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Radiation Safety Handbook

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FOREWORD

The purpose of this Handbook is to inform the University community in a concise user-friendly manner about the rules and regulations pertaining to the safe use of ionizing radiation. It is important that all persons who work in radiation-handling laboratories adhere to these procedures so as to ensure that safe working conditions are present. Safety comes from a partnership of knowledge and trust between the users and the regulators. The RSO staff look forward to working with radiation handlers to ensure safe working conditions so that the University's research and educational mission can be met.

The RSO has supplements to this Handbook for use by the University community. They contain detailed information and helpful hints on the following subjects;

- Introduction to Radioactivity
- Radiation Safety Principles
- Biological Effects of Ionizing Radiations
- Radiation Contamination Surveys
- Radioactive Waste Disposal
- Standard Operating Procedures for Iodinations
- Standard Operating Procedures for X-ray Machines
- Standard Operating Procedures for the Use of the Cesium-137 Cell Irradiator

- Policy for Pregnant Radiation Workers at UVM
- Standard Operating Procedures for:
 - Hydrogen-3
 - Carbon-14
 - Sulfur-35
 - Phosphorus-32
 - Chromium-51
 - Iodine-125

The RSO will help set up labs, purchase radiation detectors, set up safety procedures, and answering safety-related questions. Please call 656-2570 or come to the RSO in Room 004 Rowell Building. (See [Chapter 5](#) for a complete listing of RSO services.)

The procedures listed in this Handbook are required by law. Failure to follow any 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 handling privileges and the possible loss of the University's license to use radioactive materials.

The RSO Staff

- Louis Izzo, Director
- Keddy Bharathan, Associate Director
- Tom Kellogg, Senior Radiation Safety Technician
- Ron Kimball, Radiation Safety Technician
- Pat Dartt, Records Coordinator

ABBREVIATIONS USED IN THIS HANDBOOK

ALARA	As Low As Reasonably Achievable
CFR	Code of Federal Regulations
DOT	Department of Transportation
FAHC	Fletcher Allen Health Care
NRC	Nuclear Regulatory Commission
RSC	Radiation Safety Committee
RSO	Radiation Safety Office
UVM	University of Vermont

CHAPTER 1

INTRODUCTION TO RADIATION SAFETY AT UVM

USE OF RADIATION ON CAMPUS

There are more than 500 faculty, staff, and students using ionizing radiation for research and educational purposes in more than 150 laboratories in the Given Building, Soule Medical Alumni, Stafford, Hills, Terrill, Cook, Marsh, Rowell, Red Cross, Colchester Research Facility, and the Large Animal Facility. More than 30 different radionuclides are used. A Cs-137 Irradiator, x-ray diffraction devices, electron microscopes, and a neutron generator are also available. Each year, more than 1,000 vials of radionuclides containing more than 1,500 millicuries are delivered to campus, generating more than 500 cubic feet of low-level radioactive waste.

THE RADIATION SAFETY OFFICE (RSO)

The RSO is a University-wide office which oversees the use of ionizing radiation on campus to ensure compliance with federal, state, and University regulations 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 Provost, is charged with approving all uses of ionizing radiation on campus, auditing the University's radiation safety program, and recommending safety policies and procedures. It meets as often as necessary, but at least once per calendar quarter.

Contact the RSO for a [list of committee members](#) and a copy of the committee bylaws.

[NUCLEAR REGULATORY COMMISSION \(NRC\) LICENSE](#)

UVM's authority to use radiation for instruction and research purposes comes from licenses #44-00728-13 and #44-01998-06 with the NRC. 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).

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 .

The rights of all employees are outlined in the NRC form-3 in the Appendix of this document.

The principle of ALARA (As Low As Reasonably Achievable) is the basis for the University's radiation safety program. ALARA obligates the RSO 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 CFR.

