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## REED COLLEGE

### Radioactive Materials Policy and Procedures Manual Policy

#### 1. **Radioactive Materials Committee**

##### (a) Responsibilities

- i. Be familiar with all pertinent Oregon rules, the terms of the license, and information submitted in support of the request for the license and its amendments.
- ii. Establish a program to ensure that all individuals whose duties may require them to work in the vicinity of radiation or radioactive material (e.g., security, maintenance, and housekeeping personnel) are properly instructed as required by OAR 333-111-010 of the Rules for Use of the Control of Radiation.
- iii. Review the training and experience of all individuals who use or handle radioactive materials and determine that their qualifications are sufficient to enable them to perform their duties safely and in accordance with the rules and conditions of the license.
- iv. Review on the basis of safety and approve or deny, consistent with the limitations of the rules, the license, and the ALARA philosophy, all requests for authorization to use radiation or radioactive material within the institution.
- v. Prescribe special conditions that will be required during a proposed method of use of radioactive material such as requirements for bioassays, physical examinations, and special monitoring procedures.
- vi. Review quarterly the summary report of the occupational radiation exposure records of all personnel.
- vii. Review at least annually the RSO's summary report of the entire Radiation Safety Program to determine that all activities are being conducted safely, in accordance with Oregon Rules and the Conditions of the license, and consistent with the ALARA program and philosophy. The review must include an examination of records, reports from the RSO, results of inspections, written safety procedures, and the adequacy of the management control system.
- viii. Recommend remedial action to correct any deficiencies identified in the radiation safety program.

- ix. Maintain written minutes of all committee meetings including members in attendance and members absent, discussions, actions, recommendations, and decisions.
- x. Ensure that the radioactive material license is amended when necessary.
- xi. Support the RSO in enforcing the rules and procedures specified by the license and rules of radiation safety.

(b) Administrative Information

- i. The Committee shall meet as often as necessary to conduct its business, but shall meet a minimum of one time per calendar quarter.
- ii. Primary membership includes one authorized user from each department where radioactive materials are housed, the RSO, the assistant RSO, a representative from the reactor facility, the campus hazardous materials manager, and a representative of the Administration who is neither an authorized user nor an RSO. The Administration may appoint alternate members to participate in meetings in the case of absence of principal members and may consider appointing as adjunct members representatives from security, physical plant, housekeeping, and other departments.
- iii. A simple majority of the primary membership of the RAM is necessary to approve new principal users (PU) of radioactive materials. The RSO will approve new student and staff users working under the guidance of a PU after the applicant has adequately completed the training and testing requirements of Section 11. Voting may be conducted over electronic mail. To establish a quorum for voting on issues affecting policy, procedure, or the radioactive materials license, one half of the primary membership, including the RSO and Administration representative, must be present.

## 2. Personnel Dosimetry and Bioassay Programs

(a) Personnel Dosimetry Program

- i. The RSO, Health Physicist, and/or Reactor Director will review all exposure reports promptly upon their receipt.
- ii. All individuals who are occupationally exposed to penetrating ionizing radiation on a regular basis will be issued appropriate dosimetry

monitoring devices, which will be processed by a NVLAP certified contract service at least on a quarterly basis.

- iii. All individuals who potentially may be occupationally exposed to penetrating ionizing radiation on an occasional basis will be issued a personal self-reading dosimeter.
- iv. Individuals who work exclusively with low-energy beta emitters will not be issued radiation dosimeters. Classes which perform occasional experiments with micro curie-level sources will not be issued dosimeters. Past data show that no individual exposures greater than ten percent of the allowable annual limit have occurred in these classes.

(b) Bioassay Program

- i. Any individual handling organic H-3 in single packages with an activity of 10 mCi (370 MBq) or more, or inorganic H-3 in single packages of 50 mCi (1.8 GBq) or more will inform the RSO prior to the activity and will submit a urine specimen to the Assistant Health Physicist or RSO within 12-48 hours of opening the container or otherwise using the material. The sample will be submitted to Oregon Health Sciences University Radiation Safety Lab for analysis.
- ii. Any individual handling 1 millicurie (37 MBq) or more of I-125 will inform the RSO prior to the activity and will undergo a thyroid scan within 24-48 hours of opening the container or otherwise using the material. The RSO will arrange the scan with Oregon Health Sciences University Radiation Safety Lab.

(c) Personnel Dosimetry Information

- i. Whole body and ring dosimetry will be issued and exchanged quarterly.
- ii. Exposure reports will be reviewed quarterly, or more often if applicable, by the RSO, Health Physicist, and/or Reactor Director.
- iii. The RSO or Reactor Director will maintain a record of personnel dosimetry records. Each individual will receive an annual report at the end of the fiscal year apprising them of their annual accrued dose.
- iv. Any reported whole body dose in excess of 50 mrem per quarter or any extremity dose in excess of 100 mrem per quarter will be investigated by the RSO, Health Physicist, and/or Reactor Director to determine the cause of the exposure. A written report will be prepared by the RSO.

- v. If a user notifies in writing that she is pregnant, extra measures will be taken to ensure the fetus receives less than 500 mrem during the gestation period.

### 3. Radiation Safety Officer

#### (a) Duties

- i. Be familiar with all applicable laws, rules, and license application guides, and ensure that license applications are properly filled out and submitted in a timely fashion. Ensure that the institutional radiation use and safety programs comply with the license application and conditions.
- ii. Establish and maintain record systems of all radiation area surveys, wipe tests, leak tests, calibration of instruments, and personnel dosimetry reports. Perform a review each calendar year of records of surveys to determine that they are at “As Low As Reasonably Achievable” (ALARA) levels for the period.
- iii. Review personnel dosimetry reports quarterly, or more often if required. Advise individual radiation workers of any unusual exposure. Determine the cause of all overexposures so as to preclude recurrence. At the conclusion of each calendar quarter, perform a quarterly review of occupational exposure to users and workers to determine that the exposures are within the limits established for the ALARA program. At the conclusion of each calendar year, apprise each employee of annual accrued dose.
- iv. Ensure that individuals working with radiation have appropriate protective devices including shielding, ventilation, clothing, gloves, remote handling equipment (where necessary), dosimeters, instrumentation, and facilities which aid in keeping exposures ALARA.
- v. Ensure that all individuals who work with, or in the vicinity of radioactive material or sources of radiation, have sufficient training and experience to enable them to perform their duties safely and in accordance with law, rules, and the conditions of the license.
- vi. Ensure that radioactive material and radiation is used in a safe manner and in compliance with law, rules and the conditions of the license. This includes reviewing, as necessary, training programs, equipment, facilities, supplies, and procedures. (See Procedure 1: *Safe Use of Radioactive Materials*).

