



Guidelines for the Use of Radioactive Materials in Research

Office of Radiation Safety
Medical College of Wisconsin

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Abbreviations Used in this Guide

FH	Froedtert Memorial Lutheran Hospital
MCW	Medical College of Wisconsin
NRC	U.S. Nuclear Regulatory Commission
State	State of Wisconsin, Department of Health and Family Services, Radiation Protection Section
ORS	Office of Radiation Safety
RSC	Radiation Safety Committee
RSO	Radiation Safety Officer
RAM	Radioactive Material
NCRP	National Council on Radiation Protection and Measurements
ICRP	International Council on Radiation Protection
mrem	millirem
Ci	curie
mCi	millicurie
Ci	microcurie
ALI	Annual Limit on Intake

I. Organization and Responsibilities

A. Management Policy Statement

The Medical College of Wisconsin (MCW) is licensed by the State of Wisconsin for radioactive materials (RAM) for clinical and research applications at facilities located at MCW and Froedtert Hospital (FH). The license is of broad scope for the use of sealed and unsealed radioactive sources. The Administration of MCW is responsible for the maintenance of the license and the activities governed by the State. FH and MCW are jointly responsible for the implementation and review of the Radiation Safety Program to ensure that it conforms to specific license conditions and any other applicable local, state or federal regulations.

The Radiation Safety Program is directed and monitored by the Radiation Safety Committee (RSC). The RSC is

D. Authorized User

An Authorized User is an individual who has been approved by the RSC for use of RAM or ionizing radiation from RAM. Requirements to become an Authorized User are described in Section II, Authorization for the Use of Radioactive Material. Authorized Users are responsible for:

1. Maintaining compliance with applicable Federal, State and institutional rules and regulations governing the use of RAM under their authorization.
2. Maintaining a current inventory of RAM under their authorization.
3. Training personnel who work in or frequent areas where RAM are used under their authorization.
4. Informing the ORS of laboratory staff changes including new hires, terminations and transfers.
5. Submitting to the ORS amendments to change their authorization for RAM use, quantities, rooms, work areas, etc.
6. Returning required correspondence to the ORS in a timely manner.

Failure to comply with responsibilities may result in disciplinary action.

II. Authorization for the Use of Radioactive Material

The use of RAM or ionizing radiation from RAM is only permitted with the approval of the RSC.

A. Application Process

Applicants to become Authorized Users must complete the following forms, available from ORS or the ORS website:

Radioactive Materials Use Application (Non-Human Research)
Statement of Training and Experience

Instructions for completing these forms are also available from ORS.

Completed forms must be returned to ORS. Upon receipt of the forms, ORS will perform a preliminary review of the application for completeness. The application is then sent to the RSC for review. The RSC meets the second Wednesday of the second month of each calendar quarter (February, May, August and November). Applicants who wish to be considered for approval must provide completed application forms to ORS at least two weeks prior to the RSC meeting date. Requests for an expedited review can be made by contacting the ORS. Applications, whether reviewed by the RSC at a regular meeting date, or by expedited review, must receive signatures from a quorum of the RSC before becoming effective.

B. Authorization Requirements

The applicant shall be a faculty member of MCW and meet the minimum training and experience requirements to qualify as an Authorized User. The RSC may under special conditions grant authorization to a non-faculty member of MCW. Training and experience requirements depend on the type of laboratory being established. Laboratory types are classified one through four. The Laboratory Classification Scheme is presented in Section V (G), Laboratory Classification. Minimum training and experience requirements for each lab type are:

1. Laboratory Type 1 & 2 Training and Experience Requirements
 - a. A college degree at the bachelor level, or equivalent training and experience, in such areas as physical, chemical, biological, biomedical, veterinarian or engineering sciences.
 - b. At least 40 hours of training and experience in the safe handling of RAM, the characteristics of ionizing radiation, units of radiation dose and quantities, radiation detection instrumentation and the biological effects of radiation exposure appropriate to the types and forms of radioactive material used.

