

OFFICE OF ENVIRONMENTAL HEALTH AND RADIATION SAFETY

(EHRS)

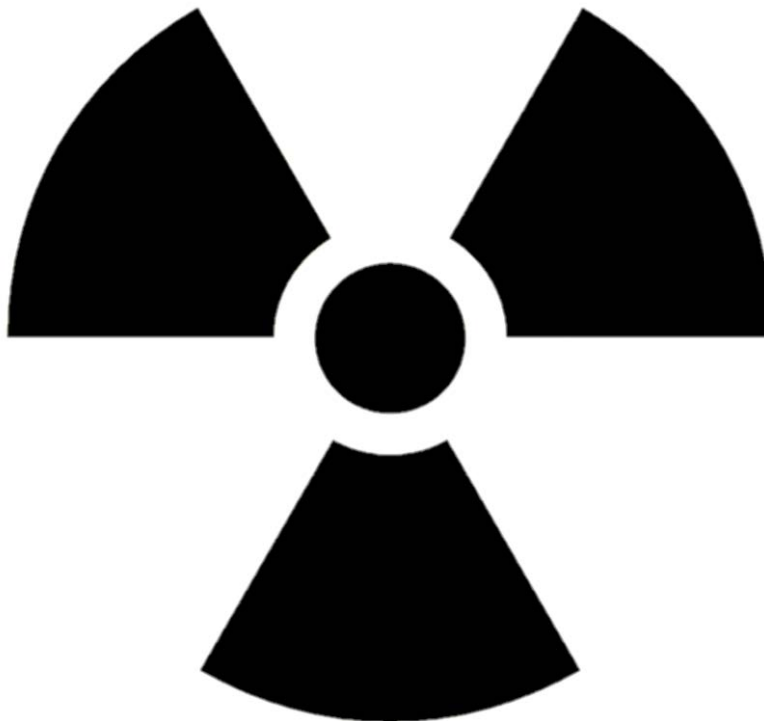
Office/On Call (215) 898-7187

www.ehrs.upenn.edu

3160 Chestnut Street, Suite 400, Philadelphia, PA 19104

RADIATION SAFETY USER'S GUIDE

RESEARCH LABS



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I. EHRS Notification

A. Emergency Notification

In case of emergencies involving only radioactive materials (RAM) call 215-898-7187

[Refer to the EHRS web page for comprehensive emergency related information.](#)

B. EHRS must be notified under the following conditions:

1. Deliberate misuse of radioactive materials. All inquiries will be kept in confidence. (Deliberate misuse of RAM will result in loss of use privileges and could result in criminal action.)
2. Radioactive contamination detected outside a licensed area.
3. Radioactive contamination that has been found to be widespread throughout the licensed area. (example: contamination found on a large portion of the floor)
4. Known or suspected personnel contamination of RAM on clothing or skin.
5. Known or suspected inhalation, injection, or ingestion of RAM.
6. Any accident resulting in direct exposure to personnel.
7. Known or suspected loss of radioactive material, including unintentional loss to the air or sewer.
8. Radioactive material shipping containers that are found to be contaminated or damaged upon receipt.

II. Spill Procedures

- A. Spills or contamination involving microcurie amounts and small volumes of liquid may be cleaned up by lab personnel. However, any time you are not sure how to proceed please contact us for assistance.
- B. If a spill occurs, perform the following steps:
 1. Notify others in the area.
 2. Prevent the spread of contamination.
 3. Until it can be cleaned, cover the spill with absorbent material and limit access to the area.
 4. Clean up the spill.

Use disposable gloves, lab coats, shoe covers and tongs (if appropriate). Proceed from the outermost edges of the contaminated area inwards, reducing systematically the area that is contaminated. Take care not to spread the contamination. Put all contaminated objects into RAM waste.
 5. Normal cleaning agents should be adequate. Keep cleaning supplies to the minimum needed to do the job. Place them into a plastic bag and into a clearly labeled waste RAM waste container.
 6. Survey
Following decontamination, monitor all personnel and the area for removable contamination with a wipe test. If the floor was contaminated, be sure to monitor the bottom of shoes. Continue decontamination until wipe test results are less than three times background. Document results in lab records.
 7. Report the spill to EHRS
If you need assistance, if there is personnel contamination, if the contamination is outside the licensed area, or if any other conditions listed in section B (above) occur.
 8. For skin or body contamination:
Notify EHRS. If possible, note the original survey meter reading, the location of the contaminated area, and the time the contamination was discovered. EHRS will use this information to calculate dose. Wash skin using mild soap and warm water. Do not abrade the skin. Measure and record the count rate. Survey and repeat until the count rate cannot be reduced any further.

III. Regulatory Oversight

- A. The State of Pennsylvania is an “agreement state”. This means that an agreement has been signed by the state with the Nuclear Regulatory Commission (NRC) to regulate certain uses of radioactive material within the state. Due to this agreement with the NRC, the Pennsylvania Department of Environmental Protection (DEP) is responsible for regulating the use of radioactive material and energized equipment (x-ray machines, x-ray diffraction units, electron microscopes, accelerators, x-ray irradiators) at The University of Pennsylvania (Penn).
- B. The DEP has granted The University of Pennsylvania (Penn) licenses authorizing use of radioactive materials and energized equipment at Penn, The Children's Hospital of Philadelphia (CHOP), The Wistar Institute, and The Monell Chemical Senses Center.
- C. Penn must follow the applicable DEP and NRC regulations as well as specific procedures stated in the licenses. Copies of regulations and the DEP licenses are available for review in the Office of Environmental Health and Radiation Safety (EHRS).

