

Radiation Safety Guide - Research

The University Of Iowa
[Environmental Health & Safety](#)
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Date Revised/Reviewed: 2019

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Preface

The University of Iowa is committed to providing its patients, visitors, students and employees with an environment where sources of radiation are used safely for the purposes of medicine, research and teaching. Attainment of this goal requires the cooperation and commitment of all persons involved.

The Environmental Health & Safety Office (EHS) is responsible for implementing the University's radiation safety program as defined by its Radiation Safety Committees, broadscope license, and state and federal regulations. Department heads, faculty members, supervisors and individual users are directly responsible for maintaining an environment that promotes compliance with these policies, license conditions, and regulations.

The purpose of this guide is to provide the necessary operational and procedural information for the safe use of sources of ionizing radiation at The University of Iowa. This guide, along with the information available from the EHS's radiation safety training sessions and educational materials should enable the radiation worker to understand and practice the safe use of ionizing radiation sources to ensure that any resultant exposure is "as low as reasonably achievable."

This guide was prepared by Environmental Health & Safety and approved by The University of Iowa's Executive Committee.

It supersedes previous University radiation protection guides.

The University of Iowa prohibits discrimination in employment and in its educational programs and activities on the basis of race, national origin, color, creed, religion, sex, age, disability, veteran status, sexual orientation, gender identity, or associational preference. The University also affirms its commitment to providing equal opportunities and equal access to University facilities. For additional information on nondiscrimination policies, contact the Coordinator of Title IX, Section 504, and the ADA in the Office of Affirmative Action, (319) 335-0705 (voice) or (319) 335-0697 (text), 202 Jessup Hall, The University of Iowa, Iowa City, Iowa, 52242-1316.

Radioactive Material Spill Response Information

In the event of a spill or accident involving radioactive materials, contact Environmental Health & Safety at 335-8501. If the phone call is placed outside of normal working hours, you will be connected to UI Public Safety.

UIHC Routine Security – 356-2658

UIHC Emergencies – 195 (outside UIHC dial 911)

- Serious Accidents
- Fire
- Unmanageable Chemical/Radioactive Material Spill
- Disruptive, Hostile, Threatening Visitor, Family, or Staff
- Patient Safety/Security Threat
- Possession of Deadly Weapons by Patients, Visitors, or Staff
- Bomb Threat

UI Public Safety – 335-5022

UI Emergencies - 911(inside UIHC dial 195)

- Serious Accidents
- Fire
- Unmanageable Chemical/Radioactive Material Spill
- Ambulance

1.0 Obtaining Authorization for Use of Radioactive Material

The use of radioactive materials at The University of Iowa is permitted only by or under the supervision of a Principal Investigator who has been approved by the University's Radiation Protection Committee. Consideration for approval as an authorized Principal Investigator (PI) for non-human use requires:

Permanent appointment at The University of Iowa.

Completion of the EHS's Basic Radiation Safety Training prior to using radioactive materials.

Submission of a resume of training and experience with radioactive materials.

Submission of a completed "*Authorization Request for Radioactive Materials Use in the Basic Sciences.*"

1.1 Application for Initial Use

To apply for initial use of radioactive tracers and sealed sources, contact EHS at 353-5389 to schedule a meeting to discuss your proposed usage. Then complete the "Authorization Request for Radioactive Materials Use in the Basic Sciences" form found on the EHS website [21 and mail it to EHS. Upon receipt, the application is initially reviewed by EHS and then forwarded to the Basic Science Radiation Protection Committee for their review. The authorization process usually takes 3-4 weeks to complete.

Once the authorization is approved, an authorization number is granted. The authorization is limited to only the radionuclide(s), chemical form(s), and methodologies identified in the application.

1.2 Application to Amend Use

The initial authorization must be amended whenever changes need to be made to the existing application. More specifically, amendments are required for the following:

- Addition or deletion of personnel.
- Addition or deletion of radioactive material use areas.
- Change in per shipment or on-hand activity limits.
- Change in radionuclide type or chemical form or methodology.

To amend an existing authorization, complete the amendment form found online at the EHS website.

1.3 Authorization Renewal Process

Each authorization for the use of radioactive materials in the basic sciences is renewed annually during a meeting between an EHS representative and the PI. The purpose of the renewal meeting is to review activities conducted under the authorization during the past year, and to ensure that EHS records (including the radioactive materials inventory) agree with the PI's usage. **This meeting satisfies the PI's annual radiation safety training requirement.**

1.4 Specific Requirements for Animal Use

Facilities used to house laboratory animals containing radioactive materials are approved on a case-by-case basis. Protocols involving the use of radioactive materials in animals require approval from the Radiation Safety Committee and the Office of Animal Resources (OAR). A "Hazardous Agent Review" form must be developed for research studies requiring OAR housing of animals containing radioactive material and must describe procedures for managing radioactive excreta, carcasses and contaminated cages and facilities. This form is available online at the [Office of Animal Resources](#).

Additionally, animal cages are required to be labeled with a "Caution - Radioactive Materials" warning notice, which includes the radionuclide administered, the activity (in microcuries), the date of the administration, the measured external radiation level at one foot from the cage, the name(s) and phone number(s) of the individual(s) to contact in the event of an emergency.

The user is responsible for preparing solid excreta, bedding and animal carcasses for disposal according to the instructions provided in EHS's "Waste Management Guidelines and Procedures Manual." Contact EHS regarding specific requirements.