2. Laboratory Type 3 Training and Experience Requirements
 - c. Same as for Types 1 & 2 except a total of 80 hours of training and/or experience for quantities of radionuclides, or similar radionuclides, proposed for use or an additional 10 hours of advanced formal training including type three quantities.
3. Laboratory Type 4 Training and Experience Requirements
 - d. Same as for Type 3 except a total of 120 hours of training and/or experience for quantities of radionuclides, or similar radionuclides, proposed for use.

Applicants who can provide documentation showing that they were an Authorized User on another Agreement State/NRC license for substantially similar uses and quantities may provide such documentation in lieu of the Statement of Training and Experience form.

C. Authorization Amendments

Any changes in RAM use, possession or order limits, rooms where RAM is used or stored, and the addition of radionuclides to an existing authorization, shall only be permitted with approval of the RSC. Request to Amend Radioactive Material Authorization forms are available from the ORS. The ORS staff will provide assistance in completing the application upon request. The review process is the same as for new applications. The RSO may give interim approval to an amendment request for minor changes, such as:

- Increase of possession limit for previously approved isotope.
- Change of isotope or chemical form for previously authorized use.
- Change of location of use or storage (excluding the BSL-3 facility, see Section F, below).

D. Authorization Termination

When an authorization is terminated the laboratory shall be surveyed for contamination and decontaminated where necessary. Remaining RAM shall be removed by transfer to another Authorized User on this license, transfer to another license, or release as radioactive waste. No RAM is to leave MCW or FH without prior approval by the ORS. Procedures for the transfer of RAM are outlined in Section XIII, Ordering and Transferring RAM.

E. Inactive Status

An Authorized User may go on inactive status when they do not have any RAM in their possession. Inactive status is for Authorized Users who have no plans to use radioactive materials for periods longer than one year, and relieves certain requirements (e.g., inventory, laboratory audits, surveys, and annual refresher training). To establish

inactive status, an amendment request must be sent to the RSC. Active status will be reinstated by filing an amendment to the RSC. The RSC will grant active status upon completion of annual refresher training for the current year. Authorizations inactive for a period of greater than three years may require full reauthorization.

F. BSL-3 Lab Users

Investigators proposing the use of RAM in the BSL-3 facility must apply for approval with a separate Application from other RAM use requests. Under normal circumstances, an investigator who is approved as an Authorized User would only need an Amendment to add a new location of use, as described in Section C. Use of the BSL-3 facility will not be considered a ‘minor’ addition to an Authorization; a complete Application with formal RSC approval will be required.

III. Training of Radiation Workers

A. Definition of a Radiation Worker

For the purposes of the Radiation Safety Program at MCW, a *radiation worker* is an individual who is likely to receive an *occupational dose* in excess of 1 mSv (100 mrem) in a calendar year.

Occupational dose, as defined by the State in DHS 157.03, “means the dose received by

5. Radiation exposure reports provided to workers.

The extent of the instructions provided shall be commensurate with potential radiological health protection problems present in the workplace and shall take into consideration assigned activities during normal and abnormal situations involving exposure to radiation or radioactive material that can be reasonably be expected to occur.

The form *Training and Instruction Checklist* must be completed for each radiation worker as soon as practical after starting to work with RAM in the lab. Upon completion, the form must be signed by both the radiation worker and the Authorized User and the completed form sent to the ORS.

Training of radiation workers may be accomplished in several different ways:

Direct Training by the Authorized User – In all cases some direct training by the Authorized User or designee is mandatory. The specifics of how and where RAM and RAM records are stored, what precautions should be taken in specific laboratory procedures, authorized use and possession limits, are unique to each lab.

Classroom Training – ORS periodically offers a classroom-based course in radiation safety for laboratory workers. This course is designed to cover training requirements not unique to individual laboratories. All radiation workers should attend this course for initial training.

