Research Lab Radiation Safety User's Guide

I. EHRS Notification

A. Emergency Notification

In case of emergencies involving only radioactive materials (RAM):

Mon - Fri, 8 a.m. to 5 p.m.: 215-898-7187

After hours emergency pager 215-573-6626

If your page is not answered:

from University locations, call 215-746-6620,
From a HUP or CHOP, dial the hospital operator

All Fire, Police and Medical Emergencies:

511 from PENN campus building only

215-573-3333 off campus and HUP

Ambulatory patients requiring treatment should go to Occupational Medicine.
After hours, report to HUP Emergency Department.

B. EHRS must be notified under the following conditions:

1. Radioactive contamination outside a licensed area.
2. 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.)
3. Known or suspected personnel contamination, inhalation, injection, or ingestion of RAM.
4. Any accident resulting in direct exposure to personnel.
5. Known or suspected loss of radioactive material, including loss to the air or sewer.
6. Contaminated or damaged radioactive material shipments.

II. Spill Procedures

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.

1. **Notify others in the area.**

2. **Prevent the spread of contamination**.

   Until it can be cleaned, cover the spill with absorbent material and limit access to the area.

3. **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.

   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.

4. **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.

5. **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 is section B (above) occur.

6. **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

1. The Pennsylvania Department of Environmental Protection (DEP) is responsible for regulating the use of most radioactive materials and energized equipment (x-ray machines, x-ray diffraction units, electron microscopes, accelerators, x-ray irradiators). The US Nuclear Regulatory Commission (NRC) is responsible for regulating the use of irradiators containing radioactive materials.

2. The DEP and NRC have granted Penn licenses authorizing use of radioactive materials and energized equipment at Penn, as well as The Children's Hospital of Philadelphia, The Wistar Institute, and The Monell Chemical Senses Center.

3. PENN must follow the applicable NRC and DEP regulations as well as specific procedures stated in both licenses. Copies of regulations and the NRC and DEP licenses are available for review in the Office of Environmental Health and Radiation Safety (EHRS).

4. Both the DEP and NRC issue a document called "Notice to Employees" (NRC "Notice to Employees", DEP "Notice to Employees"). These documents are similar to each other and include information on employees' and employers' rights and responsibilities. In general they 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 NRC, 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. **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 his/her 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.

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 Application for Authorization to Use Radioactive Materials and a Protocol Summary Form for each isotope and protocol.

B. **License Amendments**

Changes to existing licenses may be requested by filling out an Application for Amendment to Use Radioactive Materials. 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 Inactivation**

1. Licensees 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. Reactivating can be accomplished simply by a phone call or e-mail to EHRS.

2. A Licensee who remains active must continue to complete all required radiation safety requirements including security of any stored material and completion of EHRS and licensee ALARA training.

D. **License or Room Termination**

1. 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.

2. Prior to EHRS termination, the licensee must:

a) Remove all RAM (including waste) from the lab and update inventory records. Each stock vial must have a final disposal date.

b) Perform and document final monitoring. Decontaminate if necessary.

c) Remove all radiation labels from within the lab. EHRS will remove the door sign after the final survey has been completed.

d) Transfer your lab records to EHRS if the Licensee is leaving PENN.

3. If an area is being vacated because the lab is relocating within PENN, 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 or frequent areas where radioactive material is used or stored must attend EHRS training and receive training from their licensee. New Worker Radiation Safety Training is available through the EHRS web site.

B. Annual Training held by EHRS

Each calendar year, all persons who work in or frequent labs where RAM is used or stored must complete Annual Radiation Safety Training on the EHRS website.

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

In addition to EHRS 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 our 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 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.

D. ***Training for irradiator users***

Each individual must receive training by the irradiator licensee and by EHRS before using an irradiator. Irradiator Training is available through this web site.

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. Students 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. The NRC dose limit to the fetus of a declared pregnant women is 500 mrem (10% of the occupational dose limits for adults).

B. If you are pregnant or believe you may be pregnant, 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 NRC limits.

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". Room signs are provided by EHRS.**

2. **Areas or rooms where RAM is used or stored or a central bulletin board within the lab building shall be posted with an "** NRC Form 3 "Notice to Employees."

B. Labeling Requirements

1. **RAM Work Stations**

a) When possible, RAM use should be restricted to specific, labeled RAM work stations within the lab that are labeled with "CAUTION RADIOACTIVE MATERIALS".

b) Surfaces and pieces of equipment located within a labeled work area should be considered contaminated until an appropriate survey of the area determines otherwise.

c) Individuals working at a labeled work station must wear protective clothing (lab coat and gloves).