- vii. Ensure that the use of radioactive material is consistent with the ALARA philosophy and program.
- viii. Identify program problems and solutions.
- ix. The RSO will maintain records of the following items:
  - A. Dosimetry reports
  - B. Bi-weekly wipe tests
  - C. Source wipe tests
  - D. Semi-annual inventories
  - E. Annual audits of radiation safety program
  - F. Instrument calibrations
  - G. Radioactive Materials Committee minutes and communications
  - H. State inspections and communications
  - I. Principal User authorizations
  - J. Receipt, Use, and Disposal Logs
  - K. Training records
  - L. Changes to the Reed College Radioactive Materials License
  - M. Radioactive waste off-site disposal records
- x. Act as liaison agent with regulatory authorities to include being available for assistance during inspections and audits, and communication with the State of Oregon Radiation Protection Services. This includes:
  - A. Submit a written amendment request prior to making any change which would render the current Radioactive Materials License inaccurate.
  - B. Notify the State of Oregon Radiation Protection Services in the event of:
    - Any radiation accident or incident pursuant to OAR 333-120-310.
    - Within five (5) days of any positive leak test result of a sealed source.
    - Within 30 days in a report stating remedial action taken after an accident or incident.
- xi. Ensure a semi-annual inventory (Form 1) of all large sealed sources received or possessed and all radioisotopes in authorized areas is performed. Maintain an inventory control of radioisotopes at the insti-

tution and ensure that license quantities are not exceeded. Ensure all surveys, calibrations, and leak tests are performed on time.

- xii. Post conspicuously Form X, "Notice to Employees," items required under OAR 333-111 and notices of Items of Noncompliance resulting from RAM Committee inspections.
- xiii. Supply employers of terminated occupationally exposed personnel with radiation exposure records as required.
- xiv. Keep records of receipts of incoming isotopes and surveys of incoming and outgoing shipments. Ensure that all incoming and outgoing radioactive material shipments are properly packaged and labeled according to DOT requirements, and that proper shipping papers accompany shipments. Ensure that radioactive materials are disposed of properly and that records are maintained of all radioactive wastes disposed. (See Procedure 5: *Waste Disposal*).
- xv. In conjunction with the Radioactive Materials Committee, perform a review, at intervals not to exceed 12 months, of the radiation safety program for adherence to ALARA concepts. Ensure that all workers dealing with radioactive materials follow the safety program. Investigate any deviation from the program and take any remedial action necessary.
- xvi. Schedule briefings and educational sessions to inform workers of radiation safety rules and procedures:
  - A. For all new personnel working with or around radioactive materials.
  - B. With each change in license condition or safety program which will affect the employee.
  - C. Provide refresher advisories for all personnel every three years. This includes instruction in the ALARA program and philosophy.

#### 4. Monitoring, Control, and Security of Radioactive Materials

- (a) Areas where radioactive materials are stored, prepared, and used will be monitored regularly for contamination and compliance with Procedure 1: *Safe Use Procedures*. Individuals found in violation of these rules will be subject to sanctions determined by the Radioactive Materials Committee.

#### 5. Emergency Procedures

- (a) The RSO will take charge in all emergency situations in the event of major or minor spills (as defined in Procedure 2: *Emergencies*) or release of radioactive material, to ensure correct emergency decontamination and protection procedures are carried out. The RSO will also evaluate the situation that led to the emergency to reduce the chance of reoccurrence and will submit a report to the State of Oregon Radiation Protection Services if necessary (see Procedure 2: *Emergencies*).

## 6. Leak Test Program for Sealed Sources

- (a) The Health Physicist shall perform leak tests of sealed sources (see Procedure 3: *Sealed Source Leak Test*).

## 7. Area Surveys

- (a) Individuals using radioactive materials must conduct bi-weekly surveys as described in Procedure 4: *User Surveys*. The radioisotope used and the type of contamination found will determine the section of the procedure to follow.

**NOTE: Whenever radioactive contamination levels exceed 1000 dpm above background (approximately  $4.5 \times 10^{-4}$  Ci/100 cm<sup>2</sup>) the RSO must be notified immediately.**

## 8. Waste Disposal

- (a) Introduction
  - i. Waste disposal is a very expensive and strictly regulated process. To ensure compliance with regulations and to minimize releases of radioactivity to the environment, Reed College requires that users of radioactive materials follow the procedures described in Procedure 5: *Waste Disposal*. Reed College strives to reduce the amount of radioactive waste generated. The following responsibilities have been assigned towards that end.
- (b) Responsibilities
  - i. Principal Users
    - A. Ensure that no radioactive materials are discarded as ordinary trash or as other non-radioactive hazardous waste through supervision, instruction, and careful monitoring.

- B. Minimize the disposal of non-radioactive materials as radioactive waste.
  - C. Minimize the production of radioactive waste and the cost of disposal (e.g., by using materials with short half lives).
  - D. Follow disposal steps established in Procedure 5: *Waste Disposal*. Properly package and label waste for transfer to the campus radioactive waste storage facility.
  - E. Restrict sink disposal to sinks registered with RSO. Ensure that the disposal is within authorized limits, the wastes are soluble or dispersible in water, and records of disposals are kept.
  - F. Train all new student users for which they are responsible in proper laboratory techniques regarding radioactive materials.
- ii. Individual Users
    - A. Follow instructions for packaging and labeling radioactive waste.
    - B. Ensure that radioactive materials are never placed into regular trash containers or wastebaskets, or disposed through any other method that is not controlled with respect to radioactivity.
    - C. Minimize the amount of radioactive waste generated.
    - D. Record the proper information for each sink disposal of radioactive material as described in Procedure 5: *Waste Disposal*. Activity must be within acceptable limits and the material must be soluble or dispersible in water and non hazardous.
  - iii. Radiation Safety Officer
    - A. Keep a file of all radioactive waste disposal regulations and ensure the College follows them.
    - B. Receive all appropriately packaged and labeled radioactive wastes generated at the College which require disposal outside the laboratory. Package them for appropriate disposal.
    - C. Keep detailed records of amounts and methods of disposal of radioactive wastes as described in Procedure 5: *Waste Disposal*.
    - D. Monitor and record all releases from decay in-storage.

