draw upon the resources needed to help locate the material when possible.

EMERGENCIES & CONTAMINATION INCIDENTS



Often, radioactive material contamination incidents are **NOT** readily visible to a user at the time of occurrence. A volume as small as 10-20 ul of liquid stock solution contaminating a single floor tile can rapidly be spread by foot traffic and contaminate laboratories and adjacent areas. Yet, the actual act of "spilling" such material can be virtually invisible to the naked eye. Accidents can occur and will require immediate decontamination to prevent the risk of spread. OSEH-RSS maintains a 24 hour emergency response system to assist users with decontamination. First and foremost, **REMAIN CALM** during an emergency or contamination incident. Both OSEH-RSS and the Department of

Public Safety (DPS) are trained to assist you in such circumstances and will come to your aid quickly.

What does this mean to you?

- **ALWAYS** perform **post-procedural contamination checks** using a GM survey meter or other appropriate survey instrument--when using H-3, use contamination swipes to perform these checks. Contamination checks are your primary means of defense. You **MUST** check:
 - ⇒ Yourself including your labcoat and clothing
 - ⇒ Your ungloved hands and your shoes (soles and tops)
 - ⇒ The immediate work areas where material was used or brought
 - ⇒ Floor areas near where material was handled or carried

- For **MEDICAL EMERGENCIES** or other emergencies which substantially threaten safety (e.g. fire), **IMMEDIATELY call 911 to notify the Department of Public Safety (DPS)** *Advise the DPS dispatcher if you suspect that radioactive contamination is or may be present. Request that the dispatcher contact OSEH.*

- **NOTIFY OSEH-RSS immediately when CONTAMINATION has been identified:**
 - On yourself
 - On floors
 - On other items or at areas not expected to become contaminated during routine use of radioactive materials, **OR**
 - At levels exceeding 20 times background

NOTE: Notify RSS even if you believe decontamination was successful.

OSEH-RSS ASSISTS RESEARCHERS DURING LABORATORY MOVES

There has been a significant change in facilities at the University in recent years. New construction and facility remodeling / renovation is benefiting the research community. Many users are undergoing laboratory space reassignment as a result of these changes.

*Authorized Users **MUST NOTIFY OSEH-RSS PRIOR TO VACATING** laboratory usage or storage areas or **commencing use** of radioactive materials in an area not currently listed on the Authorized User's approval to use radionuclides.*

In addition, many Authorized Users are learning their existing facilities are being scheduled for partial or complete renovation. Finally, users routinely need to replace or repair equipment and instruments that had been used with radioactive materials (e.g. cell harvesters, freezers, ultracentrifuges, etc).

*Radioactive material facilities being **renovated** and laboratory instruments/equipment being moved, discarded as trash, sold, or returned for repair which had been used with radioactive materials **MUST** be checked for contamination by OSEH-RSS.*

What does this mean to you?

All new facilities must first be approved for use by the UM Radiation Policy Committee. In addition, RSS may need to affix required door postings, etc. in previously unused facilities. All facilities being vacated where radioactive materials may have been used or stored must be checked for any residual contamination and cleared

for decommissioning by OSEH-RSS. To facilitate meeting these requirements, OSEH-RSS offers these guidelines:

- Notify OSEH-RSS as much in advance as possible of any lab reassignments, renovations, or other facility changes including any changes in mailing addresses.
- Identify what radioactive materials are going to be discarded. Properly package and prepare those wastes as much in advance as possible and arrange for their collection.
- Authorized Users **RETAIN THE OBLIGATION TO CLEAN UP CONTAMINATED EQUIPMENT, STORAGE AREAS, AND WORK AREAS** in facilities being vacated. It is to your advantage to conduct a comprehensive preliminary contamination screening to identify and clean minor contamination well in advance of moving when you will otherwise be preoccupied with numerous other concerns. OSEH-RSS can assist in conducting preliminary screenings.
- Inform RSS of any equipment that is being moved that is contaminated and which cannot be completely decontaminated. With RSS approval, smaller items such as table top centrifuges can usually be wrapped in plastic bagging, boxed and moved by the researcher to new facilities. Large items such as freezers, etc may need special handling as recommended or approved by RSS.
- Consult with RSS regarding special labeled specimens, samples, etc. that may be perishable or require special handling. Remember, there may be an interim period when perishable samples need to be kept in cold storage at an alternate location while laboratory freezers are defrosted, checked for contamination, then moved to a new location. RSS can approve interim storage locations for such special purposes when notified in advance.
- Ensure that all new facilities are properly posted and labeled before arranging to transfer radioactive materials to the new facilities.
- Make sure that radioactive materials at both the old and new facilities will remain secure from unauthorized removal during the move. Ensure unattended facilities are locked and secure. Ensure storage freezers in shared or "common" areas are locked.