Computer or Video-based Training – Training materials approved by ORS may be used as a substitute for the classroom training listed above. Contact ORS for approved content.

IV. Exposure Monitoring

A. Radiation Exposure Limits

The goal of the Radiation Safety Program is to keep radiation workers and members of the public exposure to radiation As Low as

employee, a statement that she is pregnant,

The requirement for bioassays is as follows:

1. Adults likely to receive, in one year, an intake in excess of 10% of the applicable Annual Limit on Intake (ALI) in DFS 157 (excerpt in Appendix B).
- 2.

Magenta and yellow tape (as shown below), supplied by ORS, shall be placed on the floor around the radioactive work area (restricted area) except where it has physical boundaries (e.g., walls, heavy equipment, lab benches).



All areas inside the radioactive work area where unsealed sources are used will be labeled with “Caution, Radioactive Material” tape or a similar label. This tape should be minimally placed on the edges of the bench or table, where it can be readily seen. Equipment or glassware that is contaminated from RAM usage should be similarly labeled.

Radioactive work areas that contain self-shielded irradiators, or other sealed sources, are not required to be posted if the external radiation at 30 cm from the housing is less than 5 mR/hr.

B. Radioactive Cold Zones

A radioactive cold zone is an area inside a controlled area where food and drink may be consumed and where RAM is not allowed. This area must include a “cold” pathway to the entrance of the restricted area. Any cleaning or washing of hands or dining utensils, including, but not limited to, silverware, plates and cups shall be in a sink within a “Cold Zone”. Trash generated by such washing and cleaning shall be disposed in trash containers in “Cold Zones”.

C. Temporary Use Areas

An area can be used as a temporary radioactive work area if the following criteria are met.

1. ORS should be informed that the area will be used as a temporary use area.
2. The area will be used as a “one time only location” or will be used only occasionally as a RAM use area.
3. The RAM in the area is constantly attended or secured.
4. The area, bench tops, and any equipment are marked with the proper “Caution, Radioactive Materials” tape and signs for the duration of the procedure.
5. A contamination survey of the area is conducted after the procedure is completed and the records are maintained by the Authorized User.
6. All caution signs and tape are removed after the area has been monitored and decontaminated, if necessary.

D. Radioactive Storage Areas

Storage areas may consist of a refrigerator, freezer, cold room, cabinet, etc., labeled with a “Caution, Radioactive Materials” or “Caution, Radiation Area” sign as appropriate. Storage areas do not have to be inside a radioactive work area as long as RAM are stored and transported in closed containers. Storage areas outside of controlled areas

Ultimately, the Radiation Safety Committee will examine each application and determine appropriate laboratory requirements. These requirements will be listed as use conditions for each authorization.

VI. *General Radioactive Material Use*

A. Operating Considerations

1. Before any procedure is performed, consideration should be given to the amount and type of RAM being used to determine the need for additional precautions, such as remote handling, hoods, air sampling devices or special working surfaces. Consideration should also be taken for the volume and type of waste generated. ORS will be available for assistance on initial or unusual operations.
2. Determine if an individual will be required to have a personal monitoring device or participate in a bioassay or in vivo counting program. This depends on the radionuclide, quantity, frequency of use, chemical form, and type of work being performed. Refer to Section IV, Exposure Monitoring.
3. Transferring of RAM from one Authorized User to another user under our State license (MCW and FH) may be made only with PRIOR approval from ORS.
4. Gamma emitting radionuclides are to be used and stored in such a way so that the total dose equivalent to individual members of the public does not exceed 1 mSv (100 mrem) in a year or in excess of 0.02 mSv (2 mrem) in any one hour in unrestricted areas.

B. Safety Rules for Working with RAM

1. Wear appropriate protective clothing (e.g., lab coat, gloves, closed-toe shoes).
2. Use remote handling tools, as appropriate.
3. Wash hands and monitor clothing, as appropriate, for contamination after each procedure and before leaving the area.
4. Do not eat, drink, smoke, or apply cosmetics in a restricted room or area where RAM is used.
5. Do not store food, drink, or personal effects with RAM.
6. Store radioactive waste only in specially designated and appropriately shielded receptacles in a secured area.
7. Never pipette RAM by mouth.
8. Transport RAM in appropriately closed and shielded containers.