## 9. Radioactive Material Packages

- (a) All radioactive material packages will be received and surveyed in accordance with the steps in Procedure 6: *Radioactive Materials Package Ordering and Receipt*.

## 10. Auditing Radioactive Materials

### (a) Program Components

- i. The Radioactive Materials Committee will audit biennially for content and implementation of the following components of the Reed College Radioactive Materials Program. No individual will be assigned an audit of an area for which s/he has primary responsibility.
  - A. Procedure 1: *Radiation Monitoring, Control and Security*. (OAR 333-102 & 333-120)
  - B. Procedure 2: *Emergencies*. (OAR 333-120-720)
  - C. Procedure 3: *Sealed Source Leak Tests*. (OAR 333-120-460)
  - D. Procedure 4: *User Surveys*.
  - E. Procedure 5: *Waste Disposal*. (OAR 333-120-500, 520, 540, 550, & 560)
  - F. Procedure 6: *Radioactive Materials Package Ordering and Receipt*. (OAR 333-120-450)
  - G. Procedure 7: *Decommissioning Laboratories and Other Radioactive Materials Use Areas*.
  - H. Policy Manual requirements
  - I. Personnel Training
  - J. Application for Use of Radioactive Materials
- ii. The Radioactive Materials Committee will audit annually for content and implementation of the following components of the Reed College Radioactive Materials Program. No individual will be assigned an audit of an area for which s/he has primary responsibility.
  - A. Record Keeping and Annual report

## 11. Overall Program

- (a) The overall Reed College Radioactive Materials Program will be reviewed annually for content completeness. This audit will be conducted either by the Radioactive Materials Committee or by an outside consultant.

## 12. Personnel Training Program

- (a) Instruction for personnel will take place:
  - i. Before assuming duties with, or in the vicinity of, radioactive materials.

- ii. During refresher training.
- iii. Whenever there is a significant change in duties, rules, or the terms of the license.

(b) Principal Users

- i. New Principal Users (PUs) will be required to pass an authorization examination.
- ii. All new PUs will be supplied with a complete copy of the *Reed College Radioactive Materials Policy and Procedures Manual* and a copy of the U.S. Nuclear Regulatory Commission Regulatory Guide 8.13, *Instruction concerning Prenatal Radiation Exposure*.
- iii. If the PU has documentation of training and use of radioactive material at another institution, no further training is required. If no documentation exists, the PU must follow the procedure for new student users (below) to become authorized.

(c) Student Users

- i. All new student users must take and pass radioactive materials authorization examination provided by the Radiation Safety Officer.
- ii. All new student users must be assigned to work with a Principal User.
- iii. Student user trainees must watch three videos (located in the IMC: QC41.R33 1982 Video) before taking the authorization examination.
- iv. The student user trainee will be supplied with a copy of the *Reed College Radioactive Materials Policy and Procedures Manual*, *Radioactive Materials Handling Guide*, and a copy of the U.S. Nuclear Regulatory Commission Regulatory Guide 8.13, *Instruction concerning Prenatal Radiation Exposure*.

(d) Non-Authorized Personnel

- i. Those employees whose duties may bring them in the vicinity of the radioactive materials (janitors, maintenance personnel, security officers) will be trained in the following topics as part of their Right-To-Know-Training:
  - Locations where radioactive materials are used or stored.
  - Overview of the *Reed College Materials Policy and Procedures Manual* as it pertains to the survey and wipe testing of work areas.

- Procedures for entry to areas where radioactive materials are used.
  - Recognition of radioactive labels.
- (e) Refresher Training
- i. An biennial overview of the Reed College Radioactive Materials Policy and Procedures manual will be presented to all active Principle Users. Inactive Principal Users will receive refresher training prior to renewed use of radioactive material. All users will receive refresher training whenever significant changes to duties, rules, or the terms of the license occur.
- (f) Pre-Natal Training
- i. If a user notifies the RSO in writing that she is pregnant, extra measures will be taken to ensure the fetus receives less than 500 mrem during the gestation period.

### 13. Calibration of Survey Instruments

- (a) Instruments will be calibrated in accordance with procedures approved by the Reactor Safety Committee.

### 14. Monitoring, Control, and Security of Radioactive Materials

- (a) Monitoring
  - i. Bi-weekly surveys of areas where radioactive materials are stored, prepared, and used will be conducted by the RSO or designee. The surveyor will use Form 2: *Lab Survey Record* and Form 3: *Survey Checklist* to report wipe and survey findings. The location of wipes taken will be noted on the form.
  - ii. A visual inspection of the work area will be completed at the time of the survey. Any violations of proper work procedure rules will be noted and reported to Principal User.
- (b) Control
  - i. Violations found during the survey will be discussed with the Principal User (PU). Three violations by any Principal User in a calendar year may result in a temporary suspension of radioactive materials authorization. The Radioactive Materials Committee shall determine the length of suspension.

- ii. Serious violations (i.e., mouth pipeting, unauthorized radioactive materials, unauthorized users of radioactive materials, excessive contamination) may result in immediate suspension of radioactive materials authorization. The situation will be reviewed and a determination made by the Radioactive Materials Committee.

(c) Security

- i. Entrances to areas, which contain radioactive materials, will be closed and locked at all times when the area is unoccupied. This requirement is mandated regardless of the length of time the area remains unoccupied.

