



The
UNIVERSITY
of **VERMONT**



Radiation Safety Office

RADIATION SAFETY HANDBOOK

***Approved by the
UVM Radiation Safety Committee on
March 4, 2015***

This version supersedes all prior versions.

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IN CASE OF EMERGENCY:

Evenings, Weekends or Holidays..... 911 or (802) 656-FIRE (UVM Police Services)

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PREAMBLE

The purpose of this handbook is to inform and educate the University of Vermont community in a concise user-friendly manner of the policies and procedures and the rules and regulations pertaining to the safe use of ionizing radiation. It is the responsibility of all persons involved in radioactive material work to thoroughly familiarize themselves with the University's radiation safety program and to comply with its requirements and all applicable federal and state regulations.

Safety comes from a partnership of knowledge and trust between the users, the Radiation Safety Office (RSO) and the regulators. Always keep in mind that radiation safety depends on a continuous awareness of potential hazards and on the acceptance of no short cuts toward the achievement of negligible radiation exposures.

The Radiation Safety Office staff look forward to working with radiation handlers to ensure safe working conditions and to make sure the University's research and educational mission can be met. The RSO will advise and help, set up labs to use radioactive materials, recommend the purchase of appropriate radiation detectors, create safety procedures, and answer any other radiation safety-related questions. Please call 656-2570 or come to the RSO in Room 004 Rowell Building. All users, and all other personnel, are asked to extend their full cooperation to the Radiation Safety Office, which will assist in carrying out these procedures.

The practices and procedures outlined in this handbook are required by law. Failure to follow any of the procedures is considered a violation which must be corrected in a time commensurate with the severity of the violation. Failure to correct the violation, or repeat violations, may lead to a suspension of radiation use privileges and the possible termination of the University's Nuclear Regulatory Commission materials license which is required to possess and use radioactive materials.



The University of Vermont

Radiation Safety Office

MISSION STATEMENT

The mission of the University of Vermont's Radiation Safety Office is to oversee the safe use of ionizing radiation sources and lasers by the University community to ensure compliance with Federal, State, and University regulations and to protect faculty, staff, students, the public and the environment from radiological hazards.

The Radiation Safety Office Staff

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ABBREVIATIONS USED IN THIS HANDBOOK

ALARA	As Low As Reasonably Achievable
CFR	Code of Federal Regulations
DOT	Department of Transportation
NRC	Nuclear Regulatory Commission
RSC	Radiation Safety Committee
RSO	Radiation Safety Office
SI	International System of Units (Systeme International)
UVM	University of Vermont

CHAPTER 1

INTRODUCTION TO RADIATION SAFETY AT UVM

USE OF RADIATION ON CAMPUS

There are more than 300 faculty, staff, and students who use ionizing radiation sources for research and educational purposes in more than 100 laboratories on and off campus at UVM. More than 30 different radionuclides are used. Machine producing equipment, x-ray diffraction devices, medical x-ray units, cabinet x-ray devices and electron microscopes are also available but are not regulated by the rules specified in the handbook. Each year, more than 200 vials of radioactive materials containing more than 1,000 millicuries are delivered to campus, generating more than 300 cubic feet of low-level radioactive waste.

THE RADIATION SAFETY OFFICE (RSO)

The RSO is a University-wide office, in the department of Risk Management & Safety, under the executive management of the Vice President for Relations and Administration. Its main purpose is to oversee the use of ionizing radiation sources on campus and to ensure compliance with federal, state, and University regulations in order to protect employees, students, the environment, and the public. See Chapter 5 for a more extensive description of RSO responsibilities and services.

THE RADIATION SAFETY COMMITTEE (RSC)

This federally-mandated committee, appointed by the Vice President for Research, is charged with approving all uses of ionizing radiation on campus, auditing the University's radiation safety program, reviewing radiation exposures and recommending safety policies and procedures. It meets as often as necessary, but at least once per calendar quarter¹.

Contact the RSO for a list of committee members or a copy of the committee bylaws.

NUCLEAR REGULATORY COMMISSION (NRC) LICENSE

UVM's authority to use radioactive materials for education and research purposes comes from the NRC materials license #44-00728-13. The license requires UVM to follow regulations which are found in Title 10 of the Code of Federal Regulations (CFR). The primary radiation safety rules are found in Section 20 (also known as 10 CFR 20).

¹10 CFR 33.13 Requirements for the Issuance of a Type A Specific License of Broad Scope

The NRC is authorized by the CFR to conduct unannounced inspections of licensees and to issue citations for violations. Citations may carry penalties such as fines, license restrictions, public disclosure through press releases, and license suspension^{2 3 4}.

The rights of all employees are outlined in the NRC form-3^{5 6 7} at the end of this handbook.

The principle of ALARA (As Low As Reasonably Achievable) is the basis for the University's radiation safety program. ALARA obligates UVM to conduct the safety program in such a way as to minimize personnel radiation exposure. The RSO will take investigative action when any personnel radiation exposure reaches 10% of the maximum allowed by the CFR⁸.