Cages must be cleaned, decontaminated, and surveyed before they are returned to the OAR for unrestricted use.

1.5 Responsibilities of the Principal Investigator

The PI is ultimately responsible for the use of radioactive materials listed on his/her application and keeping the authorization current. This includes responsibility for ensuring that:

- Personnel receive EHS radiation safety training as required and adhere to radiation safety policies and regulations.
- Provide and document site specific radiation & hazard awareness training for your personnel that covers safe handling of all hazardous materials involved in their work in your lab.
- Provide direct supervision of inexperienced personnel using radioactive materials during initial uses.
- An accurate inventory of radioactive material in your possession shall be maintained. Each PI is expected to maintain an auditable record of all radioactive material from the

time of acquisition through use, storage, and final disposition as radioactive waste or transfer to another approved individual. Inventory records should be maintained for three years and available for inspection.

- Radiation surveys of radioactive materials use areas are performed and documented sufficiently to control contamination and maintain exposures "as low as reasonably achievable" (ALARA).
- A copy of the Radiation Protection Guide should be available to individuals listed on the PI's radioactive materials authorization. The PI is responsible for ensuring that individuals using radioactive materials under his/her supervision are familiar with the content of this guide.
- The EHS is notified of all spills involving radioactive materials as soon as possible. Report all missing sources and incidents of personnel contamination to EHS immediately.

1.6 Security of Radioactive Material

Securing of radioactive material against unauthorized access or removal is required by regulations. To ensure adherence to this requirement, EHS provides the following guidance:

- Radioactive materials and waste are considered secure if they are locked in a cabinet, refrigerator, etc., when unattended.
- Laboratories containing radioactive material or waste that are not otherwise secured as described above are required to have the lab door secured from unauthorized entry when left unattended.

1.7 Supervision

It is the PI's responsibility to ensure that all individuals named as users on his/her application are familiar with the content of the approved authorization. Only individuals who have completed required EHS training and are named on a PI's application are permitted to work with radioactive materials.

1.8 PI Absences

Principal investigators are required to notify EHS prior to extended absences (greater than 1 month). PI's must also designate an individual (preferably another principal investigator or an RA with radioactive materials use experience) to assume responsibility for radioactive materials use in their absence.

1.9 Terminating Authorization

PI's are required to contact EHS prior to leaving the University or when they no longer need to use radioactive materials. This will enable EHS to assist in the identification and removal of radioactive materials from work areas and in the timely termination of their radioactive materials authorization. EHS's "Application Cancellation" form is available online at the [EHS website](#).

2.0 Radiation Safety Training

2.1 Basic Radiation Safety Training

All new prospective users not previously authorized to use radioactive materials at The University of Iowa, including the principal investigator, are required to complete EHS's "Basic Radiation Safety Training" prior to beginning work with radioactive materials.

2.2 Annual Refresher Training

All personnel (with the exception of the authorized principal investigator) named as users on an approved radioactive materials authorization, who have previously completed EHS's basic radiation safety training, are required to complete "refresher training" annually.

Basic Radiation Safety Training along with Radiation Safety Refresher Training can be accessed at the EHS website.

3.0 Acquisition of Radioactive Materials

All individuals obtaining radioactive material for use at The University of Iowa must have prior authorization from the Radiation Safety Committee and the Radiation Safety Officer (RSO) that permits them to receive the quantity and chemical form of the material they are obtaining. This requirement pertains to all purchases, transfers from another individual or facility, receipts from vendors as a gift or demonstration samples, or any other receipt of licensed radioactive material. Instruct vendors to ship your radioactive material order to EHS at 311 Grand Avenue, Iowa City, Iowa 52246-2503. Remember – any radioactive material ordered must be listed on an approved application.

3.1 Ordering

- Step #1** Obtain PO # from the Purchasing Department.
- Step #2** Place the order through BioChem Stores or with the licensed vendor.
- Step #3** Instruct the vendor to ship the material to:

The University of Iowa
Environmental Health & Safety
311 Grand Ave. Ct.
Iowa City, IA 52246-2503

Attn: Principal Investigator's Name, Lab & Building, and Recipient Name

(Very Important: This information is necessary to prevent delays in delivery)

3.2 Delivery

Radioactive material shipments normally arrive at EHS mid-morning during normal weather conditions. At the time of delivery, EHS inspects the shipment for damage, exposure rate and contamination. You can expect delivery of your shipment by EHS from early to mid-afternoon.

3.3 Package Opening and Survey Requirements

Prior to delivery of the package, EHS verifies that the outer surface of the shipment is free of contamination. **However, the user should assume that the internal surfaces of the package (packaging material and source vial) may be contaminated and handled accordingly until proven otherwise by the user's own survey.** The principal investigator is ultimately responsible for the accountability of the radioactive material he or she orders.

- Appropriate personal protective equipment (PPE) should be utilized when opening incoming radioactive materials shipments.
- Packages containing radioactive sodium iodide or other volatile radionuclide compounds (such as S-35 methionine) should be opened in an operating fume hood.
- Open the outer package and remove the packing slip and confirm that the material received is the material ordered.
- Check the integrity of the final source container.
- Perform a wipe test of the external surface of the final source container to verify it is free of contamination.
- Add the shipment to the PI's inventory record.