- D. The DEP issues a document called "[Notice to Employees](#)". This document includes information on employees' and employers' rights and responsibilities with regard to radioactive material. In general, this must be posted areas of use.

IV. Responsibilities

A. Radiation Safety Committee (RSC)

The RSC is a group of faculty members authorized by the DEP and appointed by the Vice Provost for Research to oversee the radiation safety program, authorize the use of RAM, and set radiation safety policies.

B. Office of Environmental Health and Radiation Safety (EHRS)

The Radiation Safety Officer (RSO)/Director of Radiation Safety oversees the day-to-day management and implementation of the Radiation Safety Program. The RSO and EHRS staff advise RAM users on radiation safety and regulatory compliance issues.

C. PI Licensees

All use of radioactive material must be done under the supervision of a Licensee who has been approved/licensed by the RSC. Each Licensee is responsible for the health and safety of persons using RAM under their license, assuring that workers are properly trained, and assuring that work is done in accordance with relevant policies and procedures. Licenses to use radioactive material are typically granted only to faculty members who are principal investigators (PI).

D. Individual Lab Workers

All users of radioactive material are responsible for planning and conducting operations in accordance with the lab License and the Radiation Safety User's Guide.

V. Licensing

A. License Approvals

To request License approval, submit an [application](#) for a new license to EHRS. A complete application includes the "Radioactive License Application" form and a "[Protocol Summary Form](#)" for each isotope and protocol.

The application will be reviewed by EHRS. Once all questions have been answered and the application complete, it will be submitted to the Radiation Safety Committee for approval.

B. License Amendments

Changes to existing licenses may be requested by filling out an "[RAM License Amendment Request Form](#)". A "[Protocol Summary Form](#)" is also required if the license change is due to addition of an isotope or an increase in activity being used.

C. License/Room Inactivation or Termination

- 1) Licensees that are leaving their institution (Penn, CHOP, Wistar, Monell) must inactivate/terminate their license.
- 2) Licensees that no longer plan to work with RAM or are not planning to work with RAM for extended periods of time should inactivate their license. This will eliminate the need to keep radiation safety records and complete training requirements. Reactivating can be accomplished simply by a phone call or e-mail to EHRS.

- 3) A Licensee who remains active must continue to complete all required radiation safety requirements including security of any stored material and completion of online EHRS training and licensee ALARA training.
- 4) EHRS must be notified in advance of the choice to inactivate or terminate a license by completing a "[RAM License Amendment Request Form](#)". A final monitoring survey must be conducted by EHRS of all areas that were authorized for RAM use under the license.
- 5) Prior to EHRS's final survey resulting from a license inactivation/termination, the licensee must:
 - i. Remove all RAM (including waste) from the lab and update inventory records. Each stock vial must have a final disposal date.
 - ii. Perform and document final monitoring. Decontaminate if necessary.
 - iii. Remove all radiation labels from within the lab. EHRS will remove the door sign after the final survey has been completed.
 - iv. Transfer your lab records to EHRS if the Licensee is leaving PENN.
- 6) Licensees planning to permanently discontinue RAM work or use of a licensed room must notify EHRS in advance to arrange a final survey of the area being vacated.
- 7) If an area is being vacated because of a relocation within the institution, refer to the [Checklist for Lab Moves](#) for additional instructions.

VI. Radiation Worker Training

A. New Employee Training

Before beginning work in the lab, individuals who use radioactive material must complete online EHRS "Research Radiation Initial Training (New Workers)" training and receive training from their licensee.

B. Annual Training

Each calendar year, all persons who work with RAM must complete online EHRS "Research Radiation Annual Refresher".

C. Annual In-lab training ("ALARA Training")

In addition to EHRS online training, each licensee must hold an in-lab training session to review their experimental protocols, work habits, and available safety equipment for adherence to the [ALARA policy](#).

Documentation of an ALARA training session is required annually. The topics covered, the date, and the names of attendees must be recorded and available in the lab's records. Standard forms for documenting ALARA training can be downloaded from the EHRS [website](#).

The topics for this training must include, but are not limited to, the following:

- 1) Work habits: how to plan procedures
- 2) External exposure (time, distance, and shielding) and contamination control: how to shield (if applicable) and handle RAM to minimize personnel exposure and radioactive contamination.
- 3) Monitoring: how to properly monitor for contamination and document results.
- 4) RAM accountability and control: how to properly order, use, account for and dispose of RAM.

VII. Workers Under Age 18

- A. No one under the age of 18 may work in areas where RAM is used or stored or where radiation is produced without prior registration and training.
- B. Workers under age 18 may handle only H-3, C-14, S-35, or P-33 in quantities of 100 microCuries or less.
- C. All work with RAM must be performed under the supervision and in the physical presence of a trained radiation worker.