Laboratory renovations and moves present unique logistical problems with regard to radioactive materials. OSEH-RSS is always ready to assist users in simplifying and facilitating the process of moving.

NRC REQUIRES WARNING LABELS



NRC regulations require users of radioactive materials to affix labels to containers or items holding radioactive materials. **The labels MUST be clearly visible and durable and MUST bear the words “CAUTION, RADIOACTIVE MATERIAL” or “DANGER, RADIOACTIVE MATERIAL”.**

The label must also provide sufficient information to permit individuals handling or using the containers or items to take precautions to avoid or minimize exposures. Such information should include: 1) radionuclide(s), 2) estimated activity, and 3) date. [10 CFR 20.1904(a)]

Finally, **labels on containers that are both empty AND uncontaminated must be fully defaced or removed** prior to disposal of the containers. [10 CFR 20.1904(b)]

NOTE: *Labeling is an essential part of any safety program. Information and communication are keys to preventing mistakes and misunderstandings. You must take the time to properly identify radioactive materials, storage containers and contaminated items in your lab.*

Brief Review of Protocols & Procedures

What Every User Should Know

Users of radioactive materials must be familiar with their responsibilities and obligations. Fundamental responsibilities include following all applicable regulations and safety protocols along with maintaining good documentation.

Each user should also be familiar with the NRC Form - 3 "Notice to Employees" posted in each radioactive materials laboratory. That document describes and explains your legal rights as a worker using radioactive materials.

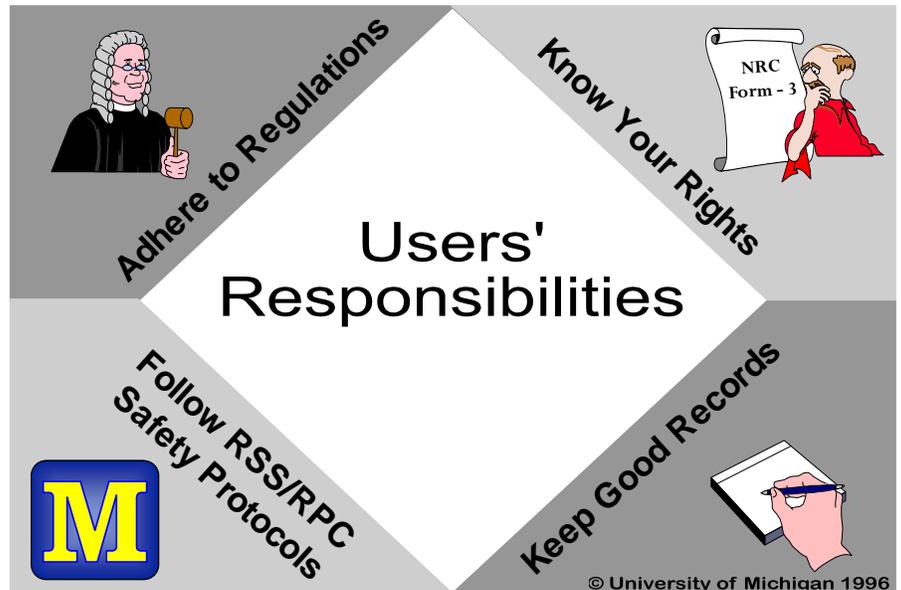
Radioactive materials are regulated from "cradle-to-grave"--from the moment radioactive materials are acquired at the University of Michigan through disposal of those materials by the University. The regulations impose a responsibility on the University to ensure: 1) personnel safety, 2) public health and safety, and 3) protection of the environment. The Radiation Policy Committee and Radiation Safety Service have been delegated the duty to implement programs and protocols necessary to fulfill that responsibility.

