Radiation Safety Guide

Environmental Health and Safety Division
Radiation Safety Office
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CHAPTER ONE
GRU RADIATION SAFETY PROGRAM

INTRODUCTION

Georgia Regents University (GRU) has been authorized by the State of Georgia to use sources of radiation in patient care, education, research and development activities. The GRU Radiation Safety Committee may authorize individual staff or faculty members, as Principal Authorized Users, to use radioactive material or radiation sources after a review of the proposed use, adequacy of facilities, and experience of the applicant. Although this provision allows GRU great flexibility in dealing with the multitude of radioactive material or radiation sources and research uses encountered on campus, it places great responsibility on investigators and the administration to comply with State regulations.

This guide summarizes the terms of GRU's authorization and the regulations most applicable to campus use of various radioactive materials and radiation sources. Special precautions, regulations, and other operating procedures specified by the Radiation Safety Committee or Radiation Safety Officer (RSO) as a condition for approval of radiation source authorization shall also be maintained and made available to laboratory personnel and Radiation Safety inspectors. Instructions for the therapeutic use of radioactive materials at affiliated hospitals are incorporated as a supplement to this guide.

Everyone involved with the use of radioactive materials or radiation sources is required to be familiar with the provisions of this manual. The manual is readily available on-line to all interested individuals. All radiation users are obligated under the conditions of our state radioactive materials license to maintain all radiation exposure to levels that are "as low as reasonably achievable" (ALARA).

RESPONSIBILITIES

RADIATION SAFETY COMMITTEE

The Radiation Safety Committee is responsible for establishing policies governing the procurement, use, storage and disposal of radioactive material or radiation sources at GRU. The committee meets quarterly. Decisions by voting require the presence of a majority of its members or alternates, including the Management Representative and the Radiation Safety Officer. The Committee and its Chair are appointed by the President of GRU.

The committee has two component subcommittees, the Non-Human Use of Ionizing Radiation Subcommittee, and the Laser Safety Subcommittee. The Non-Human Use of Ionizing Radiation Subcommittee has the responsibility and authority to act in matters involving non-human research uses of radioactive materials or radiation sources. It is the responsibility of the subcommittee to review any proposed use which involves in-vitro and animal uses of radioactive
materials or radiation sources and to evaluate the qualifications of the individuals requesting Principal Authorized User status to conduct experiments with the radioactive material or radiation sources requested. The Laser Safety Program is governed by a separate guide.

Uses of radioactive material or radioactive sources may be approved provided that greater than 50% of the subcommittee members respond and a majority of the respondents are affirmative. A subcommittee member may request full Radiation Safety Committee review of a protocol.

RADIATION SAFETY OFFICE

The Radiation Safety Office includes the personnel and other resources necessary for the oversight of the Radiation Safety Program. The Radiation Safety Office provides radiation safety services including personnel monitoring, waste disposal, shielding design, x-ray system inspection, radiation safety training, laboratory surveys, maintenance of the institution radioactive materials license, program record-keeping, research protocol review, and consultation on the safe use of radioactive material or radiation sources.

RADIATION SAFETY OFFICER (RSO)

The Radiation Safety Officer is responsible for the radiation safety program. This responsibility includes general surveillance of overall activities and areas in which radioactive material or radioactive materials or radiation sources are used, determination of compliance with rules and regulations, authorization conditions and the conditions of project approval specified by the Radiation Safety Committee, consultation on radiation safety with staff, determination of the need for and evaluation of personnel monitoring, instructional programs to train personnel in safe procedures in the use of radioactive materials or radiation sources, and termination of any project that is found to be a significant risk to health or property. The Radiation Safety Officer is appointed by the President of GRU and has authority to suspend any activity that is a threat to health, property, or the environment. In accordance with state regulation the RSO has direct access to the President on all issues related to radiation safety.

The Radiation Safety Officer is the institution’s executive agent for the state radioactive materials license. All applications for radioactive materials or radiation source use, location, procedures and possession limit changes are reviewed by the Radiation Safety Officer. The Radiation Safety Officer recommends final action on applications to the Radiation Safety Committee.

PRINCIPAL AUTHORIZED USER

The Principal Authorized User (PAU) is a staff or faculty member who has been approved to use radioactive materials or radiation sources by the Radiation Safety Committee. Most commonly the Principal Authorized User is the principal investigator for a research project involving radioactive materials or radiation sources. Other examples of PAU's are staff or faculty members who are responsible for a laboratory course in which radioactive material or sources are used, or a physician or dentist authorized to use radioactive material or radiation sources for
diagnosis or treatment. Although occasionally a staff or faculty member is given temporary
approval to use radioactive material or radiation sources under another staff or faculty member's
authorization, each staff or faculty member is encouraged to obtain independent authorization. It
is the Principal Authorized User's responsibility to ensure that students, staff and faculty using
radioactive material or radiation sources under his/her authorization receive radiation safety
training, are familiar with the terms of the authorization comply with GRU policies and
applicable regulations.

RADIATION WORKER

Radiation workers are responsible for the safe use of radioactive material and radiation
sources. Knowledge of laboratory, waste disposal, and emergency procedures is required. A
course on radiation safety principles is mandated by the state and offered by the Radiation Safety
Office. Attendance is required for irradiator and radioisotope laboratory workers before they
begin radiation work. Each Radiation Worker is responsible for the proper wearing and care of
his/her dosimeter badge (if issued) and for having bioassay measurements performed when
directed. Each individual operator of a radiation producing machine shall meet requirements in
the State of Georgia Rules and Regulations for X-Rays, Chapter 290-5-22, and receive training in
radiation safety, system safety, and patient safety (where applicable).
CHAPTER TWO

RADIOACTIVE MATERIAL OR RADIOACTIVE SOURCE AUTHORIZATION AND RADIATION WORKER REGISTRATION

To obtain authorization to procure and use radioactive materials or radiation sources, a prospective Principal Authorized User shall complete an "Application for Authorization to Obtain and Use Radioactive Materials or Radiation Sources", and forward it to the Radiation Safety Officer. The Radiation Safety Officer or his designee will review the application and schedule an interview with the prospective user to evaluate the facilities available, the training and experience of the applicant and staff for the proposed use, and the details of the work to be performed.

The procedures described in the application, as modified by the Radiation Safety Officer or the Radiation Safety Committee, become the conditions under which the PAU and his/her personnel are authorized to use radioactive materials or radiation sources. Any subsequent change in procedure regarding the use, storage or disposal of sources shall be reviewed and approved by the Radiation Safety Officer prior to instituting the change.

FACILITIES EVALUATION

The review of radiation source use applications will include a review of the adequacy of the proposed facilities. Depending on the quantity of radioactive material involved, the type of radiation source and the complexity of the proposed procedures, the following are considered:

1. Isolation from other laboratories and public areas.
2. Availability of radiation detection instrumentation.
3. Adequacy of ventilation and fume hoods.
4. Readily cleanable work surfaces and floors.
7. Security of facilities.

In accepting an authorization, the applicant agrees to open his/her facility for visits by the Georgia Department of Natural Resources and the Radiation Safety Office.
RESEARCH ON HUMAN SUBJECTS

An investigator who requests to use radioactive material or radiation sources for research purposes involving humans shall submit an “Application to Use Radioactive Material or Radiation-Producing Materials on Humans”, a copy of the research protocol, patient informed consent forms, and other supporting information to the Radiation Safety Officer for review and approval. The Radiation Safety Officer will distribute the application to the Radiation Safety Committee for their review along with a recommendation for approval/disapproval. Based on concurrence by a majority of reviewers, the Radiation Safety Officer forwards approval on behalf of the Radiation Safety Committee to the GRU Institutional Review Board (IRB). A researcher may not begin research on human subjects until their protocol has received approval from both the Radiation Safety Committee and the IRB. Approval/Disapproval of protocols is reported at the quarterly Radiation Safety Committee meetings.

An investigator who requests the use of radioactive material in a procedure that is not well established and for which a "Notice of Claimed Investigational Exemption for a New Drug" (IND) has not been accepted by the Food and Drug Administration, may receive authorization from the Radiation Safety Committee (RSC) for such research. The investigator shall provide substantial information to the RSC so that an appropriate evaluation can be made. The investigator shall report to the RSC each calendar quarter on the activities of the research conducted under such an authorization.