WASTE DISPOSAL

Radioactive waste is an inevitable byproduct of research labs that use radioactive materials. Disposal of radioactive waste presents specific challenges to UVM and requires the cooperation of the entire campus community. Labs should make every effort to minimize the amount of waste generated. The RSO staff is available to meet with labs to review their usage and waste streams to help with volume minimization.

The Low-level Radioactive Waste Policy Amendments Act of 1985 gives the states responsibility for the disposal of their low-level radioactive waste. The Act encouraged the states to enter into compacts that would allow them to dispose of waste at a common disposal facility. The state of Vermont has joined in a compact with the state of Texas and sends its long-lived radioactive waste there for shallow-land burial.

²10 CFR 19.14 Presence of Representatives of Licensees and Workers During Inspections

³10 CFR 19.15 Consultation With Workers During Inspections

⁴10 CFR 19.30 Violations

⁵10 CFR 19.11 Posting of Notices to Workers

⁶10 CFR 19.13 Notification and Reports to Individuals

⁷10 CFR 19.16 Requests By Workers for Inspections

⁸10 CFR 20.1201 Occupational dose limits for adults

CHAPTER 2

HOW TO BECOME AUTHORIZED

HOW TO BECOME AN AUTHORIZED PRINCIPAL INVESTIGATOR (PI) TO PROCURE / PURCHASE RADIATION

Faculty who need to procure radiation sources for research and/or teaching purposes must be formally approved by the RSC. Approval will be granted if the applicant has the credentials and previous on-the-job experience handling radionuclides of a similar nature and quantity. Applicants who are deficient in experience may be asked to work under an authorized PI's approval for at least 6 months before being granted their own approval.

The RSO will meet with the Principal Investigator to discuss their use and safety considerations for the use the specified radionuclide(s). At the next scheduled meeting of the RSC full authorization will be considered which will allows the investigator to procure and store a maximum quantity (called the "possession limit") of a specific radionuclide(s). This authorization may later be amended to increase the possession limit or to add other radionuclides as necessary.

Chapter 3 lists the responsibilities of an authorized Principal Investigator.

HOW TO BECOME AUTHORIZED TO HANDLE RADIATION

All persons who handle radiation for research or teaching purposes must meet the requirements set by the RSC outlined in this handbook. The requirements also apply to temporary employees such as work-study students and visiting scientists.

Unsealed Radiation Sources

Persons seeking approval to handle ionizing radiation sources must complete and pass a written multiple choice examination based on the contents of this Handbook.⁹

Application forms are available in the RSO or online at the RSO's website; <http://www.uvm.edu/radsafe>.

⁹Radiation Safety Committee policy approved at 6/23/87 meeting

CHAPTER 3

RESPONSIBILITIES OF AUTHORIZED PRINCIPAL INVESTIGATORS

Authorized investigators are responsible for the following:

1. Assume ultimate responsibility for radiation safety in the laboratories under his/her authorization.
2. Correct violations which occur in laboratories used under his/her authorization.

Failure to correct violations may lead to suspension of radiation handling privileges.
3. Train all persons using radiation under his/her authorization to follow radiation safety procedures and regulations listed in this Handbook.
4. Conduct, or designate an approved radiation handler to conduct surveys for contamination that may have resulted from the use of unsealed radiation sources.
5. Provide funds for radioactive waste disposal, film badges for lab personnel, and appropriate radiation detectors (including their annual calibration and maintenance).
6. Provide for the disposal of all radioactive waste before termination of employment at UVM.
7. Review radiation exposure reports that are received from the RSO's investigation of personnel radiation exposures and to assist the RSO in the investigation.
8. Use only radionuclides and radiation sources for which approval is given by the RSO and RSC.
9. Ensure that all laboratory personnel are approved by the RSO before handling radiation.
10. Notify the RSO before using new laboratory space for radiation handling, or when laboratory space is no longer used for radiation handling.

11. Notify the RSO prior to transferring radiation sources to other laboratories on or off campus¹⁰.
13. Notify the RSO of any personnel changes of certified radioactive material handlers in the laboratory.
12. Ensure that pregnant radiation workers who would like to 'declare' their pregnancy, meet with RSO personnel to review safety procedures¹¹.
13. Use radiation sources only for *in vitro* or animal applications. All animal use also must be approved by UVM's Institutional Animal Care and Use Committee (IACUC).
14. All uses in or on humans must be approved by the Institutional Review Board's Committee on Human Research in The Medical Science (CHRMS) and must be conducted under the NRC material license of the University of Vermont Medical Center and approved by the University of Vermont Medical Center Radiation Safety Committee.

¹⁰10 CFR 40.51 Transfer of Source or By-product Materials

¹¹10 CFR 20.1208 Dose Equivalent to an Embryo/Fetus

CHAPTER 4

RESPONSIBILITIES OF RADIATION HANDLERS

Persons who are certified and authorized by the RSO to handle radioactive materials are responsible for the following procedures:

PROCURING RADIOACTIVE MATERIALS

1. Submit all purchase requisitions for radioactive materials to the RSO for approval.

You may FAX requisitions directly to the RSO (Fax telephone number: 656-8876).

