RADIOACTIVE MATERIALS SAFETY MANUAL

Environment, Health & Safety Services

Revised August 2005

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University at Buffalo

State University of New York

Environment, Health & Safety Services

Radiation Safety Division

RADIOACTIVE MATERIALS SAFETY MANUAL

Preface

This manual is provided to those working with radioactive materials at the University at Buffalo (UB). It provides basic rules and regulations of the Environment, Health & Safety (EH&S) Services radiation safety program and is updated as necessary. This manual is a condition of the university's license to possess and use radioactive materials and therefore every radioisotope user must be familiar with its contents. A further requirement of the regulations pertaining to radioisotope use is that all users be familiar with safe practices in the handling of radioisotopes and radiation producing sources. This information is covered in the New User Orientation and the *Radiation Protection Training Manual and Study Guide.* It is essential that the rules, regulations, and procedures contained in these manuals be adhered to in all work involving use of radioactive materials.

Jeffrey W. Slawson, CHP
Radiation Safety Officer

Revised August 2005

Environment, Health & Safety Services

Radiation Safety Program Contacts:

During normal working hours call 829-3281
Fax 829-2029
Web Site http://www.ehs.buffalo.edu/

After 5:00 p.m. or weekends call University Police 2222 (on campus) or
645-2222 (off campus)

Introduction

Possession and use of radioactive materials at the University at Buffalo (UB) is authorized under various federal and state licenses. This manual applies to the use of radioactive material under UB's primary broad scope license issued by the New York State Department of Health. The license operates under laws specified in Title 10 of the Official Compilation of Codes, Rules and Regulations of the State of New York (NYCRR), Chapter I, Part 16 (hereinafter referred to as "State Code") and additional requirements of the New York State Department of Environmental Conservation as specified in Title 6 NYCRR, Part 380.

Radiation Safety Committee

All radioactive materials work under this license is reviewed and approved by the University's Radiation Safety Committee (RSC). This Committee is comprised of Principal Investigators from various departments that use radioactive materials and other individuals with radiation safety expertise. The duties of the RSC are: (1) to evaluate and approve, or disapprove, proposals for the use of radioactive materials; (2) to review policies and procedures regarding the receipt, use, transfer and disposal of radioactive materials; (3) to monitor compliance with applicable state and federal regulations; and (4) to carry out other duties as may be prescribed by the license.

About this Manual

This manual specifies practices to aid radioisotope users in recognizing situations before hazards or violations actually occur. In the final analysis, these measures taken to comply with regulations can succeed only when each user follows both the actual rules and spirit contained in this manual.

EH&S Responsibilities

The Radiation Safety Officer (RSO), a member of the Environment, Health & Safety (EH&S) Services staff, has the responsibility to implement the Radiation Safety Program. This program is designed to protect the health and safety of the members of the university community and the public from potentially deleterious effects of radiation by maintaining both external and internal exposures as low as reasonably achievable (ALARA).

EH&S performs periodic inspections of campus radioisotope laboratories to assure compliance with the provisions of this manual and the State Code. Violations posing an imminent health hazard will result in immediate cessation of work in that laboratory. Violations not corrected promptly will result in temporary suspension of purchases of additional radioactive material and may be referred to the RSC for resolution. Violations of a serious nature could result in suspension of UB's Radioactive Materials License. Such action would curtail all radioactive materials use on campus. Copies of the University's license, State Code and notices of violations are kept on file and are available for inspection during normal office hours.

User's Responsibilities

Each individual who uses radioactive material at the university must follow the procedures in this manual. All individuals working with radioactive materials must request authorization from EH&S. The two types of authorizations recognized are the Principal Investigator and the Associate Investigator.

Principal Investigator Authorizations are granted by the RSC to qualified individuals who are responsible for research projects involving radioactive materials, and/or qualified individuals responsible for supervising radioactive materials use by associate users or students in laboratories. The Principal Investigator is responsible for radiation safety in the laboratory. Request the "Application for Principal Investigator" packet for more information.

The responsibilities of the Principal Investigator include:

1. Informing new employees about safety and health procedures, rules and regulations and

their specific responsibilities.

2. Assuring that required equipment and personal protective devices are provided, maintained and used.

3. Taking prompt action when unsafe acts or conditions are reported or observed.

4. Insuring that individuals receive safety training as required by their responsibilities.

5. Promptly investigating and reporting all on-the-job accidents, and/or work related health problems and requesting medical treatment if required.

6. Coordinating or conducting internal inspections, reviews or audits to assure safe and healthful conditions and compliance with applicable safety and environmental regulations.