## 15. Records of Radioactive Material Use

- (a) The following forms will be used to record activities associated with radioactive materials usage:
  - Survey Log (Form 2)
  - Survey Checklist (Form 3)
  - Receipts, Use, and Disposal Log (Form 4)
  - Sink Disposal Log (Form 5)

## Procedure 1: Safe Use of Radioactive Materials

### 1. General Procedures

- (a) Protective equipment is needed when handling radioactive materials:
  - i. Lab coats, coveralls, or other means of protecting street clothes.
  - ii. Disposable gloves.
  - iii. Suitable shoes. Open-toed shoes are prohibited when working with radioactive materials. Tyvek shoe covers must be used if canvas shoes are worn when working with radioactive liquids.
  - iv. Eye protection (safety glasses with side shields, splash goggles) must be worn when working with radioactive liquids.
- (b) When gamma and beta emitting radionuclides with sufficiently high energies to be detected with a GM meter are in use, hands and clothing must be monitored for contamination after completing the procedure and before leaving the area.
- (c) Eating, drinking, smoking, or applying cosmetics is prohibited in areas where radioactive materials are used or stored.
- (d) Storage of food, drink, or personal effects in areas used for radioactive material storage is prohibited.
- (e) Radioactive materials transported through hallways must be securely contained, adequately shielded, and properly marked. Dispersible radioactive materials require secondary containment (tray, bucket, bag, beaker, etc.) when transported through hallways or within the lab.
- (f) Personnel monitoring devices must be worn at all times while in areas where gamma and beta emitting radionuclides with sufficiently high energies to be detected are used or stored. When not being worn to monitor occupational exposures, personnel monitoring devices should be stored in the work place in a designated low-background area. The personnel monitoring devices should not be removed from the workplace or worn by anyone other than to whom it was assigned.
- (g) Radioactive waste must be placed only in designated, labeled, and properly shielded receptacles.
- (h) MOUTH PIPETTING IS PROHIBITED.
- (i) Regular surveys of work areas using a radiation detection survey meter are required whenever gamma and beta emitting radionuclides with suf-

ficiently high energies to be detected are in use. Results will be recorded in daily log book as described Procedure 4: *User Surveys*.

- (j) Radioactive solutions are to be kept in their clearly labeled shielded containers. Labels must include the isotope, amount, name of the compound, and the date and time of receipt or preparation. Record data on form found in Form 4: *Receipt, Use and Disposal Log*.
- (k) All equipment (e.g., pipettes, glassware, automatic pipettors, etc.) used with radioactive materials will be labeled as such and will not be used for other purposes.

## 2. Specific Procedures

- (a) Tritium (H-3): Organic compounds with activity of 10 mCi (370 MBq) or more or inorganic compounds with activity of 50 mCi (1.8 GBq) or more :
  - i. Work must be carried out in a hood.
  - ii. Activity in waste, product, etc. must be balanced to account for total starting activity.
  - iii. Monitoring requirements of Section 2 of the Radioactive Materials Policy Manual must be followed.
- (b) Radioactive Iodine: All iodine compounds regardless of activity, unless specified:
  - i. Work must be carried out in a hood.
  - ii. Double gloves must be worn.
  - iii. Wastes must be double bagged.
  - iv. Any individual handling 1 millicurie (37 MBq) or more of I-125 will inform the RSO prior to the activity and will undergo a thyroid scan within 24-48 hours of opening the container or otherwise using the material. The RSO will arrange the scan with Oregon Health Sciences University Radiation Safety Lab.
  - v. Ensure that unrestricted area limits are met (Appendix B OAR 333-120 Col. II).
- (c) Phosphorus (P-32) : All Phosphorus-32 compounds regardless of activity:
  - i. Finger badges must be worn.
  - ii. Work conducted behind Lucite shield.

### 3. ALARA – As Low As Reasonably Achievable

- (a) The ALARA philosophy is one of the basic principles of Health Physics. It says simply that, since any radiation dose has a potential risk involved, each action should be taken considering the potential risk and the benefit to be gained, and the action should be designed to minimize the risk (i.e. the radiation dose). This is the case regardless of whether any regulatory limits are approached or not.

This philosophy is supported by the federal and state governments, and by the Radioactive Materials Committee, for work at Reed College.

### 4. Historical Radiation Exposures

- (a) The highest yearly whole-body radiation exposure at Reed was about 200 mR and was received by the Reactor Health Physicist who at the time was performing an operation requiring close handling of a very large source. Only a few individuals have received whole-body exposures of more than 100 mR/yr; most have been far below that, and many have recorded whole-body exposures of zero.

There is no reason why doses cannot be kept just a low in the future.

### 5. What types of actions constitute ALARA actions?

- (a) The following are examples only. Think about your work. Use your imagination.
- i. When samples are irradiated in the reactor they are to be left in the rotary specimen rack until either the experimenter needs the samples or the reactor needs to be prepared for other purposes. Removal prior to the time will inherently result in higher radiation doses without benefit.
  - ii. If you are carrying a radiation source and someone asks you a question, set the source down in a safe place and step back until your conversation is completed. Preferably, delay the conversation until the source is secured at its intended destination.
  - iii. When handling irradiated samples, use tongs or place them in wooden blocks. Remember that most of these materials are beta emitters, as are the radiochemicals used by biologists. The range of beta particles in material of unit density (i.e. 1 g/cm<sup>3</sup>) is about 1 cm. If the first

cm is part of your finger, doses will be high, if it is wood, your beta dose may be very close to zero.

- iv. Work efficiently NOT hastily. The longer it takes to do a job, the higher the dose BUT the need to redo a job or to clean up a spill resulting from hasty work can significantly INCREASE total dose.
- v. PLAN AHEAD! This is the most important ALARA aid. Discuss the entire operation with your coworkers before you begin. Know exactly who is responsible for what. If possible conduct a dry run with non-radioactive material until the operation runs smoothly. If anything goes wrong, don't panic, simply set things down gently, back off, and regroup.

## 6. Surveillance

- (a) The following specific actions will help insure ALARA.

Only the Faculty Authorized User, Radiation Safety Officer, Reactor Director, Associate Director, or Health Physicist may work in High Radiation Areas.