The investigator making the radionuclide purchase must be authorized to procure that particular radionuclide and that it will not put them over their laboratory possession limit.

All radiation sources are delivered to the RSO.

RECEIVING RADIOACTIVE MATERIALS

1. Make a record on the RADIOACTIVE MATERIALS LOG AND INVENTORY sheet each time a sample is withdrawn from the original vial of radioactivity. This form is included with each new purchase and given to the laboratory.

Radioactive materials will remain on an investigator's computer inventory until the LOG INVENTORY sheet is returned to the RSO along with the waste generated from the vial.

2. Perform a wipe test on incoming packages if you are so instructed by RSO personnel. This is only done when RSO personnel are unavailable to conduct the tests.

Send the results of the wipe test to the RSO within 24 hours¹².

¹²10 CFR 20.1906 Procedures for receiving and opening packages

HUMAN USES OF RADIOACTIVE MATERIALS

1. Radioactive materials must not be used in or on humans.

Persons interested in administering radiation to humans must file an application with the University Institutional Review Board's Human Use Committee in The Medical Science and also be granted approval from the Radiation Safety Committee at University of Vermont Medical Center.

TRANSFER OF RADIOACTIVE MATERIALS

1. Do not transfer radioactive materials to another person, on or off campus, without approval of the RSO.

The RSO must ensure that the receiver of the radioactive material is authorized by the RSC and the RSO to do so.

2. All transfer of radioactive materials to persons off campus or at other institutions must be done by the RSO to ensure that both NRC and DOT regulations are followed.

STORAGE OF RADIOACTIVE MATERIALS

1. Food or beverages must not be placed in refrigerators, cold rooms, or freezers in laboratories which are used to handle radioactive materials¹³.

The RSO will place a sign on all refrigerators, cold rooms, or freezers used to handle or store radioactive materials indicating that no food or drink is to be stored within.

2. If you store radioactive materials in glass containers, do so in a double container in locations with a low possibility of breakage or spills.

SECURITY

1. The door to a radiation handling or storage laboratory must be locked if the lab is left unattended. When present in a radiation lab you should challenge any unknown person that enters.
2. Store radiation sources in an RSO-approved lab that is always under control and which is locked at the end of the workday¹⁴
3. If radioactive materials must be stored in refrigerators or freezers in the hallways, the refrigerator or freezer must be locked at all times when not being directly

¹³NRC Regulatory Guide 8.18 Information Relevant to Ensuring that Occupational Radiation Exposure at Medical Institutions Will Be As Low As Reasonably Achievable

¹⁴10 CFR 20.1801 Storage and Control of Licensed Materials

used.

4. Do not store radioactive sources or waste in common rooms, i.e. counting rooms, cold rooms, and centrifuge rooms.

PERSONNEL RADIATION MONITORING (WHOLE BODY/RING BADGES)

1. Wear a whole body film badge when you are working with radionuclides which emit beta particles with an energy exceeding 0.5 MeV, or gamma rays or x-rays with any energy.
2. Persons using ^3H , ^{14}C , or ^{35}S exclusively are not required to wear a whole body or ring badges¹⁵ because the low-energy beta particles emitted by these radionuclides cannot be detected by the whole body badge or ring badge.
3. Wear a ring monitor if your hands are exposed to radionuclides which emit beta particles with an energy exceeding 0.5 MeV (^{32}P), or gamma rays with any energy (^{51}Cr , ^{125}I , etc.).

Wear the ring monitor exclusively on the particular hand and finger that is most likely to the highest receive radiation exposure. Do not switch hands once you have indicated to the RSO on which hand you will wear the ring monitor, or unless you notify the RSO of a change.

The ring monitor must be turned to face the radiation source and worn under the disposable gloves.

4. The NRC has established a special limit for protection of an embryo/fetus of 0.5 rem for the entire gestation period.

Pregnant radiation workers can meet with the RSO to review safety rules and to determine appropriate monitoring^{16 17}. See PREGNANCY, p.15.

5. The RSO will conduct a urine bioassay if you handle 100 millicuries or more of ^3H (tritium) in a single operation. The individual's urine must be evaluated no earlier than 24 hours and no later than 72 hours after handling such quantities.
6. Keep your whole body badge and ring monitor in a lab location free from radiation, excessive heat, moisture, and vapors when not in use.

¹⁵10 CFR 20.1501 Surveys and Monitoring

¹⁶NRC Regulatory Guide 8.13 Instructions Concerning Prenatal Radiation Exposure

¹⁷Radiation Safety Committee policy approved at 12/8/88 meeting

7. Return your previous month's whole body badge and ring monitor during the first week of each new month so that the badges can be returned to the commercial company for timely readings.

PREGNANCY

The first trimester is known to be the most radiosensitive time for a fetus, thus, it is beneficial, but not required, to meet with the RSO as soon as possible to review safety practices and monitoring options.

1. It is up to the pregnant radiation worker to decide whether or not she will formally declare her pregnancy to the RSO.

