

Chapter VI: Safe Use of Radioactive Material

Policy

The University Radiation Safety Program has been established to provide guidance for researchers in the safe use of radioactive materials and ensure compliance with the University radioactive material license, state regulations and federal regulations.

Authority and Responsibility

Office of Radiation Safety is responsible for:

- 1 Developing the Radiation Safety Program for safe use of radioactive materials;
- 2 Ensuring compliance with the University license, state regulations and federal regulations pertaining to the safe use of radioactive materials;
- 3 Providing training to employees.

Principal Investigator and Department are responsible for:

- 1 Providing adequate resources to maintain a safe work environment for laboratory staff;
- 2 Complying with all aspects of the radiation safety program for the safe use of radioactive materials.
- 3 Reporting loss, theft, or damage to any source of radioactive material to the Office of Radiation.
- 4 Ensuring the security of radioactive materials.

Employees and Students are responsible for:

- 1 Complying with all aspects of the radiation safety program for the safe use of radioactive materials.
- 2 Reporting loss, theft, or damage to any source of radioactive material to the Office of Radiation.
- 3 Ensuring the security of radioactive materials.

Facilities

It is each principal investigator's responsibility to provide adequate shielding and monitoring instruments for use with their radioactive material and to ensure compliance with the regulations and the appropriate radiation safety practices will be met by anyone working with their material. In addition, it is each applicant's responsibility to ensure they have access to a functional fume hood for use of volatile radioactive material. The Office of Radiation Safety must be notified when fume hoods used in radioactive material experiments become nonfunctional. In addition, the Office of Radiation Safety must be notified prior to service calls for clogged sinks, non-functioning hoods, or exhaust system filter changes.

Opening Packages

- Packages containing radioactive material must be opened in an area designated for the use of radioactive material, such as a lab bench covered with absorbent paper. Packages containing volatile radioactive material must be opened in a functional hood.

- Don gloves and carefully open the outer and inner packaging. Users should verify that the shipment contains the isotope, chemical compound, and activity ordered. Users should check the integrity of the final source container by inspecting for signs of damage, i.e., vial breakage, package discoloration, or fluid loss. Packaging material, such as the box, plastic inserts, etc. shall be monitored for contamination prior to disposal.
- If any contamination is found it must be identified and the incident reported to the Office of Radiation Safety.
- If the packaging material is not contaminated, obliterate, cross-out, or cover with an “Empty” label all radioactive material labels prior to discarding it into the regular trash.

Survey Requirements

Surveying for contamination must be performed by the RAM user during and after each experiment or use. Particular attention should be directed to the hands, shoe soles, lab coats, working surfaces, equipment used, waste storage areas/containers, radioactive material storage units (refrigerators, freezers, etc.), and the floor in the working area.

Proper Survey for Detection of Specific Isotope Used

- Users working with H-3 must perform wipe tests to survey for contamination and use a liquid scintillation counter to analyze the wipe tests. The following procedure must be followed when performing the wipe tests:
 - Wear appropriate personal protective equipment (e.g. gloves, lab coat);
 - Use small pieces of absorbent material (Kimwipe, filter paper, paper towel, cotton-tipped applicator) for wiping the area to be surveyed;
 - An area of 100 cm² or more should be wiped for each area to be surveyed;
 - Wipe all potentially contaminated areas in an S-shaped pattern;
 - Place each wipe sample in a vial (one sample per vial) and add the appropriate type and volume of cocktail to each vial (4 ml for a 5 ml vial);
 - Prepare a “blank wipe” sample to determine the background reading;
 - Each sample (including the background sample) must be counted for 1 minute;
 - Use the LSC protocol that is programmed for detection of the appropriate isotope energies.
- Radioactive material users working with C-14, Na-22, P-32, P-33, S-35, Cl-36, Ca-45, Cr-51, Zn-65, Rb-86, Nb-95, Tc-99m, or I-123 must survey with a thin-end window or pancake Geiger- Müller (G-M) detector. Review the section of this manual for effective use of the survey instrument. Remember to complete the battery test and operational check prior to use.
- Radioactive material users working with I-125 must survey with a sodium iodide scintillation detector. Review the section of this manual for effective use of the survey instrument. Remember to complete the battery test and operational check prior to use.