RADIATION WORKER REGISTRATION

Each Principal Authorized User and radiation worker shall submit a "Radiation Workers Registration Form" to the Radiation Safety Office. The form is available on the Radiation Safety website or from the Dosimetry Coordinator. The Radiation Workers Registration Form provides worker identification, job title, position functions, training and experience relevant to work with radioactive materials or radiation sources. The Radiation Safety Officer or his/her designee will review the registration form and schedule appropriate and necessary worker training sessions. The original approved registration form is maintained in the Radiation Safety Office. Radiation Workers Registration forms are maintained by the Radiation Safety Office as long as the individual of radioactive materials or radiation sources. The Radiation Safety Office is to be informed of all changes in personnel working with radioactive materials or radiation sources.
CHAPTER THREE
RADIATION SAFETY PRINCIPLES

EXTERNAL RADIATION EXPOSURE

External doses can be the result of exposure to gamma, x-ray, or high energy beta emitters. Because radiation from low energy beta and alpha emitters do not penetrate the outer layer of skin, they present less of an external hazard, and internal exposure is the overriding concern. The radiation dose an individual receives depends on the following factors:

1. Exposure rate emanating from the source: One of the most important factors is the "strength" (e.g., mrad/hr) of the radiation source. By reducing the amount of radioactive material used or lowering the settings on a radiation producing machine, the exposure rate, and consequently the dose can be reduced.

2. Time: The dose received from an external source is dependent on the time of exposure. Limiting exposure time limits the dose.

3. Distance: By increasing the distance between the source of exposure and an individual, the dose received can be significantly reduced. For example, when an individual doubles his/her distance from a gamma source, the dose rate at the further distance will drop to one-fourth the level at the closer distance.

4. Shielding: When radioactive materials or radiation sources are being used, absorbing material or shields can reduce exposure levels. The specific shielding material and thickness is dependent on the amount and type of radiation involved.

INTERNAL RADIATION EXPOSURE

Occupational internal exposure results from the absorption, ingestion, injection, or inhalation of radioactive material. This material can be incorporated in the body in several ways:

1. Breathing radioactive gases, vapors or dust.

2. Consuming radioactive material transferred from contaminated hands, tobacco products, food or drink.

3. Entering through a wound.

5. Absorption through the skin.

6. Injection (including inadvertent injection) into the body.
RADIATION SAFETY PROGRAM OBJECTIVES

The fundamental objectives of radiation safety are to limit radiation doses to exclude deterministic effects, and minimize stochastic effects, by:

1. Limiting exposure to external radiation to levels that are as low as reasonably achievable and well below established dose limits.

2. Limiting entry of radionuclides into the human body via ingestion, inhalation, injection, absorption, or through open wounds when unconfined radioactive material is handled, to quantities as low as reasonably achievable and well below established limits.

GENERAL RADIATION SAFETY GUIDELINES FOR RADIOACTIVE MATERIAL USE

1. The procedure for each project should be well outlined in writing for all laboratory personnel. Necessary equipment, waste containers, and survey instruments shall be available.

2. Characteristics of the radioactive material such as type of radiation, energy, half-life, significant and typical amounts, and chemical form should be known.

3. In some cases, before the procedure is actually performed with radioactive material or radioactive sources, a "dry run" practice of the procedure may be useful to familiarize personnel with the procedure to improve efficiency and to reduce the radiation dose.

4. Visitors and students in a laboratory where radioactive material or radioactive sources are used shall be supervised by a radiation worker.

5. Radioactive material or radiation sources shall not be left unattended where they may be handled or removed by unauthorized persons. A locked barrier shall exist between radioactive material and access by unauthorized persons, unless a radiation worker is present. In the absence of a radiation worker, radioactive material or radioactive sources (excluding radioactive waste and in-process experiments) shall be locked in a dedicated storage unit (refrigerator, freezer, cabinet). Waste or in-process experiments shall be maintained in a laboratory area approved for such purposes. At the end of the workday, the laboratory are secured.

6. Waste storage areas and other storage areas containing radioactive material or radioactive sources shall be secured.

7. As a general practice, work with radioactive material or radioactive sources should be confined to only the areas necessary for use. This simplifies issues with confinement and shielding, and aids in limiting the affected area in case of contamination. These areas shall be clearly labeled.
8. All work surfaces (table tops, hoods, floors, etc.) should be properly covered to facilitate decontamination. Absorbent mats or paper should be used. Protective absorbent paper with a plastic back is especially useful. If contaminated, it can simply be discarded in the radioactive waste container.

9. Plastic or metal trays (stainless steel washes easily) should be placed on the surface when liquids are to be used. The tray edges serve to confine a spill.

10. Good housekeeping shall be practiced at all times. If an area is kept neat, clean, and free from equipment not required for the immediate procedure, the likelihood of accidental contamination or unnecessary exposure is reduced.

11. NEVER PIPETTE BY MOUTH SUCTION! Always use a mechanical pipette filling device.

12. Eating, drinking, smoking, application of cosmetics, or storing of food is prohibited in areas posted as radioactive use areas.

13. Refrigerators used to store radioactive material shall not be used for the storage of food. All storage compartments (refrigerator and freezer sections) shall be conspicuously posted with radiation warning labels.

14. Wash hands thoroughly after working with or near radioactive materials.

15. Lab coats, gloves, safety glasses, and closed-toed shoes should be worn by all individuals handling radioactive materials or unsealed radioactive sources. If radioactive materials are carried between laboratories, precautions shall be taken to prevent personal skin contamination and contamination of items touched along the way (e.g. door knobs). Do not use the phone, handle books, open cabinets, etc., or leave the laboratory while wearing gloves except as noted above.

16. All reusable glassware and tools used with radioactive material should be thoroughly cleaned after use and kept separate from non-contaminated items. A marked container or area are provided for glassware and tools used in radioactive work.

**LABORATORY RADIATION SAFETY RULES**

It is the responsibility of those working with radioactive materials to protect themselves and others from radioactive hazards arising from their work. Careless working habits can unnecessarily expose others or contaminate facilities. The following safety rules shall be posted in the laboratory and shall be observed at all times:

1. Eating, drinking, smoking, and the application of cosmetics are prohibited in areas that are posted for radioactive materials use.
2. Working with radioactive materials when open wounds are present on exposed surfaces of the body is prohibited unless wounds are properly dressed and protected.

3. Pipetting or any similar operation by mouth suction is prohibited.

4. Protective gloves and laboratory coats shall be worn when handling radioactive material. The use of protective eyewear is also encouraged.

5. Disposable absorbent pads, protective trays and remote handling devices shall be utilized when possible.

6. Hands should be washed thoroughly after handling radioactive materials.

7. Food items shall not be stored in areas designated for radioactive materials.

8. Personnel monitoring badges (radiation dosimeters) shall be worn in controlled areas, as directed by the RSO.

9. Radioactive waste shall be disposed of only in the containers provided. Non-standard containers are prohibited.

10. Stock vials shall be stored in safe and secured locations.

11. Good housekeeping shall be maintained at all times.

12. In the event of a spill, follow the established emergency procedures.

13. Conduct and document survey meter readings and weekly wipe test results when radioactive materials are used. (See Chapter 5 for additional information)

14. Monitor hands and clothing prior to leaving the laboratory.

15. When measurements exceed action levels (200 dpm/100 cm²) or twice background for meter surveys), determine the cause and take corrective action to reduce contamination levels below these limits.

GENERAL RADIATION SAFETY GUIDES FOR USE OF X-RAY PRODUCING MACHINES

1. Each individual operator of a radiation producing machine shall meet requirements in State of Georgia Rules and Regulations for X-Rays, Chapter 290-5-22, and receive training in safety against radiation, machine safety, and patient safety (where applicable).

2. Only persons whose presence is necessary shall be in the room or area during exposure. Protective lead aprons of at least 0.25 mm lead equivalent shall be provided
and shall be worn by all individuals required to be in controlled areas except for the following circumstances:

- When the individuals are entirely behind protective barriers while the equipment is energized.
- When a radiation safety survey indicated that the exposure rate in the occupied area is less than 5 mrem in any one hour.

3. When a patient, animal, or image detector shall be held in position for radiography, mechanical supporting or restraining devices or other means of immobilization should be used. If such a device is not available or practical, the individual shall wear protective gloves having at least 0.5 mm lead equivalence, a protective apron of at least 0.25 mm lead equivalence, and shall keep all parts of the body out of the useful beam.

4. No individual shall be assigned to routinely hold patients, animals or film during radiation exposures.

5. Personnel involved in radiographic procedures should wear monitoring devices. Exceptions to this policy can be granted by the Radiation Safety Officer for individuals who are not likely to receive a dose in excess of 10% of the annual limit.

6. The gonads of children and persons of reproductive age should be protected from primary radiation during any x-ray examination or treatment by the use of a special gonad shield or apron when this will not interfere with the clinical objectives.

7. The operator should normally stand behind a protective barrier when making an exposure. This barrier shall have a viewing window that enables the operator to view the patient during the exposure.