WASTE DISPOSAL

Disposal of radioactive waste presents specific challenges to UVM and requires the cooperation of the entire campus community. The state of Vermont, through the Vermont Radioactive Waste Management Program, is seeking a disposal site outside the state of Vermont. At the time of production of this Handbook, UVM is able to ship waste out of state. Labs should make every effort to minimize the amount of waste generated. RSO staff are available to meet with labs to review their usage and waste streams to help with volume minimization.

CHAPTER 2

HOW TO BECOME AUTHORIZED

HOW TO BECOME AN AUTHORIZED INVESTIGATOR 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 had previous on-the-job experience handling radionuclides of a similar nature and quantity. Applicants who are deficient in experience must work under an authorized investigator's approval for at least 6 months.

RSO's provisional approval and RSC's final approval of authorization allows the investigator to procure and store a maximum quantity (called the "possession limit") of a specific radionuclide. The authorization may later be amended to increase the possession limit or to use other radionuclides.

[Chapter 3](#) lists the responsibilities of an authorized 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. The requirements also apply to temporary employees such as work-study students and visiting scientists.

Unsealed Radiation Sources

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

Cesium-137 (Cs-137) Irradiator

Persons seeking approval to use the Cs-137 Irradiator in the Red Cross Building must successfully complete a training program and a written multiple choice examination.

Application forms are available in the RSO.

CHAPTER 3

RESPONSIBILITIES OF AUTHORIZED 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, weekly tests for contamination resulting 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 received from the RSO, and inform each person of his/her personal exposure.
 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 campus.
 12. Ensure that pregnant radiation workers meet with RSO personnel to review safety procedures.
 13. Use radiation sources only for in vitro or animal applications. All human uses must be approved by the University Human Use Committee and must be conducted under the license of Fletcher Allen Health Care (FAHC) and approved by the FAHC Radiation Safety Committee.
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CHAPTER 4

RESPONSIBILITIES OF RADIATION HANDLERS

Persons who are certified to handle radioactive materials are responsible for the following procedures:

PROCURING RADIOACTIVE MATERIALS

14. Submit all purchase requisitions for radioactive materials to the RSO for approval. The RSO will FAX the requisition to the Purchasing Office which will place the order.

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.

Unsealed radiation sources must be delivered to the RSO.

RECEIVING RADIOACTIVE MATERIALS

15. Make a record on the RADIOACTIVE MATERIALS LOG AND INVENTORY Form each time a sample is withdrawn from the original vial of radioactivity. This form is included with each new purchase.

Radioactive materials will remain on an investigator's inventory in the RSO until the LOG INVENTORY form is returned to the RSO with the waste.

16. 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 hours.

HUMAN USES OF RADIOACTIVE MATERIALS

17. Radioactive materials must not be administered to humans.

Persons interested in administering radiation to humans must file an application with the University Human Use Committee and the Radiation Safety Office at the Fletcher Allen Health Care.

TRANSFER OF RADIOACTIVE MATERIALS

18. 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 materials is authorized by the RSO and the NRC to do so.

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

STORAGE OF RADIOACTIVE MATERIALS

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

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.

21. 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

22. The door to a radiation handling laboratory must be locked if the lab is left unattended.
23. Store radiation sources in an RSO-approved lab which is always under control and which is locked at the end of the workday
24. If radioactive materials must be stored in refrigerators or freezers in the hallways, the refrigerator or freezer must be locked at all times.
25. Do not store radioactive sources or waste in common rooms, i.e. counting rooms, cold rooms, and centrifuge rooms.

PERSONNEL RADIATION MONITORING (FILM/RING BADGES)

26. 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. Persons using H-3, -14C, or S-35 exclusively are not required to wear a film badge because the low-energy beta particles emitted by these radionuclides cannot be detected by the film badge.
27. Wear a ring monitor if your hands are exposed to radionuclides which emit beta particles with an energy exceeding 0.5 Mev (P-32), or gamma rays with any energy (Cr-51, I-125, etc.).

Wear the ring monitor exclusively on the particular hand which is most likely to 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.

28. The NRC has established a special limit for protection of a fetus. That limit is 0.5 rems for the entire gestation period.