- a. She may choose to declare her pregnancy to the RSO.

The Director or a designee of the RSO will meet with the pregnant worker to review radiation safety procedures, the risk to the fetus, and NRC Regulatory Guide 8.13

- b. She may choose not to declare her pregnancy to the RSO. In this case, only the radiation limits for adult radiation workers will be in effect, not the limits for the fetus.

Undeclared pregnant workers are protected under the regulations for adult radiation workers.

2. All female radiation workers will be given a copy of NRC Regulatory Guide 8.13 as part of the process of becoming a certified radiation handler.

(If preferred, copy this page and post it in conspicuous places in your laboratory)

SPILLS

Here are specific actions to take for minor and major spills containing radioactivity.

Minor spill

A minor spill is defined as a spill involving;

- 1) less than 100 microCuries (0.1 milliCuries, 3.7 MegaBecquerels), and
- 2) less than a liter, and
- 3) no personnel contamination.

ACTION TO TAKE:

1. **CONTAIN** the spill and soak up with absorbent material.
2. Conduct a wipe test to ensure that the spill has been cleaned up.
3. Send a report to the RSO using the standard contamination survey form.

Major spill

A major spill is defined as a spill involving:

- 1) more than 100 microCuries, or
- 2) any amount of activity which results in personnel contamination, or
- 3) more than a liter.

ACTION TO TAKE:

1. **CONTAIN** the spill by absorbing as much as possible with absorbent material such as paper towels.
2. **NOTIFY** all persons to leave the area of the spill.
3. **LEAVE** contaminated shoes and clothing in the room where the spill occurred.
4. **SECURE** the area by locking the door and posting a sign to "KEEP OUT", or post a guard outside the area where the spill occurred.
5. **DECONTAMINATE** any contamination to personnel; immediately wash with soap and/or commercial detergents and recheck; consider clipping finger nails. If skin is cut, irrigate with running water.
6. **CONTACT** the supervisor of the room where the spill occurred.
7. **CONTACT** the Radiation Safety Office.
8:00 AM-noon, 1:00-4:30 PM Monday - Friday 656-2570
All other times UVM Police: (Emergency)..... 911 or (802) 656-FIRE

UVM Police (656-FIRE) will contact RSO personnel and then proceed to the scene to assist lab personnel in securing the area.

8. Send a report to the RSO using the standard contamination survey report form.

GENERAL RADIATION HANDLING PROCEDURES

1. Do not use mouth suction to pipette radioactive solutions¹⁸.
2. Confine all work with volatile or dust-forming radioactive materials to fume hoods approved by the Department of Risk Management & Safety.
3. No smoking, eating, drinking, or application of cosmetics is allowed in any room where radioactive materials are handled or stored¹⁹.

To avoid the appearance that beverages were consumed in a radiation handling laboratory, do not store empty beverage containers in a radiation handling laboratory even though they were consumed elsewhere.

4. Conduct all radiation handling procedures on easily decontaminated surfaces or on absorbent paper.
5. Do not use radioactive materials for a new procedure until the procedure has been tested by means of a 'dry' run.
6. Radioactive material must not be transferred in open vessels beyond the limits of your immediate area unless carried in a tray or container with raised edges and sufficient absorbent material to absorb all the liquid contained in the vessel in case of a spill.
7. Wash your hands after handling unsealed radiation sources.
8. Use long-handled tongs whenever handling higher activity sources that produce radiation exposure to the hands or whole body such as ¹²⁵I, ⁵¹Cr and ³²P.
9. Decontaminate and/or prepare for disposal any glassware or objects that have been in contact with radioactive material.

SIGNS AND LABELS

1. The RSO will place a "CAUTION-RADIOACTIVE MATERIALS" sign on the door to each room where radioactive materials are stored or manipulated²⁰.
2. A sign must be posted on the door to any radiation-handling laboratory indicating "No Smoking, Eating, or Drinking".

¹⁸NRC Regulatory Guide 8.18 Information Relevant to Ensuring that Occupational Radiation Exposure at Medical Institutions Will Be As Low As Reasonably Achievable

¹⁹NRC Regulatory Guide 8.18 Information Relevant to Ensuring that Occupational Radiation Exposure at Medical Institutions Will Be As Low As Reasonably Achievable

²⁰10 CFR 20.1601 Control of exposure from external sources in restricted areas.

Do not remove the sign without permission from the RSO.

3. Label all vessels containing radioactive materials with standard yellow and magenta tape to identify the radionuclide, the activity, and the date the activity was determined²¹. Do not attach the labels to anything which is not radioactive.
4. Label all radioactive waste containers with a "Radioactive Waste - Do Not Empty" label. Some types of waste containers and labels are available from the RSO.
5. Label all laboratory equipment used for radioactive work i.e. microfuges, centrifuges, gel dryers.

CONTAMINATION SURVEYS

1. Surveys for radiation contamination must be made by the radiation handler after each experimental run OR at the end of the day in which radiation was handled in order to determine the extent of radiation contamination and to determine that all waste and radioactive materials have been properly stored.

