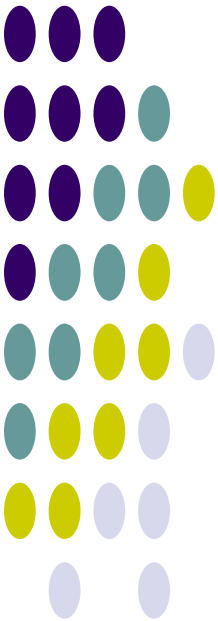
# Radiation Safety Procedures for Laboratory Personnel

# University of California Riverside



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# BACKGROUND

It is the responsibility of UCR to implement a Radiation Safety program that maintains the level of exposure to students, faculty, staff and the public "As Low As Reasonably Achievable" (ALARA). The purpose of the radiation safety program is to protect health and minimize the risk to life, property and the environment in the use of ionizing radiation.

# INTRODUCTION

This Manual assists University personnel in using ionizing radiation in accordance with current standards of good practice, the provisions of the UCR radioactive materials license, and the relevant state and federal regulations.

A copy of the manual can be found on the UCR EH&S web site: http://ehs.ucr.edu/radiation/ for use as a reference by persons involved with the project(s) that contain radiation.

The Radiation Safety Committee and the Radiation Safety Officer are authorized by the Chancellor to limit, suspend, or revoke an individual's authority to use radioactive material(s) or sources that produce radiation if such use is immediately dangerous to the life and health of individuals or violates health and safety codes.

## Who is regulated?

All personnel under University auspices who use, supervise, or control radioactive materials and sealed sources.

Users of "Generally Licensed Materials/ Exempt Quantities", which might be acquired without a State of California specific license, which include, but are not limited to: static elimination devices and particle neutralizers containing Po-210, reagents containing uranium and thorium(uranyl acetate thorium nitrate), and depleted uranium.

# ORGANIZATION AND RESPONSIBILITY

## Chancellor

According to the UCR Policy on Environmental Health and Safety, the Chancellor is responsible for the existence of a radiation safety program that will maintain compliance with relevant local, state, and federal regulations related to the use of ionizing radiation. The Chancellor has delegated responsibility for development/operation of the radiation safety program to the committees, departments, and individuals as stated below.

## Radiation Safety Committee (RSC)

The RSC is a body of faculty and other experts appointed by the Chancellor to establish policies and procedures governing the use of ionizing radiation at UCR, to maintain surveillance over activities involving them, and to report on the status of these activities to the chancellor.

## Office of Environmental Health and Safety (EH&S)

The Office of Environmental Health and Safety (EH&S) implements the radiation safety program. This program includes surveillance of all users of radioisotopes and/or radiation-producing machines and equipment. Specific functions include: monitoring of exposure levels, investigation of incidents, safety consultation, training in radiation safety, radiation safety services, and management of radioactive wastes.

The Director of Environmental Health and Safety: Responsible for the review of UCR policies on radiation and radiation safety. The EH&S Director is an ex-officio member of the RSC.

The Radiation Safety Officer (RSO): Responsible for developing and operating the radiation safety program and for assuring that radiation uses are in conformance with UCR policies and applicable government regulations. The RSO is also responsible for referring to the RSC matters requiring its review and approval. The RSO is a full voting member of the RSC.

# TRAINING

## Background

EH&S Radiation Safety provides radiation safety training for individuals who work with or around radioactive materials (RAM), radiation producing equipment (RPE), and moisture density gauges. Principal Investigators (PIs) and workers using RAM must have initial training before using radioactive materials. Refresher training is required annually for the worker categories mentioned above. Ancillary workers are trained annually.

## Worker Categories and Training Requirements

Principal Investigators (PI)

A principal investigator who wishes to use radioactive materials must have a faculty appointment. They are directly responsible for compliance with all regulations governing radiation safety in the laboratory. PIs must complete the Initial Radiation safety Training class prior to applying for the use of radioactive materials and/or radiation producing machines and are subject to the same retraining requirements as radiation workers. Credit will be given if the PI transferred to UCR from another UC Campus.

Radiation Workers (RW)

Personnel who work directly with radioactive material and who are listed as radiation workers under a PI. These personnel must complete initial radiation safety training by attending the Initial Radiation safety training class before starting work in the laboratory. Credit will be given if the worker transferred to UCR from another UC Campus.

Ancillary Workers (AW)

Personnel who have only minor contact with radioactive material such as building services, maintenance, delivery personnel, and police.

## What if a worker leaves the laboratory?

It is the responsibility of the PI to update the worker information by accessing the Laboratory Hazard Assessment tool (LHAT).

## Procedure for Radiation Safety Initial Training

All new radiation workers should review this manual (Radiation Safety Lab User Manual), the Training Manual for Users of Radioactive Material, and the PI's Radiation Use Authorization before completing the initial on-line radiation training. Copies of these manuals are available on the EH&S website (http://ehs.ucr.edu/radiation/ ). The Radiation Safety initial training class consists of sections on the fundamentals of radiation and on laboratory and control procedures. Each PI is responsible for training workers under his/her supervision on radiation safety procedures and practices specific to their particular laboratory.

## Procedure for Radiation Refresher Training

Laboratory Workers and PIs whose training is about to expire will be contacted by the UC Learning Management System. The retraining course provides updates in Radiation Safety policies, as well as general topics of interest that are relevant to those working around radioactive materials.

## How to I register for the class?

You can register for the above classes by going to the UCR Learning Center:
http://ehs.ucr.edu/training/online/index.html

# PURCHASE OF RADIOACTIVE MATERIAL

## Background

Radioactive material may be purchased only by a PI or a designee listed on the PI'S Radiation Use Authorization(RUA). All radioactive material purchases are approved by Radiation Safety prior to delivery to the lab.

The PI must be approved to possess the isotope and activity ordered. The activity may not exceed the PIs approved possession limit for that isotope.

## How do I place an order for radioactive materials/sealed sources?

The laboratory enters the ordering information into the UC Radiation Database. The order will not be accepted by the system if the possession limit for the user for that isotope is exceeded. .

## What if I need to order an isotope/sealed source, but the activity of the isotope puts the AU over their possession limit for that isotope?

Perhaps some of the inventory is waste, a waste pick-up can be submitted through UC Radiation to reduce the inventory. If this is not the case and the PI needs approval to increase their possession limit for that isotope, they will need to submit an amendment in UC Radiation.

## What if I want to purchase an isotope/sealed source, but it's not on my RUA?

The PI must submit an amendment in UC Radiation. It will be reviewed and placed on the agenda for the next scheduled Radiation Safety Committee meeting.

## What if I want to purchase a Liquid Scintillation Counter (LSC)?

The following information must be submitted to the Radiation Safety Officer by e-mail when the LSC arrives: Make, Model and Serial Number, as well as the isotope, reference activity, and reference date of the source contained within the counter. Also list the PI responsible for the counter, as well as where the counter is located. This information is needed for inventory purposes, as well as to track the sealed sources on campus.