Survey Documentation

- Frequency for Usage of 250 μCi per month or more: Each laboratory is required to document a survey once per week unless radioactive material has not been used since the last documented survey. This statement means that a survey is only required to be documented weekly during the times you use the material. (For example: If the survey was documented on Friday and someone used material on Saturday, you need to document a survey the following week, even if there was no more material used the next week.) Therefore, a survey is not required based solely upon items being on the laboratory inventory. The use of any isotope requires a documented survey for the corresponding week.
- Frequency for Usage of Less Than 250 μCi per month: The laboratory possessing and using less than 250 μCi per month may apply for a monthly survey frequency that must be approved by Radiation Safety. If a laboratory is not approved for a monthly survey frequency, they must document surveys as indicated in 3.b.1).
- Standardized Survey Forms: Surveys must be documented with one of the standardized survey forms provided by the Office of Radiation Safety. The entries on either survey form must show the areas surveyed, the date of the survey, the radiation measurements, the instrument used, decontamination results, and the initials of the person or persons performing the survey. The following standardized survey forms are posted on the Radiation Safety website: Survey Form Non-Sketch and Survey Form Sketch.
- The standardized survey form provides some brief instructions and includes a check box to signify the weeks you had no usage since the last survey. It is recommended that the laboratory staff check the Package Receipt and Disposal records each week to determine if radioactive material was used during the week (since the last survey) and to determine whether or not a documented survey is required. The following form is on the ORS website to assist in conducting and documenting a weekly check of radioactive material usage in the laboratory: Weekly Check for RAM Usage.

Decontamination Guidelines for Removable Contamination

- Researchers are required to conduct decontamination procedures when removable contamination exceeds the action levels listed below. Removable contamination is defined as radioactivity that can be transferred from a surface to a smear paper by rubbing with moderate pressure.
 - Wipe test greater than 400 cpm
 - Removable contamination above the survey instrument background exposure reading for GM and NaI probes (see 4.e for average background readings).
- After decontamination has been completed the area where the contamination was present must be resurveyed following the appropriate procedure to ensure the area is properly decontaminated. The contamination incident must be properly documented on the survey report.

Shielding Requirements for Fixed Contamination and Elevated Exposure Rates

- Researchers are required to ensure exposure rates in occupied areas are

maintained as low as reasonable achievable. Therefore, appropriate shielding must be used to decrease exposure rates in these areas below the action levels listed below. Fixed contamination is defined as radioactivity remaining on a surface after repeated decontamination attempts fail to significantly reduce the contamination level. You may expect to find elevated exposure rates around your waste storage areas, stock and sample storage areas, and work areas.

- GM survey instrument reading >0.25 mR/hr or 600 cpm, or 6 cps for Mini-Monitors and Rad-Monitors that read in cps
- NaI survey instrument reading >1000 cpm
- After shielding of the fixed contamination or area of elevated exposure rates the area must be resurveyed to ensure the shielding has been properly positioned and sufficient shielding thickness was used. The actions taken to reduce the exposure rate must be properly documented on the survey report.

Survey Instruments

- Users working with C-14, Na-22, P-32, P-33, S-35, Cl-36, Ca-45, Cr-51, Zn-65, Rb-86, Nb-95, Tc-99m, or I-123 must have access to a survey instrument with a thin-end window or pancake Geiger-Müller(G-M) detector.
- Users working with I-125 must have access to a survey instrument with a sodium iodide scintillation detector.
- Principal investigators using 1 mCi or more of C-14, Na-22, P-32, P-33, S-35, Cl-36, Ca-45, Cr-51, Zn-65, Rb-86, Nb-95, Tc-99m, or I-123 at any one time are required to have a working survey instrument with a thin-end window or pancake Geiger-Mueller probe in the laboratory at all times.
- Principal investigators using 1 mCi or more of I-125 at any one time are required to have a working survey instrument with a low energy sodium iodide crystal probe in the laboratory at all times.