Pregnant radiation workers should meet with the Radiation Safety officer to review safety rules and to determine appropriate monitoring . See [PREGNANCY](#).

29. Conduct a weekly personal urine assay if you handle in excess of 100 millicuries of H-3 in a single operation. The RSO will assist you in setting up this procedure.

Send the results of the assays to the RSO.

30. Keep your film badge and ring monitor in a lab location free from radiation, excessive heat, moisture, and vapors when not in use.
31. Turn in your film badge and ring monitor during the first week of each month so that the badges can be sent 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.

32. It is up to the pregnant radiation worker to decide whether or not she will formally declare her pregnancy to the RSO.
 - She may choose to declare her pregnancy to the RSO. The Director 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](#)
 - 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.
33. 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.

(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;

34. less than 100 microCuries (0.1 milliCuries, 3.7 MegaBecquerels), and
35. less than a liter, and
36. no personnel contamination.

ACTION TO TAKE:

37. **CONTAIN** the spill and soak up with absorbent material.
38. Conduct a wipe test to ensure that the spill has been cleaned up.

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

Major spill

A major spill is defined as a spill involving:

- 40. more than 100 microcuries, or
- 41. of any amount of activity which results in personnel contamination, or
- 42. more than a liter.

ACTION TO TAKE:

- 43. **CONTAIN** the spill by absorbing as much as possible with absorbent material such as paper towels.
- 44. **NOTIFY** all persons to leave the area of the spill.
- 45. **LEAVE** contaminated shoes and clothing in the room where the spill occurred.
- 46. **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.
- 47. **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.
- 48. **CONTACT** the supervisor of the room where the spill occurred.
- 49. **CONTACT** the Radiation Safety Office.

7:30 AM-noon, 1:00-4:30 PM Monday - Friday 656-2570

All other times: (Emergency)..... 114

Campus Police will contact RSO personnel and then proceed to the scene to assist lab personnel in securing the area.

- 50. Send a report to the RSO using the standard [contamination survey report form](#).

GENERAL RADIATION HANDLING PROCEDURES

- 51. Do not use mouth suction to pipette radioactive solutions.
- 52. Confine all work with volatile or dust-forming radioactive materials to fume hoods approved by the Department of Risk Management.
- 53. No smoking, eating, drinking, or application of cosmetics is allowed in any room where liquid (unsealed) radioactive materials are handled or stored. 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.

54. Conduct all radiation handling procedures on easily decontaminated surfaces or on absorbent paper.
55. Do not use radioactive materials for a new procedure until the procedure has been tested by means of a "dry" run.
56. Radioactive material must not be transferred in open vessels beyond the limits of the department 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.
57. Wash your hands after handling unsealed radiation sources.
58. Use long-handled tongs whenever handling radionuclides that produce radiation exposure to the hands or whole body such as I-125, Cr-51 and P-32.
59. Decontaminate and/or prepare for disposal any glassware or objects that have been in contact with radioactive material.

SIGNS AND LABELS

60. The RSO will place a "CAUTION-RADIOACTIVE MATERIALS" sign on the door to each room where unsealed radioactive materials are stored or manipulated.
61. A sign must be posted on the door to any radiation-handling laboratory indicating "No Smoking, Eating, or Drinking". Do not remove the sign without permission of the RSO.
62. Label all vessels containing radioactive materials with standard yellow and magenta tape to identify the radionuclide, the amount of microcuries, and the date the amount was determined. Do not attach the labels to anything which is not radioactive.
63. Label all radioactive waste containers with a "Radioactive Waste - Do Not Empty" label. These are available from the RSO.

CONTAMINATION SURVEYS

64. 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 stock material 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 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 cold room, counting room, or storage room.(see #2 below)

65. Conduct a weekly contamination survey, during periods of active use, in all laboratories used to handle unsealed radioactive materials, and send (or FAX (656-8876) the reports weekly to the RSO.

52 weekly contamination survey reports are expected each year for each 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 freezers.