C. Storage and Labeling of RAM

It is the responsibility of the Authorized User and radiation workers to ensure that RAM is stored and labeled to comply with the following procedures and to promptly report non-compliance to the ORS.

1. The room or area where RAM is stored shall be posted with a “Caution Radioactive Materials” sign. Refer to Section V, Radioactive Work Areas.
2. RAM must be secured from unauthorized access and removal when not in use.
3. Unbreakable containers are recommended for storage of RAM. Radioactive liquids shall not be stored in open containers.
4. Freezers used for storage of RAM shall be kept reasonably free of frost. When defrosting a freezer, caution shall be used to prevent the spread of possible contamination.
5. Radioactive gases and volatile radionuclides shall be stored in a negative pressure airflow hood.
6. Equipment or containers known or suspected to be contaminated with RAM should be marked with an appropriate sign or tape until such contamination is removed.
7. Sinks shall be designated for the disposal of radioactive liquid waste and marked appropriately.
8. Radiation caution signs and tape shall only be used in accordance with the appropriate government regulations. Indiscriminate use of caution tape (e.g., to display notices) is prohibited.

D. Security

Preventing loss or theft of RAM is essential to protect individuals and the environment from unnecessary radiation exposure. The State regulations require that MCW “shall secure licensed or registered radioactive material in an unrestricted area from unauthorized removal or access.”

For labs within the card-key access controlled areas within MCW:

Doors to labs where RAM is used or stored should be closed and locked when unattended.

Stock vial storage areas containing quantities greater than 10 times the ALI should be in locked cabinets or freezers, with key distribution to essential personnel.

For labs outside the card-key access areas, such as the Eye Institute or FH:

Doors to labs shall be locked when unattended by department personnel.

Stock vial storage areas containing quantities greater than 10 times Appendix A of DHS 157 shall be kept locked when unattended.

E. Check and Calibration Sealed Sources

A check source is any RAM less than a generally licensed quantity that is encased in a capsule designed to prevent leakage. Authorized Users may possess and use sealed sources for calibration and reference use.

F. Irradiators

Use of irradiators is limited to individual

Periodic Laboratory Surveys

Routine, documented surveys for contamination shall be performed to verify that the use of RAM has been contained and will not present an exposure hazard to staff or members of the public. The frequency of such surveys is listed in the table below:

<u>Quantity of RAM in Use at One Time*</u>	<u>Survey Frequency</u>
> 100 ALI**	Daily
10 - 100 ALI**	Weekly
< 10 ALI**	Monthly

* Quantity of RAM involved in the procedure, not the quantity of RAM in the stock vial from which it is withdrawn.

counted in a gamma counter are: Cr-51, I-125, Nb-95, Ru-103, Ce-141, and any isotopes utilized in microspheres (other than Y-90). The use of a gamma counter is similar to that of an LSC:

Use an absorbent material (e.g., cotton swab, alcohol wipe, kimwipe) to wipe the surface being investigated. The area of the wipe test shall be no less than 100 cm² (an area of 10 × 10 cm).

A background (blank) and a reference standard must be counted along with each batch of wipe tests to ensure that the equipment is functioning properly.

Geiger Counters – Under special conditions, a Geiger counter may be used to perform contamination surveys. The use of Geiger counters to perform surveys other than daily, non-documented monitoring is **only allowable with prior approval by the Office of Radiation Safety**. ORS will approve the use of a Geiger counter for such surveys if the following conditions are met:

The authorized user applies to the RSC (use the Amendment Form) and receives approval.

The use of the Geiger counter is restricted to monitoring for P-32.

The specific instrument that is to be used must be calibrated annually and certified for use by ORS.