Survey Instrument Calibration

- Survey instruments in use must be returned to the Office of Radiation Safety for recalibration on an annual basis. If needed, ORS will send the survey instrument to the manufacturer for calibration.
- If a research group purchases a new instrument, the Office of Radiation Safety must be notified. The Office of Radiation Safety will affix a sealed source to the new instrument (if a source was not purchased with the instrument) to be used for the instrument operational checks. A copy of the manufacturer's calibration certificate must be submitted to the Office of Radiation Safety. If you are unable to locate the calibration certificate, the Office of Radiation Safety will be required to recalibrate the instrument before it can be used in the laboratory.

Survey Instrument Repairs

- Minor repairs of malfunctioning survey instruments can be made by the Office of Radiation Safety for some instruments in wide use.
- Instruments requiring major repairs or instruments for which the Office of Radiation Safety does not maintain parts will be returned to the manufacturer for repair and recalibration.

- Instruments requiring repairs will require recalibration to vary proper function.

Survey Instrument Battery Test

- A battery check must be performed each day an instrument is used as a minimum. However, we recommend the battery test be completed each time the meter is turned on.
- If the battery test falls below the battery condition line, the instrument must be taken out of use until the batteries are replaced.
- Procedure for completing the battery test.
 - Move switch on base to “BAT” position.
 - The indicator needle must deflect to the “BAT TEST” range.
 - If it does not pass, you may not use the instrument! Change the batteries or call ORS for assistance.

Survey Instrument Operational Check

- An instrument operational check must be performed with a dedicated check source each day an instrument is used.
- The reading taken must fall within the range limits stated on the side of the instrument. If the reading falls outside the stated range, the instrument must be taken out of use and the Office of Radiation Safety must be contacted.
- Procedure for completing the operational check.
 - With the meter turned on, hold the probe flush against the check source location (black X) on the side of the meter. The red cap should be removed for G-M probes.
 - The display must read within the range limits on the “Check source Measurement” sticker.
 - Contact ORS if the reading falls outside the range. Do not use this instrument!

Effective Use of a Survey Instrument

The following information is provided to assist the RAM users in the proper procedure for performing contamination surveys with the survey instrument.

- Geiger-Mueller (G-M) Detector
 - After battery check and operational check, set the dial switch to the lowest scale.
 - “Instrument Background” is the highest reading when no radioactive material is present.
 - Average Backgrounds (end window or pancake probe) are: ~ 0.03 mR/hr or 30 – 100 cpm or 0.3 – 1 cps. If your background is too high you must move to another area, re-perform the operational check, and try again. A short in the cable or a contaminated probe can cause elevated backgrounds.
 - Always remove the red cap before surveying.
 - Proper survey distance is 1cm from the surface – don’t let the probe make contact with the object you are surveying!
 - Keep the probe face parallel to the area being surveyed.

- You can never survey too slowly. Recommended survey speeds range from 2-5 cm/second. Keep in mind that the efficiency of your meter varies with the isotope you are trying to detect!
- Survey with the audio “on”!
- Sodium Iodide (NaI) Scintillation Detector for Detection of gamma radiation from I-125
 - After battery check and operational check, set the dial switch to the lowest scale.
 - “Instrument Background” is the highest reading when no radioactive material is present.
 - Average background 100 to 500 cpm
 - Results in cpm only!
 - 20-30% efficiency
 - Red cover is not removable!
 - Proper survey distance is 1cm from the surface – don’t let the probe make contact with the object you are surveying!
 - Keep the probe face parallel to the area being surveyed.
 - You can never survey too slowly. Recommended survey speeds range from 2-5 cm/second. Keep in mind that the efficiency of your meter varies with the isotope you are trying to detect!
 - Survey with the audio “on”!

Liquid Scintillation Counters

The liquid scintillation counter (LSC) is used to detect low energy beta-emitters (H-3). The LSC must be used for analyzing wipe samples for H-3 contamination surveys. The instrument counting results will be in counts per minute (cpm) and the average background is usually less than 50 cpm. The LSC protocols must be programmed for detection of the appropriate isotope energies.