7. Providing or acquiring necessary resources for necessary health and safety equipment, materials and facilities.

After review and approval of a new Principal Investigator application, a "Radioactive Materials Authorization" is issued to the Principal Investigator detailing the location, isotopes and maximum amounts of radioactive materials allowed in the lab and any other special conditions.

Associate Investigator Authorizations are granted by EH&S to those individuals (technicians, faculty or staff) working under the supervision of and directly responsible to a Principal Investigator. Please note that individuals under the age of 18 (minors) require additional special approval from EH&S to work with radioactive material.

All employees have the responsibility to comply with health and safety rules, regulations, policies and procedures. These responsibilities include:

1. Following safety, health, and environmental standards, rules, policies, and regulations, procedures and orders.

2. Reporting hazardous conditions to their supervisor and/or EH&S.

3. Wearing prescribed protective equipment.

4. Reporting job-related injuries or illnesses to their supervisor and seeking prompt and appropriate medical treatment.

5. Refraining from operating equipment or apparatus, or conducting any procedure, without proper training and authorization.

Training

Each Associate Investigator must attend a "New User Orientation" **prior to** working with any radioactive material. The candidate must submit an "Application to Use Radioactive Material" to EH&S to initiate the Associate Investigator process. The Principal Investigator shall sign the application certifying that the candidate has received safety training specific to the Principal Investigator's lab.

Before attending the orientation, the applicant must complete a short answer quiz that covers information in this manual and basic safety calculations. Upon completion of the orientation and passing a post orientation exam, the user will be granted approval to work under the supervision of the Principal Investigator. Previous training or experience at another facility will **not** exempt the candidate from the training requirement.

Annual radiation safety refresher training is required for all Principal and Associate Investigators. This mandatory training is provided by EH&S. An Associate Investigator who fails to re-qualify as a radiological worker for a period greater than one year must complete the New User Orientation requirements.

Changes in Laboratory Status

To make a change in the Radioactive Materials Authorization, the Principal Investigator must submit a written request detailing the changes. This may include adding or deleting a lab,

radionuclide, or the revision or addition of a new experimental protocol. Experimental protocols require submitting a "Radioactive Materials Experimental Procedures Application." This form requires that the description of the new or revised protocol include the radiation safety practices to be followed.

After review and approval, the lab status changes will be incorporated into the Principal Investigator's revised Authorization.

EH&S is required to know who is working with radioactive materials under each Principal Investigator's authorization. **Each time an Associate Investigator begins working in a new lab, he/she must submit a new "Application to Use Radioactive Material" to EH&S.**

If the Principal Investigator plans to be away from the laboratory for an extended period of time, a designee shall be appointed (in writing by the Principal Investigator) to be responsible for the radiation safety requirements in the lab.

Principal Investigators who will be vacating their laboratories or are planning to no longer use radioactive materials must notify EH&S within a reasonable time prior to these changes so that adequate close out procedures can be performed. Once a radioactive materials lab is implemented, the Principal Investigator is responsible for completing the close out requirements prior to final shutdown of the lab.

A **Laboratory Status Report** is available from EH&S summarizing the information contained in the Principal Investigator's Radioactive Materials Authorization. This information includes: authorized labs and their classification; authorized radioisotopes and maximum quantities allowed; names of authorized individuals and training dates; survey instruments and the date of last calibration; and listings of unsealed radioisotopes and sealed sources in possession.

Lab personnel can request this report periodically to verify the accuracy of the lab's radioactive materials authorization. For example, this report can be used to perform a check of inventory records; verify each individual in the lab is properly trained; notify EH&S of individuals who have left the lab; verify each survey meter is listed so the lab will be notified of its annual calibration; etc.

Emergencies or Unsafe Conditions

Each individual has the obligation to report unsafe radiological conditions to EH&S. Please notify the EH&S office at once (call University Police after normal EH&S business hours) of emergencies such as personnel contamination, major spills, lost or stolen radioactive material (including radioactive waste), or other potentially hazardous or unsafe conditions.

Basic Radiation Protection Procedures

The goal of each worker shall be to *maintain his or her exposure to radiation and radioactive contamination as low as reasonably achievable (ALARA)*. When working with radioactive materials or radiation sources, each worker must be aware of the methods or procedures that can best be used to reduce his or her exposure. General radiation safety techniques are described below:

1. Use radioactive material in posted labs according to approved written protocols by trained individuals.

2. Design experimental protocols with safety procedures as an integral part of the instructions.

3. Rehearse operations without radioactive material to ensure the procedure and methods will be reasonably free of incidents. Inform others in the area of the use of radioactive material.