Any operation which has the potential to expose an individual to a whole-body dose of 10 mR shall be performed by or under the direct supervision of the Faculty Authorized User, Radiation Safety Officer, Reactor Director, Associate Director, or Health Physicist.

Any whole body dose in excess of 50 mrem in a quarter or an extremity dose in excess of 100 mrem in a quarter shall be investigated by the Radiation Safety Officer.

## Procedure 2: Emergencies

### 1. Definitions

- (a) A minor spill presents little to no radiation hazard to personnel.
- (b) A major spill is defined as more than 100 microcuries and presents a serious radiation hazard.

### 2. Minor Spills

- (a) Immediately notify all other persons in the room.
- (b) Confine the spill and clearly mark the boundary of the spill.
- (c) Survey yourself and all other persons in the vicinity. Decontaminate personnel first. For ALARA reasons, DO NOT stand near spill and be careful to avoid spreading contamination.
- (d) Limit access to the contaminated area to people aiding in remediation. Post a sign or a person at lab entrances to restrict access.
- (e) For liquid spills:
  - i. Don double protective gloves and eye protection.
  - ii. Cover spill with absorbent paper or use lab spill kit.
- (f) For dry spills:
  - i. Don protective gloves.
  - ii. Cover spill with damp absorbent paper, taking care not to spread the contamination.
- (g) Decontaminate as described below.
- (h) Notify the Radiation Safety Officer (RSO).
- (i) Permit no person to resume work in the area until a survey is done and approval of the RSO is obtained.
- (j) Write a complete history of the accident and subsequent activity for the laboratory records.

### 3. Major Spills

- (a) Notify all persons not involved in the spill to vacate the room at once. Alert the nearest person to contact the RSO.

- (b) If spill is liquid and hands are protected, right the container. Working to avoid personal contamination, prolonged exposure, or spread of the spill, cover the contaminated area and a two foot perimeter with absorbent paper and move away.
- (c) Step away from the work area to lower radiation dose rate.
- (d) Survey yourself and other personnel involved thoroughly.
- (e) Evacuate the room. If possible, survey personnel before evacuation. Do not spread contamination outside of the lab.
- (f) Prevent access to the room by locking doors or posting signs and/or individuals at laboratory entrances.
- (g) Take immediate steps to decontaminate personnel involved as necessary.
- (h) Survey all personnel and areas outside of the lab. Control the spread of contamination outside of the lab and decontaminate if necessary.
- (i) Decontamination shall be performed under the supervision of the RSO or other qualified Health Physics Personnel designated by the RSO. If conditions stated in Section 2b of the Reed College Radioactive Materials Policy Manual are met, perform required bioassay.
- (j) Permit no person to resume work in the area until a survey is made and approval of the RSO is obtained.
- (k) Write a complete history of the accident and subsequent activity for the laboratory records.

#### 4. **Skin Contamination**

- (a) Alert the nearest person to contact the RSO.
- (b) Begin decontamination as soon as possible. Use mild soap and tepid water. Wash the affected area several times. Strong scrubbing will abrade the skin, which can lead to increased penetration of the contamination.
- (c) If hair becomes contaminated, immediately wash with soap and water. Hair can very easily spread contamination, so take care not to allow the hair to come in contact with anything else.

#### 5. **Eye Contamination**

- (a) Flush thoroughly with isotonic solution (if available), otherwise, use water. Roll the eyelid back as far as possible.

- (b) Seek Medical attention if irritation or evidence of contamination persists.

#### **6. Nose or Mouth Contamination**

- (a) Immediately flush with water. Take care not to ingest the rinse.

#### **7. Clothing Contamination**

- (a) Contact the RSO to obtain anti-contamination clothing.
- (b) Change out of affected clothing. Take care not to allow the outside of the clothing to come in contact with skin.
- (c) Place the contaminated clothing in a plastic bag and give to RSO for cleaning or disposal.

#### **8. Shoe Contamination**

- (a) Contact the RSO for a pair of anti-contamination booties. Do not walk in contaminated shoes since this will spread the contamination.
- (b) When the shoes are covered, walk to a sink and clean the soles with soap and water.
- (c) Survey the area to find the parts of the floor that are contaminated and clean them.

#### **9. Release of Airborne or Volatile Radioactivity**

- (a) Contact the RSO.
- (b) Alert everyone in the vicinity of the release and advise them to evacuate the room but remain in the area.
- (c) Evacuate the room and close all doors. Stand guard and make sure no one enters before the RSO arrives.
- (d) All people who were in the area at the time of the release need to be checked for contamination. If/when contamination is found, commence decontamination at the nearest sink following the steps below.

#### **10. Decontamination**

- (a) Supplies:
  - i. Plastic garbage bags.
  - ii. Colored tape.
  - iii. Absorbent material.

- iv. Cleaning detergents (Simple Green works well).
  - v. Bucket for water (if needed).
  - vi. Protective clothing (possibly several layers) including booties, gloves, and safety glasses. If the spill is liquid, the protective suits should be plastic-backed.
  - vii. GM-tube, wipes, and ethanol.
- (b) Pre-decontamination:
- i. Secure area from traffic. Locate and mark off all contaminated areas. Draw a map of the room marking dirty areas if needed.
  - ii. For H-3 spills wear booties and take wipes of the room to determine the areas of contamination.
  - iii. Don protective clothing. 2-3 pairs of gloves and booties may be necessary.
  - iv. Survey just outside the contaminated room with a GM-tube to ensure the contamination has not spread.
- (c) Decontamination:
- i. Start cleaning at the edge of the contaminated area and work inward.
  - ii. Absorb standing liquids.
  - iii. Apply cleaning solution. Leave for 1-2 minutes.
  - iv. Wipe up the solution moving the wipe stroke inwards.
  - v. Use wet absorbent paper to wipe up dry or powder contamination.
  - vi. Place used cleaning rags in a plastic garbage bag, which should be marked with a Radioactive Material sticker.
  - vii. Do not remoisten absorbent paper. Do not allow cleaning solution to drip over non-contaminated areas.
  - viii. Survey and change decontamination clothing frequently (especially gloves).
  - ix. Remove and replace torn clothing immediately.
- (d) Cautions:
- i. Do not use hot water to clean H-3, C-14, or I-125 because they may vaporize.
  - ii. Do not use detergents that contain acids to clean iodine because reactions which produce toxic gases may occur.