Laboratory Notebooks

Laboratories are required to maintain radiation safety notebooks. Laboratory notebooks should contain all completed Package Receipt and Disposal Forms (Radionuclide Receipt & Usage Logs), Surveys of Removable Contamination, Radioactive Aqueous Waste Drain Disposal Logs, Training Records and Radioactive Material Inventory Records. Notebooks should be readily accessible for review by Radiation Safety personnel and Regulatory Inspectors.

Security of Radioactive Material

- There is heightened concern across the nation about acts of terrorism, therefore researchers need to be mindful of security procedures regarding the use of radioactive material.
- It is the responsibility of each principal investigator to maintain sources of radiation, (including radioactive material samples and radioactive waste) under constant surveillance and control at all times.
- The following guidelines must be observed:

- Rooms where radioactive material is used or stored must be locked when unattended.
- Eliminate unnecessary quantities of radioactive materials.
- Maintain safe and secure storage of all radioactive material in space you are directly responsible for and space you remotely oversee.
- Be aware of unexpected visitors, make inquiries and have a plan to deal with those situations.
- Report to University Police (123 or 773-702-8181) any individuals whose behavior you find threatening or suspicious.
- Maintain accurate contact information at laboratory entrances for use by emergency responders (contact information cards are available from the Safety Office).
- It is also the responsibility of each investigator to promptly report loss, theft, or damage to any source of radioactive material (radioactive waste, stock solution vials, sealed sources, etc.) to the Office of Radiation Safety.

Labeling of Containers Containing Radioactive Materials

- The University policy is to label each container (stock vials, samples, etc.) of radioactive material with a durable, clearly visible label bearing the radiation caution symbol and the words “CAUTION RADIOACTIVE MATERIAL”.
- In addition, the container shall bear a label denoting the isotope, activity, and the reference date activity. Vials and samples containing radioactive materials placed in storage (refrigerators, freezers, etc.) must be properly labeled to ensure all staff is aware of their presence.
- Counting vials do not need to be labeled if they are stored in an appropriately posted area and are attended by an individual who takes the necessary precautions to prevent personnel exposure and place the vials in the appropriate waste container.

Radiation Safety Precautions

Food and Beverages

The University is committed to maintaining a safe work environment for its employees and the University Radiation Safety Committee is responsible for the control and safe use of radioactive material. Because of the risk of ingesting small amounts of radioactive material over a long period of time, food and beverages for human consumption CANNOT be stored or consumed in radioactive material laboratories or cold rooms.

- General Rules:
 - Smoking in radioactive material laboratories is prohibited.
 - The application of cosmetics (lip gloss, hand cream, etc.) is prohibited in areas where radioactive material is used or stored.
 - Heating or preparing food or drinks for human consumption using microwaves and coffee makers in radioactive material laboratories is strictly prohibited.
- Specific Rules Regarding Food/Beverages in Radioactive Material Laboratories:

- Definition: Use or Storage of Radioactive Material is any lab, cold room, or office door that has a “Caution Radioactive Material” sign posted on it is an area where radioactive material is used or stored.
- In these Areas: Lab personnel are NOT allowed to eat food (e.g lunches, bagels, sweet rolls, or candy, etc.) or drink any type of beverages (e.g. coffee, soda pop, water, tea, etc.) and Lab personnel are NOT allowed to store food or beverages anywhere in these labs, i.e. desk drawers, cold rooms, refrigerators.
- Defined Areas For Eating and Drinking of Beverages: Lab personnel are allowed to eat and drink in areas that are clearly a separate space from the rest of the lab, i.e. an office within the lab with its own door. These areas need to be approved by Radiation Safety.

Protective Clothing

Rubber or plastic gloves and either laboratory coats or coveralls must be worn while working with radioactive material that is not in sealed source form. Gloves used while working with iodine shall be replaced frequently because iodine tends to migrate through glove material. For this reason, double gloves are recommended for iodine work. Such protective clothing must be monitored before removal and, if found to be contaminated, stored for decay in an isolated location or disposed as radioactive waste. Gloves must never be reused. In addition, shorts, skirt, and open toed shoes are prohibited.