4. Minimize the time spent near radioactive material.

5. No mouth pipetting of any kind.

6. Increase the distance between radioactive material and the body. Use remote handling tools like tweezers or forceps to handle stock vials. Do not handle stock vials with your hands for an extended period of time.

7. Use shielding between the radioactive source and your body. Use one-half inch of plastic for high energy beta emitters (P-32); lead foil for low energy gamma emitters (I-125); lead bricks for higher energy emitters (such as Na-22, Sc-46, and Fe-59). Use of such shielding material can significantly reduce radiation exposure.

8. Minimize the amount of material handled. Only use what is needed. Then put the rest away.

9. Make sure the material is properly contained. Use drip trays lined with absorbent material in case of spills; stabilize glassware to prevent it from tipping, etc. Notify EH&S before using dry powdered radioactive material. Potential sources of airborne radioactivity shall be used in a glove bag, glove box, or fume hood. Transport items in shielded containers.

10. Care must be taken so items (pens, pencils, notebooks, door knobs, telephones, etc.) are not contaminated during work with radioactive materials.

11. Segregate items used with radioactive materials from those used with non-radioactive materials.

12. Protective clothing (lab coats, disposable gloves, etc.) shall be worn when handling radioactive material. The wearing of shorts or sandals is not appropriate attire when manipulating radioactive material.

13. Personnel with breaks in the skin should use waterproof tape to seal such breaks or not manipulate radioactive materials.

14. Personnel shall monitor themselves (and their work surfaces) for contamination after **each** use of radioactive materials using appropriate techniques and equipment. Monitoring should include head, hair, hands, body, shoes, clothing, and workspace. If contaminated, EH&S shall be notified and the body and clothing shall be decontaminated before leaving the area.

15. Where contamination is found above action levels, decontamination steps must be immediately initiated.

16. Hands should be monitored and washed before leaving the lab.

17. Eating, drinking, smoking, use of cosmetics and storage of food and beverages are prohibited in radioactive materials areas.

18. **Radioactive Materials Areas must be locked when unattended to prevent unauthorized access to radioactive materials.**

19. Label all containers of radioactive materials or items used with radioactive material with labels bearing the words "CAUTION: RADIOACTIVE MATERIALS", and the radiation symbol. Labels should also include date, nuclide, and quantity of the radioactive material.

20. Items that are routinely contaminated (i.e., centrifuges, water baths, tongs, etc.) and areas used for radioactive work should be clearly labeled.

21. Work areas (and adjacent surfaces) should be non-porous and/or covered with plastic backed absorbent paper wherever radioactive materials are manipulated.

22. All stored radioactive material shall be placed in a designated and posted, secure location. Check storage areas with appropriate survey instrument. Shielding shall be used to reduce radiation levels to less than twice the background level.

23. Fume hoods used for manipulations or storage of any radioactive materials must have a face velocity of approximately 100 linear feet per minute or greater. Confirm hoods are operating properly before using opened sources

of radioactive material.

24. Objects and equipment potentially contaminated with radioactive material (water baths, centrifuges, etc.) shall be surveyed and decontaminated prior to their removal from a laboratory, or transferred to other laboratories, repair shops, surplus, etc.

25. Dosimeters must be worn, if issued, when working with radioactive material. Store dosimeters on the racks provided when not in use. Dosimeters must not be left on your lab coat or shared by another user (for further information, see the section on Personnel Radiation Monitoring).

26. Dispose of radioactive waste properly. Follow the instructions provided on the containers. Refer to the section of this manual on Waste Disposal for additional information.

27. EH&S must be notified whenever maintenance or renovation of potentially contaminated facilities or items (sinks, hoods, lab benches, equipment, etc.) is required, so a survey can be performed to assure it is safe to proceed with the work.

28. Records of Radioactive Material Inventory, survey results, a copy of this manual, and a copy of the Radioactive Materials Authorization must be kept in the laboratory accessible to workers in the laboratory, EH&S staff, and New York State Department of Health inspectors.

Ordering and Receiving Radioactive Materials

All radioactive material must be ordered through EH&S using the "Radioactive Materials Purchase Requisition" (available by request from EH&S). Upon receipt of your requisition, EH&S will verify the items requested will be used as specified in the Principal Investigator's Radioactive Material Authorization. Upon approval, EH&S will then submit the requisition to the UB Purchasing Department.

Requisitions should be typed, if possible. Handwritten requisitions should be in black ink and legible. For faster service, fax requisitions to EH&S at 829-2029.

Receipt of Radioactive Material

Vendors must deliver all radioactive material to EH&S. When calling in orders to vendors, please make sure the "ship to" address is Radiation Safety 14 Parker Hall, Buffalo, New York, 14214, For: <Principal Investigator's name>.