The RSO recommends that each contamination survey be documented and the records kept in the laboratory for inspection by the RSO. The minimum requirement is that at least one weekly written contamination survey report must be sent to the RSO for each radiation handling laboratory during periods of active use and a monthly report must be sent for each room where no radioactive materials were handled, such as a cold room, counting room, or radioactive material/waste storage room. (See #2 below)

2. Send the RSO a weekly contamination survey, during periods of active use, in all laboratories used to handle unsealed radioactive materials^{22 23}. These contamination survey reports can be mailed, emailed (radsafe@uvm.edu) or Faxed (656-8876) to the RSO.

52 weekly contamination survey or "No RAM Use" (see #4 below) reports are expected each year for each laboratory identified as a radiation handling laboratory.

12 monthly surveys are expected each year for rooms used only to count radioactivity, and those which are used to store radioactivity such as cold rooms and freezer rooms.

²¹10 CFR 20.1601 Control of exposure from external sources in restricted areas.

²²10 CFR 20.1501 Surveys and monitoring

²³NRC Regulatory Guide 8.23 Radiation Surveys at Medical Institutions

3. If contamination is found, clean it up and resurvey. Send a report to the RSO.
Call the RSO if you need any assistance with clean up.

4. If you do not use radioactive materials in any particular week, send a weekly "inactive" (no handling of radioactive materials) report. Visit the RSO's website at: <http://www.uvm.edu/~radsafe/no.ram.use.form.htm> for online submission of this report.

If the period of inactivity extends more than 3 consecutive weeks, you must conduct an area survey and/or wipe test for the 4th week to determine that stored radioactive material or waste has not produced contamination.

5. Use survey meters with valid calibration dates. Annual calibration is required.

The RSO will assist with sending survey meters for calibration, and has loaner detectors available for use when your detector has been sent for calibration.

6. Before using any portable radiation survey meters to check for contamination, you must use a radioactive source to ensure that the detector is responsive, check the battery level, and check the background radiation count.
7. If more than one laboratory group utilizes the same space, it is recommended that each group conduct their own contamination survey.

PERSONAL PROTECTION

1. Wear a full-length laboratory coat whenever you are handling unsealed radiation sources. The coat should be buttoned and the sleeves extended to cover the arms.

Remove the laboratory coat when leaving the radiation handling laboratory. Do not place near "street" clothing.

2. Wear at least one pair of disposable gloves when handling unsealed radioactive materials²⁴.
3. Remove gloves before leaving the work area and dispose in the radioactive waste container if the gloves are contaminated or are suspected to be contaminated.
4. Safety glasses or goggles are recommended when working with ³²P or other radioactive materials with a splash potential.

²⁴NRC Regulatory Guide 8.18 Information Relevant to Ensuring that Occupational Radiation Exposure at Medical Institutions Will Be As Low As Reasonably Achievable

SHIELDING

1. Apply lead shielding, as needed, to all gamma ray emitting radiation sources to minimize radiation levels to as low as reasonably achievable, but not to exceed 2.5 milliroentgens/hour at the surface of the container.

The RSO has a calibrated radiation ion chamber detector to determine the radiation exposure rate.

2. Use 0.5 inch thick Plexiglas (Lucite) or shielding when handling ^{32}P .

Contact the RSO for information on purchasing or recycling Plexiglas (Lucite) shields.

3. For vials containing more than one milliCurie (mCi) of P-32 apply additional lead shielding outside the Plexiglas (Lucite) shielding should be used.

WASTE DISPOSAL

1. Sort the waste by appropriate categories defined by the RSO.
2. The RSO will pick up your radioactive waste that you have for disposal on Fridays. Call the RSO (6-2570) to schedule a Friday appointment.
3. Radioactive waste is not allowed to be disposed in the sink or sewer without special permission from the RSC and the Vice President for Research²⁵.
4. Radioactive waste must not be disposed in the normal trash²⁶. Check the normal trash containers when you are checking other areas of the laboratory for contamination.
5. Radioactive waste is not allowed to be incinerated without special permission from the RSC and Vice President for Research.²⁷
6. Radioactive waste must only be moved or handled by persons that are certified as radiation handlers. Do not ask uncertified personnel to do this task.
7. Evaporation of radioactive liquid waste in fume hoods is not allowed without special permission from the RSC and Vice President for Research.²⁸

²⁵10 CFR 20.2003 Disposal By Release to Sanitary Sewerage

²⁶10 CFR 20.2001 Waste Disposal - General Requirements

²⁷10 CFR 20.2004 Treatment or Disposal By Incineration

²⁸Radiation Safety Committee policy adopted at the 6/23/87 meeting

8. The RSO will manifest your radioactive waste which identifies the type and quantity of radionuclide as well as the chemical form. Please make sure you have the information available for the RSO.
9. Give or send to the RSO the "Log & Inventory Sheet" for vials that are disposed in the radioactive waste. This will allow the RSO to remove that vial from the Investigator's inventory of radioactive materials.

The Log & Inventory Sheet is included with the vial when it is delivered to your laboratory by the RSO.