Records of surveys must be maintained, the same as for other lab surveys.

If a Geiger counter is used in an area where other isotopes are also currently in use, a wipe test must also be done.

Contamination Limits

While the occupational dose limits are 50 mSv (5000 mrem) per year, and the dose limit for members of the public is 1 mSv (100 mrem) per year, it is the goal of the MCW Radiation Safety Program to keep the dose from RAM contamination to below 0.25 mSv (25 mrem) per year. In order to maintain doses below this level, limits for surface contamination are established below:

For laboratories performing surveys using LSCs or gamma counters that are automatically calibrated to give wipe test results in disintegrations per minute (DPM), the limit for removable surface contamination in both restricted areas and unrestricted areas is 2000 DPM/100 cm², unless otherwise stated as a condition of authorization by the RSC.

For laboratories performing surveys using LSCs or gamma counters that give wipe test results in counts per minute (CPM), results must be converted to DPM. To do this, the counting efficiency (Ccontamrd, the same

For laboratories using an ORS-certified Geiger counter, the contamination limit will be listed on the calibration certificate.

Decontamination

VII. Possession Limits

A. Kits for *In Vitro* Testing

The State has issued a general license to MCW and FH for the use of certain prepackaged kits, such as those used for radioimmunoassay (RIA). Strict activity limits apply to the following isotopes:

- ^3H Units not exceeding 50 μCi for each use
- ^{14}C Units not exceeding 10 μCi for each use

The following kits may also be used, with total possession not to exceed 200 Ci for each:

- ^{125}I Units not exceeding 10 μCi for each use

Transfers of RAM shall be approved by ORS prior to the transfer. Violations of this policy may result in disciplinary action against the Authorized Users involved.

Transferring to an Authorized User within MCW – ORS shall be informed of the transfer prior to transferring the RAM. ORS will need to know the nuclide, quantity, chemical form and inventory number of the material being transferred. After the transfer is approved, the new Authorized User will receive a new Material Use Sheet.

Transferring to and from Another Institution – Transfers may be made to other NRC or Agreement State licensees if prior approval is obtained from both institutions. Contact ORS for shipping and transfer procedures. **NO SHIPMENTS MAY OCCUR WITHOUT ORS APPROVAL.**

IX. Disposal of Low-Level Radioactive Waste

A. Waste Minimization

Authorized Users and radiation workers should be aware of the volume and activity of waste produced. Should any proposed work with RAM generate a waste that cannot be processed by the methods described in this section, contact ORS prior to beginning the project.

In all cases, whether waste is shipped for disposal or held onsite for decay, volume minimization is very important. Please survey materials to be sure that non-radioactive wastes are not unnecessarily placed in the radioactive waste.

B. Separation of Waste Types

ORS uses several methods to process low-level waste at MCW, depending on the chemical and physical form. It is essential that labs segregate waste according to type before it is offered to ORS for disposal.

HAZARDOUS MATERIALS, LEAD SHIELDING AND UNDEFACED RADIATION STICKERS OR LABELS ARE NOT PERMITTED IN RADIOACTIVE WASTE.

C. Scintillation Fluids

High-Flashpoint (Bio-Safe) Cocktail – As a general policy, MCW allows the use of only non-hazardous liquid scintillation (LS) fluids. In some cases, low-flashpoint (toluene-xylene based) cocktails may be used, but only with prior approval by ORS.

H-3 and C-14 – Liquid scintillation fluids containing only H-3 and C-14 in concentrations less than 0.05 Ci/ml must be kept separate from other scintillation fluids. The concentration is averaged over each “batch” of vials.

Isotopes with Half-Lives Less than 120 Days – LS fluids of this type can be held for decay, and must be separate from other types.

Other Isotopes or Fluids – The disposal of other long half-life isotopes or low flash-point cocktails must be arranged with ORS. These wastes are often EPA-regulated “mixed” wastes, the cost of disposal for which can be high. The Authorized User may need to bear a portion of the disposal costs.