Upon receipt of the requisitioned radioactive material, EH&S will perform required radiation and contamination monitoring. An "Inventory/Disposal Record" form is generated. EH&S will then notify the lab of the receipt and the item will be delivered to the lab.

If a shipment is received directly at the laboratory, immediately notify EH&S for proper procedures.

Radioisotope Package Opening Instructions

After receipt of a radioactive materials package in the lab, it must be opened in a designated area such as a fume hood or lab bench. Then:

1. If appropriate, don issued dosimeters (whole body badge and extremity ring).

2. Perform a wipe test on the inner vial to check for leakage. If contamination is greater than three times background notify EH&S for assistance.

3. Isotopes delivering significant radiation levels at close range (such as P-32, I-125,) require shielding.

4. Before disposing of shipping containers in regular waste verify that no contamination is present and remove or deface all "radioactive" markings.

5. Store the stock vials in a designated posted area.

6. Retain the Inventory/Disposal form.

Radioactive Material Inventory Records

Always keep accurate records of the radioactive material in the laboratory:

1. Log each date and the amount of material withdrawn from a stock container on the Inventory/Disposal form.

2. Indicate the disposal method on the Inventory/Disposal form. Record the amount of material disposed of as radioactive waste on the waste container label.

3. Store the forms together in a consistent location such as the binder provided by EH&S.

4. Return the form to EH&S when the radioisotope vial has been properly disposed of.

5. Do not keep "old" radioisotopes. Most radioactive compounds have a limited shelf life due to radiolytic decomposition. If the shelf life has been surpassed, the chemical integrity of the compound cannot be assured. Over time the laboratory may lose track of old stock vials or dilutions.

6. Be sure personnel clean up their work area and properly dispose of any waste before they leave the laboratory.

7. Contact the vendor for further information on the shelf life of radioactive labeled chemicals and EH&S for appropriate disposal procedures.

Transportation of Radioactive Materials

If it is necessary to transport radioactive materials between labs, the following guidelines should be followed:

1. Call EH&S to determine if the recipient of the transferred material is authorized to receive it.

2. If the transfer is between labs within the same building, the material must be in a strong, tight container and clearly labeled "Caution - Radioactive Material".

3. If the transfer is between buildings, contact EH&S for the proper shipping procedures.

4. Use the EH&S "Transfer Approval Form" to document the transfer. Also indicate the transfer on your inventory control form.

Radioactive Material Surveys

Radioactive contamination on laboratory surfaces and equipment presents two types of safety problems:

1. Loose surface contamination is easily transferred to an individual’s hands, feet, or clothing. This material can be either ingested, causing internal exposure or it can remain on the person, causing unnecessary direct radiation exposure, or it can be spread to non-radioactive areas. Transfer of loose surface contamination can also be detrimental to experimental results.

2. Fixed surface contamination can cause unnecessary direct radiation exposure to individuals frequenting the contaminated area. Or, through age and surface erosion, it can become loose surface contamination.

Because of these problems, it is imperative that contamination of laboratory surfaces be prevented, or at least rapidly detected with corrective action taken. Checks for contamination shall include **both wipe and portable meter surveys (when appropriate).**

Surveys for radioactive contamination must be performed AFTER EACH USE of radioactive material. The purpose of this survey is to identify any contamination present and to prevent its spread.

A formal survey for radioactive contamination and radiation levels (if appropriate) must be performed and recorded on forms provided by EH&S at least

once in each month that radioisotopes are handled, or at such other times or intervals as specified by EH&S. All of the requested information on the form must be completed.

Trained personnel must perform required surveys. A copy of the survey report form must be faxed or sent to EH&S by the first of the month due date. Keep the original copy with raw data attached to the survey form in the lab binder.

A Notice of Violation will be sent if the survey is not received on time. This Notice of Violation temporarily suspends the lab's privilege to order and receive additional radioactive material until the survey is performed.

In addition to the monthly survey requirement, recorded post manipulation surveys may be required whenever large quantities of radioactive material are received in the laboratory. Whenever more frequent surveys are required, users are notified and survey forms are provided.

Contamination Survey Procedures

Wipe Surveys

The most common survey procedure to detect the presence of loose contamination is called a wipe test. In this procedure, a piece of filter paper (usually about one square inch or circular) is used to wipe over a surface suspected of being contaminated. The area which the wipe should cover is approximately 100 square centimeters. Depending on the surface being wiped or the type of material being surveyed for, it may be necessary to wet the wipe material with alcohol or other solvent for better adhesion of contaminated particles to the wipe.