Survey the packing material to ensure that it is free of contamination and obliterate all radiation warning labels before discarding as normal trash.

4.0 Transfer of Radioactive Materials

4.1 On-campus Transfers

Radioactive materials transfers are only permitted between authorized investigators. Transfer recipients must be approved for the radionuclide, chemical form and quantity of radioactive material they wish to receive.

For each transfer, obtain a "Transfer of Radioactive Materials" form from EHS (335-9550), or at the EHS website. This form serves to document the exchange of inventory between the two applications. Forward a copy of the completed transfer form to EHS. The radioactive material must be transported on foot in an unbreakable, secondary container to ensure that the radioactive material cannot be spilled if the container is dropped or bumped. For identification purposes, place a radioactive material warning label on the secondary container. Never leave the material you are transferring unattended. Radioactive material cannot be transferred in a motor vehicle or on public

transportation unless specifically authorized by EHS to ensure that it meets all applicable Department of Transportation Regulations.

Contact EHS at 353-5389 if radioactive material must be transferred other than by foot. Transport of radioactive material on public roads and highways must comply with Department of Transportation (DOT) regulations. EHS requests at least 24 hours' notice prior to the date you need the material transported.

4.2 Off-Campus Shipping

The shipment of radioactive material must comply with Department of Transportation (DOT) and International Air Transport Association (IATA) regulations. EHS requires at least 2 – 3 days' notice in order to obtain a copy of the recipient's radioactive materials license verifying their authorization to receive the shipment and prepare the shipment, prior to the date you need the material sent. Contact EHS at 335-8518 for assistance with shipping radioactive material off-campus.

5.0 Radiation Safety Guidelines

5.1 Responsibilities of the Individual User

Individual users are required to adhere to state and federal regulations and University policies concerning radioactive materials usage. User responsibilities include:

- Limit use to authorized radionuclides, chemical forms, quantities, and use methodologies.
- Avoid unnecessary exposures.
- Keep inventory and radioactive waste records current.
- Perform thorough and timely exposure and contamination surveys.
- Wear appropriate protective apparel and use protective equipment as necessary for the type and quantity of ionizing radiation present.
- Use spill trays and absorbent bench paper to prevent/control contamination from radioactive materials.
- Label items and equipment that are used to manipulate or store radioactive materials.
- Decontaminate items and equipment promptly.
- Notify EHS prior to lab relocations, remodeling and renovation, and prior to maintenance activities.
- Notify EHS of all spills and incidents of personnel contamination.
- Notify EHS prior to lab relocations, remodeling and renovation, and prior to maintenance activities.
- Equipment, glassware, etc., used in the manipulation or processing of radioactive materials has the potential of becoming contaminated and should be treated as such until proven otherwise by appropriate survey.

- Contaminated items or equipment from a posted area should not be transferred to a non-posted area.

5.2 Contamination and Exposure Control

Individuals using radioactive materials are responsible for conducting and documenting radiation surveys of their radioactive materials use and storage areas. User survey methods must be capable of detecting the type(s) of radioactive material in use or in storage, at a frequency to control contamination and maintain radiation exposures ALARA. It is prudent practice to perform surveys after each use or before leaving an area posted for radioactive materials work. EHS audits the effectiveness of user contamination and exposure control measures on a periodic basis and may require that survey frequency be increased if evidence of contamination is found.

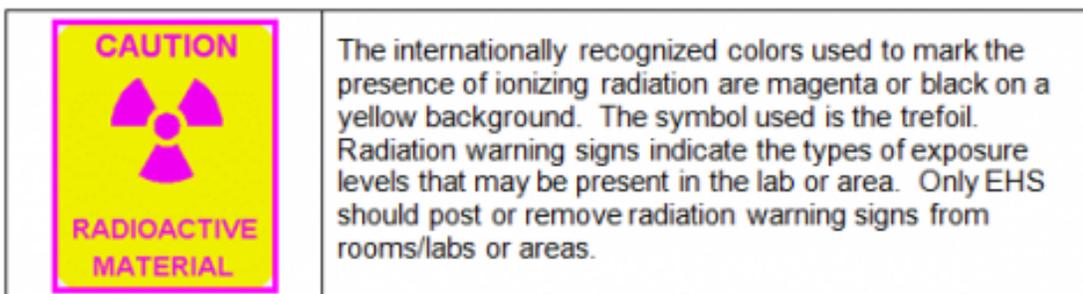
Check common use items and areas such as bench tops, water baths, centrifuges, telephones, handles, doorknobs, control knobs, floors in labs and entryways to adjacent clean areas. Monitor hands, lab coats and soles of shoes frequently. Clean up contamination immediately to prevent or minimize its spread. If necessary, contact EHS for assistance in decontamination of equipment or work areas.

A survey/inventory form may be found at the EHS website.

Area Contamination Action Levels

- Recommended Action Level: ≥ 200 dpm/100 cm²
- Action Required: $\geq 2,000$ dpm/100 cm²

5.3 Radiation Warning Signs and Labels



- **Caution – Radioactive Materials.** This warning sign is used to indicate that radioactive materials may be used or stored in this lab or area.
- **Caution – Radiation Area.** This warning sign is used to indicate areas where radiation levels may exist that are in excess of 5 mrem per hour at a distance of 30 cm from the source of radiation or from any surface that the radiation penetrates.