10. For dry radioactive waste, only use distinct yellow waste containers, with covers, provided by the RSO or special Plexiglas (Lucite) shielded boxes with proper radiation labels attached.
11. Do not dispose of decayed waste in the normal trash. Because of landfill requirements, the waste must be brought to the RSO where it will be inspected and certified as "non-radioactive".

IODINATIONS

1. All persons who want to conduct iodinations must meet with the RSO, review the SOP for Protein Labeling and pass a multiple choice examination administered by the RSO.
2. Protein labeling with ^{125}I or ^{131}I must only be conducted in the special fume hood in the RSO's iodination facility²⁹.

Call the RSO to reserve a time to use the Iodination Facility.

3. All persons conducting iodinations must return to the RSO between 6 to 72 hours after each iodination for a thyroid gland assay^{30 31}.

The first failure to return for a thyroid assay will result in a written warning. The second failure will result in a suspension of iodination privileges until a written plan has been submitted to the RSO for approval. The third violation will result in a suspension of privileges, with reinstatement possible only after approval by the RSC.

²⁹Radiation Safety Committee policy adopted at the 1/14/85 meeting

³⁰10 CFR 20.1204(c) Determination of internal exposures

³¹NRC Regulatory Guide 8.20 Applications of Bioassay for I-125 and I-131

ANIMAL HANDLING

1. The RSO will work with your lab personnel and the Office of Animal Care Management personnel to setup space for animals under the approval of UVM's Institutional Animal Care and Use Committee (IACUC) that are administered radioactive material.
2. Label cages with "Caution-Radioactive Materials" signs provided by the RSO.
3. Use absorbent mats at the bottom of each animal cage.
4. Place contaminated litter in a plastic bag with a label with the name of investigator, radionuclide, activity and date. Call the RSO for a waste pick up.
5. Place animal carcasses in a plastic bag and label as radioactive. Call the RSO to have them pick up the carcasses for disposal.
6. Conduct a wipe test on all cages before reuse. Send the results of the test to the RSO.
7. The RSO must verify that animal cages are not contaminated before they are returned or given to animal care personnel for washing.

RADIATION DETECTORS

1. All radiation detectors used for contamination surveys or area monitoring must be calibrated annually.
2. Labs must have appropriate detectors available to them during times of radioactive material use and for routine contamination surveys.

Consult with the RSO to make sure you have the appropriate detector for the radionuclides you are using.

3. Labs must have portable radiation detectors available for use during the handling of gamma ray emitters (such as Iodine-125 and Chromium-51) and/or high energy beta particle emitters such as Phosphorus-32.

These detectors must be checked prior to each use for proper battery level, background count rate and radiation response (using a check source).

Contact the RSO if you need information on purchasing a radioactive check source.

4. When you use a particular detector for contamination surveys, you must know the efficiency of the detector for each radiation to be detected.

The RSO is prepared to assist you in determining the efficiency of your detector for various types of radioactive materials used in your laboratory.

5. An approved vendor must be used to calibrate the detector annually.

The RSO will collect, prepare and ship your detector for calibration.

The RSO will loan you a calibrated detector that you can use while your detector is sent away for calibration.

6. Do not change the high voltage or any other internal setting without consulting the RSO. Doing so will nullify the calibration, and the device will have to be recalibrated.
7. Contact the RSO if your detector is not functioning properly or it has been damaged. It may need to be sent for re-calibration.

CHAPTER 5

SERVICES AND RESPONSIBILITIES OF THE RADIATION SAFETY OFFICE

EDUCATION / TRAINING/ CONSULTATION SERVICES

1. The Radiation Safety Office (RSO) provides basic safety education to all radiation handlers on campus^{32, 33} as well as special instruction in waste handling, contamination surveys, iodination protein labeling, x-ray diffraction as well as other types of x-ray producing equipment.

The following services and materials are available:

- periodic safety lectures and trainings
- private meetings to discuss general and personal safety procedures, contamination survey methods, waste handling, pregnancy, etc.
- group meetings with laboratory staff to discuss safety concerns
- radiation safety DVDs available from the RSO
- many handouts

Contact the RSO to schedule any of the above activities.

2. Maintains a mailing list of certified radiation handlers and x-ray device users for periodic communications regarding policy and procedural changes as well as announcements of available courses.
3. Maintains a World Wide Web (WWW) site on the Internet dealing with radiation safety information. The URL is: <http://www.uvm.edu/radsafe>
4. Annually sends a letter to all persons currently listed in the RSO database with annual reminders and with other timely radiation safety information

³²10 CFR 19.12 Instructions for Workers

³³NRC Regulatory Guide 8.29 Instruction Concerning Risks from Occupational Radiation Exposure

INSPECTIONS (SAFETY AUDITS)

1. Conducts inspections of all UVM radiation handling laboratories at least once per year to ensure adherence to the safety regulations outlined in this Handbook
2. Notifies the investigator of the results of all inspections.
3. Evaluates the appropriateness of the investigator's response to a violation notice.
4. Conducts repeat inspections of laboratories with identified violations.
5. Inspections of UVM laboratories^{34 35} may be unannounced or announced.
6. Inspects laboratories at the request of employees. Such requests can remain anonymous.
7. Ensures that labs conduct regular surveys for contamination; reviews all reports for accuracy and completeness. The RSO will follow up with labs if areas of contamination persist.