Post manipulation wipe samples should include yourself, your working areas, floor space near your working areas, and any other area where contamination may be likely. Waste container areas and waste storage areas must be surveyed at least once a month, even if not used for that month.

Analyze the wipe samples, using an appropriate instrument. Beta-emitting isotopes below 200 keV (H-3, C-14, S-35, etc.) must be analyzed using a liquid scintillation counting system. Wipe samples of gamma or x-ray emitters (I-125, Cr-51) should be analyzed using a gamma counting system.

Data from the monthly wipe survey print out must be transferred to the appropriate survey form which must include **Background, Source Count Rates** and counter **Efficiency** for each isotope used.

Portable Survey Instrument Surveys

Portable survey instruments should be used to survey for gross contamination. Geiger Mueller (GM) tubes and sodium iodide (NaI) probes have detection efficiencies that are much lower than a sample counted in a scintillation or gamma counter. Before using any instrument, become familiar with its proper operation by reading the operating manual. Perform the following steps each time the instrument is used:

1. Check the calibration due date (listed on the calibration label). Do not use any survey meter past its recalibration date.

2. Check the batteries. Replace old or weak batteries. Turn off the instrument when it’s not in use.

3. Check the operability of the detector by exposing it to the check source attached to the side of the meter. Verify the reading matches the one listed on the calibration label.

4. Determine the background reading for future reference in interpreting results.

To conduct a survey using a portable instrument, hold the detector approximately 0.5 cm from the surface being checked. Do not let the detector touch the surface being surveyed to prevent contaminating (or damaging) the detector. Move the probe slowly over the surface. If the area being surveyed is greater than three times the background count rate, then consider the area contaminated. Any contamination found should be wipe tested for removable contamination. Contamination found using a survey probe indicates a high level of contamination is present and the surface must be

cleaned immediately.

GM counters with thin window probes can be used to detect beta-emitting isotopes (other than H-3). Where gamma emitting isotopes are used such as I-125 and Cr-51, a survey instrument with a NaI probe should be used. Refer to the calibration sticker affixed to the side of the instrument for the efficiency of the detector for the nuclide being detected.

Instrument Calibrations

Portable survey equipment must be properly calibrated at least once a year, whenever battery or check source test functions indicate a problem, or after servicing. EH&S performs such calibrations. Do not use an instrument if it is out of calibration.

Liquid scintillation and gamma counters used to analyze wipe samples (as well as your own samples) must have calibrated reference standards readily available. These standards must be counted and recorded on the monthly survey reports in order to verify efficiencies, machine settings, and proper machine operation. A blank containing a clean wipe sample and scintillation fluid shall be counted to determine the instrument's background. If at any time background changes dramatically, check the counter for contamination or faulty operation. A significant change (greater than three standard deviations) in an operational standard's mean count rate also indicates operational problems.

Contamination Limits

All removable contamination shall be kept as low as reasonably achievable (ALARA). Items or areas that could come in contact with skin or personal clothing must always be decontaminated until undetectable. Notify EH&S whenever measurable contamination is detected on skin or clothing.

For removable contamination greater than the **action level** (see table below), the item or area must be cleaned up to the lowest practical levels within one working day. "Lowest practical level" means that level at which the risk from the contamination hazard is minimal. Controlled areas such as, labeled items in designated work areas should be decontaminated to less than the action level value. Uncontrolled items (e.g.. an internally contaminated centrifuge to be transferred to the shop for repair, pipettors or bench tops used for non-radioactive work) must be decontaminated until no contamination remains.

Removable Beta/Gamma Contamination Limits

(dpm per 100 square cm)

Application	Action Level	Reportable
Inside hoods, microfuges, or other controlled areas	2,500	5,000
Benchtops, refrigerators, freezers, equipment, etc.	500	1,000
Skin, personal clothing, floors, telephones, other uncontrolled items or areas	*No Contamination Allowed*	

Removable contamination greater than the **reportable** level must be decontaminated to the lowest practical levels at once. Report these contamination incidents to EH&S within one working day. EH&S will perform a follow-up survey to ensure proper decontamination.

Radiation Limits

Radiation levels shall be kept as low as reasonably achievable (ALARA). EH&S will measure for radiation exposure rates and recommend shielding or corrective actions when necessary.

Incidents Involving Radioactive Materials

Major incidents such as contamination of the body or clothing, suspected ingestion of radioactive material, contamination that cannot be cleaned readily, etc. must be reported to EH&S immediately.

Minor incidents such as a spill involving contamination less than 1,000 dpm per 100 square centimeters may be decontaminated by laboratory personnel under supervision of the Principal Investigator or his/her designee.