VIII. Pregnant Workers

- A. A declared pregnancy is when an employee voluntarily informs the licensee (EHRS) in writing of their pregnancy and estimated date of conception. This typically occurs during a counseling session with an EHRS physicist.
- B. It is entirely the choice of the worker whether to declare a pregnancy. A worker may also choose to rescind their written pregnancy declaration at any time.
- C. If a pregnancy is declared, the PA State and NRC dose limit to the embryo/fetus is 500 mrem for the entire pregnancy (10% of the annual occupational dose limits for adults). If a worker chooses to not declare their pregnancy, the lower dose limit does not apply.
- D. If you are pregnant or have questions concerning working with or around radiation during pregnancy, please contact EHRS. All inquiries will be kept in confidence. We will take the following steps:
 - 1) Provide an opportunity to **declare** your pregnancy.
 - 2) Evaluate your dose history and exposure potential.
 - 3) Provide you with information concerning risk.
 - 4) Provide suggestions for reducing exposure.
 - 5) Monitor your radiation dose with respect to the regulatory limits.
- E. You may read the [Pregnant Worker Policy](#) for more information.

IX. Posting and Labeling

- A. Posting Requirements
 - 1) Each room that is approved for the use or storage of RAM must be posted with, "CAUTION RADIOACTIVE MATERIALS".
 - 2) Penn labs can request a room sign online by filling out a "Warning Sign & Label Request Form" from the EHRS [website](#).
 - i. CHOP & Wistar labs may contact their Safety department for sign changes
 - 3) Areas or rooms where RAM is used or stored or a central bulletin board within the lab building shall be posted with a "[PA DEP Notice to Employees](#)" sign.
- B. Labeling Requirements
 - 1) RAM Workstations
 - i. When possible, radiation use should be restricted to specific, labeled workstations within the lab that are labeled with "CAUTION RADIOACTIVE MATERIALS".

- ii. Surfaces and pieces of equipment located within a labeled work area should be considered contaminated until an appropriate survey of the area determines otherwise.
 - iii. Individuals working at a labeled workstation must wear personal protective equipment (lab coat and gloves).
- 2) Containers
- i. Individual containers of RAM must be labeled with "CAUTION RADIOACTIVE MATERIALS" unless they are being attended by an individual.
- 3) Equipment
- The following equipment must be labeled with "CAUTION RADIOACTIVE MATERIALS":
- i. "Hot" sinks
 - ii. Fume hoods, refrigerators, cabinets etc. used to store RAM
 - iii. Centrifuges, pipettes, water baths, etc., that are used for RAM work must be labeled if contaminated
- 4) Waste
- i. All radioactive waste containers must be labeled with "CAUTION RADIOACTIVE WASTE - do not empty" and a label indicating the isotope(s) contained.
 - ii. EHRS will provide labeled five-gallon waste containers. If you need a different waste container, EHRS will provide "CAUTION RADIOACTIVE WASTE - do not empty" labels for the container.
 - iii. Radioactive warning labels must be conspicuously affixed to any container used for radioactive specimens, waste, sharps containers, etc.

X. Ordering and Receiving RAM

A. Obtaining Approval

All radioactive material received in the lab must be approved by EHRS before the order is placed, including purchases from a radioactive material vendor, purchases from EHRS, gifts, transfers from another Licensee, and transfers from another institution.

- 1) Approval may be obtained through the "[RadSaf](#)" database. Instructions for obtaining an approval number can be found our [website](#).
- 2) Each stock vial, sealed source, standard, marker, etc. must have it's own unique approval number. For example, if you are ordering 2 x 0.250 mCi of P-32, you should make two entries and receive two approval numbers.

B. Placing the order

To order from a vendor – University of Pennsylvania Labs

- 1) Obtain an approval number from EHRS
- 2) All University orders must be purchased using the University's Purchasing System. Radioactive materials vendors have been instructed not to accept orders placed any other way.
- 3) Purchase orders that take advantage of the Penn Marketplace for ordering will be required to enter the approval number while they are completing the

requisition. Free form orders must include the approval number in the descriptions field of the order.

- 4) RAM purchases are not permitted via the PRO CARD.

To order from a vendor - CHOP Labs

- 1) Obtain an approval number from EHRS.
- 2) Record the approval number on the purchase requisition to be given to Research Administration/Purchasing.
- 3) Research Administration will not approve the order for RAM without an EHRS approval number recorded on the purchase requisition.

To order from a vendor - Wistar Labs

- 1) The Purchasing Department will receive EHRS approval for RAM purchases and then place the order to the vendor.
- 2) Purchasing will provide the approval number to the lab.

To transfer RAM between licensees at PENN

- 1) The lab receiving the material must obtain EHRS approval. Enter the name of the licensee supplying the material in the "vendor" field.
- 2) The lab sending the material should record the transfer date on their inventory log.
- 3) All transfers of RAM between licenses must be hand carried in secondary containment. No RAM can be transferred via motorized vehicle unless authorized by EHRS.

Transfers Outside Penn

- 1) Any transfer or shipment of RAM to another institution must be approved by EHRS before making the transfer.

C. Receiving RAM

- 1) Identifying Radioactive Packages
See the types of Radioactive Package Labels below.