### Procedure 3: Sealed Source Leak Test

1. Record all data on a Wipe Test Worksheet (SOP 23 Appendix A) or an equivalent electronic version. An electronic version is available as an Excel spreadsheet on the computer by the wipe test counter in the southeast corner of the radiochemistry lab. Double-click the worksheets alias on the computer desktop to start the program. Save the worksheet with a unique name (e.g., the date).

#### 2. Frequency of Testing

- (a) Sealed sources will be tested every 6 months with the following exceptions:
  - i. Alpha emitters used for their alpha emissions which are greater than 10 microcuries (370 kBq) will be tested every 3 months.
  - ii. Alpha emitters less than or equal to 10 microcuries (370 kBq) need not be tested.
  - iii. Sources containing only gas or tritium need not be tested.
  - iv. Sources which are in storage and are not being used need not be tested. Sources meeting these criteria must be tested prior to being put back in use.
  - v. Sources which contain less than or equal to 100 microcuries (3.7 MBq) of a beta or gamma emitting material need not be tested.
  - vi. Sources should be leak tested within 24 hours if there is reason to suspect their integrity (i.e., damaged).

#### 3. Procedure

- (a) Quality control
  - i. Indicate on the worksheet whether the wipe test is routine or special. If it is special, describe it (e.g., Shipment 05-01).
  - ii. Indicate which Geiger counter is being used. Normally the Eberline MS-3 scaler is used.
  - iii. To measure the background, put an unused wipe in the counter (this simulates the actual counting conditions). Set the timer for 5 minutes and start the count. Record the results on the worksheet. Calculate the counts per minute (cpm). If the background counts are too high or too low, ensure that there are no old wipes in the counter and no external radiation fields affecting the background. Perform the count

again. If the count is still outside the limits then notify the reactor supervisor.

- iv. To do a quality control check, put the small Sr-90 source (thin disc with printed side down) in the counter. Set the timer for 1 minute and start the count. Record the results on the worksheet. Calculate the net cpm by subtracting background cpm. If the source counts are too high or too low, ensure that there are no old wipes in the counter, no external radiation fields affecting the background and that the source is properly placed in the center of the tray with the printed side down. Perform the count again. If the count is still outside the limits then notify the reactor supervisor.
- v. 6 Record the background cpm and the source net cpm on the Wipe Test Control Chart Log (SOP 23 Appendix C) in the front of the wipe test log. Plot the data points on the quality control charts. If the counter is working properly the points will be within the two standard deviation lines.
- vi. If the background or source counts are outside the standard deviation lines on the chart, ensure that there are no old wipes in the counter and no external radiation fields affecting the background. Check that the source is properly placed in the center of the tray. Perform the count again. If the count is still outside the limits then notify the reactor supervisor.

(b) Wipe tests

- i. Using a filter paper moistened with a few drops of methanol or ethanol, take the required wipes and any others deemed necessary to cover all areas of activity where possible contamination may occur. Each wipe shall cover an area of approximately 100 square centimeters (e.g., 4-inches by 4-inches, or 1-inch wide by 15-inches long).
- ii. Count each wipe for 5 minutes, record the data in the table on the worksheet, and calculate the Net Counts where:

$$\text{Net Counts (cpm)} = (\text{Gross Counts} \div 5) - \text{background cpm} \quad (1)$$

- iii. Calculate the contamination level using the efficiency factor (F) posted on the detector:

$$\text{Microcuries (Ci) per 100 square centimeters} = \text{net cpm} \times F \quad (2)$$

- (c) For further detail or clarification, consult the Reed Reactor Facility SOP 23: *Wipe Tests*.
- (d) The presence of 0.005 microcuries (185 Bq) of removable contamination on the wipe is evidence that the source is leaking.
- (e) Extreme caution should be exercised when wiping alpha sources. DO NOT WIPE THE OPEN FACE OF THE SOURCE.



## Procedure 4: User Surveys

### 1. Ambient Exposure Rate Surveys

- (a) When gamma and beta emitting radionuclides with sufficiently high energies to be detected with a radiation detection device are in use, surveys of work areas must be conducted using a radiation detection survey meter appropriate for the radionuclide. The results of these surveys must be recorded at least bi-weekly and whenever unexpected readings occur.
- (b) In storage and waste storage areas: survey monthly with a radiation detection survey meter. Record results.
- (c) In sealed source storage areas: survey monthly with a radiation measurement survey meter. Record results.

### 2. Removable Contamination Surveys

- (a) When low energy beta emitting radionuclides are in use, bi-weekly wipe tests are required. These tests must be counted in a liquid scintillation counter and recorded in the logbook.
- (b) If higher than expected counts occur in the survey described in section one (above), another wipe test must be conducted and counted using a liquid scintillation detector to determine if the contamination is removable. Results must be recorded.
- (c) The wipe sample assay procedure should be sufficiently sensitive to detect the presence of 200 dpm/100 cm<sup>2</sup> of removable contamination. A radioactive source with a known amount of activity must be used to convert sample measurements (usually in counts per minute) to  $\mu\text{Ci}$ .
- (d) Records must be kept in a logbook.