- **Caution – High Radiation Area.** This warning sign is used to indicate areas where radiation levels may exist that are in excess of 100 mrem per hour at a distance of 30 cm from the source of radiation or from any surface that the radiation penetrates.
- **Radiation Warning Labels.** Use radiation warning labels to mark containers and equipment used to manipulate or store radioactive materials, contaminated items, or other sources of ionizing radiation.
- Remove all radiation warning labels on items that no longer contain radioactive material, are no longer contaminated as determined by the appropriate survey or can no longer produce ionizing radiation.

5.4 Laboratory Safety Guidelines

Time. Radiation dose is directly proportional to the length of time exposed to a radiation source. Therefore, the less time spent near such a source, the smaller the total dose received.

Distance. Distance is one of the simplest and most effective means of reducing radiation exposure. The relationship between distance and dose rate follows the inverse square law for point sources of penetrating radiation (x- or gamma). That is, doubling the distance from such sources will reduce the exposure by approximately a factor of four. Distance can be used to significantly reduce exposure from a radiation source. Additionally, the use of tongs or other handling devices can significantly reduce finger extremity exposure.

Shielding. Properly shielding sources of radiation can dramatically reduce the dose to personnel. It is important to choose shielding appropriate for the type of radiation involved. For instance, Plexiglas is an effective shielding for beta emitters, whereas lead is a better material for gamma radiation. Shielding is available in a variety of forms, e.g., bricks, sheets, etc. Contact EHS at 335-8501 for guidance on shielding types and supplies.

5.5 General Rules of Good Practice

All work with radioactive material should be conducted in a manner designed to keep radiation exposure "as low as reasonably achievable" (ALARA).

- Be familiar with the materials you are working with (e.g., chemical, biological, radioactive). Refer to written laboratory protocols and review the MSDS (Material Safety Data Sheets) for chemicals. Consider the toxicity of the materials and the health and safety hazards of each procedure (e.g., generation of aerosols). Take advantage of the knowledge and experience of laboratory personnel and the safety equipment that is available.
- Do not work alone in the laboratory. When hazardous operations are conducted, arrangements should be made to have another person present in the lab.
- Conduct practice runs (without radioactive material) of operations that will use radioactive materials to investigate which activities have the potential to produce contamination, volatile material and/or aerosols.

- Know and have available in the posted area, emergency information concerning each methodology used involving radioactive materials. Consider all hazards involved in the work such as mechanical, electrical, chemical, biological and fire.
- Work over absorbent, plastic-backed bench paper or spill trays to prevent contamination of lab surfaces. Monitor and replace as needed on a regular basis.
- Remove funnels and keep all radioactive waste containers covered or capped when not in use.
- After working with radioactive materials, personnel should wash their hands and check hands and shoes for contamination.
- Monitor work surfaces and equipment for contamination.

5.6 Prohibited Activities

- Eating, drinking, smoking, food storage, or the application of cosmetics in any area posted for the use and/or storage of radioactive materials.
- Leaving radioactive materials unsecured while unattended.
- The use of microwave ovens in posted areas to heat food or beverages for human consumption.
- Pipetting of radioactive solutions by mouth.
- Storage or use of radioactive materials in areas not approved by EHS and posted for such use (such as non-authorized laboratories, hallways, and stairwells).

5.7 Personal Protective Equipment (PPE)

- Minimize skin exposure at all times.
- Always wear appropriate clothing in the laboratory (e.g., pants, shirts, shoes). Open toed shoes or sandals are prohibited; shorts and skirts are not recommended.
- Wear disposable gloves and lab coat at all times while directly handling primary containers of unsealed sources of radioactive material.
- Remove PPE before leaving a posted area to prevent contamination in non-posted areas.

5.8 Biosafety Cabinets/Culture Hoods

Working with volatile radioactive material is not recommended in biosafety cabinets not vented to the outside. Most biosafety cabinets on campus recirculate HEPA-filtered air back into the room. Please contact EHS's Biological Safety Officer at 335-8501 if you need to use radioactive materials in a biological safety cabinet or culture hood.

5.9 Fume Hoods

Radioactive materials operations producing aerosols or volatile compounds should be performed in a fume hood.

Use radioactive materials in fume hoods that have a current EHS air flow performance sticker.

Contact EHS at 335-8501 to schedule an air flow performance check or for additional information on specific use requirements, or visit EHS's website.

5.10 Iodination Requirements and Safety

Volatile, radioiodine use areas are approved on a case-by-case basis. **For use of unbound forms of 1-125 or 1-131 over 1 mCi, the use of a charcoal-filtered mini-hood located within an operating fume hood is required.** The mini-hood serves to greatly minimize the chance of both personnel exposure and area contamination. Contact EHS at 335-8501 for information pertaining to the use of charcoal-filtered mini-hoods.

5.11 Sulfur-35 Volatility Control Requirements

Users of volatile S-35 labeled compounds such as methionine and cysteine and high specific-activity thio-labeled nucleotides are required to take steps to control contamination due to the volatility of these compounds. EHS evaluates requests to use these compounds on a case-by-case basis.

Generally, use of volatile S-35 compounds require the use of activated charcoal cartridges or filter papers during incubation procedures; secondary containment during storage; and venting with a charcoal trap when withdrawing activity from stock vials. Lab personnel are encouraged to perform contamination surveys following each use of these compounds.