8. For portable radiographic and fluoroscopic equipment, protective aprons of at least 0.25 mm lead equivalent shall be available and used by the operator and other individuals in the room and within 2 meters of the patient or x-ray tube during an exposure. The operator shall warn all persons in the room that an exposure is about to be made and allow enough time for them to leave.

9. As a general principle, the exposure to the patient shall be kept to the practical minimum consistent with clinical objectives.

10. Visitors and students in the area of work should be supervised by the equipment operator.

11. Radiation producing machines shall not be left unattended in an operational mode.
12. Structural shielding requirements for any new x-ray equipment installation, or any modifications to an existing unit or room, shall be approved by Radiation Safety before the system is used.

13. Portable x-ray equipment routinely used in one location to which patients are transported shall meet the same shielding requirements as fixed units.

14. Because of the high exposure rate, special care is needed when working with x-ray diffraction units. Follow the specific procedures for training, operation and emergency response that have been developed for these devices.

IRRADIATORS

Access to irradiators is strictly controlled in accordance with Nuclear Regulatory Commission requirements. Workers requiring unescorted access to irradiators shall complete the required radiation safety training, operational training and security background check.

1. Radiation Safety Training - Each user of the irradiator shall complete the initial radiation safety course. See the Radiation Safety website for details.

2. Operational training - Before using an irradiator, all users shall be trained in the safe and proper operation of the irradiator. Employees shall contact the trainer(s) for the irradiators they intend to use to arrange for operational training. See the Radiation Safety website for details. Training, at a minimum, shall include the following:

   - Design and operation of the unit
   - Step-by-step operating procedures
   - Emergency procedures
   - Security procedures
   - On-the-job operational training consisting of several irradiation procedures performed under the supervision of the trainer.

3. Irradiator User Registration and Security Background Check. In certain cases, a one page proposal is completed by the applicant’s supervisor if the applicant is not a PAU. A Trustworthiness and Reliability application is completed by the worker’s supervisor, and an appointment is made to have the applicant’s fingerprints taken. The applicant’s fingerprints are submitted for a NRC/FBI criminal history records check. For complete instructions, refer to the Radiation Safety website.

RESPONSIBILITIES OF THE IRRADIATOR USER

1. All irradiator users are responsible for conducting operations in accordance with the manufacturer’s Irradiator Users’ Guide and operating and emergency procedures.

2. All individuals who use the irradiator(s) are responsible for promptly reporting any malfunction of the irradiator to the Radiation Safety Office.
3. Irradiator users are not permitted to perform maintenance of any kind on the irradiator(s).

4. Users are responsible for ensuring all security measures are in place upon exiting the Irradiator.

5. Users will report any security issues or violations to the RSO immediately upon discovery.
CHAPTER FOUR

PROCUREMENT OF RADIOACTIVE MATERIALS

ORDERING

To order radioactive materials or radiation sources, a PeopleSoft requisition should be created by the requesting department with a status of pending approval. The Radiation Safety Office reviews PeopleSoft requisitions for radioactive materials or radiation sources for approval daily. Upon approval, the Radiation Safety Office changes the requisition status to approved. The requisition can then be processed by Materials Management. The following information is needed in the requisition in addition to that required by Materials Management:

1. Name of the Principal Authorized User
2. Authorization Number (PAU number) assigned by the RSO
3. Radionuclide
4. Total activity (millicuries or microcuries)

The RSO will verify:

1. Principal Authorized User is approved for requested radionuclide
2. Order does not exceed approved limits
3. Current training for the Principal Authorized User and lab personnel
4. Appropriate dosimetry issued
5. Current instrument calibration
6. Approved lab for delivery point

If these criteria are met the requisition is approved for order processing by Materials Management. If the criteria are not met, or if required information is missing or incorrect on the requisition, the requesting department are notified for resolution.

When the order has been approved, a Radioisotope Receipt and Disposal Form is generated (except for certain items exempt from inventory record keeping requirements). The quantity is added to the Principal Authorized Users inventory to ensure that approved limits will not be exceeded when all outstanding orders have been received.

RECEIPT OF RADIOACTIVE MATERIALS

RECEIPT DURING NORMAL WORKING HOURS

Shipments of radioactive materials that arrive during normal working hours are delivered to the Receiving Warehouse (except as noted in the following paragraph) and stored in the radioactive materials storage area. Radiation Safety staff will document the receipt and survey the package within three hours of receipt by GRU during normal working hours prior to delivery.
Individual patient doses for Nuclear Medicine and Radiation Therapy are delivered by the vendor directly to the department where the receipt and survey are documented.

RECEIPT AFTER NORMAL WORKING HOURS

Except for deliveries to Nuclear Medicine and the Radiation Therapy Center, Public Safety shall be notified when radioactive packages arrive after normal working hours. Public Safety shall contact Radiation Safety personnel for specific instructions.

PACKAGE SURVEYS

The RSO will perform surveys as required by Georgia state regulations [391-3-17.03 (12)(f3)] for external contamination and radiation levels. Surveys are performed on the exterior surfaces and inner source containers for all packages that contain a radioactive materials transport label and on any package that appears to be damaged or leaking. Wipe test results are documented on the Radioisotope Receipt and Disposal form. After the survey is performed and the package is authorized by Radiation Safety for delivery, the radiation safety technician will transport the package to the lab. A Radioisotope Receipt and Disposal form are sent with each item. Receipt documentation are maintained in the Radiation Safety Office.

Lab personnel should open the package immediately upon receipt using the following procedures:

1. Wear gloves, a lab coat, and safety glasses.

2. Visually inspect the package for damage. If damaged, immediately notify the Radiation Safety Office.

3. Open the package and verify contents against the packing list and purchase order. Sign the Receiving Report for return with the delivery. Any order discrepancies shall be reported to Materials Management (721-2218) within 48 hours of receipt to avoid being charged incorrectly, and reported to the Radiation Safety Office (721-9826). Do not return any package without Radiation Safety Office approval.

4. Wipe the final source container and count the wipe with an appropriate measuring instrument (liquid scintillation counter, gamma counter, etc.) If removable contamination is greater than 200 DPM/100 cm² when counted with a scintillation counter or twice background when counted with a GM counter, notify the Radiation Safety Office.

5. Monitor the packing material. If contaminated, treat as radioactive waste. If not contaminated, obliterate radiation wording and symbols before discarding in regular waste.

and return the form to the Radiation Safety Office when all radioactive material has been properly disposed.

ON CAMPUS TRANSFERS

When it is necessary to transfer radionuclides from one user or location to another, approval shall be obtained from the Radiation Safety Office. When transfers are made from one Authorized User to another, receipt and disposal records shall be generated to maintain accurate inventory records. When material is transferred from one room to another or one building to another, the Radiation Safety Office will evaluate the proposed transfer with respect to the packaging, container and method to ensure that it can be accomplished safely. Specifically, liquids should be transported only in sealed containers with secondary containment if there is a possibility of spillage, breakage or leakage. The Radiation Safety Office shall confirm that the room radionuclides are transferred into has been approved for radionuclide use and is on the survey list.

OFF CAMPUS TRANSFERS

All transfers of radioactive materials off campus shall be made through the Radiation Safety Office to ensure compliance with all license conditions and DOT regulations.

DISPOSAL OF RADIOACTIVE MATERIALS

Radioactive waste disposal is discussed in detail in Chapter 8. When all material has been disposed of, the Radioisotope Receipt and Disposal form shall be completed and returned to the Radiation Safety Office. The activity of each order remains on the investigator's inventory record until this form is received by the Radiation Safety Office. The total activity disposed shall equal the activity received.
CHAPTER FIVE
RADIATION AND CONTAMINATION SURVEYS

RESPONSIBILITY

Prevention of contamination and excessive radiation exposure is the responsibility of the Principal Authorized User and all radiation workers. The PAU is also responsible for providing radiation detection equipment to monitor removable contamination and external radiation exposure levels as appropriate. Radiation detection devices appropriate to the isotope being used, such as liquid scintillation counters, gamma counters, and portable survey instruments shall be available.

SURVEYS CONDUCTED BY RADIATION SAFETY OFFICE

"Survey" means an evaluation of the radiation hazards incident to the use, release, disposal and presence of radioactive materials. Radiation Safety Office personnel periodically (typically monthly) inspect the laboratories of PAUs to monitor the in-lab radiation safety program. Radiation exposure rates and removable contamination levels are measured and record keeping systems are reviewed during the survey. The frequency of surveys is determined by the type/quantity of radioactive materials used, results of previous surveys, and general compliance with State and GRU Radiation Safety regulations and policies. Although the Radiation Safety Office inspections fulfill a need for oversight, they do not provide adequate day-to-day information regarding the effectiveness of radiation control procedures used in the laboratory. Therefore, laboratory personnel shall routinely monitor their laboratories when using radioactive material.