You help meet your share of that responsibility by being familiar with and adhering to the programs and protocols developed by the RPC and RSS relating to:

- Acquiring Radioactive Materials
- Safely Using Radioactive Materials
- Safe Disposal of Radioactive Materials

ACQUIRING RADIOACTIVE MATERIALS

Radioactive materials may only be used as approved by the Radiation Policy Committee (RPC). Principal Investigators with a minimum of 40 hours of experience and training using radioactive materials may apply to become Authorized Users by submitting to RSS a completed RSS-101 Application to Use Radionuclides. That application describes the radionuclides proposed for use and the manner in which they will be used. It summarizes the "Who, What, Where, When and How". The



application is reviewed and approved by the RPC based on the information it contains and any other information gathered by a Radiation Safety Service Health Physicist after visiting the lab and speaking with the applicant.

Authorized Users and their staff may obtain radioactive materials in accordance with the limits and descriptions specified in their authorization. Materials can be obtained from various sources such as vendors, other institutions, or transfers from other researchers at the UM. *Users **must** receive prior approval from RSS for each item to be received **before** an order is placed (contact RSS if you are interested in establishing a standing order).*

In all instances, please remember these steps:

- Call RSS in advance--for transfers, call at least 4 hours in advance;
- Be prepared to fully describe the radioactive materials you wish to receive;
- For transfers, provide RSS with the pick-up and delivery locations;
- Provide RSS with your LABORATORY address for delivery to you (RSS WILL NOT deliver to office addresses or mailrooms);
- Provide vendors / shippers with the RSS address for all deliveries to UM, include the Authorized User's name and lab address in an attention line (e.g. ATTN: User / Lab Address);
- For transfers, ensure that someone will be present at both the pick-up and delivery locations to meet RSS personnel at the time the transfer is scheduled.

TIP: A chart outlining the procedures for acquiring radionuclides can be downloaded ["here"](#).

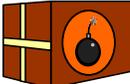
USING RADIOACTIVE MATERIALS

Your responsibility to apply safety and accountability protocols begins as soon as radioactive materials arrive in your laboratory.

**Package Opening
Procedures**

- Inspect Package for Signs of Damage
- Review Packing List for Proper Contents
- Open in a Designated Work Area

- Swipe Test or Survey Inner Packing Material
- Swipe Test Container Surfaces
- Deface Radioactive Labels on Carton
BEFORE discarding



RECEIPT: Begin by safely inspecting packages for integrity and contamination, then documenting receipts as part of your in-lab inventory.

PREPARATION: Wear protective clothing (labcoat, disposable gloves). Avoid wearing shorts, open-toed sandals or other items of clothing that leave areas of skin exposed. Use dosimeters when required by RSS.

Personnel Protection Devices

- Lab Coats
- Disposable Gloves
- Eye Protection

Wearing Whole-Body Dosimeters

- Wear on *UpperBody*
- Wear with Name Plate *Facing Source*
- Wear **ONLY** the Dosimeter Issued to **YOU**
- Don't Wear UM Dosimeter at Other Institutions
- Remove During Personal Medical Procedures

Remember that eating, drinking, applying cosmetics, etc. are prohibited in designated radioactive material work areas in a lab and when radioactive materials have been removed from storage and are being used.

Use Proper Equipment

Appropriate Shielding

Trays or Absorbent Pads

USE: When using materials, work in designated areas, use absorbent pads or spill trays, and use appropriate shielding when applicable. Use facility protection devices, such as fume hoods, as directed by RSS. Change gloves often and remove gloves before handling pens, books, door handles, or other items to be protected from contamination.

POST-PROCEDURE: Make sure all radioactive wastes generated during a procedure have been properly disposed. Make sure all radioactive materials used are secured when returned to storage. Wash hands.

Conduct *post-procedural checks* for contamination using an appropriate survey instrument or by using swipes analyzed with an LSC (swipes tests **are required** for H-3). You need not record the results of these checks. Clean items and areas found to be contaminated and document follow-up checks. If excessive contamination is found (> 20X background), contact RSS immediately. Use warning labels on items containing radioactive materials that are placed in storage.