- i. Packages containing quantities considered exempt by the Department of Transportation may not be labeled.
- 2) Procedures for receiving packages
 - i. Receive the package in a licensed lab by a trained radiation worker.
 - ii. Put on lab coat and gloves while handling and opening the package.
 - iii. Examine the package to ensure that it is not damaged or leaking.
 - iv. Notify the appropriate person that the package has arrived and place it in a secure location until it can be monitored and opened. Monitoring and opening should be performed right away!
 - v. If the package is labeled as shown above do the following:

1. Monitor the external surface of the shipping container (box) for removable contamination (wipe test) and document the results in your receipt log.
2. Perform the wipe within 3 hours of receipt. Wipe an area of 300 cm².
3. Notify EHRS immediately if wipe test is greater than 3 times background wipe results.

D. Opening RAM Packages

- 1) Put on lab coats and gloves before opening the outer package.
- 2) Open the inner package to verify the contents and check the integrity of the final source container (inspect for evidence of breakage, leakage, discoloration, etc.) Report any problems to EHRS.
- 3) Remove the radioactive material immediately and store it in your lock box.
- 4) Document the receipt in your lab inventory records.
- 5) Monitor the package and the packing material for contamination. If there is no contamination, obliterate all radiation labels and discard the packaging in regular trash.

XI. RAM Inventory

A. Each laboratory must maintain a strong inventory and accountability system. Your inventory should enable you to continually track incoming shipments of material and account for its use, transfer, and disposal. In addition, it should ensure that material is secured and accessible only to approved persons. Standard forms for documenting inventory can be downloaded from our [website](#).

B. Receipt Log

Receipt records must include at least the following:

- 1) Radionuclide
- 2) date of receipt
- 3) initial activity
- 4) amount of each withdrawal from the stock vial and disposal method
- 5) date of final stock vial disposal
- 6) package monitoring results
- 7) EHRS approval number

XII. Laboratory Security

- A. Access to radioactive material must be controlled so that unauthorized persons do not have access to the licensed material.
- B. Stored radioactive material must be secured (locked). Stock vials and sealed sources must be stored in locked containers. The containers must be kept locked at all times. Locked boxes must be secured to the refrigerator/freezer/cabinet. Lock boxes can be purchased from EHRS.
- C. Material that is not in storage must be controlled and maintained under constant surveillance.

XIII. General Radiation Safety Practices

- A. A current copy of the RADIATION SAFETY USERS' GUIDE must be available to all personnel within the laboratory. This can be accomplished by printing a copy from our web site, or by posting the website address in your lab records:
<https://ehrs.upenn.edu/radiation-safety>
- B. Follow practices to prevent personnel and facility contamination and spills.
- 1) Wear laboratory coats and appropriate laboratory clothing (no shorts or open-toed shoes) when handling RAM or working at a labeled RAM work area. Use safety glasses or other appropriate splash shields when handling RAM.
 - 2) Wear disposable gloves when handling RAM or working at a labeled work area.
 - 3) Do not eat, drink, smoke, store food, or mouth-pipette in areas where RAM is used or stored.
 - 4) Wash hands thoroughly and survey yourself and your work area after working with RAM.
 - 5) Carefully plan experiments with RAM and perform dry runs. Use distance, shielding (if required) and monitoring to keep doses ALARA.
 - 6) Store and transport RAM in appropriate containers, including secondary containment, to prevent spills and/or exposures.
 - 7) Use smooth work surfaces, protective bench coverings, proper equipment, and segregated work areas.
 - 8) Work with volatile radioactive material in a fume hood to reduce the possibility of inhalation of radioactive material. Iodination of proteins using I-125 is the most common procedure requiring use of a fume hood. When required by license conditions, use approved fume hoods or glove boxes to control possible airborne contamination. See section [XVIII](#) for more information regarding use of volatile RAM.
- C. Follow practices to prevent personnel exposure
- 1) Minimize Time
The total radiation exposure is proportional to the length of time of the exposure. Therefore, minimizing the time of exposure to radiation will keep the total radiation exposure low. Some of the methods of minimizing exposure time include planning experiments in advance, and performing dry runs with non-radioactive or tracer amounts of radioactive material.
 - 2) Maximize Distance
Radiation exposure levels decrease rapidly with increasing distance. This relationship is known as the inverse square law and states that the intensity of the radiation exposure decreases in proportion to the inverse of the distance squared.
$$E \sim 1/d^2$$

For example, an exposure rate of 1000 mR/hr at 1 cm from a radiation source would be 10 mR/hr at 10 cm. Therefore, any increase in distance from a source will reduce the total radiation exposure to an individual. For instance, using tongs or forceps to handle specific types of radioactive material.
 - 3) Use Shielding

Because most work with radioactive material in research involves relatively small activities, shielding is not necessary in most cases. If shielding is necessary, it will be stated in your RAM lab license conditions.

The type and thickness of material needed for shielding depends on the radioisotope and the activity of the radioisotope being used. For beta emitting radioisotopes, shielding made from materials with low atomic numbers, such as plexiglass, are used. For example, a minimum of 3/8" plexiglass is recommended when working with certain quantities of P-32.

- 4) If you have questions about shielding, call or e-mail EHRS.