5.12 Chlorine-36 Requirements

Due to its extremely long half life (301,000 yrs), use of Chlorine-36 is generally discouraged. However, if no suitable alternatives are available the following guidelines must be followed:

- Handle and store millicurie or greater amounts behind plexiglass shields of approximately 0.5 cm thickness.
- A survey meter should be used to monitor work surfaces after each use. Records of dry wipe smear surveys should also be maintained for inspection.
- Cl-36 liquid waste must be segregated from all other liquid radioactive wastes.

5.13 Facility Maintenance and Renovation

All facilities in which radioactive materials have been used or stored need to be surveyed prior to maintenance or renovation activities. Contact EHS a minimum of 1 week prior to scheduled work so that required surveys can be performed.

5.14 Equipment Service and Surplus

Any equipment or apparatus used to manipulate or store radioactive material must be free of radioactive contamination prior to being serviced or disposed of. Contact EHS prior to scheduled work so that required surveys can be performed.

5.15 Posting and Deposting Laboratory Spaces

Areas in which radioactive materials are used or stored must be posted as such by EHS. Contact EHS at 335-8501 prior to using or storing radioactive materials in any area. EHS will put up the appropriate signs and create diagram(s) of the area(s) as needed.

Similarly, all areas in which radioactive materials were used or stored must be verified free of radioactive materials, waste and contamination before signs can be removed and the room is released for general use. Contact EHS as soon as you know that you will no longer be using an area so that these surveys can be performed.

6.0 Instrument Calibration

6.1 Requirements

Radiation monitoring instruments used for quantitative radiation measurements must be calibrated at intervals not to exceed 12 months as required by regulation. This includes survey meters used in research labs and any other location where quantitative radiation determinations are needed. Survey instruments that have never been calibrated or are out-of-calibration cannot be used. Instruments found out-of-calibration by EHS will be tagged as "out-of-service."

6.2 Calibration Services

EHS or another appropriately licensed vendor must perform the annual calibration test. Contact EHS at 335-8501 for more information regarding instrument calibration services, or visit the EHS website.

7.0 Maximum Permissible Dose Limits

7.1 Radiation Workers

The maximum permissible occupational dose limits for adult radiation workers are listed below. The limits apply to any combination of dose received from external or internal exposure. These limits do not apply to doses received from background radiation or from medical tests or procedures. An adult radiation worker is defined as an individual 18 years of age or older. Iowa child labor laws prohibit individuals under the age of 18 from working with certain types of radioactive materials or in certain areas where occupational radiation exposure may occur. It is EHS policy that minors are not normally permitted to work with sources of ionizing radiation at The University of Iowa. For further information regarding this policy, please contact EHS at 335-8501.

	Annual Maximum Permissible Dose Limit	
	mrem	rem
Whole Body Deep Dose Equivalent <i>(Head, trunk, active blood-forming organs & reproductive organs)</i>	5,000	5
Whole Body Shallow Dose Equivalent <i>(Skin of the whole body)</i>	50,000	50
Lens of Eye Dose Equivalent	15,000	15
Extremities <i>(Hands, forearms, feet and ankles)</i>	50,000	50

7.2 Embryo/Fetus of a Declared Pregnant Radiation Worker

Under state and federal law, the dose limit of the pregnant radiation worker is 5,000 mrem per year until she specifically declares her pregnancy in a written and signed statement. The declaration is voluntary. The dose limit to the embryo/fetus is limited to 500 mrem for the duration of the pregnancy following receipt of a signed pregnancy declaration form.

Upon the receipt of a pregnancy declaration form, EHS will monitor potential internal and/or external exposure to the embryo/fetus as appropriate. A copy of EHS's pregnancy declaration form is available at the EHS website.

EHS recommends that a pregnant radiation worker declare her pregnancy so that routine and non-routine work situations can be evaluated to ensure that the dose to the unborn child does not exceed 500 mrem over the duration of the pregnancy.

7.3 Members of the General Public

The limit to members of the general public (including laboratory workers not involved in working with sources of ionizing radiation) is 100 mrem per year from licensed activities at this institution.

8.0 The ALARA Program

The maximum permissible occupational dose limits established by regulation are based on limiting individual radiation dose to what is considered to be an acceptable level of occupational risk. However, it is assumed that any radiation exposure may carry some risk. Therefore, regulation also requires that the University provide a program designed to reduce exposures As Low As Reasonably Achievable (ALARA) to the extent practical by utilizing procedural and engineering controls.

The University's ALARA Program provides a process for the Radiation Safety Committee and the Radiation Safety Officer to investigate any occurrences where occupational exposures exceed established program action levels. Additionally, EHS provides instruction on implementing ALARA practices to minimize radiation exposure.

Action Levels. The University has established the following investigational levels for occupational exposure to radiation.

ALARA Level I	ALARA Level II	
200 mrem/month	400 mrem/month	Whole Body Deep Dose Equivalent (Head, trunk, active blood-forming organs & reproductive organs)
2000 mrem/month	4000 mrem/month	Whole Body Shallow Dose Equivalent (Skin of the whole body)
600 mrem/month	1200 mrem/month	Lens of Eye Dose Equivalent
2000 mrem month	4000 mrem/month	Extremities (Hands, forearms, feet and ankles)

Action Level I

In addition to contacting the exposed individuals and their supervisor, EHS requires the completion of a questionnaire regarding the possible cause(s) in this category.