66. 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.
67. If you do not use any radioactive materials in any particular week, send a weekly "inactive" (= no manipulation of radioactive materials) report. If the period of inactivity extends more than 3 consecutive weeks, conduct an area survey and/or wipe test for the 4th week.
68. 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.
69. Before using any portable radiation survey meters to check for contamination, you must use a radioactive check source to ensure that the detector is responsive, check the battery level, and check the background radiation count.
70. If more than one laboratory group utilizes the same space, we recommend that each group conduct their own wipe tests.

PERSONAL PROTECTION

71. 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.
72. Wear at least one pair of disposable gloves when handling unsealed radioactive materials.
73. Remove gloves before leaving the work area and dispose in radioactive waste container if the gloves are contaminated or are suspected to be contaminated.
74. Wear plastic eye glasses when handling 32P.

SHIELDING

75. Apply Lead shielding 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 shielding. The RSO

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

76. Use 0.5 inch thick plexiglass shielding when handling ³²P. Contact the RSO for information on purchasing plexiglass shields.
77. Apply additional Lead shielding outside the plexiglass shielding if more than one millicurie of P-32 is stored.

WASTE DISPOSAL

78. Sort the waste by appropriate categories defined by the RSO.
79. Bring all radioactive waste to the RSO for appropriate disposal on Fridays. Call the RSO (6-2570) for an appointment. The RSO will pick up radioactive waste from buildings outside the Given Medical complex.
80. Radioactive waste must not be disposed in the sink or sewer without permission of the RSC and the Provost.
81. Radioactive waste must not be disposed in the normal trash. Check the trash cans when you are checking other areas of the laboratory for contamination.
82. Do not incinerate radioactive waste without permission of the RSC and Provost.
83. Liquid radioactive waste must be brought from laboratories to the RSO by persons who have been certified as radiation handlers. Do not ask uncertified radiation handlers to do this task.
84. Do not evaporate radioactive wastes in fume hoods unless approved by the RSO and Risk Management. Approval requires a trial to determine if any environmental releases and fume hood contamination occurs. You must know all the chemicals which are being evaporated in order to get approval.
85. Bring waste to the RSO with a manifest which identifies the type and quantity of radionuclide as well as the chemical form. The manifests are available from the RSO.
86. Bring the LOG INVENTORY form with the waste. This will allow the RSO to reduce the Investigator's inventory of radioactive materials. This form was included with the vial when it arrived in the lab from the RSO.
87. For dry waste, only use special dry waste containers (yellow with covers) provided by the RSO. When bringing waste to the RSO, bring the entire container, not just the bag with the contents.
88. 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

89. All persons who want to conduct Iodinations must review the SOP for Protein Labeling and pass a multiple choice examination administered by the RSO.

90. Protein labeling with I-125 or I-131 must only be conducted in the special fume hood in the RSO.
91. All persons conducting Iodinations must return to the RSO between 6 to 72 hours after each iodination for a thyroid gland assay .

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 after consideration by the RSC.

ANIMAL HANDLING

92. Label cages with "Caution-Radioactive Materials" signs provided by the RSO. Label the door to the cage room with a similar sign.
93. Use absorbent mats at the bottom of each animal cage.
94. Place contaminated litter in a plastic bag with a label with the animal number, investigator, radionuclide, activity and date. Bring the bag to RSO for disposal.
95. Place animal carcasses in a plastic bag and label as radioactive. Bring carcasses to the RSO for disposal.
96. Conduct a wipe test on all cages before reuse. Send the results of the test to the RSO.
97. Wear rubber gloves, rubber boots, face mask, and apron when washing animal cages. Do not wash in a recycling cage washing machine.