XIV. Personnel Contamination Monitoring and Decontamination

A. Personnel Monitoring

- 1) Monitor yourself during and after each use of radioactive materials. If the isotope being used can be detected with a survey meter, keep one next to your work area so that you can easily check gloves for contamination while you work.
- 2) When finished work, after surveying and removing gloves, monitor your lab coat and areas not covered by it: hands/wrists, face, pants, and shoes.

B. Personnel Decontamination

- 1) If contamination is identified on a lab coat, remove the coat, place in a location to prevent spread of contamination, and notify EHRS. If clothing other than a lab coat is contaminated, contact EHRS. If the contamination is on a shoe, try to stay in one place to prevent spreading the contamination.
- 2) Skin decontamination: Initial decontamination should be prompt and thorough and should only involve the use of soap and tepid water, or just flushing with water. If possible, monitor the contaminated area before decontamination and document results.
 - i. Using tepid water, wet skin and apply soap.
 - ii. Rub gently. If necessary, use a soft brush to gently scrub the area, but do not abrade the skin. Activity can enter the body through skin that is not intact.
 - iii. After cleaning, dry the skin and resurvey until area is at background. Dispose of any materials used during decontamination (paper towels, brushes) in the radioactive waste. Contact EHRS.
 - iv. If initial cleaning was not successful, repeat. If after three cleanings contamination is still present, consult with EHRS before continuing.

XV. Laboratory Monitoring

A. When to monitor

- 1) Labs should be checked for contamination after each use of RAM.
- 2) Labs may choose to document surveys in two ways:
 - i. Document after each survey or
 - ii. Record at least one such survey to be documented WEEKLY.

- 3) Labs must choose a method for monitoring documentation and record it in their lab records. If you wish to change your method of monitoring you must contact EHRS.
- 4) Standard forms for documenting monitoring results can be downloaded from the EHRS [website](#).
- 5) If no RAM is used in a given week, an entry of "No RAM Use" must be recorded. During weeks when radioactivity is used in limited areas within a laboratory, the survey may be limited to the applicable areas and "No RAM Use" recorded for other areas.
 - i. This is not required if lab documents after each use of RAM.
- 6) If no RAM is to be used for extended periods of time, license inactivation is recommended.

B. What to monitor

- 1) Include areas of potential radioactive contamination such as bench tops, the floor, telephones, doorknobs, faucet handles, freezer/refrigerator handles, etc. during routine monitoring.
- 2) Monitor all facilities and equipment (liquid scintillation counters, centrifuges, pipettes, refrigerators, fume hoods, RAM sinks, etc.) used with RAM prior to being returned to non-controlled use and before performing any maintenance or repair work. Remove or deface "Caution Radioactive Material" labels from equipment if found to be free of contamination.

C. How to monitor

Survey meters may be used in areas where certain gamma emitters (eg. I-125) or certain beta emitters (eg. P-32, P-33, S-35) are used. Wipe tests must be used to check for contamination in labs using RAM that cannot be easily detected with a survey meter (eg. H-3, C-14, Cr-51).

- 1) Use of survey meters:
 - i. Prior to use, assure that the instrument is functioning properly by performing a battery test, checking the background reading, and assuring that it responds to radiation.
 - ii. Verify that the meter and probe are appropriately sensitive for the isotope being monitored. Use a low-energy gamma scintillation probe for I-125; a pancake probe for energetic beta emitters like P-32.
 - iii. To perform a survey, move the meter/probe slowly over the surface you are monitoring. Keep the face of the probe parallel to the surface, and as close as possible without contaminating the meter. All measurements will be read in units of cpm.
 - iv. Do not use a meter in high background areas. Instead, wipe tests will need to be performed.
- 2) Performing a wipe test
 - i. Put on gloves and lab coat.
 - ii. Drag the "wipe" over the surface to be tested applying moderate pressure and covering approximately 100 cm² (total area that the wipe actually touches the surface).

- iii. Count the wipes in a liquid scintillation counter. Include one "blank" sample to verify that the background reading on the counter is consistent.
- iv. Perform a constancy test before using the counter. Most counters come with a "standard source" that can be used for this test. The constancy reading should be consistent (typically within 10% of the average value for the source).

Liquid scintillation counters often contain internal sealed sources of RAM. Contact EHRS before disposing of or moving a counter to make arrangements for proper removal and disposal of the internal radiation source. Do not attempt to remove the source yourself.

D. Records must include

- 1) a map of the lab or a description of where each measurement is taken
- 2) the date of the survey
- 3) the initials/name of the person performing the survey
- 4) the survey instrument used
- 5) the background reading in cpm
- 6) the survey results for each area in cpm (for wipe tests, this can be a copy of the liquid scintillation counter print-out)
- 7) Forms for recording survey results can be downloaded from our [website](#).

E. Positive Monitoring Results

- 1) Contamination exceeding three times background must be corrected.
- 2) Following decontamination, perform a resurvey. Record resurvey results in lab records.
- 3) For widespread contamination, personnel contamination, or if assistance is needed, contact EHRS immediately.

XVI. ALARA Policy

- A. The acronym ALARA, "As Low As Reasonably Achievable", means that persons using sources of ionizing radiation should make every reasonable effort to keep radiation exposures to individuals and releases of RAM to unrestricted areas as far below the regulatory limits as is practicable. As a general rule, exposures and releases should be kept below 10% of the regulatory limits.
- B. Personnel shall review their work habits and available safety equipment for adherence to the ALARA principle.
- C. EHRS will notify individuals when personnel exposures exceed ALARA levels. These exposures will be investigated and reviewed by the Radiation Safety Committee.