## Procedure 5: Waste Disposal

### 1. Sink Disposal

- (a) Liquids may be disposed of by release to the sanitary sewer or evaporative release (with permission of the Radiation Safety Officer) to the atmosphere. This does not relieve the licensee from complying with other regulations regarding toxic or hazardous properties of these materials.
- (b) Rules for disposal in the sanitary sewer appear in OAR 333-120-500. Material must be readily soluble or dispersible in the water. The quantity of licensed or other radioactive material allowed to be released in to the sewer in one month is shown in Appendix D. These maximum monthly quantities have been calculated by multiplying the limits listed in 10 CFR 20 Table 3 of Appendix B to 20.001 to 20.2401 by the average monthly volume of water released into the sewer at Reed College.
- (c) Register the sink used for sewer disposal with the Radiation Safety Officer (RSO). Post a “Caution – Radioactive Material” sign at the sink.
- (d) Record the following information: date, radionuclide, estimated activity that was released (in millicuries or microcuries), estimated concentration, vent site at which the material was released, and initials of individual making the disposal on Form 5: *Sink Disposal Log*. Disposals must also be recorded on Form 4: *Receipt, Use, and Disposal Log*.
- (e) Flush the sink profusely with water, continuing until the material is washed from the sink.
- (f) Change disposal logs as needed. Send a copy to the RSO when changed. The RSO may request a copy of the log at any time. Disposals must also be recorded on the form found in Form 5: *Receipt, Use, and Disposal Log*.

### 2. Disposal by Decay in Storage

- (a) Some short-lived material (physical half-life less than 90 days) may be disposed of by decay in storage.
- (b) Waste must be separated by radionuclide so that shorter-lived wastes can be stored only as long as necessary for radiation to decay to background levels.
- (c) Liquids must be absorbed onto vermiculite, clay absorbent, or other material so that no free liquids remain. This is to reduce the possibility of spills during storage.

- (d) Materials to be decayed in storage must be packaged in sealed plastic bags. The materials must be labeled with the following information (labels are available from the RSO):
  - i. Radionuclide and approximate activity.
  - ii. Date.
  - iii. Chemical compound(s) contained in the waste.
  - iv. Room where the waste was generated.
  - v. Name of person preparing package.
- (e) When decay in storage materials are packaged, contact the RSO to schedule a waste pick up. Disposals must be recorded on Form 4: *Receipt, Use, and Disposal Log*. The material will be decayed for at least 10 half-lives. Before release to trash the material will be monitored using the appropriate radiation detection device. Wastes must be at background to be disposed of in the regular trash. All radioactive materials labels must be removed or defaced before disposal in the regular trash.
- (f) Prior to disposal, the RSO will label the waste and record the following information:
  - i. Activity at time of disposal.
  - ii. Date.
  - iii. Initials of individual conducting the survey.

### 3. Transfer by Burial

- (a) Except for material suitable for decay in storage and some animal carcasses, solids with a half-life greater than 90 days must be transferred to a burial site.
- (b) Waste materials must be packaged in sealed plastic bags. The materials must be labeled with the following information (labels are available from the RSO):
  - i. Radionuclide and approximate activity.
  - ii. Date
  - iii. Chemical compounds(s) contained in the waste.
  - iv. Room where the waste was generated.
  - v. Name of person preparing the package.

- (c) When materials are packaged for transfer to a disposal site, contact the RSO or Reactor Director to schedule a waste pick up. Disposals must be recorded on the form found in Form 5: *Receipt, Use, and Disposal Log* .
- (d) The RSO or Reactor Director will arrange for disposal at a secure burial site through a commercial waste disposal service and will oversee compliance with all applicable DOT and NRC regulations concerning labeling, packaging, and transportation of radioactive wastes.



## Procedure 6: Radioactive Materials Package Ordering and Receipt

### 1. Procurement and Authorization

- (a) Each request for purchase of radioactive materials must be approved by the Radiation Safety Officer (RSO) prior to placing the order. It is the responsibility of the Principal User to obtain RSO authorization to place an order to purchase radioactive materials.

### 2. Receipt

- (a) Regardless of which department orders radioactive material, the package must be delivered to the chemistry stockroom manager. Before delivering the package to the intended recipient, the stockroom manager must contact the RSO and give the following information: radioisotope, chemical form, activity, recipient, supplier, purchase order number.
- (b) Only the Principle User is authorized to open and survey packages of radioactive materials which must be done within three hours of receipt.

### 3. Survey (Excluding Tritium or Carbon-14)

- (a) Any package received is assumed to be contaminated until thoroughly surveyed.
- (b) The individual receiving the package must wear badge and finger ring. Gloves must be worn over ring, with ring facing palm.
- (c) The package should be placed on absorbent paper in a fume hood. If a fume hood is unavailable and the material is sufficiently low in activity to use outside of a hood, simply place package on absorbent paper.
- (d) After turning the survey meter ON, measure the radiation level at one meter from the surface of the package. The reading should agree with the transport index (TI) indicated on the label. If the reading is higher, assume the integrity of the package is broken. Record all readings on Form 4: *Receipt, Use, and Disposal Form*. (An ion chamber should be used for this measurement unless you have a GM meter which is calibrated for use with the particular isotope being measured).
- (e) Move the survey meter far enough away from the package for background reading.
- (f) Check gloves with survey meter. If not contaminated, wipe the package with a dry tissue or filter paper.

- (g) Survey the paper by placing it next to the meter probe. If the reading is no higher than background, open the package and wipe the inner container using same procedure as above. Survey second wipes using the same procedure. Record all readings on Form 6: *Survey Reports*.
- (h) Deface all radioactive materials labels on uncontaminated packaging before disposal.

The shipping label gives the amount of material in becquerel (Bq). Make the calculation to determine if this agrees with what was ordered. One Bq equals one disintegration per second. One Curie is equal to  $3.7 \times 10^{10}$  dps, which is 37 gigabecquerel (GBq).

#### 4. Survey for Tritium or Carbon-14

- (a) Any package received is assumed to be contaminated until thoroughly surveyed.
- (b) Don protective gloves and safety glasses.
- (c) The package should be placed on absorbent paper in a fume hood. If a fume hood is unavailable and the material is sufficiently low in activity to use outside of a hood, simply place package on absorbent paper.
- (d) Perform wipe test on the outside of the package. Analyze using a liquid scintillation counter (LSC). Record all readings on Form 6: *Survey Reports*.
- (e) If no contamination is found on box, open the package and perform wipe test on the inside of the package and on the bottle. Analyze using a liquid scintillation counter (LSC). Record all readings on Form 6: *Survey Reports*.
- (f) Deface all radioactive materials labels on uncontaminated packaging before disposal.
- (g) If readings greater than 1000 dpm above background are found in any of the above steps, carefully clean the outside of the bottle before use. Double bag all contaminated material for disposal as radioactive waste. Inform the RSO.