RADIATION DETECTORS

98. All radiation detectors used in a radiation handling laboratory must be calibrated annually.
99. Labs must have appropriate detectors available to them for weekly contamination surveys. Consult with the RSO to make sure you have the appropriate detector for the radionuclides you are using.
100. Labs must have portable radiation detectors available for use during the handling of gamma ray emitters (such as Iodine-125 and Chromium-51) and high energy beta particle emitters such as Phosphorus-32. These detectors must be checked prior to each use for proper battery level and radiation response (using a check source). Contact the RSO if you need information on purchasing a check source.
101. 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 detectors for various types of radioactive materials.
102. Use an approved vendor to calibrate the detector annually. The RSO will provide the names of vendors. The RSO has a limited number of

detectors that we can loan you for a short time period while your detector is being calibrated.

103. 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.

CHAPTER 5

SERVICES AND RESPONSIBILITIES OF THE RADIATION SAFETY OFFICE

EDUCATION / TRAINING/ CONSULTATION SERVICES

104. Provides basic safety education to all radiation handlers on campus as well as special instruction in waste handling, contamination surveys, protein labeling, x-ray diffraction, x-ray machine use, and custodial responsibilities.

The following services are available:

- periodic safety lectures
- 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 videotapes available from the RSO for viewing in the
- Dana A/V Library
- many handouts (see Foreword)

Contact the RSO to schedule any of the above activities.

105. Maintains a mailing list of radiation handlers for periodic communications regarding policy and procedural changes as well as announcements of available courses.
106. Publishes articles in UVM Safety News on safety tips, techniques, and regulations.
107. Maintains a World Wide Web (WWW) site on the Internet dealing with radiation safety information. The URL is:
<http://www.uvm.edu/~radsafe>

INSPECTIONS (SAFETY AUDITS)

108. Conducts unannounced annual inspections of all UVM radiation handling laboratories on campus to ensure adherence to the safety regulations in this Handbook
109. Notifies the investigator of the results of all inspections.
110. Evaluates the appropriateness of the investigator's response to a violation notice.
111. Conducts repeat inspections of laboratories with repeat violations.
112. Conducts unannounced inspections of UVM laboratories .
113. Inspects laboratories at the request of employees. Such requests can remain anonymous.
114. Ensures that labs conduct weekly surveys for contamination; reviews all reports for accuracy and completeness.

EMERGENCIES

115. Responds immediately to:
 - personnel contaminated with radiation
 - major spills of radioactive materials
 - fire in a radiation-handling laboratory.
 - requests by lab personnel for assistance.
116. Campus police have the home telephone numbers of RSO staff to contact them for emergencies after work hours.

PERSONNEL MONITORING SERVICES

117. Arranges with a commercial vendor to have film badges and ring monitors provided for all persons working with gamma ray-emitting and certain beta particle-emitting radionuclides.
118. Distributes film badges and ring monitors to all participating departments each month.
119. Reviews the personnel radiation exposure readings each month to ensure that they are within the ALARA action levels of 10% of the NRC limits.
120. Notifies persons in writing when exposure readings exceed ALARA action levels of 10% of the NRC limits.
121. Notifies persons in writing if monthly whole body exposure badges exceed 42 millirems, 125 millirems to lens of the eye, 417 millirems to the skin, or if monthly ring badges exceed 417 millirems.
122. Takes action to reduce radiation exposures when necessary.
123. Reports personnel radiation exposures to the RSC each calendar quarter.
124. Maintains lifetime personnel radiation exposure records.
125. Meets with pregnant radiation workers to discuss and explain monitoring and safety techniques.
126. Obtains radiation exposure records from all personnel who have worn badges at other institutions .

127. Sends an annual radiation exposure report to all current UVM personnel who used film badges and ring monitors during the year.
128. Sends a written report to the lab supervisor whenever one or more persons in that lab receive an exposure 10 millirems in any month. If all persons in that lab have received M exposure (minimal), no report will be sent to the lab that particular month.
129. Recovers all costs associated with this service by direct billing to the investigator.