SURVEYS CONDUCTED BY PRINCIPAL AUTHORIZED USER

Weekly contamination/radiation surveys are required for areas authorized for use of radioactive materials under a PAU sublicense. In areas where radioactive material is maintained in sealed containers, exposure levels are low (<0.1 mrad/hr) and there is a low potential for contamination, weekly surveys by the user may not be required and a monthly survey by the Radiation Safety Office is sufficient. Examples include: liquid scintillation counting areas not used for sample preparation and autoradiography dark rooms for film development purposes only. The schedule is subject to change by the Radiation Safety Officer in accordance with the frequency of source use, potential for exposure and the established safety record.

When higher energy beta emitters such as P-32, or gamma emitters such as I-125, Na-22, are used in the laboratory, the weekly PAU survey shall consist of both a wipe test and instrument survey using an appropriate portable survey meter. The instrument make, model, serial number, calibration date and readings shall be recorded on the written survey report. When lower energy beta emitters, such as H-3, C-14, P-33, or S-35, or small quantities of gamma emitters contained in commercial test kits are used in the laboratory, only a wipe test for contamination is required.
If no radioactive material has been used during a week, a statement of that fact may be entered into the Radiation Safety records in lieu of a recorded survey. A record of the most recent weekly survey shall be on file showing that all radiation and contamination levels are within the specified guideline limits. The Radiation Safety Officer may, according to particular conditions including quantities or types of materials and a Principal Authorized User's safety and compliance record, set radiation safety survey schedules specifically for named laboratories or Principal Authorized Users.

**INSTRUMENT SURVEYS**

The routine use of radiation survey instruments during the course of any work using gamma or high energy beta emitters is required. Low energy beta emitters such as H-3, C-14, S-35, or P-33, do not require an instrument survey. After each use of radioactive material:

1. Monitor hands, arms, front of lab coat and other potentially contaminated areas.
2. Monitor bench tops, floor areas, equipment, etc.
3. Additionally, monitor hands and clothing before leaving the laboratory.

**WIPE TESTS FOR CONTAMINATION SURVEYS**

Wipe tests are performed by wiping a filter paper disk or a Q-tip across a 100 cm² area where the potential for contamination exists and then determining the radioactivity in a counter calibrated for the suspected radionuclide. Wipe tests are more sensitive than instrument surveys and should be used especially when instrument surveys indicate possible contamination. Wipe tests are the only practicable method of monitoring weakly-penetrating beta emitters, such as H-3, C-14, P-33 or S-35, and are to be substituted for instrument surveys for those emitters. They should be used for all surveys conducted for the purpose of identifying or documenting removable contamination levels.

Wipe tests shall be taken in all areas where activity is handled in unsealed form on a routine basis. The location of wipe tests should be indicated on the survey form and should be chosen for maximum probability of contamination, e.g. areas where individual doses are drawn up, incoming packages received, or frequent pipetting carried out. Floors (particularly near doorways), lead syringe shields, and door and drawer handles should be wipe tested frequently.

Low energy beta emitters will require liquid scintillation counting for wipe assay.

Measure the background count rate under the same counting conditions used with the wipes and record. Subtract background counts from sample counts to obtain the net counts. An individual wipe test should routinely cover approximately 100 cm². Cleanup is required for activity levels at or above 200 dpm/100 cm².

**ACTION LEVELS**

**External Radiation** - Radiation levels should be kept to less than 2 millirems/hr at 30 cm from the source surface and to levels as low as reasonably achievable. An area in which the
radiation exposure level exceeds 5 millirem/hr at 30 cm from the source shall be designated as a "Radiation Area" and posted with an appropriate sign (available from the Radiation Safety Office). When such levels are expected, the Radiation Safety Officer will indicate specific procedures to be followed when the authorization to use radioactive materials is issued. Contact the Radiation Safety Officer if unanticipated conditions are encountered.

**Contamination**

<table>
<thead>
<tr>
<th>Level (dpm/100 cm²)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 200</td>
<td>Record actual measurement for formal survey. Clean up recommended to as low as practicable levels.</td>
</tr>
<tr>
<td>200 and above</td>
<td>Record actual measurement for formal survey. Cleanup to less than 200 dpm/100 cm², and as low as reasonably achievable.</td>
</tr>
</tbody>
</table>

Techniques for conducting contamination and radiation surveys are taught in the training sessions which all laboratory personnel and new PAUs are required to attend within the first sixty (60) days following employment or authorization. Radioactive material may not be ordered or used by individuals prior to successfully completing the state-mandated initial radiation safety course. Annual refresher training shall be completed by any individual using or responsible for radiation sources.

**SURVEY INSTRUMENT CALIBRATION**

All portable survey instruments shall be calibrated annually. The calibrations are performed by the Radiation Safety Office, or by a qualified contractor. The Radiation Safety Office shall be informed of the purchase of a new survey instrument or repair and factory calibration of an existing instrument. PAUs are responsible for delivering portable survey instruments in need of calibration to the Radiation Safety Office a minimum of one week prior to the calibration due date.

**LABORATORY EQUIPMENT MOVES**

Any equipment in the laboratory which could have been contaminated with radioactive material or which contains a radiation source shall be surveyed before removal to another laboratory, transfer to a repair shop, or transfer to Surplus Property. Before the equipment is transferred and following a satisfactory survey, all warning signs and labels shall be removed. A Safety Clearance tag shall also be completed. This tag shall be affixed to the equipment to notify the appropriate personnel that the equipment is considered free of any radiation hazard. Radiation warning tags may be left on equipment that is to be moved from one lab to another and is designated for radiological use in the new lab, however, this equipment shall not be left in a non-rad use area.
VACATING LABORATORY SPACES

The Radiation Safety Office shall be informed of all changes in authorized laboratory spaces, including transfers or departures from GRU and laboratory relocations. Principal Authorized Users are issued sublicenses through the Radiation Safety Office that include authorization to use radioactive material in specific laboratories. Research using radioactive material is not authorized in a new laboratory until the lab is posted and a revised sublicense issued.

The PAU is responsible for surveying all spaces and equipment and proper removal of all radioactive waste and radioactive sources prior to the change. The PAU completes the Asset Management Request for Moving/Surplus Services Form available from Asset Management.

Upon notification by Asset Management the Radiation Safety Office will complete a final clearance survey of the applicable spaces/equipment and a Radiation Lab and Equipment Clearance Form.

Relocation to a new radioactive material use laboratory requires the Radiation Safety Office to prepare the new laboratory by posting required signs, preparing a new laboratory notebook for laboratory personnel to record required weekly swipe/survey meter results, verify equipment is adequate to meet regulatory requirements, and issue a revised sublicense. The PAU should notify the Radiation Safety Office about a pending relocation as early as possible.
CHAPTER SIX

RADIATION EMERGENCIES/SPILLS OF RADIOACTIVE MATERIALS

RADIATION EMERGENCIES

A radiation emergency exists if unplanned personnel exposure to radioactive material is possible due to loss of radioactive material or radioactive contamination of facilities or personnel. For any emergency involving radioactive materials, radiation sources or radiation producing devices contact the GRU Radiation Safety Office (706-721-9826) and GRU Public Safety (706-721-2911). Medical care and treatment takes priority over radiological concerns.

SPILLS OF RADIOACTIVE MATERIALS

The radiation worker responsible for a spill is also responsible for decontamination. DO NOT CALL HOUSEKEEPING TO CLEAN UP RADIOACTIVE SPILLS. It is a responsibility of all individuals who work with radioactive materials to have a basic understanding of decontamination principles and to be aware of their responsibilities in the event of an emergency. Emergency procedures shall be posted in all radioactive materials laboratories.

Major Spill Response (equal to or greater than 1 millicurie)

1. Stop work.
2. Warn others.
3. Isolate the spill.
4. Keep potentially contaminated personnel nearby for follow-up.
5. Keep uninvolved people out of area until cleanup or appropriate measures are completed.
6. Call the Radiation Safety Office for assistance.

Minor Spill Response (less than 1 millicurie)

1. Stop work.
2. Warn others.
3. Isolate the spill.
4. Keep uninvolved people out of area until cleanup is complete.
5. Complete decontamination,

The Radiation Safety Office Response Actions

1. Supervise cleanup or restriction of area until emergency no longer exists.
2. Determine that the area is decontaminated.
3. Determine if report shall be made to regulatory agencies in case of loss of material or exposure of personnel, and make the necessary report.
CHAPTER SEVEN
PERSONNEL MONITORING

EXTERNAL EXPOSURE

Personnel monitoring devices are provided by the Radiation Safety Office to measure individual radiation exposure from gamma, energetic beta and x-ray sources. The standard monitoring device is a whole body dosimeter or ring dosimeter bearing the individual's name, date of the monitoring period and a unique identification number. The badges are provided, processed and reported through a commercial service company that meets current requirements of the National Institute of Standards and Technology National Voluntary Laboratory Accreditation Program (NVLAP). In some circumstances, an alternate dosimeter may be used such as calibrated personal electronic dosimeter per U.S. NRC Regulatory Guide 8.34 Monitoring Criteria and Methods to Calculate Occupational Radiation Doses.