## What if I want to purchase a Gamma Counter?

E-mail the following information to the radiation safety officer when the gamma counter arrives: Make, Model and Serial Number. Also list the PI responsible for the counter, as well as where the counter is located. This information is needed for auditing purposes, as well as to track the gamma counters on campus.

# RECEIPT OF RADIOACTIVE MATERIAL

## Background

The PI or designee shall ensure that all radioactive material packages are inspected upon receipt for evidence of damage or breakage.

## Package Receipt Check-In and Delivery

All off site shipments of radioactive materials arrive at EH&S Radiation Safety and are checked for radiation exposure and possible contamination. Damaged or contaminated packages will be held at EH&S Radiation Safety until the matter is resolved with the vendor/ shipper. EH&S Radiation Safety does not open the package and survey the inside of the package or the stock vial.

Information on the packing slip is checked against what is entered in the UC Radiation Database to verify that the items received are the same as those approved/ ordered. The package is delivered to the user, who signs the package receipt log.

### What the laboratory needs to do once the package arrives

- Wear proper protective clothing. Examples include a lab coat gloves, and a body and ring badge, as needed.
- Open all packages containing volatile radioactive material (i.e. $^{35}S$ and radioiodine) in a hood approved for radioactive material use. Confirm that the contents of the package match the information contained on the packing slip. If it does not match, it is the responsibility of the laboratory to contact the vendor.
- If there is no evidence of isotope contamination, remove and/or completely deface the trefoil warning labels on the package before disposing as non-radioactive trash.

# TRANSFER OF RADIOACTIVE MATERIALS, LSCs, AND SEALED SOURCES

## Background

External and internal transfer of radioactive materials, sealed sources, and liquid scintillation counters (LSCs) either on campus (internal transfer) or off campus (external transfer) must be entered into the UC Radiation Database

Transport of radioactive material between PIs at UCR approved for the isotope /sealed source transfer shall proceed in a manner that minimizes exposures and risks from accidental release of radioactive material.

Transport of radioactive material off-campus must conform to all applicable state and Federal regulations. **Contact EH&S Radiation Safety if you plan on shipping or transporting radioactive materials off-campus.**

## What if I want to transfer radioactive material/sealed source to another PI at UCR?

### On-Campus Transfers

All on campus transfers of radioactive material between laboratories must be entered into UC Radiation which will verify that the receiving PI is authorized to possess the isotope.

## What if I want to transfer radioactive material/sealed sources to someone at another institution, within or outside of the United States?

All off campus transfers of radioactive material must be entered into UC Radiation.

**Only EH&S Radiation Safety is authorized to ship radioactive materials off-campus.**

## What if I'm transferring a Liquid Scintillation counter to another PI at UCR, or a PI outside of UCR?

Contact the Radiation Safety Officer. The Radiation Safety Officer will ask you where the counter is going to be located, as well as the name of the PI to whom the counter is being transferred. If the LSC is being transferred to a PI outside UCR, see the section on Decommissioning Equipment for the paperwork that is required. Also, further documentation may be necessary from the receiving institution.

# SURVEY METER MAINTENANCE AND CALIBRATION

## Background

PIs are responsible for ensuring that their survey meters are calibrated annually.

## What type of calibration is performed by Radiation Safety?

Meters are electronically calibrated by an outside vendor. There is a charge for this service. The meter is delivered to EH&S and is picked up by the outside vendor. Once the meter is returned, isotope efficiencies are performed by EH&S Radiation Safety and the calibration information is entered into UC Radiation. The laboratory is then contacted that their meter is ready to be picked up.

## What if the meter requires dose rate calibration?

Meters requiring dose rate calibration need to be sent by the PI to an outside vendor. If there are any doubts about where to have the meter calibrated, contact Radiation Safety prior to sending the meter to a vendor.

## When do I need to bring the meter for calibration?

Before the expiration date for calibration of the meter is reached. Make sure that the survey meter's batteries are in good working order and that the meter and probe are free from contamination. If the probe is protected with paraffin or plastic caps, these must be removed prior to bringing the meter in for calibration. If a repair is needed the instrument will be calibrated after the repair is completed.

## What if the meter is not working?

If the meter is not functioning properly, bring the meter to EH&S and the outside vendor will pick it up. The PI is responsible for all charges incurred for any repairs. The meter will be calibrated after the repair is complete. The PI is also responsible for having a meter available in their laboratory for survey purposes if

their meter is being repaired or calibrated. EH&S Radiation Safety has meters available on loan while the meter is being calibrated.

## If the meter has been calibrated by an outside vendor, does it still need to be brought in to be calibrated?

After the meter has been calibrated by an outside vendor, bring the meter AND a copy of its calibration certificates to EH&S Radiation Safety for determination of isotope efficiencies since the vendor only checks the electronic linearity of the meter.

## If a new meter is purchased, what needs to be done?

If a new meter is purchased, bring it to EH&S for determination of isotope efficiencies, along with a copy of the calibration certificate from the vendor.

## What precautions should be taken for the survey meter?

Many labs protect the probe of the survey meter with paraffin or plastic caps. This practice is appropriate when using the meter to detect possible contamination occurring during the experiment. However, when carrying out contamination surveys, an **UNSHIELDED** probe shall be used.

Protect the probe from contamination by avoiding contact with surfaces that may be contaminated.

Batteries in the survey meter should be checked every time the meter is used. This is generally done by turning a switch to the “BATT” position or by pressing the button labeled “Battery Check.” If the needle does not reach the “Battery OK” range, the batteries must be replaced immediately to ensure that the meter functions properly.

To prevent damage from corrosion, remove the batteries from the meter if it will not be used for an extended period.

Protect the meter from bumps and drops. The crystals in a gamma detector shatter on impact, and GM probe windows can easily become damaged, releasing the gas necessary for the meter to function. Also, the electronics in the meter box can develop loose connections.

# POSTING AND LABELING

## Background

All rooms and areas where regulated quantities of radioactive material are used or stored must be posted with appropriate signs and labels to inform personnel and visitors to use caution upon entering the area. A Notice to Employees (Form #RH2364) sheet must be posted so that all employees can observe and have the opportunity to read the notice on their way to or from their work area. An Emergency Placard containing emergency contact information should be posted on or near the door of the laboratory.

## Where do I obtain needed labels and forms?

All radiation labels and tape, and Notice to Employees forms can be obtained from EHS Radiation Safety. The placard can be generated by accessing the EHS web page and clicking on the Emergency Placard System link located at: https://ehs.ucr.edu/documents#hazardous_materials . It is the responsibility of the laboratory to keep this information current.

## How, what and where do I label?

### Laboratory Areas

A "Caution Radioactive Materials" label should be posted at the entrance or on the door for each area or room where licensed quantities of radioactive materials are stored or used along with an E-Contact placard containing emergency contact information.

A Notice to Employees" information sheet should be posted in an area in the main lab that is readily visible to all employees. It does not need to be posted on every room.