Action Level II

In addition to operational and Level I actions, EHS requires a meeting with the staff member and supervisor in its investigation of an exposure in this category.

9.0 Determination of Exposure

9.1 Personal Dosimeters

Personal monitoring devices used to record occupational radiation exposures are supplied and processed through a commercial dosimeter service accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards & Technology. The administration and management of the personnel monitoring program is provided by EHS. Copies of dosimetry reports are provided to each dosimeter account and are maintained on file at EHS.

Personal dosimeters are assigned to individuals based upon regulatory requirements and their potential occupational exposure to penetrating radiation. Dosimeters are not effective for measurement of exposure from H-3, C-14, P-33, S-35, and Ni-63. Dosimeters are normally exchanged on a monthly basis. Temporary dosimeters are available for interim issue until permanent dosimeter assignment is established. EHS's dosimetry request and change forms are available online at the EHS website. For questions on dosimeter usage, call EHS at 335-8501.

9.1.1 Types of Dosimeters

Whole body dosimeters provide measurement of penetrating and non-penetrating radiation. Penetrating radiation is designated on reports as "DDE" for deep dose equivalent, and includes exposure to the whole body (head, trunk, active blood-forming organs, and reproductive organs). Non-penetrating radiation is designated on reports as "SDE" for shallow dose equivalent, and includes exposure to the skin and extremities. Lens of the eye dose equivalent is designated as "LDE."

Ring dosimeters provide measurement of radiation exposure to the extremities (hands and forearms).

9.1.2 Dosimeter Requirements for Personnel Using Radioactive Materials in Research Laboratories:

Whole body and ring dosimeters are required for individuals who routinely work with > 1mCi quantities of:

- Beta emitters with average energies > 250 keV (P-32)
- Gamma emitters with max. energies > 20 keV (Cr-51)

9.1.3 Returning Dosimeters

Monthly dosimeters must be received by EHS by no later than the 10th day of the month following the wear period. If dosimeters are received late or lost three or more times during a 12-month period, one of two things will happen, depending on your status as a dosimeter participant:

1. Required Participants –The department of an individual who is required to have dosimetry based on his/her job duties will be assessed an administrative fee. This will continue for each subsequent lost or late dosimeter until the participant has less than three late or missing dosimeters during the preceding 12 month period.
2. Elective Participants - Dosimeter service will be canceled following the third late or lost dosimeter. Individuals wishing to reinstate dosimeter services, are required to contact EHS and pay an administrative reinstatement fee.

9.2 Bioassays

Thyroid and/or urine bioassays are performed for personnel for whom internal exposure to radioactive materials is considered most likely.

Bioassays are normally performed for:

- Users of unbound radioiodine.
- Individuals using large quantities of radioactive materials as determined by EHS.
- Declared pregnant radiation workers working with unsealed radioactive material.
- Individuals with accidental or suspected intake of radioactive material.
- Anyone who suspects that they have had an intake of radioactive material through any pathway (for example, ingestion, inhalation or skin absorption) should contact EHS immediately at 335-8501 so that an evaluation can be performed.

10.0 Emergency and Spill Response Procedures

Each radioactive material user must be ready and equipped to handle a radiological spill or emergency. Information and knowledge concerning the type of radioactive materials being

used, the availability of adequate spill response supplies, and knowing when and who to call for assistance are all critical elements needed to effectively respond to any type of radioactive material incident. No one should work with radioactive material unless they have received proper training. It is the responsibility of the PI to ensure that personnel are trained and periodically practice likely spill or emergency response scenarios. EHS is available to provide guidance, training and support regarding spill and emergency response strategies and management.

Emergency and spill response procedures are required to be developed and readily available to personnel as a condition of radioactive materials use authorization. The information should include recognition of spills and emergencies; how to handle the spill/emergency; first aid, containment and clean up. Keep this information up-to-date.

10.1 Emergency Contact Phone Numbers

University Public Safety 911
Fire, Police, Ambulance 911
UIHC Emergency Treatment 356-2233

10.2 Spill Response Guidance

Collect MSDS's for all hazardous chemicals that may be used in conjunction with radioactive materials work. Maintain a call list (daytime and after-hours) of individuals who should be notified in the event of a spill. Maintain appropriate spill response supplies. These supplies can be obtained from lab safety suppliers, and the University's General, Biochemistry and Chemistry Stores.

Some general guidelines include:

- Report all spills and incidents of personnel contamination to EHS (335-8501) and the principal investigator.
- Notify others in the area that a spill has occurred and restrict movement of personnel in the area to avoid the spread of contamination.
- If the spill involves other hazards such as a serious personal injury or fire, call 911.
- Do not delay medical assistance for personal injuries because of the possibility of contamination. Inform medical responders of the potential contamination and material involved so that they can take appropriate action.
- Monitor individuals in spill areas for possible contamination prior to their leaving the area. Monitoring should include hands, clothing, and soles of shoes.
- Do not risk contamination to save an experiment unless not doing so would cause a significant safety risk.
- If necessary, cover the spill with absorbent material to prevent the spread of contamination.
- Survey the area, as appropriate, to determine the extent of the contamination.

- Wear appropriate protective apparel such as shoe covers, disposable gloves and a lab coat when cleaning up a radioactive materials spill.