Radiation safety regulations and GRU policy require that appropriate personnel monitoring equipment be provided to individuals who:

1. Are likely to receive a radiation dose in a year in excess of ten percent (10%) of:
   - 5 rem to the whole body;
   - 15 rem to the eyes;
   - 50 rem to the extremities or the skin of the whole body;

2. Are under 18 years of age and are likely to receive a radiation dose in a year in excess of ten percent (10%) of:
   - 0.5 rem to the whole body;
   - 1.5 rem to the eyes;
   - 5.0 rem to the extremities or the skin of the whole body;

Students or minors under the age of 18 shall not be authorized to work with radioactive materials or radiation producing devices unless specifically approved by the Radiation Safety Officer. Principal Authorized Users shall take measures to ensure that students or minors under the age of 18 are not exposed to radiation and are excluded from any rooms or areas which may contain, store or use radioactive materials or radiation producing devices.

3. Have declared a pregnancy;

4. Enter a High Radiation Area (exposure to greater than 100 millirem in any one hour at 30 cm from the source of the radiation);

5. Meet other issuance criteria as assessed by the Radiation Safety Officer or his/her designated representative.
PERSONNEL MONITORING PROCEDURE

Each individual who works with radiation or radioactive materials and meets the monitoring criteria in the assignment matrix (below), or is uncertain of monitoring requirements, shall file a Radiation Worker Registration Form. This form helps the RSO assess training and experience and personnel monitoring needs. Further evaluations are made through registration updates, application reviews, personnel monitoring reports, ALARA investigations, surveys, and observations by Radiation Safety staff.

In general, personnel monitoring devices are exchanged monthly for individuals who are monitored to demonstrate compliance with State regulations. Personnel monitoring devices are ineffective for monitoring exposure from low energy beta emitters such as H-3, C-14, and S-35 or very small quantities of radioactive material such as I-125 in-vitro testing kits, and will not normally be issued to individuals who work only with these materials.

Summary Table

<table>
<thead>
<tr>
<th>Radioisotope or Radiation Source</th>
<th>On-Hand Activity</th>
<th>Type of Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEXA</td>
<td>NA</td>
<td>Area</td>
</tr>
<tr>
<td>Declared pregnant worker</td>
<td>NA</td>
<td>WB plus fetal</td>
</tr>
<tr>
<td>Radiation Therapy and Nuclear Medicine Students (Allied Health); Nuclear Physics instructor and students, ASU; Radiation Safety personnel</td>
<td>NA</td>
<td>WB plus ring</td>
</tr>
<tr>
<td>Non-routine evolutions, new techniques, area monitoring results above expected values</td>
<td>NA</td>
<td>As determined by the RSO</td>
</tr>
<tr>
<td>On request of employee</td>
<td>Any</td>
<td>WB</td>
</tr>
<tr>
<td>Low energy beta emitters &lt; 500 keV, including $^3$H, $^{14}$C, $^{33}$P, $^{35}$S, $^{45}$Ca</td>
<td>Any</td>
<td>None</td>
</tr>
<tr>
<td>$^{125}$I RIA Kit &lt; 25 uCi/kit</td>
<td>Any</td>
<td>None</td>
</tr>
<tr>
<td>High energy beta emitters &gt; 500 keV including $^{32}$P, $^{36}$Cl</td>
<td>$&lt; 1$ mCi</td>
<td>None</td>
</tr>
<tr>
<td>Low energy gamma emitters $\leq 100$ keV, including $^{51}$Cr, $^{57}$Co, $^{109}$Cd, $^{111}$In, $^{125}$I, $^{83}$Sr</td>
<td>$\geq 1$ mCi</td>
<td>Area</td>
</tr>
<tr>
<td>High energy gamma emitters $&gt; 100$ keV, including $^{22}$Na, $^{59}$Fe, $^{60}$Co, $^{65}$Zn, $^{85}$Sr, $^{95}$Nb</td>
<td>$&gt; 5$ mCi</td>
<td>WB plus ring</td>
</tr>
<tr>
<td>Animal Irradiators</td>
<td>Any</td>
<td>Area</td>
</tr>
<tr>
<td>Dental X-ray</td>
<td>NA</td>
<td>Area</td>
</tr>
</tbody>
</table>

It is the responsibility of each monitored worker to properly handle and wear the badge(s) while working with radiation or radioactive materials, and to return the badges to the unit dosimetry coordinator on time. Occupational radiation dose records shall be maintained on all monitored personnel by the Radiation Safety Office.
OTHER PERSONNEL MONITORING DEVICES

The Radiation Safety Officer may require the use of pocket dosimeters, electronic dosimeters, ring badges, or other monitoring devices when particular procedures are in operation.

USE OF PERSONNEL MONITORING DEVICES

The whole body badge (or other device) is to be worn on the body where it will most likely approximate the radiation exposure to the head and torso of the wearer. A badge assigned for whole body monitoring is not to be used to monitor the extremities. Separate badges shall be assigned for extremity monitoring. Generally, whole body badges are to be worn between the waist and the neck. When a lead apron is worn, the badge is to be worn at the collar, outside the apron.

Ring badges are available in small, medium or large sizes. They should be worn on the dominant hand with the ring monitoring element (label area) toward the palm. Gloves should be worn over the ring badge when contamination is possible.

Personnel monitoring devices are not to be removed from the work place.

INTERNAL EXPOSURE

BIOASSAY

Bioassay is the determination of the kind, quantity or concentration, and location of radioactive material in the human body by direct (in-vivo) measurement or by indirect (in-vitro) analysis of materials excreted from the body. Commonly employed bioassay techniques include urinalysis and thyroid counting. A bioassay program provides the necessary personnel monitoring to measure operational or accidental intakes by radiation workers.

Radioactive material use is approved only when the associated safety program, equipment, facilities and staff experience assures that safe use are routinely maintained. The potential for radiation exposure due to inadvertent failures of procedures and equipment may increase when certain combinations of radionuclides, chemical or physical forms and activities are involved.

Radiation safety survey results provide evidence that few, if any, radioactive material procedures currently in use allow routes for personnel uptakes. Some procedures do incorporate radionuclide form and activity combinations which warrant bioassay monitoring to assure that designated precautions remain effective.

A determination of bioassay personnel monitoring needs and frequency is made by the Radiation Safety Officer during the review of applications. The status of existing use programs is periodically reviewed through radiation worker registrations, surveys, inventory records and a verification of radiation staff and radionuclide use limits.
Routine bioassay monitoring are conducted when any individual is working with radionuclide form/activity combinations exceeding established limits. "Working with" includes withdrawing an aliquot from a stock supply which exceeds a limit, even though the activity actually used is below the bioassay limit.

**Tritium (H-3)**

Urinalysis is required within 24 hours, if possible, but not later than 72 hours after working with 80 millicuries or more of tritium in any form.

**Iodine (I-125, I-131)**

An external thyroid bioassay is required within 24 hours, if possible, but not later than 72 hours after performing a clinical therapeutic or diagnostic procedure with 30 millicuries or greater of unsealed (unencapsulated) I-131. An external thyroid bioassay is required within 72 hours of performing a research procedure using either unsealed I-125 or I-131 in the following amounts:

1. Processes in an open room or bench with possible escape of iodine from process vessels:
   - 1 mCi if volatile form
   - 10 mCi if bound to a nonvolatile agent
2. Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity and performance reliability:
   - 10 mCi if volatile form
   - 100 mCi if bound to a nonvolatile agent
3. Processes carried out within glove boxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage:
   - 100 mCi if volatile form
   - 1000 mCi if bound to a nonvolatile agent

**Other Radionuclides (C-14, P-32, S-35, Ca-45, Cr-51, etc.)**

Urinalysis is required within 24 hours, if possible, but not later than 72 hours following ingestion, inhalation, or skin contamination of personnel that could, in the judgment of the Radiation Safety Officer, lead to an exposure greater than or equal to one tenth of regulatory limits.

\[\text{b U.S. NRC Regulatory Guide 8.20 Applications of Bioassay for I-125 and I-131.}\]
Standard methods for bioassay evaluations are normally sufficient to measure a small fraction of an Annual Limit of Intake (ALI). Bioassay results are recorded and maintained as part of the radiation worker's overall personnel monitoring history. If a bioassay indicates an intake greater than ten percent of the applicable ALI, the internal dose are added to the external dose.