### Refrigerators and Freezers

Refrigerators and freezers that are used to store radioactive material stock solutions and sample preparations should be prominently labeled with a "Caution Radioactive Material" sign. Refrigerators and freezers used for radioactive material storage not in a lockable lab need to be posted with an Emergency Contact Information Sheet containing a rad label along with the name of the PI and an alternate to contact in the event of an emergency. It also should be

locked, unless a secured lock-box is contained within. If a secured, internal lock-box is used, a radiation label should be placed on the outside of the lock-box. If any sample preparations are stored inside, the isotope, total activity, and the date should be posted somewhere on the outside of the lock-box.

### Waste Containers

All radioactive waste containers must be labeled with a “Caution Radioactive Material” label. The trefoil labels must be large enough and clearly visible from all sides of the waste container. The isotope information should also be listed on the container.

### Small Laboratory Equipment

All trays, containers, racks, tools, etc. that are used for radioactive material experiments must be labeled with “Radioactive Material” tape.

### Hallway Equipment

Equipment in hallways used with radioactive material (other than refrigerators or freezers mentioned above) must be labeled “Caution Radioactive Materials.” In addition, these items must be posted with an Emergency Contact Information Sheet listing the AUs name and emergency contact, after-hours telephone number.

### Stock Solutions and Sample Preparations

All trays, containers, and racks that contain stock solutions of radioactive material must be labeled with “Radioactive Material” tape indicating isotope, estimated activity, and reference date if it is stored in a refrigerator or freezer. While it is not reasonable to expect that each tube or vial is labeled, each tray or rack that holds radioactive material must be labeled.

## What is considered “special labeling”?

“Radiation Area” refers to any area accessible to personnel in which the radiation levels are such that a major portion of the body could receive a dose of 5 mrem or more in one hour at 30 cm, or 100 mrem in any five consecutive days.

“High Radiation Area” refers to any area accessible to personnel in which the radiation levels are such that a major portion of the body could receive a dose of 100 mrem or more in one hour at 30 cm. Ropes or fences should be used in addition to the warning signs to clearly mark restricted areas. A locked door must be used to control access when unattended.

Please contact Radiation Safety if you feel you have any lab areas that fall under these categories.

## What are the exemptions from posting and labeling?

Areas or rooms containing radioactive material for periods of less than eight hours are exempt from posting requirements if one of the following conditions is met:

- Containers are attended by an individual who takes the precautions necessary to prevent the exposure of other people (less than 2 mrem) in an hour at a distance of one foot) and does not involve the manipulation of open radioactive material; or

- Containers are in transport and are packaged and labeled in accordance with the U.S. Department of Transportation (USDOT) regulations.

# INACTIVE PI STATUS, STORAGE MODE, ABSENCE FROM LAB

## Background

Radiation safety has a classification of “Inactive” for laboratories that do not need to possess or use radioactive material for the foreseeable future. An inactive PI is relieved of the requirements to complete laboratory contamination surveys, and refresher training requirements.

## What do I need to do to become inactive?

1. Send an e-mail to the Radiation Safety Officer.
2. If you do not wish to dispose of your isotope, you will be asked to relocate your material to another laboratory that is authorized for that isotope.
3. Any radioactive waste present in your lab must be picked up. Submit a pickup request through UC Radiation.
4. Return all personnel dosimetry to EH&S Radiation Safety.
5. The laboratory space will be decommissioned by Radiation Safety. All signage will be removed by Radiation safety after the final decommissioning survey
6. Confirmation by EH&S(You are considered to be on inactive status when an e-mail is received by EH&S)

## What if I want to become active again?

1. Send an e-mail to the Radiation Safety Officer requesting reactivation. Send updated room maps with survey locations, as well as an updated protocol to Radiation Safety. If there have been no changes to your room maps or protocols, send an e-mail indicating there have been no changes to the Radiation Safety Officer
2. Verify that survey meter instruments are within annual calibration or that you have access to a calibrated survey meter
3. Verify that radiation workers and the PI have satisfied the training requirements. You can retrain on-line by accessing our website at http://ehs.ucr.edu/training/
4. Obtain required personnel dosimetry for radiation workers, and the PI.
5. Radiation safety will post the room with the proper labels
6. The anticipated time for the re-activation process is 2 working days

7. Confirmation by EH&S(You are considered to be on active status when an e-mail is received by EH&S

1. **What if I do not have isotopes in my laboratory, but still want to remain on active status?**

2. **What if I have isotopes in my laboratory but will not be using them for a period of greater than 6 months and still want to remain on active status?**

The PI can elect to go into Storage Mode. Storage mode is for a Primary Investigator (PI) who wishes to remain active with or without radioactive material inventory for a **period greater than 6 months**. Storage mode means that the PI has chosen to maintain their laboratory in immediate readiness for isotope usage, even if they have no active inventory. **Therefore, training for all involved personnel must be up to date**. The laboratory will no longer need to perform surveys while in storage mode. You can drop the use of dosimetry until use starts again.

If you wish to place your laboratory into this status, send an email to the Radiation Safety Officer.

To remain in storage mode, the PI must also send a notification to the Radiation Safety Officer every 6 months that states:
1. No isotope use has occurred in the laboratory.
2. All isotope stock vials have been checked to ensure that no loss of radioactive material has occurred.
3. If this notification is not received, an e-mail will be sent to the PI, the department chair, and the chair of the Radiation Safety Committee.

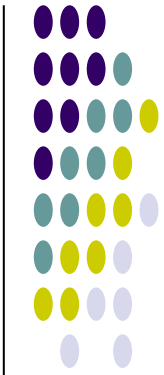
Resumption of isotope use shall not occur unless an e-mail requesting active status is sent to the Radiation Safety Officer. Once you resume isotope use, you must ensure that your meter has been calibrated, and obtain dosimetry if you are required to do so. You will also be required to perform contamination surveys as outlined in the RUA.

The Radiation Safety Office will visit the laboratory twice a year, and will check all stock vials to confirm that no radioactive material use has occurred. If isotope use has occurred, an e-mail is sent to the PI, the department chair and the chair of the Radiation Safety Committee.

## What if I am going on sabbatical?

If you are going on sabbatical, an individual must be designated to assume responsibility for all radiation safety issues if you will be away from UCR. This individual must be another PI (not a technician) preferably within the same department. Please contact the Radiation Safety Officer indicating the dates you are going on sabbatical, when you will be returning, as well as the PI that will be assuming responsibility for all radiation safety issues in your absence.

# RADIOACTIVE MATERIAL INCIDENT RESPONSE/REPORTING



## Background

All laboratories should have an emergency response plan appropriate for their laboratory.

## When do I need to call Radiation Safety?

Each PI is responsible for making certain that Radiation Safety (827-5528) during office hours (8:00 a.m. – 5:00 p.m.) or UCR Police (827-5222)) after hours, weekends, and holidays is called immediately in the event of:

- A major spill, theft or loss of radioactive material;
- Personnel contamination;
- Contamination outside a restricted area;
- Accidental ingestion of radioactive material; or
- Accidental disposal of radioactive material to the normal trash.