2. **Containers**

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"

1. "Hot sinks"

2. Fume hoods, refrigerators, cabinets etc. used to store RAM

3. Centrifuges, pipettes, water baths, etc., that are used for RAM work must be labeled if contaminated

4. Waste

All radioactive waste containers must be labeled with "CAUTION RADIOACTIVE WASTE do not empty" and a label indicating the isotope contained. 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. 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 RAM Order Approval section of our web site or by calling our office (8-7187) between 9:00 am and 3:30 pm.

2. A radiation safety approval number will be issued if the order is approved.

3. 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

Whenever possible, order your radioactive material from EHRS.

1. To order from EHRS:

a) EHRS supplies certain P-32, P-33, and S-35 compounds at reduced cost and increased convenience to researchers. We do not restrict you to the activities that the vendors provide, i.e. you can order as little as 50 microCuries.

b) To order from EHRS, log on to the Purchase P-32 from EHRS section of our web site and complete the requested information, or place your order by phone. The material will be available that same day.

c) For additional information about the compounds available, hours of operation, and prices refer to the Guidelines for Purchasing RAM from EHRS.

2. To order from a vendor - University Labs

Obtain an approval number from EHRS.

1. 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.

2. 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.

3. RAM purchases are not permitted via the PRO CARD.

3. To order from a vendor - CHP/Abramson Labs

Obtain an approval number from EHRS.

1. Record the approval number on the purchase requisition to be given to Research Administration/Purchasing.

2. Research Administration will not approve the order for RAM without an EHRS approval number recorded on the purchase requisition.

4. To order from a vendor - Wistar Labs

The Purchasing Department will receive EHRS approval for RAM purchases and then place the order to the vendor.

Purchasing will provide the approval number to the lab.

5. To transfer RAM between licensees at PENN

The lab receiving the material must obtain EHRS approval. Enter the name of the licensee supplying the material in the"vendor" field.

The lab sending the material should record the transfer date on their inventory log.

C. Receiving RAM

How are radioactive material packages identified?

Radioactive Packages IDs

Packages containing quantities considered exempt by the Department of Transportation may not be labeled.

What are the procedures for receiving packages?

1. Receive the package in a licensed lab by a trained radiation worker.

2. Put on lab coat and gloves while handling and opening the package.

3. Examine the package to ensure that it is not damaged or leaking.

4. 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!

5. If the package is labeled as shown above do the following:

a) Monitor the external surface of the shipping container (box) for removable contamination (wipe test) and document the results in your receipt log. [Graphic of box being wiped]

b) Perform the wipe within 3 hours of receipt. Wipe an area of 300 cm2.

c) Notify EHRS immediately if wipe test results exceed background.

6. Put on lab coats and gloves before opening the outer package.

7. 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.

8. Remove the radioactive material immediately and store it in your lock box.

9. Document the receipt in your lab inventory records.

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, loss of liquid, discoloration of packaging, etc.). Report any problems to EHRS.

3. 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

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.

A. 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
5. date of final stock vial disposal
6. package monitoring results
7. EHRS approval number

XII. Laboratory Security

1. Access to radioactive material must be controlled so that unauthorized persons do not have access to the licensed material.

2. 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.

3. Material that is not in storage must be controlled and maintained under constant surveillance.

XIII. Transfers Outside Penn

Any transfer or shipment of RAM to another institution must be approved by EHRS before making the transfer. Contact us in advance for assistance with special packaging, shipment papers, and monitoring requirements.

XIV. 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 web site address in your lab records

B. Follow practices to prevent personnel and facility contamination and spills.

1. Wear laboratory coats and appropriate laboratory clothing (no shorts or sandals) 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. Use careful experimental planning, dry runs, shielding, distance and monitoring .

6. Use, store, and transport RAM in appropriate containers to contain a spill and/or prevent exposure.

7. Use smooth work surfaces, protective bench coverings, contamination monitoring, 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.

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, and 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 (using tongs or forceps to handle specific types of radioactive material) will reduce the total radiation exposure to an individual.

3. Use Shielding

Because most work with radioactive material involves relatively small activities, shielding is not necessary in most cases. If shielding is necessary, it will be stated in your lab license. If you have questions about shielding, call or e-mail EHRS.

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 P-32.

XV. Personnel Monitoring and Decontamination

A. Personnel monitoring

Monitor yourself during and after each use of radioactive materials. If the isotope being used can be detected with a survey meter, keep one on next to your work area so that you can easily check gloves for contamination while you work.