10.3 Personnel Contamination and Injury

Remove contaminated clothing and flood the exposed area with warm water and wash with a mild soap. Continue until contamination has been removed or upon the advice of EHS. Avoid the use of abrasive materials that could injure skin and increase absorption. Do not use organic solvents; these compounds may increase the probability of the radioactive material penetrating the pores of the skin. In some instances, it may be possible to cover that contaminated area with plastic wrap to induce perspiration that can help remove contamination from the skin. Notify EHS at 335-8501 of all incidents of personnel contamination as soon as possible.

Never delay medical attention due to the possibility of radioactive contamination. Medical attention is available 24 hours a day at the UIHC's Emergency Treatment Center or by calling 356-2233. Report all personal injuries as required to your supervisor and EHS.

- Minor injuries. Wash with soap and water to remove contamination.
- Major injuries. Call 911 and provide medical treatment appropriate for the nature of the injury.
- Splash in eyes. Immediately rinse eyes continuously with water for at least 15 minutes. Obtain medical attention as needed.

10.4 Missing Radioactive Materials

Immediately report all missing sources of radioactive material to EHS at 335-8501.

Unaccounted for radioactive material can result in a serious safety and regulatory concern.

11.0 Radioactive Waste

Radioactive waste must be properly prepared to ensure that all regulatory requirements are met. Waste not properly identified and prepared cannot be picked up for disposal. Radioactive waste tags are supplied with the waste containers. Radioactive waste is considered licensed material and remains subject to the same regulatory requirements as the original radioactive material. Maintain secure storage of radioactive waste at all times. If possible, store waste in the area where it is generated.

Sewering of liquid radioactive waste is prohibited unless specifically authorized by EHS.

Some general guidelines for radioactive waste handling and disposal are outlined below.

- Segregate different waste types into separate containers. Segregate waste containing short-lived from long-lived radioisotopes.
- Keep volumes of liquid waste small.
- Store liquid waste containers in a secondary container capable of containing the entire volume should the primary one break.
- Avoid accumulating radioactive waste containers – arrange for timely radioactive waste pick-ups by EHS.
- Ensure that lids and caps of radioactive waste containers are securely in place at all times when the container is not in use.
- When necessary, shield radioactive waste stored in frequently occupied areas in accordance with the ALARA requirements. ALARA objectives should be <0.5 mR/hour for any lab areas where personnel are routinely present.
- Be aware that dangerous chemical reactions can occur between mixtures of liquid wastes. Personnel should not mix waste if they are unsure of the result – contact EHS for information before proceeding.
- Keep a record of each radionuclide and its activity that is consigned to waste. Record keeping is a requirement of authorization and will facilitate the user's quick and accurate completion of the waste tag.
- Radioactive waste containing infectious material must be treated to render it non-infectious prior to pick-up by EHS.

For specific information on properly packaging and preparing radioactive waste for collection, refer to EHS's "Waste Management Guidelines and Procedures" manual. This manual and EHS's "Radioactive Waste Pickup Request and Shipping Paper" are available at the EHS website.

12.0 Regulatory and University Requirements

12.1 Agreement State Status

In 1986 the State of Iowa signed an agreement with the Nuclear Regulatory Commission (NRC) to regulate radioactive materials within its border, with the exception of federal institutions (like the Veteran's Administration Medical Center) and nuclear power plants, which remain under NRC control. The NRC periodically reviews this "agreement" and the actions taken by the state under this agreement to ensure regulatory conformity.

12.2 Iowa Department of Public Health – Bureau of Radiological Health

The Iowa Department of Public Health (IDPH) regulates the use of sources of ionizing radiation and the registration of radiation-producing machines within the State of Iowa.

12.3 Radioactive Materials License

The use of radioactive materials at The University of Iowa is conducted under the authority of the University's "broadscope academic-medical license" issued by the IDPH. This type of license allows the University considerable flexibility in its use of radioactive materials in exchange for the establishment of a radiation safety program for managing their use.

The broadscope license has one feature that should be remembered by each radioactive material user: there is only one license for the entire University and University Hospitals. Any individual or action that jeopardizes the license endangers the permission of all research and medical use of radioactive materials at The University of Iowa. Therefore, this license places significant responsibility on individuals who use radioactive materials to conform to safe work practices, and to conduct and complete all required compliance activities in the course of their use of radioactive materials.

Permission to use radioactive materials or radiation-producing machines at The University of Iowa does not constitute permission to use the same materials or machines at the Veteran's Administration Medical Center (VAMC). The VAMC is a federal agency regulated by the VA's National Health Physics Program and the NRC. The VAMC has its own separate radioactive materials license and radiation safety officer.

12.4 Notice to Workers and Reporting Violations

State regulations require the University to provide workers access to certain notices, instructions and reports and the options available to individuals in conjunction with IDPH inspections, safety concerns and suspected violations.

- **Your Right to Inspect Documents Concerning Licensed Activities.** University employees are advised that they may examine copies of the following documents by contacting EHS at 335-8501:
 - Iowa Department of Public Health Regulations for Radiation Machines and Radioactive Materials
 - The University's Broadscope License
 - Your individual monthly dosimeter report
 - IDPH inspection reports
- **Reporting Concerns and Violations.** If you believe that a violation of state regulations or this facility's broadscope license conditions has occurred, you should report the violation to the authorized user supervising the work or area involved. If you believe that adequate corrective action has not been taken, you should notify the Radiation Safety Officer at 335-8517. If the violation has not been resolved through intra-facility channels, you have the right to contact the Bureau of Radiological Health, IDPH, at 515-281-3478 (after hours 515-323-4360.)
- **Notice to Workers.** State regulations require that the "Notice to Workers" posting is

available to radiation workers. This posting is displayed in various locations throughout the University and is available at EHS's web site. It provides information regarding your responsibilities as a radiation worker and those of your employer, including the location on campus where the regulations and regulatory correspondence can be reviewed, and the location and phone numbers of the IDPH.