The incidents listed **MUST** be reported to Radiation Safety.

## What if you have a release Involving a Gas, Volatile Liquid, Dust, or a Sealed Source Rupture?

- No immediate attempt should be made to clean the spill.
- All windows should be closed, fans and air conditioners should be shut off or vents sealed, and everyone should leave the room.
- All doors should be closed, locked, and a warning sign placed at each access door.

- If powdered or gaseous sources are involved, the door and all other openings leading into the room should be sealed with wide tape (masking tape, duct tape, adhesive tape) and plastic sheeting or heavy wrapping paper.

- Minimize the spread of radioactive contamination by restricting the movements of potentially contaminated persons to a local zone just outside the “spill” area until the extent of personnel, shoe and clothing contamination is determined.

- Every person who might have been contaminated should be monitored for activity, and, if contaminated, should remove his/ her clothing and be decontaminated. If no means are available for monitoring, it should be assumed that the person is contaminated.

- The Radiation Safety Officer (RSO) must be called immediately. If necessary, outside consultants experienced in radiation hazards should be called in by the RSO and their advice followed.

## How do I know if it is a major or minor spill and how do I make this determination?

Spill assessment considerations:

- Isotope emission characteristics
- Radioactive material volatility
- Quantity of radioactive material involved
- Size of contaminated area
- Potential for spreading contamination
- Potential dose – external and internal

## Definition of Minor Spill

A spill that remains contained, that can easily and effectively be cleaned up without assistance from Radiation Safety, and that does not involve personnel contamination.

## Definition of Major Spill

A spill that involves contamination of personnel or results in contamination outside of the intended work area, and that cannot be promptly cleaned up.

## What if I determine that it is a minor spill?

1. Survey clothing, hands and shoes for potential personnel contamination.
2. Notify others in the area of a minor radiological spill.
3. Remove contaminated bench paper and/or gloves, and dispose of as radioactive waste.
4. Decontaminate the work area and survey to verify all contamination has been removed.
5. Document incident, attach decontamination results, and place report in the lab's recordkeeping binder.

## What if I determine that it is a major spill?

1. Survey clothing, hands and shoes for potential personnel contamination.
2. Notify others in the area of a major radiological spill.
3. During business hours (weekdays 8:00 a.m. - 5:00 p.m.) call Radiation safety at 827-5528.
4. After hours (weekdays 5:00 p.m. - 8:30 a.m., weekends and holidays) call UCR Police (911) and indicate there is "**A Radiation Spill**."
5. Give Safety or Security your name, the PIs name, location, and telephone number.
6. Establish a secure boundary to prevent spreading of contamination.
7. Do not leave the area (unless in immediate danger) until initial investigations by Safety have been completed.

## What if there is a Multiple Emergency?

When a radiation emergency is accompanied by other hazards (fire, explosion, chemical exposure, or other event that endangers life or property), it is important to deal first with those hazards that have the greatest potential impact. In an educational setting the quantities and types of radiation used are such that, in general, response personnel (fire and medical) can deal with severe threats to life, health, and property without concern for the radiation present if: 1) They respond with their usual personal protective equipment, and 2) Are monitored for radiation contamination and decontaminated as necessary before leaving the site of the emergency.

# SECURITY OF RADIOACTIVE MATERIALS

## Background

All radioactive material must be secured against unauthorized removal.

## What types of radioactive material need to be locked?

Stock vials or stock solutions. Radioactive waste does not need to be in a locked container but should be kept in a secure area of the laboratory.

## Does equipment that contain radioactive material need to be locked?

Yes, cabinets, refrigerators, freezers that contain stock vials and/or stock solutions must be locked or contain a secured lock-box within and should be labeled(Refer to Page 16 –Posting and Labeling)

## What if the equipment doesn't contain radioactive material?

If the labeled equipment (i.e. cabinets, refrigerators, freezers) is not being used for radioactive material storage, then the equipment should be decommissioned.
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# PERSONAL PROTECTIVE EQUIPMENT/ PERSONAL SAFETY

## Background

To ensure the health and safety of all members of the UCR research community.

## What is PPE and why is it so important?

In general, the use of Personal Protective Equipment (PPE) is meant to prevent direct skin contamination and minimize the risk of internal contamination. Long pants, closed toe shoes, laboratory coats, gloves, and eye protection are the primary form of PPE against contamination.

## PPE – When, Where and How

### Eye Protection

Eye protection is required if there is risk of splash or splatter in the laboratory and where radioactive material is stored and handled. Contact lenses should not be worn when working with volatile chemicals in the laboratory.

### Laboratory Coats

Laboratory coats and other PPE shall be worn at all times while handling radioactive material. Laboratory coats should be fastened completely to provide complete protection.

### Gloves

Selection of proper glove materials is important. Disposable gloves should be worn while handling unsealed radioactive material. Contaminated gloves must not be reused and must be disposed of as radioactive waste. Potentially contaminated gloves should not be worn when handling uncontaminated materials. **DO NOT wear gloves outside the laboratory.**

## General safety tips that you need to follow

Food, beverages, cosmetics, medications

Federal and state laws **prohibit** storing as well as eating, drinking, chewing gum, smoking, applying cosmetics, and taking medications in **all** laboratory areas. This includes standard laboratory areas, cold rooms, warm rooms, equipment rooms, common use and other laboratory related areas. Any food, drink, and their containers found in laboratory areas will be confiscated and disposed. All food or drink used for research purposes must be labeled "NOT FOR HUMAN CONSUMPTION."

Certain hand lotions are, however, permitted. However, after this rule went into effect, it was brought to the attention of OSHA that petroleum-based hand lotions affect the integrity of latex gloves. A list of five recommended hand lotions that are non-petroleum based are recommended if you are using latex gloves in the laboratory. These five lotions are:

- Johnson and Johnson Baby Lotion
- Cetaphil
- Jason Natural Cosmetics
- Nexcare
- Keri Lotion

### Clothing

Dresses, shorts, ties, or other dangling clothing should not be worn while conducting experiments in the laboratory. Open-toed shoes or sandals are not permitted in the lab.

### Transportation of radioactive materials

All laboratory materials must be transported in a double containment. The material to be transported must be in a leak-proof container that is then placed into an outer container. The surface of the secondary container must be sufficiently free of materials to be handled without the use of PPE.

# RADIOACTIVE WASTE DISPOSAL

## Background

The PI shall implement an effective radioactive waste management program that includes proper labeling, shielding, minimization, and assurances that disposals go into the correct radioactive waste stream. All radioactive waste disposal requests are submitted to WASTe via the UC Radiation database.

## What does the PI need to do?

The PI is responsible for obtaining any shielding required for his/her waste management program. Boxes and liners are provided by the EH&S waste management team.

## General waste handling procedures

Radioactive waste should be separated by type – dry solids, vials, SHARPS, liquids, and animals – and by isotope. Dual-label experiments are the only exception. **DO NOT**, under any circumstances, place radioactive waste in the hallways where housekeeping personnel might pick it up.