Persons not having a thyroid or having a non-functional thyroid are exempt from iodine bioassays.

PERSONNEL MONITORING REPORTS

Occupational radiation dose reports are sent to each unit Dosimetry Coordinator monthly. These reports contain personal information and shall be protected accordingly. Routine monitoring periods are monthly. Each report will include the name, monitoring period date, and dose (millirem) for the immediate past period, current calendar quarter, and calendar year for each member of the group.

PREGNANT RADIATION WORKERS

The GRU Pregnant Radiation Worker Policy incorporates safety practices and radiation dose guidelines for ensuring the safety of the embryo/fetus of occupationally exposed women. Participation in the program is voluntary. A copy of the policy, a pregnancy declaration form and information package is available through the Radiation Safety Office and is available to any interested individual.

Following a worker’s voluntary declaration of her pregnancy, the Radiation Safety Officer (or his designee) will meet with the worker to review and discuss the following:

1. The worker’s responsibilities and assignments.
2. Prior radiation exposure history.
3. Need to restrict or change job assignments during pregnancy.
4. Issue and use of special radiation dosimeters (fetal dosimeters).
5. Need, if any, for bioassay.
6. Reference material on fetal exposure.

ALARA POLICY

GRU is committed to maintaining radiation exposures as low as reasonably achievable (ALARA) to employees, students, patients, visitors, and the general public. This is accomplished by observing the requirements of this guide, such as survey requirements for investigators using radionuclides in research, and an extensive survey and quality control program for x-ray devices.
Specific procedures for responding to any occupational radiation dose which exceed ALARA Level I or ALARA Level II in the following table have been established.

<table>
<thead>
<tr>
<th>Measure</th>
<th>ALARA I (mrem)</th>
<th>ALARA II (mrem)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole body</td>
<td>125</td>
<td>375</td>
</tr>
<tr>
<td>Eyes</td>
<td>375</td>
<td>1125</td>
</tr>
<tr>
<td>Extremities and skin of the whole body</td>
<td>1250</td>
<td>3750</td>
</tr>
</tbody>
</table>

**ALARA Action Procedures**

Individuals receiving exposures in excess of ALARA Level I are notified of their exposures in writing, with a copy to their supervisor. The individual is asked to review his or her work procedures to evaluate the cause of their exposure and whether there are reasonable measures which can be taken to reduce future exposures. Radiation Safety Office reviews and consultation are offered.

When ALARA Level II doses are exceeded, the Radiation Safety Officer or designee shall conduct an investigation, including an interview with the person involved. A written investigation shall be provided to the worker; the supervisor; and the Radiation Safety Committee. Conclusions drawn from the investigation provide a basis for confirming or modifying the dose and for establishing corrective actions.

ALARA Levels may be adjusted for particular high exposure level situations by the Radiation Safety Officer with the consent of the Radiation Safety Committee. If a regulatory overexposure occurs, the Radiation Safety Officer will make appropriate notifications.
CHAPTER EIGHT

RADIOACTIVE WASTE DISPOSAL

It is important to dispose of radioactive wastes in accordance with radiation safety regulations. This avoids exposure to personnel and releases to the environment. It also avoids regulatory penalties and the possible loss of radioactive material use privileges. Radioactive wastes may not be disposed of in the sanitary landfill and shall not be placed in any container used for the collection of non-radioactive waste.

DEFINITIONS

Radioactive Waste - Material to be disposed of that contains, or may contain, radioactive material.

Contaminated Biological Radioactive Waste - Animal carcasses and bedding material contaminated with radioactive material.

Dry Solid Radioactive Waste - Radioactive waste that does not contain free liquids. Dry waste may be damp from aqueous materials, but shall not contain standing liquid.

Liquid Radioactive Waste - Radioactive waste material to be disposed that does not contain solids.

Water Miscible Liquid - A liquid or mixture of liquids that mixes with water, e.g., water, mineral acids, acetic acid, ethanol, methanol, etc.

Non Water Miscible Liquid - A liquid that is not miscible in water, e.g., chloroform, xylene, benzene, toluene, etc.

Mixed Hazardous Waste - A radioactive waste that is also a listed hazardous waste or exhibits characteristics of a hazardous waste. Examples include chloroform, solvents with a flash point less than 140° and corrosive liquids with a pH < 2 or > 12.5 that are combined with radioactive material. The cost of disposal of any mixed waste shall be the responsibility of the PAU.

Source Vial - A vial in which stock radioactive material is delivered.

DISPOSAL TO THE SEWER

Sewer disposal of radioactive waste in laboratories is not authorized except for trace quantities of radioactive material associated with washing glassware.
SEGREGATION AND PACKAGING RADIOACTIVE WASTE FOR PICKUP

There are five basic categories of radioactive waste: dry solids, liquids, scintillation vials, biological materials, and mixed hazardous waste. These categories are subdivided for disposal purposes according to chemical and radiological characteristics as described below.

Biological Radioactive Waste

There are three categories of biological waste based on half-life and radionuclide. Isotopes having a half-life ≤ 60 days; Isotopes having a half-life > 60 days; and Tritium (H-3), Carbon-14 (C-14), and Iodine-125 (I-125) in concentrations less than 0.05 uCi/g.

Biological wastes are to be segregated according to half-life category, and placed in a clear plastic bag which is then placed in a yellow radioactive waste bag provided by the Radiation Safety Office. Each bag shall be labeled with a Radioactive Waste Tag, also provided by the Radiation Safety Office, and placed in the specifically designated biological waste freezer in building CS-1003. Call Radiation Safety to gain access to the freezers.

Dry Solid Radioactive Waste

Waste containers and specially marked yellow transparent bags for dry radioactive waste are provided for laboratories using radionuclides. Contact the Radiation Safety Office when additional containers are needed.

1. Segregate wastes according to half-life category. Materials contaminated with nuclides with a half-life of ≤ 60 days are to be kept separate from nuclides with a half-life of > 60 days. No free liquids, no organic solvent (identified by odors) and no metals are allowed in dry solid waste.
2. Sharps shall be placed in a hard-walled container.
3. Infectious dry waste shall be sterilized before placing in radioactive waste containers.
4. Each bag shall be labeled with a Radioactive Waste Tag.

Liquid Radioactive Waste

Separate by miscible or non-miscible criteria. Use carboys provided by the Radiation Safety Office. Carboys shall have secondary containment. Please observe the following packaging guidelines:

1. Liquids shall not contain solids. No filters, pipette tips, stir bars, gels, etc. are allowed.
2. Leave at least 10% head space for thermal expansion and to facilitate pouring of the waste when the containers are emptied at the waste facility.
3. Remove external contamination prior to waste pickup.
**Scintillation Vials**

Glass vials are preferred. Vials are stored in buckets provided by the Radiation Safety Office and tagged with a Radioactive Waste Tag. Do not include dry vials, test tubes or any other waste forms. Vials shall have tight, secure tops to prevent leakage during storage.

Scintillation fluid shall be biodegradable (for example Scintiverse BD). Special approval in writing by the Radiation Safety Officer shall be obtained for the use of non-biodegradable scintillation fluids (e.g., toluene or xylene based cocktails). The cost of disposal of any mixed hazardous waste shall be the responsibility of the Principal Authorized User.

**Source Vials**

Source vials may be disposed of at the normal scheduled waste pickup times and locations.

**Lead Shields**

Lead pigs or other lead-containing materials shall not be placed in the radioactive waste containers. Deliver lead pigs to Radiation Safety during normally scheduled waste pick-ups. The lead are surveyed for contamination and recycled. The survey results are documented and results shall not exceed 200 dpm/100 cm².

**Radioactive Waste Pickup**

The Radiation Safety Office has weekly pick-ups of radioactive waste. This schedule is posted on the Radiation Safety Office website.

Waste bags or boxes containing improperly packaged or non-radioactive waste are refused until properly re-packaged by laboratory personnel.
CHAPTER NINE

RECORDS MAINTAINED BY THE PRINCIPAL AUTHORIZED USER

Under the terms of GRU's authorization to use radioactive materials/radiation sources, the Radiation Safety Office is charged with maintaining "cradle to grave" surveillance of all radioactive material and radiation sources on the campus. In order to facilitate this surveillance and to insure that a high awareness of the rules and regulations governing the safe use of radioactive materials or radiation sources, it is required that certain records and reference materials be maintained. It is necessary for the Principal Authorized User to keep the material current and to make it readily available to laboratory workers, the Radiation Safety Office, and appropriate state agencies. It is recommended that a notebook be maintained with the required information. Records are to be maintained by the Principal Authorized User for a period of three years unless advised otherwise.