12.5 Regulations

Regulations pertaining to the use of radioactive materials are found in section 641 of the Iowa Administrative Code (IAC) Chapters 38-45. Copies of the regulations are available for review at the EHS or can be accessed online.

12.6 Non-Compliance Policy for the Non-Human Use of Radioactive Materials

EHS responds to non-compliance with regulations, University policy and the University's license as directed by The University of Iowa's Executive Radiation Protection Committee. Any violation of policy or regulations that seriously compromises health and safety may result in the immediate revocation of use privileges by the University's Radiation Safety Committee and/or the Radiation Safety Officer.

However, if the RSO at any time is not satisfied with the adequacy of safety practices employed by any user, cessation of use may be required until satisfactory procedures have been adopted.

13.0 Administrative Organization

13.1 Radiation Safety Committee

The University of Iowa's radiation safety program operates under the management oversight of the Vice President for Research. Operation of the radiation safety program is delegated to the Radiation Safety Committee (RSC) and the Radiation Safety Officer (RSO). The RSC and the RSO have authority to communicate with, enforce, and direct University personnel regarding radioactive material regulations, license conditions, and University radiation safety policies. The RSC is comprised of four interrelated committees that function to provide radiation protection program oversight, review, policy development, and radioactive materials use authorization under the management of the Vice President for Research.

Executive Committee

The Radiation Protection Executive Committee is responsible for providing oversight and review of the University's radiation protection program and establishing radiation safety use and enforcement policies. The Executive Committee is comprised of representatives of the University administration and EHS; the chair and vice-chairpersons of the Basic Science Radiation Protection Committee, the Medical Radiation Protection Committee, and the Hospital Radiation Safety Review Group.

Basic Science Radiation Protection Committee

The Basic Science Radiation Protection Committee (BSRPC) is responsible for the review of applications for non-human use of radioactive materials to ensure that they conform to currently accepted radiation protection practices, regulations and license conditions. The Committee also provides radiation protection policy recommendations to the Executive Committee. The membership of the BSRPC is comprised of authorized radioactive material users from within the University's Basic and Health Sciences and a representative from EHS. The chair and vice-chairpersons serve as representatives to the Executive Committee.

Medical Radiation Protection Committee/Radioactive Drug Research Committee

The Medical Radiation Protection Committee (MRPC) is responsible for ascertaining that all experimental or research uses of radiation in or on human beings conform to currently accepted radiation protection practices, regulations and license conditions. The Committee also provides radiation protection policy recommendations to the Executive Committee. The membership of the MRPC is comprised of licensed physicians, individuals with specialized training and knowledge as necessary, and a representative from EHS. The chair and vice-chairpersons serve as representatives to the Executive Committee.

The membership of the MRPC also serves as the **Radioactive Drug Research Committee (RDRC)**. The RDRC is responsible for the review and approval of certain proposed uses of radioactive drugs for human research intended to obtain basic information regarding metabolism, human physiology, pathophysiology, or biochemistry in preparation for filing an Investigational New Drug (IND) application with the Food & Drug Administration (FDA), but not for diagnostic or therapeutic use or for clinical trials.

Hospital Radiation Safety Review Group

The Hospital Radiation Safety Review Group (HRSRG) is responsible for the review of the University Hospital's radiation safety program. This includes approving individuals to work in the healing arts as an authorized user, nuclear pharmacist, medical physicist, or radiation safety officer; and proposed clinical uses of radiopharmaceuticals and radioactive material devices. The Review Group also provides radiation protection policy recommendations to the Executive Committee. The membership of the HRSRG is comprised of representatives of the UIHC's administration, nursing service, licensed physicians, and other individuals with specialized training and knowledge as necessary, and a representative from EHS. The chair and vice-chairpersons serve as representatives to the Executive Committee.

13.2 Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible for the day-to-day implementation of the University's radiation safety program as outlined by the Radiation Safety Committees, the University's radioactive materials license; and state and federal regulations. The RSO has the authority to communicate with, enforce and direct University personnel regarding radioactive material regulations, license conditions, and University radiation safety policies.

The RSO also has the authority to terminate any use of licensed radioactive material determined to be a threat to health, safety, or property.

13.3 Radiation Safety Staff

EHS's Radiation Safety Staff is responsible for promoting radiation safety for the protection of employees, the general public, and UI property. EHS maintains the University's radioactive materials license and all radiation-producing machine registrations.

14.0 Internal Review

14.1 EHS Audit Program

EHS periodically audits the use of radioactive materials. Radiation and contamination levels are monitored by EHS as part of its routine area survey program. This is done to ensure that exposures to radiation are maintained ALARA and contamination is controlled.

14.2 IDPH Inspection Program

Compliance with radioactive material regulations is enforced through licensing, registration, and inspection activities carried out by the IDPH's Bureau of Radiological Health. The IDPH performs unannounced inspections to ensure that Iowa Administrative Code (IAC) regulations and University license conditions are met.