Liquid radioactive waste should be double-contained so that leakage from a breach in the primary container is fully contained by the secondary vessel. Also, the container should not be left open and should be capped when not in use. An Ecofunnel could be used as a substitute for a cap.

Any container used to store radioactive waste should be prominently labeled with a radiation trefoil sign and the isotope should be listed on the waste container. This will alert housekeeping personnel that it is a radioactive waste container and not an ordinary trash container.

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## Types of Radioactive Waste

### Dry Waste

This category of waste consists of anything that has come into contact with radioactive material such as disposable labware, gloves, bench paper and polyacrylamide gels. The waste should be placed in a box which contains a liner.

### SHARPS

SHARPS include: discarded hypodermic needles, syringes, scalpel blades; cannulas, coverslips, microscope slides, all pipettes (glass or plastic) and pipette tips, test tubes, glass Petri dishes, and other materials designed for use in biological, etiological, bacteriological or tissue culture work capable of causing puncture wounds or cuts; broken glass or any other item capable of causing puncture wounds or cuts.

Radioactive waste classified as SHARPS **MUST NOT** be mixed with dry solid materials, but must be contained in puncture-proof/rigid containers.

All contaminated SHARPS; needles, syringes and scalpel blades; and all materials designed for use in biological, etiological, bacteriological or tissue culture work capable of causing puncture wounds or cuts must be placed in red rigid SHARPS containers and the container must contain a radioactive label.

### Liquid Scintillation Vials

Vials containing or having contained scintillation fluids, as well as background vials. The scintillation vials should be placed in a box provided by the EH&S waste team.

### Liquid Waste

Liquid radioactive waste other than those containing iodine must be maintained at a pH between 5 and 9. Liquids containing iodine must be maintained at a pH between 7 and 9. Use only waste containers approved by EH&S that are compatable with the liquid being collected. Fill containers only to 80% of capacity.

## Uranyl and Thorium Compounds

Uranyl and thorium compounds are picked up and disposed of by EH&S. This includes liquid, dry/solid waste, and uranyl acetate/nitrate in powder form. An RUA is not required to possess these compounds. Therefore, a waste pickup can be submitted directly through WASTe.

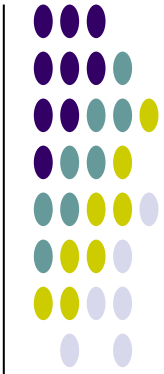
## Sealed Sources

If you want to dispose of a sealed source, submit a waste pickup request on WASTe through UC Radiation.

## Lead Pigs and Bricks

Lead is a regulated material and cannot be disposed of as normal trash. If your laboratory has lead to pick up, indicate this when you submit your waste pickup request on WASTe through UC Radiation.

# BIOASSAYS



## Background

Bioassays are required for employees who are likely to receive an internal, measurable radiation dose. Bioassay procedures include, but are not limited to, thyroid screening and urinalysis.

## When is a bioassay required?

A bioassay is required any time more than 1 mCi of radioactive iodine in volatile form is used, or if you are using more than 10 mCi of tritium. This includes opening a stock vial containing more than 1mCi of volatile radioactive iodine or 10 mCi of tritium.

## Radioactive iodine bioassay – what do I need to do?

Call Radiation Safety before handling more than 1 mCi of volatile radioactive iodine. A baseline bioassay must be done for anyone involved in the procedure that does not have a baseline bioassay on file.

## Tritium bioassay – What do I need to do?

Call Radiation Safety before handling more than 10 mCi of tritium. If bioassays are to be performed, a baseline bioassay must be done for anyone involved in the procedure that does not have a baseline bioassay on file. If you use tritium sources in metallic foils, a bioassay is not required

# DOSIMETRY

## Background

Each individual likely to receive a measurable radiation dose shall wear a personal radiation dosimeter.

## Who is required to wear a badge?

- Individuals routinely using high energy beta emitters (ie: P32) are required to wear a body and ring badge
- Individuals using gamma emitters(ie: Na22) are required to wear a body and ring badge regardless of the frequency of use

## Who is not required to wear a badge?

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- Individuals working with sealed sources
- Individuals working with low energy beta emitters such as C-14, S-35, H-3 and Ca-45.

## Do I need a special badge if I'm working with a neutron source?

Yes. For experiments and procedures involving the use of neutron sources, personnel monitors sensitive to neutron radiation must be worn. These can be obtained by contacting Radiation Safety.

## What if I'm pregnant or think I might be?

Any radiation worker who is pregnant or thinks she might be pregnant may declare herself a "Pregnant Worker" by completing a "Declaration of Pregnancy Form" and sending it to the Radiation Safety Officer. Declaration of pregnancy is voluntary. Counseling will be provided and an additional dosimeter will be issued which is read every month. This additional fetal badge is worn such that any dose to the developing baby is conservatively measured. The "Declaration of Pregnancy Form" can be found on the EH&S website (https://ehs.ucr.edu/radiation/ ) under "Forms".

## Where can I get a badge?

Badges can be obtained by filling out a badge request form. You can request a badge on-line by accessing E&S website (https://ehs.ucr.edu/radiation/ ) under Radiation Safety Forms.

## How often are badges exchanged, and what is the procedure for exchanging a badge?

Badges exchanged monthly include:

- Fetal badges
- Campus Health Center personnel that use dental/medical x-ray machines

Badges exchanged 3 times per year include:

- Any individual issued a badge that is not included in the monthly category

Badges are received at EH&S Radiation Safety and are mailed to the laboratory contact for each laboratory. Old badges can be returned either in person or by campus mail. The badges are then sent to an outside vendor for analysis. All dosimetry reports are reviewed by the Radiation Safety Officer. One copy is kept on file in EH&S Radiation safety and a second copy is sent to the laboratory contact.

## What if my badge is lost or damaged?

Report lost or damaged badges (crushed, broken, melted, washed, accidentally exposed, contaminated, heated in any way, etc.) to Radiation Safety as soon as you are aware of the situation so that a new badge can be issued.

## How should I properly use and care for my dosimeters?

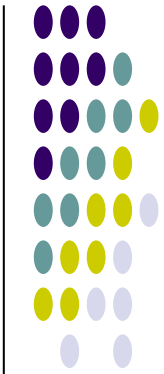
- The whole body badge shall be worn between the neck and waist. If, however one area of the body is more likely to be exposed than the rest, the badge should be worn in that area.
- The front of the badge must be exposed toward the source of radiation with no obstruction such that it correctly samples the actual exposure of the radiation worker.
- The badge shall be worn outside of any PPE.

- Extremity badges (ring badges) should be worn under any protective gloves, on the hand most likely to receive the greatest exposure. The front of the ring badge should face toward the radiation source.
- **Badges are issued to a single user and shall not be shared.**
- Store the badge in a radiation-free area, such as a desk drawer, when not in use. Do not take the dosimeter home.