All spills of radioactive material must be cleaned promptly. The responsibility for cleaning up the spill rests on the individuals working in the area involved. Under no circumstances should an untrained person attempt to examine or clean up a spill of radioactive material. When assistance is needed, contact the EH&S office.

The following general procedures should be followed when dealing with spills of radioactive materials:

1. **Inform others of the spill**. Adjust your response to the seriousness of the spill. Instruct those personnel present, in the room at the time of the spill, to minimize their movement to prevent contamination spread. Have someone notify the EH&S office of the incident. If after normal working hours, report the incident to University Police. Personnel shall not eat, drink, apply cosmetics or smoke until they are monitored and found free of contamination.

2. **Contain the spill**. If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure. If the material is a liquid, place an absorbent material such as paper towels, tissues, cloth, etc. over the spill to prevent its spread.

   If a radioactive powder is spilled, attempt to contain its spread by covering the area with a protective barrier such as a drip tray, empty beaker, section of kraft paper, etc.

   If appropriate, close doors and windows and shut off ventilating equipment that may transport contaminated air or particles from the spill area to other parts of the building. Post or cordon off the contaminated area.

3. **Assemble in a nearby safe or clear area**. Begin monitoring and decontamination of affected persons. Remove contaminated clothing at once; flush contaminated skin areas thoroughly. DO NOT LEAVE THE AREA without the permission of EH&S.

4. **Decontaminate the area**. Provide adequate protection and supplies for personnel involved in the cleanup. Begin at the periphery and work toward the center of the contamination. Cover cleaned areas with plastic or paper to prevent its recontamination. Place all contaminated items in the proper waste containers. The degree of decontamination shall be to the limits specified in the chart "**Removable Beta/Gamma Contamination Limits**" in this manual.

5. Monitor the progress of the decontamination.

6. Using appropriate survey techniques (wipe samples counted in a liquid scintillation or a gamma counter, scan of the area with a GM counter, etc.) to verify all personnel and materials are properly decontaminated before releasing them to clean areas.

7. Immediately notify the EH&S office of a large area of contamination or contamination not readily removed after two cleaning attempts.

Waste Disposal

Waste, radioactive and otherwise, is generated in laboratories. All waste must be properly handled and disposed of in accordance with university and regulatory agency requirements. Do not place contaminated items in (non-radioactive) trash receptacles. Be aware that waste disposal requirements are subject to change. Specific instructions for the disposal of radioactive waste are found in the EH&S "Guide to Radioactive Waste Management."

All radioactive waste must be collected in containers supplied by EH&S. Refer to the instructions provided with each waste container for the proper disposal procedures. All waste storage areas should be managed with close attention to cleanliness. Refer to your laboratory's waste disposal memorandum or contact EH&S if you have any questions.

Radioactive Waste Minimization

Each user is encouraged to develop methods and procedures to reduce the amount of radioactive waste generated. Some minimization techniques are:

1. Continually review all procedures to ensure that radioactive waste is not created unnecessarily. Use less radioactive material, recycle when possible, etc.

2. Be certain only radioactive waste is placed in the containers. If in doubt, a simple wipe test or instrument survey can determine if the material is radioactive or contaminated. If only a small area of an item (lab bench top absorbent, for example) is found to be radioactive, dispose of only the contaminated portion.

3. Work on easily decontaminated trays (i.e. stainless steel) that can be washed.

4. Wash glassware and survey for contamination. Remember to place contaminated wash water in an EH&S liquid radioactive waste container.

5. Consider using non-radioactive methods.

Disposal Regulations

1. Disposal of radioactive liquid waste via sink or other modes of entry into the sewer is **not** permitted.

2. Water used for the final wash (after at least two rinses) of glassware used to contain radioactive material can be disposed to the sink as long as it can be demonstrated to contain no radioactivity.

3. Consult with EH&S for instructions on the disposal of radioactive biohazard waste.

4. If gaseous or airborne particulate waste is suspected, contact the EH&S office. The area will be monitored to determine if airborne material is present.

5. Radioiodinations must only be performed in hoods approved by EH&S.

6. Users of high activity (such as I-125 iodination columns) must contact EH&S for proper disposal procedures.

7. No evaporation of radioactive waste is allowed.

8. Waste container covers must be secured when the container is not being used.

9. No laboratory release of decayed stored waste is allowed.

10. All liquid scintillation fluid, with or without radioactive contamination, must be collected for disposal by EH&S.

11. Lead cannot be disposed of in regular trash. EH&S will collect lead (containers, foil, bricks, etc.) for proper disposal.