All Other Isotopes – Waste from any isotopes other than H-3 and C-14 must be placed in separate bags.

Sharps – Contaminated sharps must be stored in approved sharps containers. Contaminated sharps must be segregated according to isotope, the same as for other dry, solid waste.

F. Biological Waste

Animal carcasses or tissue containing RAM must be disposed of through transfer to ORS. Waste must be bagged, tagged, and kept frozen.

Animal tissue containing H-3 or C-14 in quantities less than 0.05 Ci/gram, averaged over the weight of the entire tissue or carcass may be combined into the same bag.

All other isotopes or H-3 and C-14 concentration above 0.05 Ci/gram must be bagged separately.

Due to freezer space constraints, the Authorized User should consult with ORS before starting any projects involving biological waste containing RAM. The cost of storing biological waste may be passed on to the Authorized User.

G. Mixed Hazardous and Radioactive Waste

Projects that generate hazardous waste mixed with radioactive contamination must be declared on the Application for Authorization and approved by the RSC. Contact EHS for hazardous waste criteria.

H. Waste Tags

A waste tag must be completed for every item of waste. Waste tags are part of the Environmental Health and Safety Assistant (EHSA) online database, and should be printed from a computer. For special items, contact ORS for tags. The following information must be provided:

Authorized User name;
Isotope;
Activity;
Physical form (e.g. solid, biological);
Chemical form, if applicable for hazardous or other constituents;
Date completed.

Waste items without a radioactive waste tag, or with incomplete information will be sent back to the Authorized User, and will not be picked up by ORS.

I. Shipping Containers, Vials

Shipping Containers – Shipping containers and the secondary containment vial holders that arrive from the vendor with RAM orders are checked for contamination upon arrival at MCW. However, it is the responsibility of the Authorized User to verify boxes, cartons, shielded containers and any packing materials are not contaminated in the laboratory.

In general, shipping materials should be kept contamination-free so that they may be disposed of in the ordinary trash. Before disposal in the ordinary trash, verify that:

A survey confirms that no radioactive contamination is present,
All shipping labels or other markings or symbols indicating “Radioactive” or references to activity have been clearly defaced, so that a member of the public would not confuse the package for one containing radioactivity,

B. Spill Classification, Major or Minor

Radionuclides	Minor Spill		Major Spill
	Not Reportable	Reportable	Reportable
³ H, ¹⁴ C, ¹⁸ F, ³³ P, ³⁵ S, ⁴⁷ Ca, ⁴⁷ Sc, ⁵¹ Cr, ⁵⁵ Fe, ⁵⁷ Co, ⁶⁷ Ga, ⁷¹ Ge, ⁷² Ga, ⁸⁵ Kr, ⁹⁹ Mo, ^{99m} Tc, ¹⁰³ Pd, ^{113m} In, ¹¹⁵ Cd, ¹³³ Xe, ¹⁴¹ Ce, ¹⁷⁷ Lu, ¹⁹⁷ Hg, ²⁰¹ Tl, ²⁰² Tl	< 1 mCi	< 100 mCi	100 mCi
²² Na, ³² P, ³⁶ Cl, ⁴² K, ⁴⁵ Ca, ⁴⁶ Sc, ⁵⁴ Mn, ⁵⁸ Co, ⁵⁹ Fe, ⁶³ Ni, ⁶⁵ Zn, ⁷⁴ As, ⁷⁵ Se, ⁸⁵ Sr, ⁸⁶ Rb, ⁹⁰ Y, ⁹⁵ Nb, ⁹⁹ Tc, ¹⁰³ Ru, ¹⁰⁵ Ag, ¹⁰⁹ Cd, ¹¹¹ In, ¹¹³ Sn, ¹²³ I, ^{129m} Te, ¹²⁹ I, ¹³² Te, ¹⁴⁰ Ba, ¹⁴⁰ La, ¹⁴⁷ Pm, ¹⁵³ Gd, ¹⁹² Ir, ¹⁶⁹ Yb, ¹⁹⁸ Au, ²⁰³ Hg	< 0.1 mCi	< 10 mCi	10 mCi
⁶⁰ Co, ¹²⁵ I, ¹³¹ I, ¹³⁴ Cs, ¹³⁷ Cs, ¹⁴⁴ Ce	< 0.01 mCi	< 1 mCi	1 mCi
⁹⁰ Sr, ²¹⁰ Po	< 0.001 mCi	< 0.1 mCi	0.1 mCi