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 Contamination

1. If contamination is identified on a lab coat, remove the coat, place in a location to prevent contamination spread, 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. Personnel Decontamination: Initial decontamination should be prompt and thorough and should involve only soap and tepid water, or just flushing with water. If possible, monitor the contaminated area before decontamination and document results.

    a) Using tepid water, wet skin and apply soap.

    b) 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.

    c) After cleaning, dry the skin and resurvey. Survey paper towels and dispose of in radioactive waste if contaminated.

    d) If initial cleaning was not successful, repeat. If two or three cleanings have not completely removed activity, consult with EHRS before continuing.

XVI. Laboratory Monitoring

A. When to monitor

Labs should be checked for contamination after each use of RAM. At least one such survey must be recorded WEEKLY. Standard forms for documenting monitoring results can be downloaded from our website.

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. 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.

C. How to monitor

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

1. Use of survey meters:

a) Prior to use, assure that the instrument is functioning by performing a battery test, checking the background reading, and assuring that it responds to radiation.

b) 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.

c) 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.

d) Do not use a meter in high background areas.

2. Performing a wipe test

a) Put on gloves and lab coat.

b) Drag the "wipe" over the surface to be tested applying moderate pressure and covering approximately 100 cm2.

c) Count the wipes in a liquid scintillation counter. Include one "blank" sample to verify that the background reading on the counter is consistent.

d) 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).

Scintillation counters often contain internal sealed sources. 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

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.

Forms for recording survey results can be downloaded from our web site.

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 or personnel contamination, contact EHRS immediately.

XVII. 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.

XVIII. 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 monitoring is 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 on line by completing the Badge Request Form on our website.

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. In addition, personnel monitoring results are routinely distributed to the licensee and should be posted in the lab area.

B. Internal Dosimetry

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 thyroid bioassays are required for iodinators, and

urine bioassay for users of larger quantities of H-3. Although unlikely, bioassay may also be requested by EHRS in response to a spill or personnel contamination.

XIX. Iodination

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

B. Iodinations may be performed only in fume hoods that have been approved by EHRS.

C. Each iodinator must:

1. Have previous iodination experience or receive training from an experienced iodinator. Training must include observation of at least three iodination's performed by an approved iodinator.

2. Register with EHRS prior to iodinating.

3. Receive a baseline thyroid bioassay at EHRS prior to iodinating or beginning training.

4. Perform the first iodination under the supervision of EHRS.

5. Receive a follow up thyroid bioassay at EHRS within 72 hours following the first iodination.

D. An iodination log must be posted on each approved fume hood.

E. Following each iodination, 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.)

F. Each iodinator must receive monthly thyroid bioassays when actively iodinating. These bioassays will be performed by EHRS.

XX. 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 RSC as a way to report the results of 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

D. Survey results will be reported to the Radiation Safety Committee quarterly.

XXI. 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 the Radiation Safety Committee 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 X-ray User's Guide, and specified in your University License.

2. Dispose of sacrificed animals and animal bedding as radioactive waste, as appropriate.

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.

XXII. 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. For all laboratories except for those at the New Bolton Center, EHRS designates one day each month for performing requested waste collections for each building. Waste at the New Bolton Center is collected quarterly, during the EHRS laboratory audit.

2. EHRS also offers centralized waste collection each week during which properly packaged and tagged containers of radioactive waste can be delivered to EHRS.

3. In order to be collected, radioactive waste must be packaged and tagged as described in this Guide. This is necessary in order for the University and your laboratory to be in compliance with various federal, state, and local regulations.

4. Schedules for waste pick-ups and centralized waste collections are available from the EHRS Waste Disposal Calendar.

B. Requirements for All Waste Types

1. Obliterate all radioactive material labels and markings before putting the waste into the container. The radioactive material symbol is the familiar "propeller" design.

Radioactive material markings are the words "Caution Radioactive Material," "Danger Radioactive Material," 'Radioactive I," "Radioactive II," and similar phrases (as specified in regulations). At times, people affix radioactive material labels to the outside of waste containers. These must also be obliterated before the waste is collected.

2. Do not put any red or orange bags, or red or orange sharps containers 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. Note that sharps containers that are not red can be purchased from many laboratory supply companies (e.g., Fisher Scientific).

3. 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.

4. 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.

5. Segregate all waste by isotope. If a procedure involves multiple isotopes, put the waste in containers for the isotope with the longest half-life.

6. Label the outside of all RAM waste containers 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 EHRS supplies do not meet your needs, you may purchase any appropriate container and plastic liners, and EHRS will supply labels to affix to the containers. For information on how to obtaining supplies, refer to the EHRS RAM Waste Packaging.