XVII. Personnel Dose Monitoring

A. External Dosimetry

- 1) Personnel dosimeters are devices worn to measure external radiation doses. Federal and State regulations require the use of monitoring devices for workers who are likely to receive 10% of the regulatory dose limit. Most research lab workers receive minimal exposures and dosimeters are not required.

- 2) Dosimeters (whole body and extremity) are required for individuals who at any time handle RAM with activities exceeding the following limits:

Isotopes	Activity
I-125, Cr-51, Tl-201	5.0 mCi
P-32, Y-90, Rb-86, Ce-141, Sn-113	1.0 mCi
I-131, I-123, Tc-99m, Co-57, Se-75	0.5 mCi
F-18, C-11, I-124, Zn-65, In-111, Fe-59, Co-60, Na-22, Nb-95, Sc-46, Sr-85, Cs-137, C-11, N-13	0.25 mCi
other beta-emitters exceeding 250 keV, or other gamma or x-ray emitters	consult EHRS

- 3) In research labs, dosimeters are generally issued quarterly. They are changed on the first of January, April, July, and October. EHRS delivers new dosimeters to each lab a few days in advance of the change date and collects used dosimeters about a week later. To properly assess each persons' occupational exposure, it is very important that dosimeters are changed in a timely manner. If your dosimeter is consistently not returned in time, it may be discontinued.
- 4) Dosimeters can be requested online by completing a “[Dosimeter/Badge Request Form](#)”.
- 5) Whole body dosimeters should be worn between the waist and shoulders, with the name plate facing away from the body, when working with RAM or when handling subjects being x-rayed. Rings should be worn under gloves. When not in use, dosimeters must be stored in a low background area such as an office.
- 6) All personnel monitoring results are maintained in EHRS and are available at your request. Additionally, individuals can access their personal dose history online via instructions posted [here](#).

B. Internal Dosimetry

- 1) When using radioactive material, accidental intakes may occur. This can happen as a result of a spill or loose surface contamination, or as a result of using volatile radioactive materials. Routine bioassays are not required for most radiolabelers. Although unlikely, bioassay may also be requested by EHRS in response to a spill, personnel contamination, or suspected intake.

XVIII. Radiolabeling

- A. Radiolabeling may be performed only if approved as a special condition on your license.

- B. Radiolabeling may be performed only in fume hoods that have been approved by EHRS.
- C. Each radiolabeler must:
 - 1) Have previous radiolabeling experience or receive training from an experienced radiolabeler. Training must include observation of at least three radiolabeling procedures performed by an approved radiolabeler.
 - 2) Perform the first radiolabeling under the supervision of EHRS for approval.
- D. A “radiolabeling log” must be posted on each approved fume hood. This is available on the EHRS [website](#).
- E. Following each radiolabeling, monitor yourself, the fume hood, and the immediately surrounding area for contamination. Decontaminate if necessary. (If you are using a shared hood, it is recommended that monitoring also be performed prior to using the hood.)

XIX. Radiation Safety Inspections

- A. EHRS will perform unannounced inspections quarterly. Typically, one individual in the lab will have responsibility for maintaining radiation safety records and assuring compliance. However, all individuals working in the lab should be aware of the location of records and should be able to answer questions asked by inspectors.
- B. Laboratories will be inspected for compliance with the requirements specified in this guide and the conditions specified in the individual license.
- C. A point system has been established by the Radiation Safety Committee as a way to report the results of lab surveys. Each deficiency is noted along with an associated point value. Repeat infractions are assigned double point values. Licensees accruing 35 points or more in a single survey will be required to respond in writing detailing the following:
 - 1) Mitigating circumstances
 - 2) Corrective actions taken
 - 3) The date of compliance
 - 4) Survey results will be reported to the Radiation Safety Committee quarterly.

XX. Use of RAM in Animals

- A. Protocol Approval
 - 1) Protocols involving animals and the use of radioactive materials, irradiators, or x-rays machines are reviewed and approved by EHRS and the Institutional Animal Care and Use Committee (IACUC).
 - 2) If necessary, amend your License to include the isotopes and rooms where the animal work is performed. Include the ULAR facility if the animal will contain radioactive material while being housed there. Include any imaging locations such as Nuclear Medicine, MRI, etc.
 - 3) Submit an IACUC protocol review form to IACUC. For amendments to an existing protocol, you must also submit a Potentially Hazardous Substances Form. All forms can be found on Penn's Office of Regulatory Affairs [website](#).
- B. Use of Animals in your Lab

- 1) Follow procedures for use of RAM as listed in this Guide, the Irradiator User's Guide, the X-ray Diffraction User's Guide, or the Cabinet X-ray User's Guide and any procedures specified in your RAM License.
- 2) Dispose of sacrificed animals and animal bedding as radioactive waste, unless instructed otherwise by EHRS.