Working Surfaces

Working surfaces should be covered with absorbent material that has a waterproof backing. The waterproof backing side must be down on the surface to be covered with the absorbent side up. These covers should be checked after each experiment or use. If contamination is found, discard the absorbent paper as radioactive waste and replace the absorbent material.

Fume Hoods

Work involving volatile liquids, gases, fine powders, boiling, dust, vapors, energetic stirring, or any other operation where radioactive materials are likely to become airborne must be performed in a hood having a minimum face velocity of 100 linear feet per minute at any point of the hood opening. The base of the hood should be covered with absorbent material that has a waterproof backing. Hood exhaust filters should be maintained in good condition in order to exhaust dust and vapors efficiently. The Plant Department should be contacted to make such measurements and to replace the filters if necessary.

Iodinations with I-125 sodium iodide must be performed in a fume hood having a minimum face velocity of 100 linear feet per minute at any point of the hood opening. When using any volatile radioactive materials, the hood should be left running at all times.

Mouth Pipetting

Radioactive solutions shall not be pipetted by mouth.

Release of Equipment Used in Radioactive Material Experiments

Prior to the release of equipment (ice buckets, centrifuges, pipetters, etc.) that were used in radioactive material experiments, the equipment must be surveyed to ensure that no residual contamination is present. All “Caution Radioactive Material” signs must be removed, to certify that no radiological hazards exist. If the equipment is to be released to a vendor for repair or released to movers for packing, the monitoring must be performed by the Office of Radiation Safety.

Labeling Equipment Use in Radioactive Material Experiments

All equipment (centrifuges, pipetters, pens, etc.) used in radioactive material experiments must be labeled with “Caution Radioactive Material” signs to communicate to all lab personnel the potential radiological.

Radionuclide Use Involving Animals

- The principal investigator under whose application the material is obtained is responsible for posting each cage with a sign bearing the standard radiation caution sign, radionuclide, total activity in each animal, date and name of experimenter.
- Animals containing radioactive material must be housed in separate cages segregated from other animals. Animal attendants should monitor themselves before leaving the area, particularly their hands and the soles of their shoes. Lab personnel are responsible for conducting area surveys after experiments as prescribed in the laboratory survey section.
- Principal investigators and authorized personnel must have access to rooms housing animals injected with radioactive material. Animal housing facilities for animals containing radioactive materials must be locked at all times.
- Radiation Safety, when applicable, will assign waste containers for the collection of radioactive waste (excluding carcasses).
- Animal Care Facilities, cages, animal carcasses, waste, bedding/excreta, and related equipment must be held by the investigative staff until surveyed by the Office of Radiation Safety for release to the Animal Resource Staff.
- Investigative staff may be issued additional protection and control instructions from the Animal Resource Committee and/or the Office of Radiation Safety. The Research Group will be required to follow these instructions.

Repair of Hoods and Drains

Researchers are required to notify the Office of Radiation Safety before repairs are made to laboratory drains or hood ventilation systems to determine if special monitoring is required to protect the Physical Plant worker or outside contractor.

Sealed Source Leak Test

- Sealed sources containing either of the following licensed radioactive material must be leak tested.
 - Alpha emitting source (half-life greater than 30 days) having an activity of more than 10 microcuries.
 - Beta or gamma-emitting source (half-life greater than 30 days) having an activity of more than 100 microcuries.

- Alpha-emitting sources generally require testing at three-month intervals. Beta and gamma-emitting sources require testing at six-month intervals.
- It is the responsibility of the individual under whose application the source is used or stored to ensure that the leak tests are performed. Generally, Radiation Safety conducts the leak tests unless the University Radiation Safety Committee has approved an alternate means of complying with the regulations or license conditions. Access to the location of the source(s) or the device must be made accessible by the principal investigator for such testing.

Additional Requirements

The University Radiation Safety Committee or Radiation Safety Officer may specify additional requirements, procedures, or medical examinations, and may grant exemptions to the requirements herein specified.