**Can I request my dose record?**

Yes, you can request your dose record at any time by contacting EH&S Radiation Safety.

# DECOMMISSIONING EQUIPMENT OR ROOMS



## Background

PIs or laboratory personnel needing to have equipment or laboratory areas cleared for maintenance or disposal must contact EH&S prior to the equipment leaving the lab or if any maintenance work needs to be done in laboratory areas. EH&S will respond to this request to ensure no potential radiological or biological/ pathogenic contamination exists to the equipment or specified lab area.

### How do I dispose equipment that was used for radioactive material?

Fill out the following form which can be found on the EH&S website:
https://ucriverside.az1.qualtrics.com/jfe/form/SV_7UoOOblTydyCzJj

### What do I do if equipment that is used for radioactive material breaks and I need to have it repaired or have it serviced in the lab?

Contact the Radiation Safety Officer. The lab will be given specific instructions on cleaning of the equipment for radiological, as well as biological/chemical contamination. Any radiation label on the equipment will be removed by Radiation Safety once it has been surveyed and the survey verifies the equipment is free of contamination. If the equipment is found to be contaminated, the lab will be responsible for decontaminating it. Fixed contamination will be dealt with as deemed appropriate by the Radiation Safety Office, as well as the manufacturer's requirements.

### What if a piece of equipment or a lab is no longer used for radioactive material, or I want to move a piece of equipment labeled as radioactive into a lab not used for radioactive material use?

Fill out the following form which can be found on the EH&S website:
https://ucriverside.az1.qualtrics.com/jfe/form/SV_7UoOOblTydyCzJj

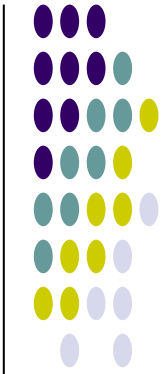
You will be contacted by a member of the Radiation safety staff regarding the procedure you will need to follow.

## What if I want to decommission my laboratory areas?

Fill out the following form which can be found on the EH&S website:
https://ucriverside.az1.qualtrics.com/jfe/form/SV_7UoOOblTydyCzJj

You will be contacted by a member of the Radiation safety staff regarding the procedure you will need to follow.

# LABORATORY CONTAMINATION SURVEYS/ DECONTAMINATION GUIDELINES



## Background

PIs shall perform contamination surveys and document the results in appropriate units for all areas where radioactive material is used or stored under their supervision. Radiation Safety will conduct periodic surveys and audits to assure proper use of all radioactive material, as well as assist laboratory personnel on how to perform decontamination procedures.

## When do I need to perform laboratory surveys?

Any laboratory containing radioactive material is required to perform and document a contamination survey monthly. **If more than 200uCi of an isotope are used on a daily basis, then a documented full lab survey will be required weekly. If more than 200uCi are used only occasionally, a documented post experimental survey of the work area will be done.**

## What if I have isotopes in storage but do not actively use them?

A number of laboratories contain radioactive material, but do not actively use it. They are still required to perform a monthly radiation survey unless they have been placed in Storage Mode.

## What if I do not have isotopes in my laboratory, but still want to keep the room as a RAM active room?

The PI should decommission the laboratory for radioactive material use or be placed in storage mode. If the PI decides to use radioactive materials, contact Radiation Safety so the room can be posted with the appropriate signage and labels.

## What documentation do I need?

Survey documentation shall include meter efficiencies to confirm that limits for removable contamination or restricted area exposure rates are not exceeded (see the “Posting and Labeling” section of this manual for definitions of restricted areas). All records require both count rate measurements with an appropriate, calibrated survey meter and wipe tests performed to identify removable contamination. If your laboratory uses only $^{3}H$, only a wipe test needs to be performed. Attach the wipe test results to the room survey map.

## What items do I need before I perform a contamination survey?

These procedures are intended as a guideline for performing a standard lab survey, and may vary from lab to lab.

Gather all necessary items, including:

- A map of the survey area for marking locations of probe readings and wipe locations.
- An appropriate, calibrated meter.
- Material for performing the wipe test, such as cotton swabs, tissue, or filter paper.
- Vials in which to place the wipes.
- Tweezers to allow handling of the wipes without cross-contaminating the samples.

## Should I perform a meter survey, a wipe test, or both?

The following chart was created to assist you in selecting the best method and instrument for performing contamination surveys:

| Nuclide | Radiation Emitter | Energy, keV | Contamination Survey Technique * |
|---|---|---|---|
| $^{14}C$ | β (beta) | 156 | WL + SG |
| $^{36}Cl$ | β | 714 | WG + SG |
| $^{51}Cr$ | γ (gamma) | 320 | WL + SN |
| $^{3}H$ | β | 18.6 | WL |
| $^{125}I$ | γ | 35 | WL + SN |
| $^{22}Na$ | β/γ/γ | 545/1275/511 | WG + SG |
| $^{32}P$ | β | 1710 | WG + SG |
| $^{33}P$ | β | 248 | WL + SG |
| $^{86}Rb$ | β/γ | 1780/1078 | WG + SG |
| $^{35}S$ | β | 167 | WL + SG |

* See key below

W = WIPE to check for removable contamination
S = SURVEY with meter (Geiger-Mueller (GM) or Sodium Iodide (NaI)) for fixed contamination
L = run on LSC
G = use GM or "sandwich" probe
N = use NaI or "sandwich" probe

Example: "WL + SG" means to perform a smear to wipe the surface and count the smear with a liquid scintillation counter, plus perform a meter survey for fixed contamination using a GM probe.

When checking for removable contamination, you always perform a wipe. When checking for fixed contamination, you measure the total radiation from the surface with a hand-held instrument then subtract the removable component from this, if appropriate.

The sandwich probe (beta-gamma sandwich detector) combines a plastic scintillator to detect beta with a Sodium Iodide crystal to detect gamma.

## How do I perform a meter survey?

When surveying a lab with a survey meter, concentrate on regions where radioactive material has been used. Do not overlook areas where radiation users may have inadvertently walked or items that they may have touched. Hold the meter as close to the surface as possible without touching it to avoid

contaminating the meter. Move the meter slowly and deliberately along lab benches, near selected floor regions, radioactive material work areas, all small equipment, sinks, refrigerators and freezers, telephones, light switches and doorknobs. Also pay close attention to laboratory coats, waste areas, and containers for both radioactive and normal trash.

**All meter surveys should be performed with an unshielded probe**. Meter surveys performed with a probe covered with parafilm, saran wrap, or a meter cap will not be valid. Probe efficiencies are calculated by EHS Radiation Safety using an unshielded probe.

**What do I need to write down?**

Record the Make, Model, Serial Number, and calibration date of the survey meter on your survey sheet. Record the count rates in counts per minute (cpm) for all locations on the survey data sheet. **Convert all count rates from cpm to disintegrations per minute (dpm) if the cpm value is twice background after background subtraction.** The isotope efficiencies can be found on the sticker that is attached to your meter. Also record next to the count rate the isotope that caused the contamination, decontaminate that area, re-wipe, and attach the results to the original survey.