12. Liquid scintillation counters typically have a built in radioactive source. The system owner must arrange (with the manufacturer) for the removal of this internal source prior to disposing of the counter.

Ordering Radioactive Waste Containers

Radioactive waste containers may be obtained by faxing a "Request for Radioactive Waste Disposal" form to EH&S. The specific pick up and delivery schedule can be obtained from EH&S.

The radioisotope(s) disposed and the estimate of the amount of waste (in mCi or μCi) deposited in the container must be recorded on the "Statement of Waste Container Contents" associated with the waste container. EH&S will not collect containers that have not been surveyed for contamination or waste that is not properly packaged.

Radioactive Materials in Animals

All procedures using radioactive materials in live animals must first be approved by EH&S before

being reviewed by the University's Institutional Animal Care and Use Committee (IACUC). Animal users must adhere to established regulations as outlined in the IACUC guidelines for the proper care and maintenance of animals and areas.

Special consideration must be given to the handling and housing of animals used in research involving radioactive materials. Radiation exposure to individuals can occur as direct radiation exposure from the animal, exposure to airborne radioactive concentrations from exhalation of metabolized radioactive compounds, or radioactive contamination of individuals from animal wastes, cages or bedding. The following rules apply to radioactive materials use in animals:

1. Injection of radioactive materials into animals and dissection must be performed in trays lined with absorbent material. With large animals, where trays cannot be used, surfaces should be lined with plastic-backed absorbent paper. Protective gloves and clothing must be worn during these procedures.

2. All cages housing radioactive animals shall be labeled with a "Caution - Radioactive Animals" sign. Appropriate identification must be written on the sign such as the isotope used, amount, date, Principal Investigator's name, etc.

3. Adequate ventilation must be provided in instances where animals are kept after an injection with materials that may become volatilized and dispersed into the room.

4. Metabolic cages should be used to reduce production of contaminated animal litter.

5. Animal cages must be located in an area sufficiently ventilated to reduce potential airborne concentrations to permissible levels.

6. Records of injections of radioactive material in animals, transfer of animal carcasses for incineration, and disposal in waste containers must be entered on the EH&S Inventory/Disposal Record form.

Whenever laboratory animal caretakers are required to care for animals, the Principal Investigator must provide adequate instructions on the handling requirements of the animals and excreta.

Sealed and Electroplated Sources

A sealed source is one in which any radioactive material is permanently bonded or fixed in a capsule or matrix designed to prevent the release and dispersal of such radioactive material under the most severe conditions that are likely to be encountered in normal use and handling. Sealed sources are used for reference standards and found in devices such as gas chromatographs (Ni-63, H-3), ionization type static eliminators (Am-241, Po-210), and sample irradiators (Co-60, Cs-137). The following rules apply to sealed and electroplated sources:

1. All sources must be secured from unauthorized removal. Storage containers must be properly labeled.

2. Do not touch electroplated sources, as this may result in the removal of the active material. Do not use handling tools in such a way as to penetrate the surface of sources. Storage containers should not have material that abrades the surface of electroplated sources.

3. Sealed sources shall **not** be opened under any circumstances. Only authorized individuals shall perform repair and cleaning of sources.

4. The exhaust from a gas chromatograph shall be directed into a hood whenever tritium detectors are in use. Tritium detectors shall be stored in a well ventilated, secure location whenever they are not mounted in the chromatograph unit.

5. Sealed and electroplated sources must be leak tested at designated intervals by EH&S. Generally, alpha sources need leak testing every three months while beta sources require leak testing every six months.

Personnel Radiation Monitoring

Personnel monitoring devices (whole body and extremity dosimeters) are provided based on the type and amount of radioisotopes being used, as indicated on the Principal Investigator's Radioactive Materials Authorization. Individuals using only H-3, C-14, P-33, and S-35 will not be monitored because personnel dosimeters cannot detect the low energy beta particles emitted from these isotopes and they do not pose an external radiation exposure hazard.

Dosimeters are changed on a monthly or bi-monthly basis depending on the level of radiation normally encountered in the laboratory. Do not wear outdated dosimeters. Every one or two months a radiation report will be posted in the laboratory. Review this report to monitor any exposure received. If your radiation exposure is above an EH&S investigation level, EH&S will contact you to discuss the causes and work with you to reduce future exposure levels.

General Rules for Personnel Dosimeter Use

1. Wear your whole body dosimeter between the waist and neck level when using gamma emitting isotopes or if one area of the body is more likely to be exposed than the rest, the dosimeter should be worn in that area. When using high energy beta emitting isotopes such as P-32, the dosimeter should be worn on or near the collar to measure potential lens of the eye dose equivalent.