## Procedure 7: Decommissioning Laboratories and Other Radioactive Materials Use Areas

### 1. Responsibilities

- (a) The decommissioning process shall be carried out by the RSO or his/her designee.

### 2. Survey

- (a) Thoroughly survey the laboratory using a GM-meter if appropriate. Use Form 3: *Survey Checklist* to record findings.
- (b) Perform wipe tests to determine if removable contamination is present. Analyze using a liquid scintillation counter or other appropriate counting equipment.
- (c) Perform a wipe test of the sink drain-pipe. Use tongs or other device to ensure that the wipe sample is taken from fairly deep within the drain.
- (d) Perform a survey and/or wipe test on adjacent laboratories to check for spread of contamination or unauthorized use.

### 3. Waste Removal

- (a) Use Form 4: *Receipt, Use and Disposal Log* to balance the radioactive materials inventory for the lab.
- (b) Dispose of all waste materials in accordance with Procedure 5: *Radioactive Waste Disposal Procedures*.

### 4. Clean-Up

- (a) If any contamination is found, thoroughly clean the area and retest. Repeat until laboratory is free of contamination.

### 5. Remove Labels

- (a) When all radioactive materials and waste have been removed from the lab and surveys indicate that no contamination is present, remove all radioactive materials labels from the laboratory door, equipment, and work benches.

### 6. Records

- (a) The Principal User will forward final records of any laboratory decontamination, radioactive materials disposal, and inventory balance to the RSO. The RSO will inspect the lab and send a memo to the Principal User and the chair of the Radiation Safety Committee documenting that the lab is decommissioned.

## Procedure 8: Audit

### 1. Program Components

- (a) The following components of the Reed College Radioactive Materials Program will be audited biennially by the Radioactive Materials Committee for content and implementation. No individual will be assigned an audit of an area for which s/he has primary responsibility.
  - i. Procedure 1: *Radiation Monitoring, Control and Security*. (OAR 333-102 & 333-120)
  - ii. Procedure 2: *Emergencies*. (OAR 333-120-720)
  - iii. Procedure 3: *Sealed Source Leak Tests*. (OAR 333-120-460)
  - iv. Procedure 4: *User Surveys*.
  - v. Procedure 5: *Waste Disposal*. (OAR 333-120-500, 520, 540, 550, & 560)
  - vi. Procedure 6: *Radioactive Materials Package Ordering and Receipt*. (OAR 333-120-450)
  - vii. Procedure 7: *Decommissioning Laboratories and Other Radioactive Materials Use Areas*.
  - viii. Personnel Training
  - ix. Policy Manual requirements
  - x. Application for Use of Radioactive Materials
  - xi. Record keeping and Annual report

### 2. Overall Program

- (a) The overall Reed College Radioactive Materials Program will be reviewed annually for content completeness. This audit will be conducted either by the Radioactive materials Committee or by an outside consultant.

### 3. Audit Form

- (a) Audits will be performed using the Audit Form, form 8. Each Audit should include:
  - i. Interviews with affected personnel as necessary
    - A. RSO
    - B. Health Physicist
    - C. Reactor Director

- D. Principal User
- E. Authorized Laboratory personnel/students
- ii. Review of pertinent procedure
  - A. Is the procedure clear and consistent with the rest of the program?
  - B. Are the required records maintained?
- iii. Review of pertinent records
  - A. Are the records in place?
  - B. Are the records clear and legible with all units of measurements and required signatures in place?
- iv. Review of applicable regulations as found in OAR 333 divisions 100 through 120.
- v. Review of Reed College Radioactive Materials Policy and Reed College Radioactive Materials License as needed.

## Procedure 9: Personnel Training

### 1. New Student Users

- (a) All new student users must take and pass a radioactive materials authorization examination provided by the RSO.
- (b) All new student users must be assigned to work with a Principal User.
- (c) Before the student may begin work with radioactive materials, the PU will train the student to use a scintillation counter (if applicable) and/or in safe laboratory use of radioactive materials. Before the student's authorization is complete, a signed *Certificate of Training* (form 10) must be received by the RSO.
- (d) Student user trainees must watch three video tapes (QC41.R33 1982 VIDEO located in the IMC) before taking the authorization examination. The video tapes pertain to Principles of Radiation, Laboratory Safety, and Emergency Procedures.
- (e) The student user trainee will be supplied with a copy of *Reed College Radioactive Materials Policy and Procedures manual* and a *Study Guide* to prepare for the examination.

### 2. New Principal Users

- (a) New Principal Users will be required to pass the authorization examination.
- (b) All new Principal Users will be supplied with a copy of the *Reed College Radioactive materials Policy and Procedures Manual*.
- (c) If the PU has documentation of training and use of radioactive materials at another institution, no further training is required. If no documentation exists, the Pu must follow the procedure for new student users (above) to become authorized.
- (d) The PU must complete *Application for Use of Radioactive Materials* (see form 9) and submit it to the Radioactive Materials Committee for approval before RAM may be used in the laboratory.

### 3. Non-Authorized Personnel

- (a) Those employees whose duties may bring them in the vicinity of radioactive materials (Housekeeping, maintenance, security) will be trained in the following topics as part of their Right-To-Know training:

- i. Locations where radioactive materials are stored.
- ii. Overview of *Reed College Radioactive Materials Policy and Procedures Manual* as it pertains to the survey and wipe testing of work areas.
- iii. Procedures for entry in to areas where radioactive materials are used.
- iv. Recognition of radioactive materials labels.

#### 4. Refresher Training

- (a) An biennial overview of Reed College Radioactive Materials Policy and Procedures will be presented to all active Principal Users. Inactive Principal Users will receive refresher training before resuming use of radioactive materials. Additional refresher training will be required whenever significant changes to duties, rules, or the terms of the license occur.

# Forms

Form1



# Form 2



**Form 3**



# Form 4



# Form 5



# Form 6



# Form 7



# Form 8



# Form 9



# Form 10



\*Appendices

## **Appendix A**



## **Appendix B**



## **Appendix C**



## **Appendix D**