EMERGENCIES

1. Responds immediately to:
 - a. personnel contaminated with radioactive materials
 - b. major spills of radioactive materials
 - c. fire in a radiation-handling laboratory.
 - d. requests by lab personnel for emergency assistance.
2. UVM Police have emergency contact telephone numbers of RSO staff in the event they need to be contacted after normal work hours.

PERSONNEL MONITORING SERVICES

1. Arranges with a commercial vendor to have whole body and ring monitors provided for all persons working with gamma ray-emitting and certain high energy beta particle-emitting radionuclides.
2. Distributes whole body and ring monitors to all participating lab groups each month.

³⁴10 CFR 20.1501 Surveys and monitoring

³⁵NRC Regulatory Guide 8.23 Radiation Surveys at Medical Institutions

3. Reviews the personnel radiation exposure readings each month to ensure that they are within the ALARA action levels of 10% of the NRC limits.
4. Notifies persons in writing when exposure readings exceed ALARA action levels of 10% of the NRC monthly limits. These monthly limits are: for whole body exposure badges exceed 42 millirem, 125 millirem to lens of the eye, 417 millirem to the skin, or if monthly ring badges exceed 417 millirem.
6. Takes action and meets with radiation users to discuss methods to reduce radiation exposures³⁶ when necessary.
7. Reports personnel radiation exposures to the RSC at each calendar quarter meeting.
8. Maintains lifetime personnel radiation exposure records.
9. Meets with pregnant radiation workers to discuss and explain the possible need for fetal monitoring and any additional safety practices that may be needed.
10. Obtains radiation exposure records from all personnel who have worn radiation dosimeters at other institutions^{37 38} within the calendar year.
11. Sends an annual radiation exposure report to all current UVM personnel who were issued whole body and ring monitors during the year.
13. Recovers all costs associated with this service by direct billing to the investigator.
14. Provides radiation dosimeter information requested by a previous radiation user's new employer for their history of radiation dose while at UVM.

WASTE DISPOSAL SERVICES

1. Collects and processes all radioactive waste generated on campus.
2. Receives decayed dry radioactive waste for proper disposal through bio-medical waste incineration.

³⁶10 CFR 20.1501(c) Surveys and Monitoring

³⁷10 CFR 20.2104 Determination of Prior Occupational Dose

³⁸10 CFR 20.2101 Records - General Provisions

3. Sorts radioactive waste into appropriate categories defined by the RSO and commercial disposal facilities.
4. Packages all radioactive waste, following NRC, waste broker and disposal site requirements.
5. Can store short-lived and long-lived radioactive waste, as necessary, at the Low-Level Radioactive Waste Facility in the Ungulate Facility on Spear Street.
6. Arranges with a certified radioactive waste broker for commercial disposal of radioactive waste generated at UVM.
7. Provides dry and some liquid waste disposal containers to all radiation handling laboratories.
8. Maintains all records of radioactive waste disposal³⁹ as required by NRC and the State of Vermont Agency of Natural Resources.
9. Recovers all radioactive waste disposal costs by direct billing to the investigator who generates the waste. Billing is based on volume and waste category.

IODINATIONS

1. Oversees all Iodinations conducted at UVM in the Iodination Facility in room 012 of the Rowell Building.
2. Prepares the Iodination Facility prior to use.
2. Trains and certifies all personnel prior to conducting Iodinations.
3. Stores the stock vials of Iodine-125 for the Investigators.
4. Checks each iodinator before and after each iodination for radiation contamination.
5. Takes air effluent samples in restricted areas and unrestricted areas to ensure compliance with NRC regulations^{40 41 42}.

³⁹10 CFR 20.2101 Records - General Provisions

⁴⁰10 CFR 20.1201 Occupational Dose Limits for Adults

⁴¹10 CFR 20.1301 Radiation Dose Limits for Individual Members of the Public

⁴²10 CFR 20.1301 Radiation Dose Limits for Individual Members of the Public

6. Conducts wipe tests after each iodination to ensure the lab is clean before the next iodination.

Decontaminates and cleans the Iodination Facility if necessary.
7. Disposes of the waste generated during the iodination and bills the iodinator's lab group.
8. Conducts a thyroid burden assay for each iodinator before and after (between 6 and 72 hours) each iodination.
9. Takes investigative action if any iodinator's thyroid burden assay indicates any uptake of ^{125}I or ^{131}I above the detector's minimal detectable activity.

AUTHORIZATION

1. Reviews and evaluates all new applications submitted by Principal Investigators prior to RSC approval for; the qualifications of an investigator, the impact on University's radionuclide possession limit, safety of the project, and adequacy of funds for waste disposal.
2. Administers and grades written examinations taken by radiation handlers as part of the certification process.
3. Approves and commissions all rooms which are proposed to be used as a radiation handling or storage laboratory.
4. Decommissions a radiation handling laboratory when an investigator terminates radiation work or prior to such time when renovations are planned for a radiation handling or storage laboratory.
5. Recertifies all radiation handlers.