C. Using Radioactive Material in ULAR

- 1) Animal care is the responsibility of the licensee while the animals are radioactive.
- 2) Complete a Radioactive Animal Label and attach it to the cage. Post the cage and/or room with "CAUTION RADIOACTIVE MATERIALS". Place a suitable container in the room to hold any waste generated during the procedure. Label the container with "CAUTION RADIOACTIVE MATERIALS".
- 3) Monitor the cages, equipment, and rooms for removable contamination with a suitably sensitive survey method before the room is released for unrestricted use, and weekly during the time that the animals contain radioactivity. Document the results in your lab records.
- 4) Perform decontamination if monitoring results exceed three times background. Contact EHRS if you need assistance.
- 5) Remove radioactive waste and transfer to EHRS via normal waste disposal procedures.

D. Transporting Animals containing Radioactivity

- 1) Transfer animals in a manner to prevent release of radioactive material to unrestricted areas. Depending on the animal, it may be necessary to catheterize, anesthetize, use enclosed containers, etc.
- 2) Label and shield (if necessary) the container.
- 3) Transport of animals containing radioactive material in a motorized vehicle on public roads is not authorized without approval from EHRS.

XXI. Radioactive Waste Disposal

A. Waste Collection

- 1) EHRS collects radioactive waste from all laboratories in the University of Pennsylvania, the Hospital of the University of Pennsylvania, the Children's Hospital of Philadelphia, the Wistar Institute, and from affiliates in the Science Center. EHRS designates one day each month for performing requested waste collections for each building.
- 2) To request a waste pick-up, a "Radioactive Waste Pickup Request" must be submitted through the "[RadSaf](#)" database. Instructions for Waste Pick up Requests can be found on the EHRS [website](#).
- 3) In order to be collected, radioactive waste must be packaged and tagged as described in this Guide below. This is necessary in order for the University and your laboratory to be in compliance with various federal, state, and local regulations.

B. Requirements for All Waste Types

- 1) Obliterate all radioactive material symbols and markings before putting the waste into the container. The radioactive material symbol is the familiar “propeller” design:



- 2) Radioactive material markings are the words “Caution Radioactive Material,” “Danger Radioactive Material,” “Radioactive I,” “Radioactive II,” and similar phrases (as specified in regulations). These must also be obliterated before the waste is collected.
- 3) Do not put any red or orange bags in the radioactive waste. Since biohazardous material is not permitted in the radioactive waste and red is associated with biohazardous material, the presence of red bags makes disposal of the waste difficult.
- 4) Obliterate any biohazard symbols and markings (“Biohazard: Caution,” “Biohazard: Sharps,” and the like) on any material in the waste and from the outside of the waste containers.



- 5) When practical, minimize the amount of radioactive waste generated by surveying items before putting them into the waste. If a survey in a low-background area shows no reading distinguishable from background, dispose of the material as non-radioactive waste. If readings exceed background, dispose of the material as radioactive waste.
- 6) Segregate all waste by isotope when possible. If a procedure involves multiple isotopes, put the waste in containers for the isotope with the longest half-life.
- 7) Label the outside of all RAM waste buckets with stickers indicating "Caution Radioactive Waste do not empty" and with the isotope contained (one isotope per container). EHRS will provide waste buckets, labels, and heavy plastic bags to line the containers. If the containers supplied do not meet your needs, contact EHRS for guidance. For information on how to obtain supplies, refer to the “Radioactive Waste Supplies” on the EHRS [website](#).
- 8) When waste buckets are no longer needed, survey them and, if found to be free of contamination, obliterate all radiation symbols/markings and dispose in the ordinary trash. Do not allow empty waste containers to accumulate in the lab.
- 9) Shield all RAM waste containers properly, if required by EHRS.
- 10) Do not allow waste to accumulate in the lab or to overflow a container.
- 11) Complete a “Radioactive Waste Pickup Request” for each container (either a plastic bag, non-biohazard sharps container, or a plastic liquid container) of waste you wish to dispose. Each request generates a “RAM waste tag” with the regulatory information for the container of waste along with a tracking

number to uniquely identify the container. This must be taped to the outside of the container.

C. Dry Waste

Dry waste is any material that has been contaminated with radioactive material, usually gloves, paper towels, plasticware, glassware, etc. In addition to the requirements for all waste types above, requirements for dry waste are as follows.

- 1) Place dry waste in a clear plastic bag provided by EHRS. Securely close the bags and tape a properly completed "RAM waste tag" to each bag (a single tag cannot be used for multiple bags).
- 2) Do not put used scintillation vials in the dry waste.
- 3) Do not put lead, organic solvents, or other material regulated under RCRA in the dry waste.
- 4) If you want to know if a specific material can be put in the dry waste, contact EHRS.
- 5) Pipettes, glass plates and other similar items must be placed in an appropriate rigid container of sufficient strength that the material will not puncture it. Sealed rigid containers can then be placed in a dry waste bag. Needles and syringes (with or without the needle attached) will be accepted only in a commercial sharps container (see requirements for all waste types) with biohazard symbols and markings obliterated.
- 6) Do not put vials that still contain stock material in the dry waste unless EHRS personnel are in your laboratory to take the waste. Note that empty stock vials may be put into the dry waste at any time.
- 7) Containers with small quantities of liquid (i.e., less than 10 ml) should be put in the dry waste along with a sufficient amount of absorbent material to absorb twice the volume of the liquid.
- 8) Do not put any infectious material or biohazard labels or bags in the dry waste. Disposal of these items is discussed below.