These records and references include, but are not limited to, the following:

1. REFERENCES:
   
   • GRU Radiation Safety Guide (available electronically at the Radiation Safety Office website).
   • Authorized User's Sublicense and Application to use Radiation Sources or radioactive materials.

2. RECORDS:

   • Radioactive Materials Receipt and Disposal Forms (maintain until turned in to the Radiation Safety Office).
   • Radiation and contamination surveys performed by the Principal Authorized User or laboratory radiation workers.
CHAPTER TEN

SHIPPING RADIOACTIVE MATERIALS FROM GRU

GENERAL

Shipments of radioactive materials from GRU shall be in full compliance with the Department of Transportation, Nuclear Regulatory Commission, and Georgia requirements. The Radiation Safety Office maintains copies of the regulations and is prepared to assist with shipments.

REQUIREMENTS

1. Shipments may be made only to persons who are licensed to receive radioactive materials and in accordance with procedures established by such persons.

2. Prior to making a shipment of radioactive materials, a copy of the recipient's radioactive materials license shall be on file in the Radiation Safety Office.

3. Shipments shall be arranged to be in accordance with the recipient's procedures for receiving radioactive materials.

4. All aspects of the shipment (container, packaging, labeling, surveys, shipping papers, etc.) shall be in accordance with Department of Transportation requirements.

SHIPPING ASSISTANCE

Persons contemplating shipping radioactive materials shall contact the Radiation Safety Office to assure compliance with regulations. Specialized Department of Transportation training is required to prepare and ship radioactive materials. The Radiation Safety Officer or designee is the statutory shipper and shall sign the shipping papers. A stock of required labels is maintained, and a limited stock of shipping papers is available. Assistance with package radiation surveys, wipe tests and label selection is available. The PAU shall provide appropriate containers or packaging for the shipment.

REGULATORY NOTIFICATIONS

Regulatory reports/notifications, as specified in a radioactive material license issued by the State of Georgia or the Nuclear Regulatory Commission, are made by the Radiation Safety Officer (RSO) or designee. In cases where a third party makes notifications required in a Radioactive Materials License or Import/Export of Radioactive Materials License due to security or other special circumstances, the RSO or his designee will verify directly and in advance with each regulatory authority (U.S. or International) that notifications required by regulation have been made in the time frame designated.
CHAPTER ELEVEN

USE OF RADIOACTIVE MATERIALS IN ANIMALS

The GRU Radiation Safety Committee authorizes investigators to administer radioactive materials to animals for research. Laboratory Animal Services shall be notified well in advance of plans to house radioactive animals. Note that research with animals requires the approval of the Institution Animal Care and Use Committee. The following rules apply to radioactive animals:

1. Isolate radioactive animals from the other animals that do not contain radioactive material.

2. Label cages with an appropriate radioactive materials warning sign.

3. Post "Notice to Employees" and "Emergency Procedures" in a conspicuous place within the animal facility.

4. Line the bottom of the cages with absorbent paper pads with plastic backing or other appropriate absorbent materials. Specially designed cages with drains may be used when approved by the Radiation Safety Office.

5. A radioactive material waste disposal container should be in the area where the animals are located for use when cleaning the cages.

6. Animal attendants should use disposable gloves when handling radioactive materials wastes from animals containing radioactive material. Dispose of the gloves in the radioactive materials waste disposal container.

7. Clean and survey cages at the end of each experiment. Survey records are to be maintained by the Principal Authorized User.

8. Animal carcasses shall be double bagged and kept in a specially designated freezer. Contact the Radiation Safety Office for specific instructions.
Therapeutic Use of Radioactive Material at Georgia Regents Medical Center and Affiliated Hospitals

Supplement to the Radiation Safety Guide
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CHAPTER ONE
RADIATION SAFETY PROGRAM

GENERAL

The GRU Radiation Safety Program serves the Georgia Regents enterprise and hospitals affiliated with Georgia Regents Medical Center for clinical uses of radioactive material. Most radiation safety program requirements apply equally and generally to the enterprise, and are addressed in the basic Radiation Safety Guide. This supplement includes radiation safety guidelines for the therapeutic use of radiation that are not addressed in the basic Radiation Safety Guide.

RESPONSIBILITIES

RADIATION SAFETY COMMITTEE

The GRMC Radiation Safety Committee is responsible for the oversight of radiation and radioactive materials used for clinical purposes. The committee meets quarterly. Committee decisions require the presence of a majority of its members or alternates, including the Management Representative and the Radiation Safety Officer. The committee and the chair are appointed by the CEO of GRMC.

The committee has four component subcommittees: the Non-Human Use of Ionizing Radiation Subcommittee; the Human Diagnostic Use of Ionizing Radiation Subcommittee; the Human Therapeutic Use of Ionizing Radiation Subcommittee; and the Safeguards and Security Subcommittee. It is the responsibility of the committee to review any proposed clinical use of radioactive materials or machine-produced radiation; to designate Authorized Users of radiation or radioactive materials; and to approve areas controlled for radiation or radioactive material use. The responsibilities of the Human Use of Therapeutic Radiation Subcommittee are described in greater detail in the next section.

Uses of radioactive material or radioactive sources may be approved provided that greater than 50% of the subcommittee members respond and a majority of the respondents are affirmative. A subcommittee member may request full Radiation Safety Committee review of a proposed protocol.

HUMAN USE OF THERAPEUTIC RADIATION SUBCOMMITTEE

The subcommittee sets policies and establishes procedures for the safe use of therapeutic radiation sources at GRMC and other hospitals affiliated with GRMC for therapeutic uses of radiation. The subcommittee is charged with developing radiation safety policy in such a manner as to assure compliance with all federal, state, and local regulations; maintain exposures as low as reasonably achievable for both radiation workers and the general public; and authorize
the use of therapeutic procedures involving radiation sources. The subcommittee will meet as often as necessary to carry out its functions.

AUTHORIZED USERS

All persons in the enterprise or affiliated hospitals who use radioactive material for clinical therapeutic purposes shall obtain authorization from the Human Use of Therapeutic Radiation Subcommittee, or work under the direct supervision of an individual who is authorized. Applications for authorized user status may be obtained from the Radiation Safety Officer. The completed application shall be sent to the Radiation Safety Office for review. After review, recommendations are made to the subcommittee for appropriate action.

The Georgia Department of Natural Resources has established acceptable training and experience criteria for physicians licensed to use radionuclides for therapeutic procedures in the practice of medicine, medical physicists, and nuclear pharmacists. These criteria are applied to requests for designation as an authorized user.

In instances where an investigator desires to use therapeutic sources of radionuclides in a research protocol, the investigator shall provide information to the subcommittee to allow for evaluation of the proposal. To perform a procedure for which a “Notice of Clinical Investigational Exemptions for a New Drug” (IND) has not been accepted by the Food and Drug Administration, the Radioactive Drug Research Committee shall grant approval to the proposal before authorization can be reviewed by the subcommittee.

NURSING PROCEDURES

LOCATION OF PATIENT

Patients treated with therapeutic radiopharmaceuticals are placed in designated rooms approved by the Radiation Safety Officer. Adjacent rooms or other areas where the radiation exposure exceeds guidelines shall remain vacant during the treatment period.

PATIENT CARE

Radiation Safety will post specific nursing instructions for radioactive patients. Radiation Safety will establish maximum stay time limits for nurses in the patient’s room. Perform routine nursing procedures as efficiently as possible to limit time of exposure.

EMERGENCY PROCEDURES

Immediately notify persons in the vicinity who may be affected by unusual or emergency events involving exposure to radiation or contamination, then call Radiation Safety. Phone numbers (including after-hours contact numbers) are posted on the patient’s door and in the patient’s chart.
USE OF RADIATION SOURCES

INTRODUCTION

The authorized user physician (AUP) is responsible for ensuring that the use of radiation sources under his/her supervision complies with regulatory requirements, and the specific conditions and limitations of his/her authorization. The AUP shall ensure that all persons who use radiation sources under his/her authorization are supervised, properly trained and experienced, and aware of the attendant radiation hazards.

Emergency procedures are included in the Appendix. Emergency procedures should be posted in all areas where radioactive materials are used except in the case of patient rooms, in which case nursing staff will receive written and oral instructions from Radiation Safety.

LOCATION OF USE

Therapeutic radionuclides are used only in areas that have been approved by the Radiation Safety Officer. These include source storage areas, source and applicator preparation areas, and patient rooms. The RSO will monitor use areas and post warning signs as necessary.

Therapeutic radiopharmaceuticals are ordered from a radiopharmacy and received at Nuclear Medicine or the Radiation Therapy Center. Upon receipt packages are tested for radiation levels and removable contamination by Nuclear Medicine or Radiation Safety personnel.