## How do I perform a wipe test?

Perform a wipe test of the laboratory, including the areas indicated previously. Also, take wipes of regions where high counts were found with the survey meter. Wipes may be wetted with alcohol or distilled water to increase the “lifting” ability. Typical wipe tests should be performed over a 100 $cm^2$ area.

**What do I need to write down?**

Record on the room map the locations of the wipe tests and the area wiped. Take wipes of broader areas initially but remember that for determination of contamination, smaller wipes should be taken as well. Load wipes in the appropriate radioactivity counter (liquid scintillation counter for beta emitters and a gamma counter for gamma emitters). All results must be converted to units of dpm per 100 $cm^2$ or in µCi/100 $cm^2$. It is understood that this represents net dpm (i.e. that background has been subtracted). If your radioactivity counter is not programmed to convert cpm to dpm, refer to the manual that is provided with the counter for the isotope efficiencies**, and record them on your survey sheet. if the cpm value is twice background after background subtraction, convert the cpm value to dpm**.

A blank consisting of a clean wipe along with the same volume of scintillation fluid used for your sample wipes should be run along with your wipe samples.

If the results are at twice background levels record the isotope that caused the contamination, decontaminate that area, re-wipe, and attach the results to the original survey.

## Can I use my survey meter to run my wipes instead of an LSC?

If your lab uses only $^{32}P$, $^{22}Na$, $^{36}Cl$, or $^{86}Rb$, a survey meter can be used to count your wipes. However, if you use $^{32}P$, $^{22}Na$, $^{36}Cl$, or $^{86}Rb$ in addition to other isotopes, you must use the LSC. If you use a portable survey meter, record the Make, Model, Serial Number, and its calibration date on the survey sheet. Record the count rates in cpm for all locations on the survey data sheet. Convert cpm to dpm. The cpm to dpm calculation, as well as the isotope efficiencies, can be found on the tag that is attached to your meter. Identify those areas which show count rates that are twice background after background subtraction. Also record next to the count rate the isotope that caused the contamination, decontaminate that area, re-wipe, and attach the results to the original survey.

## What is fixed contamination and how do I know?

Fixed, or non-removable, contamination is when radioactive material has been absorbed into a material and can only be detected by a survey meter. A wipe test will not pick up this type of contamination.

## Decontamination Procedures: How do I do it?

### Floor Decontamination

- Put on appropriate PPE (double gloves, booties, lab coat, goggles) before entering areas where there may be contamination.
- Define the outer boundary of the contaminated area and mark off with tape.
- Clean from the outer edge of the contamination and work inward.
- Use a spray solution and wipe up with paper towels or other absorbent material to remove as much removable contamination as possible.
- Low activity spills not containing hazardous materials can be cleaned up by using soap and water. Take a 1ml sample of the waste water. If it is radioactive, it must be disposed as liquid radioactive waste.

- While cleaning towards the center area, check newly cleaned areas for loose contamination before walking or kneeling in these areas. Bench paper may be placed over these areas to prevent recontamination.
- Tape off and shield any areas where the contamination cannot be easily removed for further decontamination efforts.
- Re-survey area.
- Wash until removable contamination is gone.
- When wipe tests confirm only fixed contamination remains, appropriately shield the contaminated area and label with isotope, activity and date.
- Document that the area has been decontaminated and place in the lab notebook along with the initial survey.

**Equipment Decontamination**

- Use a spray solution and wipe up with paper towels or other absorbent material to remove as much removable contamination as possible. Be cautious not to flood the area with cleanser since it will wash the contamination into cracks, which will be difficult to decontaminate.
- Low activity spills not containing hazardous materials can be cleaned up by using soap and water. Take a 1ml sample of the waste water. If it is radioactive, it must be disposed as liquid radioactive waste.
- Wash until removable contamination is gone.
- Re-survey the equipment.
- Wash until removable contamination is gone.
- When wipe tests confirm only fixed contamination remains, appropriately shield the contaminated area and label with isotope, activity and date.
- Document that the area has been decontaminated and place in the lab notebook along with the initial survey.

Chemical Hood Decontamination

- Ensure that the chemical hood is running.
- Remove items from the hood and place them on clean bench paper outside of the hood, segregating contaminated items.
- **Volatile isotopes should be placed into bags and sealed before removing them from the hood.**
- Cut out and remove contaminated bench paper from the hood and remove the remaining bench paper. Place contaminated paper with dry rad waste.
- Check floor area for contamination from transporting contaminated items.
- Low activity spills not containing hazardous materials can be cleaned up by using soap and water. Take a 1ml sample of the waste water. If it is radioactive, it must be disposed as liquid radioactive waste..
- Re-survey the chemical hood. Check the backside of the hood sash, as well as the walls of the hood for additional contamination.
- Wash until removable contamination is gone.

- When wipe tests confirm only fixed contamination remains, appropriately shield the contaminated area and label with isotope, activity and date. Short-lived isotopes may be left for decay; long-lived isotopes may require destructive removal and replacement by the RSOF.
- Document that the area has been decontaminated and place in the lab notebook along with the initial survey.

**Clothing Decontamination**

- Remove the contaminated clothing carefully to avoid or minimize contaminating your skin.
- Check your skin for possible contamination. Decontaminate the skin as indicated below before continuing with clothing decontamination.
- Determine approximate activity on the clothing.
- If clothing contamination is less than the daily sewer disposal limit, wash the clothing with soap and water in the sink, recording the sewer disposal activity.
- Re-survey the clothing.
- If the clothing contamination is more than the daily sewer disposal limit and cannot be easily cleaned, the clothing will have to be held for decay or disposed as radioactive waste.

**Skin Decontamination**

- Have someone in the lab contact Radiation Safety
- Wash contaminated area with mild soap and rinse with running tepid water (or wetted towels).
- Do not abrade or scrub the skin.
- Survey after each washing and drying for cleaning efficiency.
- When washing with soap and water no longer reduces the contamination, record the remaining activity on the skin and apply lotion to keep the skin moist and help loosen the contamination. Apply a bandage over the area to sweat out contamination. Monitor the area each day until the contamination is gone. Survey the bandage and dispose of it as RAM waste, if necessary.

# RECORD KEEPING AND AUDITS

## Background

Record retention must conform to all applicable Federal and state regulations. Records must be kept up-to-date and be readily available for inspection by University Administration, Federal, and state regulatory authorities. It must be possible from the documentation to establish that all conditions for the safe use of radioactive material has been met.

## What is a laboratory notebook, and what should I put in it?

**Laboratory Notebook**
Each user must maintain records in a notebook (3-ring binder).
It must be available for review by EH&S Radiation Safety and State of California Radiologic Health Branch. It must contain the following information:

- Copies of the original application and authorization
- Radioisotope Authorization Update forms
- Room Surveys
- Documentation of training provided in the laboratory to lab personnel.
- Dosimetry Records

## Why do I need to keep these records?

Records must be kept up-to-date and be readily available for inspection by the University Administration, Federal, and state regulatory authorities, as well as EH&S Radiation Safety.