D. Unused Material in Stock Vials

- 1) Stock vials containing unused material should be kept in a lock box or otherwise secured until EHRS personnel are in your laboratory to take the waste. If a request for waste pick-up includes stock vials, EHRS personnel will contact someone in the lab. At that time, place the vial with unused material in clear plastic bag provided by EHRS. Securely close the bags and attach a properly "RAM waste tag" to each bag (a single memo cannot be used for multiple bags).

E. Animal Carcasses and Biological Material

- 1) In addition to the requirements for all waste types above, animal carcasses, infectious waste, and biohazardous waste containing radioactive material must meet the following requirements.
 - i. Waste containing biohazardous, pathogenic, or infectious material must be treated to reduce any potential non-radiological hazard from the material. After treatment, all "biohazard" and "regulated medical waste" symbols and markings must be obliterated.

- ii. Place frozen carcass and biological waste in clear plastic bag provided by EHRS. Securely close the bags and attach a properly completed "RAM waste tag" (a single memo cannot be used for multiple bags). Keep the material frozen until pickup.
- iii. Segregate the material by isotope when possible. Animal carcasses containing no more than 0.05 $\mu\text{Ci/gm}$ of H-3 or C-14 can be placed in separate bags from other carcasses. These carcasses are not regulated as radioactive. EHRS must be contacted for approval before disposal of these carcasses as non-radioactive waste.

F. Liquids scintillation fluid in vials

- 1) All liquid scintillation vials and fluid must be transferred to EHRS for commercial disposal. The "biodegradable" scintillation fluids are not listed as "soluble" in water and therefore are not suitable for drain disposal. Contact EHRS prior to purchasing scintillation fluid to determine if it is chemically hazardous or non-hazardous. It is strongly recommended to purchase a chemically non-hazardous scintillation fluid unless research requires a hazardous type. In addition to the requirements for all waste types above, scintillation vials containing radioactive material must meet the following requirements.
 - i. Tightly cap each vial.
 - ii. Segregate vials by isotope when possible. Vials containing only tritium and carbon-14 can be intermingled.
 - iii. When ready to dispose, place the vials into clear plastic bags, closed at the neck. Attach (tape) a completed RAM waste tag to each plastic bag of vials (a single tag cannot be used for multiple bags). The "Radioactive Waste Pickup Request" and RAM waste tag must provide the type of scintillation fluid in the vials so that EHRS can determine the applicable regulations for disposal of the vials.

G. Sewer Disposal

- 1) Solubility
 - i. Only material that is readily soluble in water (or readily dispersible biological material) may be disposed of into the sanitary sewer. Before disposal, you should know the chemical form and the solubility of the material to be disposed. The solubility class of a compound can be determined from common literature (e.g., Handbook of Chemistry and Physics, Handbook of Chemistry, or safety data sheets.) If a compound is classified as "vs" (very soluble) or "s" (soluble), this would indicate the compound is "readily soluble". Certain compounds are classified as class "d" (decompose). If the decomposed species of these compounds are classified as either "vs" or "s", this would indicate that the parent compound is "readily soluble".
 - ii. Note that "biodegradable" scintillation fluids are not "soluble" in water and therefore are not suitable for drain disposal.
- 2) Limits and Records
 - i. Each licensee's daily sink disposal is limited these amounts:

- a. 200 uCi/day of H-3
 - b. 200 uCi/day of C-14
 - c. 50 uCi/day of all other isotopes combined
- ii. Laboratories that dispose of material to the sink no more than once per week may dispose of up to five times these amounts at one time with permission from EHRS.
 - iii. Liquids disposed to the sink must not contain chemicals regulated as hazardous, carcinogens, or mutagens.
 - iv. Maintain records of all sink disposal, including the radionuclide, activity, and date of disposal. A log for this information should be posted in the vicinity of the sink used for disposal or in the lab radiation safety records.

H. Bulk Liquid

- 1) Put bulk liquids into a new quart or gallon container that is compatible with the liquid. Laboratories are responsible for ensuring the compatibility of the liquid and the container.
- 2) Place a completed chemical waste tag on each container when waste is first added to the container. For information on completing chemical waste tags, contact the EHRS Chemical Waste Disposal Program. University of Pennsylvania labs can call EHRS to have chemical waste tags sent via campus mail.
- 3) The plastic containers should be filled no more than 90% full (to allow for expansion of the liquid) and capped with a tight-fitting cap.
- 4) Segregate all liquids by chemical and radionuclide.
- 5) Attach the completed RAM waste tag to the container of liquid waste (a single RAM waste tag cannot be used for multiple containers).

I. Sealed Sources

- 1) Sealed sources are devices containing radioactive material which are engineered to prevent the material from escaping the device. The most common example found in research laboratories are calibration standards for scintillation counters and gamma counters. To dispose of these sources, simply complete a "Radioactive Waste Pick-up Request" with the relevant information, note the manufacturer, model number, and the serial number of the source, if any, in the "Comments" section, place the source or sources in a plastic bag or other container, and securely attach the RAM waste tag to the outside of the container. EHRS personnel will collect the sources during routine waste collection.