7. When waste buckets are no longer needed, survey them and, if found to not be contaminated, obliterate all markings and dispose in the ordinary trash. Do not allow empty waste containers to accumulate in the lab.

8. Shield all RAM waste containers properly, if required.

9. Do not allow waste to accumulate in the lab or to overflow its container.

10. Complete a Radioactive Waste Pick-up Request for each container (either a plastic bag, non-biohazard sharps container, or a plastic liquids container) of waste you wish to dispose. Each request generates a Waste Tag with the regulatory information for the container of waste along with a tracking number to uniquely identify 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 of polyethylene at least 4 mils (0.1 mm) thick or of other material of similar strength. Securely close the bags and attach (staple) a properly completed waste transfer memo to each bag (a single memo cannot be used for multiple bags).

2. Do not put used scintillation vials in the dry waste.

3. Do not put lead, organic solvents (i.e. scintillation vials), or other material regulated under RCRA in the dry waste. Lead should be transferred to EHRS separately.

4. If you want to know if a specific material can be put in the dry waste contact EHRS.

5. Sharps and glass plates in the waste must be placed in an appropriate rigid container of sufficient strength that the material will not puncture it. Needles and syringes (with or without the needle attached) will be accepted only in a commercial sharps container that is not red or orange (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

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, include a note in the "Additional Instructions" section. When EHRS personnel arrive to collect the waste, they will contact someone in the lab. At that time, place the vial with unused material in clear plastic bag of polyethylene at least 4 mils (0.1 mm) thick or other material of similar strength. The bag may already contain other dry waste so long as the Radioactive Waste Tag for the bag reflects the correct total activity. Securely close the bags and attach a properly completed waste transfer memo to each bag (a single memo cannot be used for multiple bags).

E. Animal Carcasses and Biological Material

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.

1. 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.

2. Place frozen carcass, infectious waste, and biological waste in clear plastic bag of polyethylene at least 4 mils (0.1 mm) thick or other material of similar strength. Securely close the bags and attach a properly completed waste transfer memo to each bag (a single memo cannot be used for multiple bags). Keep the material frozen until pickup.

3. Segregate the material by isotope. Animal carcasses containing no more than 0.05 µCi/gm of H-3 or C-14 must be placed in separate bags from other carcasses. These carcasses are not regulated as radioactive.

4. Do not generate animal carcasses that contain activity greater than 0.05 µCi/gm of H-3 or C-14 or that contain any RAM with a half life greater than 120 days without prior approval.

F. Liquids scintillation fluid in vials

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. In addition to the requirements for all waste types above, scintillation vials containing radioactive material must meet the following requirements.

1. Tightly cap each vial.

2. Segregate vials by isotope and vial type (mini vial/regular). Vials containing only tritium and carbon-14 can be intermingled.

3. Determine, from its label, whether the scintillation fluid contained in the vials is hazardous or non-hazardous. Frequently terms such as “biodegradable,” “eco-friendly,” or “non-flammable” are used on the label instead of “non-hazardous.” When completing the radioactive waste pick-up request, check the appropriate box.

4. When ready to dispose, place the vials into clear plastic bags of polyethylene at least 4 mils (0.1 mm) thick or other material of similar strength, closed at the neck. Attach (staple) a completed waste transfer memo to each plastic bag of vials (a single memo cannot be used for multiple bags).

The waste transfer memo 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

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 material 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".

Note that "biodegradable" scintillation fluids are not "soluble" in water and therefore are not suitable for drain disposal.

2. Limits and Records

a) Each licensee's daily sink disposal is limited these amounts (Note: There is no sewer disposal for laboratories located at the New Bolton Center.):

200 uCi/day of H-3
200 uCi/day of C-14
50 uCi/day of all other isotopes combined

b) 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.

c) Liquids disposed to the sink must not contain chemicals regulated as hazardous, carcinogens, or mutagens.

d) 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.

e) Each quarter, report the total activity of radioactive material disposed to the sewer to EHRS, broken down by isotope.

H. Bulk Liquid - Transfer to EHRS

1. Put bulk liquids into a new quart, gallon, or 5-gallon plastic 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. 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 waste transfer memo to the container of liquid waste (a single memo cannot be used for multiple containers).

I. Sealed Sources

Sealed sources are devices containing radioactive material which are engineered to prevent the material from ever 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 and model number, and the serial number of the source, if any, in the “Additional Pick-up Instructions” section, place the source or sources in a plastic bag or other container, and securely attach the Waste Tag to the outside of the container. EHRS personnel will collect the sources during routine waste collection.