2. Wear your extremity (ring) dosimeter (if issued) on the *inside* of your glove of the hand most likely to receive the highest dose (usually your non-dominate hand), with the label turned to the inside of your index or fourth finger. You may double glove your monitored hand to prevent ripping of the plastic glove by the dosimeter.

3. Clip the dosimeter to your clothing so that the front stays upright and faces away from your body. Never allow clothing, buttons, pens, etc. to shield the front of the dosimeter.

4. The dosimeter must be worn ONLY BY THE PERSON TO WHOM IT IS ISSUED.

5. Dosimeters should be protected against damage by heat, moisture, pressure and contamination. Check your hands for contamination before removing your ring dosimeter.

6. Dosimeters must not be worn during non-occupational exposure, such as during treatments with medical and dental x-rays.

7. When not in use, dosimeters should be stored on the racks provided to prevent their damage or loss and to prevent exposures being recorded when not worn by a user.

Notify EH&S immediately if a dosimeter becomes contaminated, damaged, lost, or whenever an individual's personnel dosimeter is no longer needed.

Radiation Exposure Limits

For occupational workers, age 18 years or over, external radiation exposure will be restricted under normal conditions to the limits below:

1. The annual limit, which is the more limiting of:
   (a) The total effective dose equivalent (internal and external exposure) being equal to 5 rem (0.05 Sv); or
   (b) The sum of deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rem (0.5 Sv).

2. The annual limits to the lens of the eye, to the skin, and to the extremities, which are:
   (a) An eye dose equivalent of 15 rem, (0.15 Sv) and
   (b) A shallow dose equivalent of 50 rem (0.5 Sv) to the skin or any extremity.

For individuals under age 18 (such as visitors to the lab and minors), the external radiation exposure limits are one-tenth (1/10) of the above values.

The dose equivalent limit to the whole body for individual members of the public from all sources of radiation other than natural and medical sources is 0.1 rem/year (100 mSv) and shall not exceed 0.002 rem (2mSv) in any one hour.

External Radiation Exposure Information for Pregnant Workers

Refer to the most current edition of the EH&S information booklet "Instructions Concerning Prenatal Radiation Exposure." Individual copies of this guide are available from EH&S upon request.

Under normal circumstances, declaring pregnancy should not result in a mandatory change in the declared pregnant woman's work duties. However, a declared pregnant woman is encouraged to discuss her situation with her Principal Investigator to make sure all possible precautions are being taken to reduce both external and internal radiation hazards in the lab.

Internal Monitoring of Radioactive Material

Internal exposure monitoring is accomplished by bioassay and/or whole body counting as appropriate. Such monitoring techniques will be implemented and an exposure report furnished whenever:

1. A quantity of volatile I-125 or I-131 at any time, which equals or exceeds 100 μCi used on a benchtop, 1 mCi used in a hood or a quantity of H-3 that equals or exceeds 100 mCi. The investigator shall notify EH&S of such use so arrangements for a bioassay within 72 hours may be made.

2. Internal monitoring is performed when actual surveys or calculations indicate that an individual has been exposed to excessive radioactive concentrations in air or water in excess of the established values listed in the State Code.

Summary

You are responsible for your own safety when using radioactive materials. Use the information in this manual and other documents available from EH&S to help minimize your exposure to radiation. These rules have been established for your protection and benefit. Keep in mind that violations of these rules may result in the loss of privilege to use radioactive material as well as cause an undue hazard to both you and your colleagues in the surrounding work area. Obey cautionary signs. Report problems, first to your supervisor then to EH&S. Stay informed of changes in your laboratory and EH&S procedures.

REFERENCES

Radiation Protection Training Manual and Study Guide.

Instructions Concerning Prenatal Radiation Exposure.

Guide to Radioactive Waste Management.

Radiation Equipment Safety Manual.

Campus Commitment to Safety Policy.

BIBLIOGRAPHY

New York State Department of Health, State Sanitary Code, 10NYCRR, Chapter I - Part 16: Ionizing Radiation, as amended.

New York State Department of Environmental Conservation, 6NYCRR, Part 380: Rules and Regulations for Prevention and Control of Environmental Pollution by Radioactive Materials, as amended.

US Nuclear Regulatory Commission, 10CRF Part 20, Standards for Protection Against Radiation, as amended.

National Council on Radiation Protection and Measurements, Washington, D.C., the following reports:

NCRP Report No. 30, Safe Handling of Radioactive Materials, March 1964.

NCRP Report No. 39, Basic Radiation Protection Criteria, January 1971.

NCRP Report No. 58, A Handbook of Radioactivity Measurements Procedures, April 1984.