C. Minor Spill Procedures

1. Notify personnel in the area(s) that a spill has occurred.
2. Cover the spill with a suitable absorber.
3. Follow decontamination procedures in Section E.
4. Contact the ORS as soon as practical during normal working hours.
5. If the spill is not reportable, retain survey information for later review. If the spill is reportable, submit a written report to the Radiation Safety Officer within 7 days describing the incident including actions to be taken to prevent a recurrence.

D. Major Spill Procedures

1. Notify personnel in the proximity of the spill to vacate the room(s) or area(s).
2. Cover the spill with a suitable absorber, but do not attempt to clean it up. Confine the movement of all potentially contaminated personnel to prevent the spread.
3. If possible, the spill should be shielded, but only if it can be done without further contamination or significantly increasing your radiation exposure.
4. Contact the ORS or Security immediately.
5. Secure the area(s) as practical to restrict entry.
6. If personnel contamination is found or suspected, identify the contaminated area(s) with a survey meter. Follow personal decontamination procedures in Section F.
7. Decontamination may only be performed under the direction of the ORS. Follow decontamination procedures Section E.
8. Submit a written report to the Radiation Safety Officer within 7 days describing the incident including actions to be taken to prevent the recurrence.

E. Decontamination Procedures

1. Perform appropriate surveys. Draw a floor plan indicating area(s) where surveys were performed and document the results of the surveys.
2. Wear protective clothing and use remote handling equipment as necessary or appropriate. Absorb liquids with absorbent paper or other suitable absorbent.
3. Place contaminated materials into receptacles or bags designated for radioactive waste. Decontaminate until the removable contamination is below 200 dpm per 100 cm² in unrestricted areas or 2000 dpm per 100 cm² in restricted areas. During and at the end of clean up, monitor hands, shoes, clothing and any equipment used to clean up the spill.
4. If the contamination is not removable, suitable shielding materials may be used to cover the contamination until the radiation level is reduced to less than 3 times background in a unrestricted area or 6 times background in a restricted area.

F. Personnel Decontamination Procedures

1. Remove contaminated clothing and store for further evaluation by ORS.
2. If the spill is on the skin, flush thoroughly with lukewarm water and re-survey.
3. If the contamination is still present, wet hands and apply detergent. Work up good lather and keep lather wet. Use mild soap and lukewarm water.
4. Work lather into contaminated area(s) by rubbing gently for at least 5 minutes (flush with water for at least 15 minutes when washing eyes), applying water frequently and rinse thoroughly with lukewarm water.
5. Repeat above procedures 2 through 4 several times, gently scrubbing residual contaminated area(s), as necessary.

G. Known or Suspected Overexposure to Radiation

1. Eliminate the cause of the suspected overexposure and/or prevent personnel from entering area(s) where suspected high radiation levels exist.
2. Contact the ORS or Security immediately.
3. Transport overexposed personnel to the FH Emergency Department where appropriate medical assistance can be obtained.
4. Collect and forward dosimeters to ORS for emergency processing so that dose information can be obtained as soon as practical.
5. Submit a written report to the Radiation Safety Officer within 7 days describing the incident including subsequent actions to prevent recurrence.

H. Radioactive Dusts, Fumes and Gases

1. Have personnel in the area(s) evacuate the room or area(s) as quickly as practical.
2. Seal off area(s), if practical. Secure the room or area(s) to restrict entry into the contaminated area(s). Limit the movement of all involved employees to confine the potential spread of contamination.