## How long do I need to keep these records?

Records of the above items must be maintained until the appropriate Federal and state regulatory agencies terminate the University's radioactive material license.

## What is a Radiation Safety Audit?

A minimum of 2 audits per year are performed for each PI and consists of two parts: A survey of all rooms that are surveyed by that AU, as well as an audit of all laboratory records. **The audit frequency might be increased based on the findings found during the routine audits.** An annual audit of the program is also conducted

## What is checked during an audit?

The laboratory audit form is divided into 2 areas; Contamination-Related Findings and Laboratory Practice-Related findings. Contamination-related findings include review of survey records and survey frequency. Laboratory Practice-Related findings include checking the survey meter that is being used to ensure that it is within annual calibration. Inventory records are managed within the UC Radiation database by the individual laboratories. The database tracks all decay calculations in real time, and validates against the laboratory and university possession limits to ensure that they are not exceeded.
Items that are evaluated in the annual laboratory audit program include:

- Possession limits not exceeded
- Survey records
- Adequacy of surveys
- Instrument availability
- Possession limit inventories

## What if the auditor finds a problem and what happens next?

Issues that are identified during a routine laboratory audit can usually be corrected at the time of the audit. If the issue cannot be corrected at the time of the audit, a notice is sent to the PI. Corrective action deadlines are based on the severity of the issue that is found.

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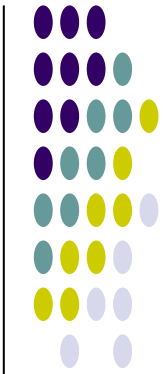
# URANYL ACETATE



## Background

Uranyl acetate is not regulated as radioactive material, but must be disposed as waste by EH&S.

## Description of Uranyl Acetate

Uranyl acetate is a naturally occurring radioactive material that emits alpha ($\alpha$), beta ($\beta$) and gamma ($\gamma$) radiation. It is used as a stain for electron microscopy viewing enhancement. Although the radiation associated with the material is far less hazardous than its chemical toxicity, it should be treated as a radioactive hazard.

## What about external dose?

One hundred grams of uranyl acetate powder has a maximum unshielded dose rate of 0.6 mrem/hr.

Assume you are at 10 cm from this source and working with 25 grams. The maximum dose would be 150µrem/hr. At 1 meter, the dose rate would be 1.5µrem/hr. Background radiation is about 1000 µrem/day, or 42µrem/hr. Therefore, distance exposure at 1 meter from 25 grams gives about 4% of natural background.

## What about skin dose?

Uranyl acetate will give a skin dose rate of 6.7 mrem/hr per µCi/cm$^2$. The activity of 1 gram of uranyl acetate is 2 µCi/g. If one gram were spread over 100 square centimeters, the contact dose rate would be 134 µrem/hr. This is a very low dose rate. Wearing laboratory gloves will provide adequate protection.

## What is the external radiological hazard from uranyl acetate?

The gamma dose at 10 cm from 25 grams is ≤150 μrem/hr. So you would have to stay in this radiation field for 667 hours before reaching the public exposure limit of 100 mrem in a year. Skin/finger dose is also low. Assume 1/50 of the allowed extremity occupational exposure value of 50,000 mrem. You would have to have your fingers touching the material for 75 hours to obtain this 1000 mrem dose limit.

## What is the internal radiological hazard from uranyl acetate?

The stochastic annual limit of intake is 10 μCi. Don't inhale or injest it. Use it in a chemical hood. Chemical safety procedures will suffice. Follow the safety procedures from the Safety Data Sheet (SDS) for uranyl acetate.

# GENERAL RULES FOR THE SAFE USE OF RADIOACTIVE MATERIALS

1. Prior to working with radioactive materials, individuals are **required** to complete initial on line radiation training. Refresher training is **required** annually.

2. To ensure that you are using the appropriate personal protective equipment (PPE), review the Laboratory Hazard Assessment.

3. Use appropriate engineering controls based on the chemical form of the isotope that you are using.

4. Use appropriate personnel monitoring devices based on the isotope and activity. Monitors must be returned for processing at the end of the monitoring period and when the user leaves the University.

5. Use the proper radiation survey instruments based on the isotope that you are using.

6. Eating, drinking, smoking, and application of cosmetics in the laboratory is not permitted.

7. Label work areas, materials, and/or containers.

8. Monitor work areas, equipment, gloves, and lab coats after each procedure and at the end of the day. Decontaminate areas and equipment according to instructions in the UCR Radiation Safety Manual which can be found on the EH&S website (ehs.ucr.edu). If assistance is needed or if there are questions, call EH&S Radiation Safety at x5529. A documented survey of laboratory should be done at least monthly.

9. Place waste materials in properly labeled containers.

10. Remove PPE, wash hands, and perform a confirmatory survey of hands with suitable survey method before leaving laboratory.

11. In an emergency, follow the directions listed on UCR Injuries and Medical Treatment flipchart which is posted in the laboratory.

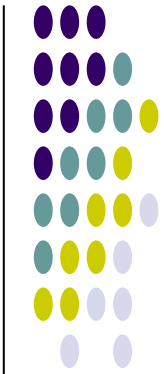
## Regulatory References for this manual

17CCR, Division 1, Subchapter 4
10CFR Part 19 and Part 20
NRC Regulatory Guide 8.32, Criteria for Establishing a Tritium Bioassay
NRC Regulatory Guide 8.23, Radiation Safety at Medical Institutions
NRC Regulatory Guide 8.20 Applications of bioassay for I-125 and I-131
UCR Broadscope License 1362-33
"Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM via NRC NUREG-1575, EPA 402-R-97-016)

UC Radiation system link: https://ehs.ucop.edu/radiation

# ISOTOPE AND SHIELDING REQUIREMENTS

The following chart is a general guide only. Please call the EHS Radiation Safety or consult the information sheet that comes with the isotope should you require further information on the specific thickness of the shielding that is required.



| Isotope | Energy | Shielding |
|---|---|---|
| $^{45}Ca$ | 0.257 Mev beta | None |
| $^{51}Cr$ | 0.320 Mev gamma | Lead |
| $^{14}C$ | 0.156 MeV beta | None |
| $^{36}Cl$ | 0.710 MeV beta | Lucite |
| $^{125}I$ | 0.035 MeV gamma/X-ray | Lead |
| $^{32}P$ | 1.71 MeV beta | Lucite |
| $^{33}P$ | 0.249 MeV beta | None |
| $^{22}Na$ | 1.275 MeV gamma<br>0.546 MeV position | Lead |
| Tc-99m | 0.141 MeV gamma | Lead |
| $^{3}H$ | 0.019 MeV beta | None |
| $^{35}S$ | 0.167 MeV beta | None |
| $^{86}Rb$ | 1.77 MeV beta<br>1.077 MeV gamma | Lucite first, then lead |