RECORDS: Ensure all necessary records (e.g. usage and disposal logs) have been completed and are properly filed. Perform *routine* contamination surveys at the frequency specified by your authorization--usually monthly, but weekly for users with a per order limit of > 10 mCi. Routine contamination surveys differ from post-procedure checks in that they are performed only periodically. However, they are more comprehensive and must be conducted at all facilities listed in an authorized user's authorization. These include facilities shared with other users (e.g. cold rooms, etc). Document results of routine contamination checks. Decontaminate areas or items found to be contaminated and document the results of follow-up checks and surveys. Contact RSS if contamination is identified in excess of 20X background or has spread onto floors or non-radioactive work areas (e.g. desks, offices, etc).

[Download the RSS-105 Form \(Radioactive Contamination Survey Record\)](#)
[Download the Radionuclide Receipt, Utilization and Disposal Record Form](#)

DISPOSAL OF RADIOACTIVE MATERIALS

Radioactive wastes are collected by the [OSEH Hazardous Materials Section \(HazMat\)](#). OSEH HazMat has prepared a pamphlet which should be available in each lab using radioactive materials. The pamphlet entitled [Proper Segregation and Disposal of Low-Level Radioactive Wastes \(LLRW\) at the University of Michigan](#) provides a complete description of what each user needs to know when disposing of LLRW including how to handle old stock vials, lead-shielded containers and other special disposal concerns.

In general, LLRW is segregated into containers supplied to each user by OSEH HazMat. Segregation is by both physical/chemical form and by radionuclide. Some examples of segregated forms are shown in the table below--waste in the forms listed must be kept separate from each other and will require separate waste containers for each type.

Low-Level Radioactive Waste Segregation by Physical / Chemical Form	
Form	Approved Disposal Container
Solid wastes (paper, plastic, unbroken glass)	OSEH-supplied fiber drum
Liquid (Aqueous)	OSEH-supplied 4 liter plastic jug
Liquid (Chemical)	OSEH-supplied 4 liter plastic jug
Liquid Scintillation Vials	Keep in flats and store upright in original carton with absorbent liner (blue pads)
Contaminated Sharps	OSEH-supplied 5 gallon snap-lid pail or user-supplied sealed sharps container from a lab supply company

Low-level radioactive wastes are further segregated into 5 categories based upon radionuclide half-lives. Long-lived materials must be kept separate from short-lived materials. Radionuclides in one category cannot be combined with those of another category except as otherwise permitted in the [Proper Segregation and Disposal of Low-Level Radioactive Wastes pamphlet](#) (e.g. P-33).

Category	Commonly Used Radionuclides
A	H-3 and C-14
B	Ca-45, Co-57
C	S-35, P-33
D	I-125, P-33
E	P-32

Remember these General Guidelines when disposing of radioactive wastes:

1. **NEVER** discard materials or items known or suspected of being contaminated in ordinary trash.
2. **NEVER** discard radioactive liquids by disposal down a sink or other drain.
3. **ONLY** use OSEH-approved waste containers.
4. **Segregate** radioactive wastes by form and radionuclide.
5. **Minimize** the generation of mixed wastes (wastes that contain both radioactive materials and hazardous chemicals).
6. **DON'T** overfill containers.
7. **Prepare waste manifests** as described in the OSEH *Proper Segregation and Disposal of Low-Level Radioactive Wastes* pamphlet.
8. **Affix** waste container identification labels to containers prepared for OSEH collection.
9. **Perform a swipe test** on the outer surfaces of each waste container--clean the container surface if surface contamination exceeds 3X background--contact OSEH / RSS (4-4420) or OSEH / HazMat (3-4568) if you need assistance.
10. *Keep copies of the manifest and your container swipe test results (LSC printout) in your lab radioactive materials records binder for inspection by OSEH-RSS or the NRC.*

DOSE LIMITS AND "ALARA"

The Concept of "As Low As is Reasonably Achievable"

OCCUPATIONAL DOSE LIMITS

The Nuclear Regulatory Commission (NRC) has established Maximum Annual Occupational Radiation Dose Limits. These limits apply to exposure to radiation resulting from occupationally-related activities.