3. Contact the ORS or Security immediately.
4. With a low energy range, thin window GM survey meter, check hands and clothing of involved individuals for contamination.
5. Decontamination is to be performed under the direction of ORS.
6. Perform an air monitor survey. Work shall not be permitted in the affected room until approved by the Radiation Safety Officer.
7. Submit a written report to the Radiation Safety Officer within 7 days describing the incident including subsequent actions to prevent recurrence.

XI. Records

A. Training Records

Radiation workers training records are to be kept by each Authorized User and a copy of the training form must be sent to ORS. If a radiation worker transfers to another Authorized User, the training record will follow the worker, with the new Authorized User responsible for the training of the worker in areas specific to the new job duties. This new training must also be documented with a copy furnished to the ORS. Training

E. Laboratory Audits

The ORS conducts inspections (audits) of areas where unsealed sources of RAM is used or stored on a quarterly basis. Audits normally check for:

1. Performance of contamination surveys at proper intervals and detection levels.
2. Proper laboratory procedures (e.g., storage, use and disposal of RAM).
3. Markings, labels and postings in accordance with procedures.
4. Required record keeping (e.g., waste disposal, aqueous waste, etc.).
5. Any items not in compliance with the authorization, institutional policy, state and federal regulations.
6. Other items based on current compliance trends and issues.

Exposure Type	Annual Limits for Radiation Workers		ALARA Level I (per calendar quarter)		ALARA Level II (per calendar quarter)	
	mSv	mrem	mSv	mrem	mSv	mrem
Whole Body		5,000	1.25	125	3.75	375
Extremity or Skin*	500	50,000	12.5	1,250	37.5	3,750

Individual 117.187e85(.7803 ref38.243.76472003 r3)005B5(n)7,(,al672001138)00)3(n*)TB.Organs550,00012.5 1,250

Appendix A

Laboratory Classification Scheme

Isotope	Relative Radiotoxicity	Type 1 Lab Possession Limit (mCi)*	Type 2 Lab Possession Limit (mCi)	Type 3 Lab Possession Limit (mCi)	Type 4 Lab Possession Limit (mCi)
H-3	1	10	100	1000	10000
C-14	1	1	10	100	1000
F-18	1	10	100	1000	10000
Na-22	2	0.1	1	10	100
P-32	2	0.1	1	10	100
P-33	1	1	10	100	1000
S-35	1	1	10	100	1000
Cl-36	2	0.1	1	10	100
K-42	1	10	100	1000	10000
Ca-45	2	1	10	100	1000
Sc-46	2	0.1	1	10	100
Cr-51	1	10	100	1000	10000
Mn-54	2	1	10	100	1000
Fe-55	1	1	10	100	1000
Fe-59	2	0.1	1	10	100
Co-57	2	1	10	100	1000
Co-58	1	1	10	100	1000
Ni-63	1	1	10	100	1000
Zn-65	2	0.1	1	10	100
Ge-71	1	10	100	1000	10000
Ga-67	1	10	100	1000	10000
As-74	2	1	10	100	1000
Se-75	2	1	10	100	1000
2310	1000	100000	10000		

Appendix A

* Except as noted in 10 CFR 33.11

For laboratories using more than one isotope, the sum of the fractions (actual possession limit: maximum possession limit) shall not exceed one.

The actual hazard of working with radionuclides is dependent on the processes performed, as well as the relative radiotoxicity. For this reason, modifying factors to the possession limits listed above are appropriate for all but Type 1 Laboratories.

Modifying factors for Types 2, 3 and 4 laboratories:

10	Simple wet operations
1	Normal chemical operations; labeling
0.1	Complex chemical operations
0.1	Simple dry operations
0.01	Dry and dusty operations

Relative Radiotoxicity:

1	Slight
2	Moderate
3	High
4	Very High