WASTE DISPOSAL SERVICES

130. Receives all radioactive waste generated on campus.
131. Receives decayed dry waste for proper disposal in city landfill or approved incinerator.
132. Sorts radioactive waste into appropriate categories defined by commercial disposal sites.
133. Packages all radioactive waste, following NRC and disposal site requirements.
134. Stores short-lived and long-lived radioactive waste at the Low-Level Radioactive Waste Facility in the Large Animal Facility.
135. Arranges for commercial disposal of all radioactive waste generated on campus.
136. Provides dry waste disposal containers to all radiation handling laboratories.
137. Maintains all records of radioactive waste disposal as required by NRC and the State of Vermont Agency of Natural Resources.
138. Recovers all radioactive waste disposal costs by direct billing to the investigator who generates the waste. Billing is based on volume and waste category.
139. Participates in the development of State legislation regarding low-level radioactive waste regulations.

IODINATIONS

140. Oversees all Iodinations conducted on campus in the Iodination Facility in Room 012 Rowell.
141. Trains all personnel prior to conducting Iodinations.
142. Stores the stock vials of Iodine-125 for the Investigators.
143. Checks each iodinator for contamination.
144. Takes air effluent samples in restricted areas and unrestricted areas to ensure compliance with NRC regulations .
145. Conducts wipe tests after each iodination to ensure the lab is clean before the next iodination. Decontaminates the iodination laboratory if necessary.
146. Disposes of the waste generated during the iodination and bills the iodinator.

147. Conducts a thyroid gland analysis for each iodinator before and after each iodination.
148. Takes investigative action if any iodinator's thyroid gland assay indicates any uptake of I-125 or I-131.

AUTHORIZATION

149. Screens all applications by new investigators prior to review by the RSC.
150. Administers and grades written examinations for radiation handlers.
151. Approves and commissions all space which is proposed for use as a radiation handling laboratory.
152. Decommissions a radiation handling laboratory when an investigator terminates radiation work
 - Also, decommissioning must occur prior to such time when renovations are planned for a radiation handling laboratory.
153. Recertifies all radiation handlers.

INSTRUMENTATION

154. Conducts quality control tests on all radiation detectors used by the RSO.
155. Assists laboratories to determine the efficiency of their detectors for various radionuclides.
156. Ensures that all radiation detectors used for contamination survey reports are calibrated annually.
157. Loans Geiger counters to labs for short time periods.
158. Allows labs to use the RSO's liquid scintillation counter for short time periods.

ORDERING AND RECEIVING OF RADIOACTIVE MATERIALS

159. Approves all orders for radioactive materials after receiving the purchase requisition from the authorized investigator.
160. Maintains an inventory of all radiation sources and radioactive materials at UVM to ensure that the University's possession limit is not exceeded.
161. Provides copies of Investigator's radionuclide inventory upon request.
162. Checks all packages of unsealed radioactive materials for contamination before transfer to the authorized Investigator.

LEAK TESTS

163. Conducts leak tests on all actively used sealed radiation sources on campus every 6 months, including the Cs-137 Irradiator and the neutron howitzer.

RADIOGRAPHIC X-RAY MACHINES

164. Arranges for the State of Vermont to conduct safety checks on all x-ray machines.
165. Trains personnel to use x-ray machines.

SPONSORED PROJECT APPROVAL

166. The Office of Sponsored Programs requires RSO approval for all grant applications which propose to use radiation.

Approval is based on: qualifications of investigator, impact on University's radionuclide possession limit, safety of the project, and adequacy of funds for waste disposal.

Approval by the RSO at the time of grant submission does not eliminate the need for a formal and detailed evaluation of the project if and when it is funded.

CESIUM-137 IRRADIATOR

167. Assists in the training of all persons who need to use the Irradiator.
168. Conducts leak tests every 6 months as required by NRC.

LICENSING

169. Ensures that UVM's license is renewed every 5 years
170. Amends the NRC license when necessary
171. responds to NRC notice of violations and takes corrective actions.
172. Notifies the NRC if there is any:
 - loss or theft of licensed material
 - major contamination incident
 - overexposure of personnel to radiation.
 - excessive levels and concentrations released to the environment
173. Secures permits for the use of disposal sites.

MISCELLANEOUS

174. Provides financial data to Grants and Contract Accounting to be used in indirect rate computations.
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