NRC MAXIMUM ANNUAL OCCUPATIONAL RADIATION DOSE LIMITS	
ADULT	
Whole Body ("TEDE")	5000 mrem / yr
Lens of the Eye	15,000 mrem / yr
Extremities	50,000 mrem / yr
Skin	50,000 mrem / yr
Individual Internal Organs ("TODE")	50,000 mrem / yr
OTHER EMPLOYEE LIMITS	
Embryo/Fetus of "Declared Pregnant Woman"	500 mrem over entire pregnancy
Minor (< 18 Yrs. of Age)	10% of Adult Limits

Whole Body:

The head, neck and trunk including those portions of both arms above the elbows and those portions of both legs above the knees but does not include skin or the lenses of the eyes.

TEDE: "Total Effective Dose Equivalent" referring to the combined dose to the whole body from exposure to external sources of radiation and to sources internally distributed within the body, if any.

Extremities: The portion of either arm extending from the hand to the elbow and the portion of either leg extending from the foot to the knee.

TODE: "Total Organ Dose Equivalent" referring to the dose to a specific internal organ from exposure to both external sources of radiation and from internal sources deposited within the organ, if any.

Declared Pregnant

Woman (DPW): a woman who has *voluntarily* informed her employer, *in writing*, of her pregnancy **and** of the *estimated date of conception*. Note that an individual may revoke their declaration of pregnancy (in writing to the employer) at any time. Contact RSS for more information.

AS LOW AS IS REASONABLY ACHIEVABLE (ALARA)

The dose limits established by the NRC represent annual maximum limits and doses at those levels present a small risk of potential adverse health effects. However, that small risk will be reduced further by making the effort to keep occupational doses to **as low as is reasonably achievable** ("ALARA"). Doses must not only be below the regulatory limits, but they must be kept as much below those limits as is reasonably achievable. *The NRC mandates that all persons working with licensed radioactive materials **must** use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles in order to achieve occupational doses (internal & external) that are ALARA.*

How Does U-M Apply Principles of ALARA?

The UM Radiation Policy Committee has adopted **ALARA Dose Level I and II** thresholds. Individuals at the UM who exceed these levels are contacted by Radiation Safety Service to advise them that some additional effort will be needed to reduce individual doses. RSS tracks ALARA thresholds for individuals issued dosimeters to monitor external doses or who obtain bioassays to monitor internal doses, if any.

With very few exceptions, the majority of researchers using radioactive materials at the UM have routinely been able to maintain personnel doses well within the ALARA thresholds established by the RPC.

In general, ALARA Level I and Level II thresholds approximate 10% and 30% of the NRC annual maximum dose limits, respectively. These thresholds are further divided into monthly or quarterly fractions depending on the type of dosimeter issued to users. There are a number of other variations to accommodate differing circumstances. Contact RSS for the Level I and Level II thresholds applicable to your circumstances.

ALARA Level I

If You Exceed ALARA Level I:

- RSS will send you and the Authorized User with whom you work, a written notice indicating that your reported measured dose for the calendar period has exceeded the ALARA Level I threshold.
- Review your practices, techniques and usage frequency.
- Apply the principles of *Time, Distance, Shielding and Contamination Control* to determine what changes are reasonable and can be adopted.
- Contact RSS for advice and assistance (764-4420).

ALARA Level II

If You Exceed ALARA Level II:

- RSS will send you and the Authorized User with whom you work, a written notice indicating that your reported measured dose for the calendar period has exceeded the ALARA Level II threshold.
- An RSS Health Physicist will contact you to conduct a review of the circumstances that were likely to have contributed to the dose. The Health Physicist will assist you in evaluating your practices and usage levels and will provide suggestions to reduce doses in the future.
- When special considerations are involved, the Health Physicist or the Radiation Safety Officer can consult with the Authorized User to improve process and engineering controls as necessary.

[Download the Acquiring Radioactive Materials Chart](#)

[Download the Annual Refresher Training Acknowledgment Form](#)