INSTRUMENTATION

1. Maintain the Radiation Safety Office's various radiation detectors used for the evaluation of radiation hazards present at UVM.
2. Assists labs to determine efficiency of their detectors for various radionuclides.
3. Ensures that all radiation detectors used for contamination survey reports are calibrated annually.
4. Loans survey meters to labs for short time periods while theirs is being calibrated or repaired.

5. Allows labs to use the RSO's liquid scintillation and gamma counters.

ORDERING AND RECEIVING OF RADIOACTIVE MATERIALS

1. Approves and contacts the vendor to order all radioactive materials.
2. Maintains an inventory of all radiation sources and radioactive materials at UVM to ensure that the University's NRC possession limit is not exceeded.
3. Provides copies of Investigator's radionuclide inventory upon request.
4. Checks all packages of radioactive materials for radiation levels and contamination before transferring it to the authorized Investigator's lab group⁴³.

LEAK TESTS

1. Conducts leak tests on all actively used sealed radiation sources on campus every 6 months⁴⁴ as required by our NRC materials license.

RADIOGRAPHIC X-RAY MACHINES

1. Arranges for the State of Vermont to conduct safety checks on x-ray devices as needed.
2. Registers all x-ray devices with the State of Vermont Radiological Health Department when newly purchased and after that once every three years.
3. Certifies and trains all x-ray device users on the safe use of x-ray equipment.

LICENSING

1. Ensures that UVM's NRC license is renewed in a timely manner.
2. Amends the NRC license when necessary.
3. Responds to NRC notice of violations and takes corrective actions.

⁴³10 CFR 20.1906 Procedures for Receiving and Opening Packages

⁴⁴10 CFR 35.14 Specific Licenses for Certain Groups of Medical uses of By-product Materials

4. Notifies or reports to the NRC in the event of any:
 - a. loss or theft of licensed material⁴⁵
 - b. major contamination incident⁴⁶
 - c. overexposure of personnel to radiation⁴⁷
 - c. excessive levels and concentrations released to the environment⁴⁷
5. Maintains records and submits license required paperwork as obligated.

⁴⁵10 CFR 20.2201 Reports of Theft or Loss of Licensed Material

⁴⁶10 CFR 20.2202 Notification of Incidents

⁴⁷10 CFR 20.2203 Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the limits

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WHAT IS THE NUCLEAR REGULATORY COMMISSION?
The Nuclear Regulatory Commission is an independent Federal agency responsible for licensing and using nuclear power plants for commercial uses of radioactive materials.

WHAT DOES THE NRC DO?

The NRC's primary responsibility is to ensure that workers and the public are protected from unnecessary or excessive exposure to radiation and that facilities, including power plants, are constructed to high quality standards and operated in a safe and secure manner. The NRC does this by setting and enforcing the Code of Federal Regulations (10 CFR) and licenses issued to nuclear users.

WHAT RESPONSIBILITY DOES MY EMPLOYER HAVE?

Any company that conducts activities licensed by the NRC must meet the NRC's requirements. If a company violates NRC requirements, it may be fined or have its license modified, suspended or revoked. Your employer must tell you which NRC radiation requirements apply to your work, and must post NRC Notices of Violation involving radiological conditions.

WHAT IS MY RESPONSIBILITY?

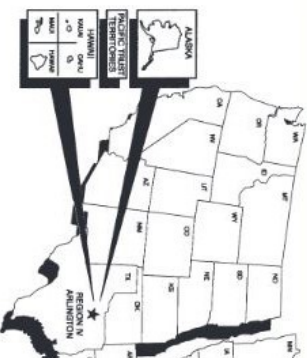
For your own protection and the protection of your co-workers, you must follow the radiation protection requirements of the license. If you observe violations of the requirements or have a safety concern, you should report them.

WHAT IF I CAUSE A VIOLATION?

If you engaged in deliberate misconduct that may cause a violation of the requirements, or would have caused a violation if it had not been detected, you should report the violation to your supervisor. If you have deliberately provided inaccurate or incomplete information to either you or your employer, you may be subject to enforcement action. If you have provided false information to the NRC, you may be subject to enforcement reporting in determining the appropriate enforcement action, if any.

HOW DO I REPORT VIOLATIONS AND SAFETY CONCERNS?

If you believe that violations of NRC rules or the terms of the license occurred, or if you have a safety concern, you should report them directly to your supervisor. You may report violations or safety concerns with the licensee since the licensee has the primary responsibility for ensuring that the licensees comply with the requirements of the license. If you have a safety concern, you should report it to an NRC Regional Office or to the NRC. You may report it to an



▲ - Callaway Plant Site in Missouri and Grand Gulf Plant Site in Mississippi. The Portsmouth Gaseous Diffusion Plant in Ohio is under