TRANSFER OF RADIONUCLIDES

All transfers of therapeutic radioactive material from the Radiation Therapy Center to one of the affiliated hospitals are made by a therapy physicist, the RSO, or the AUP, accompanied by a radiation safety technician. Sources transported in vehicles on public roads shall be packaged in DOT approved containers. Additional rules for specific sources are given in Chapter Two.

SURVEYS AND INVENTORY

Administration of therapeutic radionuclides in quantities greater than 30 millicuries requires advanced notification of the Radiation Safety Office. Certain information, such as the patient’s name, hospital, room number, type of procedure and anticipated date and time, should be given to the RSO as far as possible in advance, but at least 24 hours before the procedure. The RSO will monitor external radiation levels during the therapeutic procedures and post necessary signs on the patient’s door, bed and chart. Radiation levels in adjacent rooms and hallways shall be such that no individual (other than the patient and radiation workers wearing monitoring badges) could receive a dose in excess of 2 millirems in any one hour or will receive a dose in excess of 100 millirems in a year. The Radiation Safety Office will perform final surveys of patient rooms to ensure that the external radiation and removable contamination levels are acceptable before releasing the room for other use.
The AUP or medical physicist shall log sealed sources used for temporary implants in and out in the inventory book kept in the cesium storage room at the Radiation Therapy Center. Careful source accountability is required. Radiation Safety shall conduct an inventory of all sealed sources and a survey of the ambient radiation dose in and around the storage area quarterly. Radiation Safety shall leak test the sources semi-annually.

PERSONNEL MONITORING

Nurses and other persons who are involved with five (5) or more therapeutic radionuclide treatments per quarter are required to wear a radiation dosimeter furnished by their employer. Any exposures over 100 millirems in a monitoring period should be reported to the RSO. Individuals who prepare sealed sources for temporary implants should also wear a ring badge. Individuals who administer more than 30 millicuries of I\textsuperscript{131} in volatile form shall have a bioassay performed after each such administration.

WASTE DISPOSAL

The Radiation Safety Office is responsible for disposing of all radiation sources and contaminated articles. Radioactive waste shall be placed in properly labeled containers provided by Radiation Safety, and never mixed with nonradioactive waste.
CHAPTER TWO

PROCEDURES AND NURSING INSTRUCTIONS

GENERAL PROCEDURES

TRANSPORTATION

Transportation of radioactive sources from the Radiation Therapy Center to an affiliated hospital in a vehicle on public roads shall be performed by Radiation Safety personnel with the sources secured in a properly labeled Department of Transportation-approved container. The AUP, physicist or radiation safety technician may transport sources to University Hospital or GRMC in the approved source transport container. When the national security posture is elevated a Public Safety escort is required.

INSTRUCTIONS TO PATIENTS

The physician administering a radiopharmaceutical or permanent implant is responsible for providing the patient with written and verbal radiation safety instructions that will help to keep radiation dose to caregivers, household members, and the public as low as reasonably achievable. The physician may delegate the actual briefing to a radiation safety technician present during the administration of the radiopharmaceutical.

RECORDS

The following information should be entered into the chart or electronic patient record:

1. Date and time of administration
2. Radionuclide and activity administered
3. Name and emergency number of physician responsible for administration
4. Results of initial exposure rate measurements 1 meter from patient
5. Removal date and results of final exposure rate measurements 1 meter from patient (permanent implant or radiopharmaceutical administration).
6. Name(s) of person(s) performing exposure rate measurements
7. Radiation restrictions, if any, for patient when released
8. Name and emergency number of the Radiation Safety Officer.

The following information should be recorded on the Radiation Safety Survey:

1. All the above information
2. Results of all exposure rate measurements 1 meter from patient
3. Results of initial exposure rate measurements in adjacent areas
4. Number of sources removed and results of final exposure rate survey of room (temporary implants)
5. Calibration information for portable radiation survey instruments
6. Storage and disposal information for contaminated articles, unused seeds, etc.
WARNING SIGNS

Signs and labels as described in this guide shall be placed on the patient’s chart and the
doors to the room. The information on these signs shall include radionuclide, activity, date of
administration, exposure rate at one meter, and instructions to nurses and visitors.

BRACHYTHERAPY

A list of individuals permitted to handle brachytherapy sources at the Radiation Therapy
Center shall be posted in the cesium room. The following instructions apply to Radiation Safety
personnel:

1. After sources are checked in at the warehouse, radiation safety personnel shall take
them to the cesium room at the radiation therapy center, perform an inventory and set
up a log sheet for the source container.

2. After the physician has counted the sources and completed the log entry for sources
removed from or returned to the cesium room, radiation safety personnel shall verify
the source count(s) and initial the log.

3. At the time of implant, radiation safety personnel shall measure dose rates at one
meter from the patient and in all accessible adjacent areas to the room.

4. The brachytherapy form shall be completed in duplicate. One form is labeled with
tape bearing the radiation symbol and put into the patient's chart (or scanned into an
electronic medical record) as a permanent record. The outside of the patient's chart
shall also be labeled with tape bearing the radiation symbol.

5. The second form shall be posted on the door to the patient's room with tape which
bears the radiation symbol. After removal of the sources, the second form are
removed from the door and returned to the radiation safety office as a permanent
record.

6. After the physician removes the sources from the patient's room, a survey are
performed and recorded. An operational check of the instrument used is documented.

The following instructions apply to the AUP:

1. No sources are removed from the cesium room unless radiation safety personnel are
present.

2. The sources shall be signed out/in each time they are removed from/returned to a
storage container in the cesium room. The following information shall be included in
the log:

   Date and time of check-out
3. Only those sources intended for use in a treatment are taken to a treatment location.

4. A tag containing the following information is attached to the transport container:
   - Isotope
   - Number and activity of sources
   - Patient's name
   - Hospital
   - Initials of person inspecting and transporting the package
   - Institution name (GRTC) and phone number
   - Emergency instruction
   - Initials of person inspecting and transporting the package

   This tag should be removed when the sources are returned to the cesium room and kept as a permanent record. If the number of sources and/or activity differs for the return trip a new tag are completed and attached to the transport container.

5. Prior to the implant, the AUP shall prepare an order, signed and dated, specifying the patient, treatment site, radioisotope, number of sources, total source strength and treatment time. Verify the patient's identity, using more than one method, as the individual named in the above order.

6. If the treatment plan is changed prior to explant, an amended order shall be completed and signed by the AUP.

7. If any sources are not implanted they shall not be left in the patient room but are returned to the cesium room.

8. It is the responsibility of the AUP to ensure that sources in the transport container are never left unattended.

9. A shielded container shall be left in the patient's room during the treatment. If it is likely that the transport container will not be left in the room, a second container should be taken to the patient's room at the time of implant.
10. Sources shall be returned to the storage container in the cesium room after removal from the patient. A count of sources removed from the patient shall be reported to the radiation safety personnel.

11. Sources temporarily explanted and not under the direct observation of the AUP shall be returned to the Radiation Therapy Center cesium room in the approved transport container. The sources may be stored in the container with appropriate radiation labeling, and the wheels of the transport container secured. The AUP shall count the sources when the sources are explanted; when the sources are placed in the cesium room; when the sources are taken from the cesium room; and when the sources are re-implanted. All source counts shall be documented.

12. When sources are returned to a storage container in the cesium room an inventory of the container are documented and the results reconciled with the logout entry. Any discrepancy shall be reported to the Radiation Safety Office immediately.

**Radiopharmaceutical Therapy**

Prior to the administration of any radiopharmaceutical therapy procedure, the AUP shall sign and date an order which specifies the patient, the radiopharmaceutical, the dosage, and the route of administration.

A pre-therapy negative serum beta HCG pregnancy test is required for all females of reproductive potential who are treated therapeutically with radiopharmaceuticals.

**Iodine-131 THERAPY PROCEDURES**

**Definition of Major and Minor Therapies**

- Minor therapies of $^{131}$I are single doses of 30 mCi or less.
- Major therapies of $^{131}$I are single doses greater than 30 mCi.

**Handling Instructions**

All vials containing volatile forms of $^{131}$I should be opened in a fume hood prior to administration to a patient to allow for escape of vapor. The activity of each dose shall be measured in a dose calibrator and verified to be within 10% of the prescribed dose.

Since the exposure rate on the outside of the lead pig or shipping box may be quite high, adequate precautions shall be taken when transporting doses.

**Minor Therapies**

Minor therapies at GRMC may be performed in the Nuclear Medicine clinic. The actual administration of the $^{131}$I is made by an AUP or by a radiology resident, nuclear pharmacist or nuclear medicine technologist under the supervision of an AUP. Nuclear Medicine personnel
(technologists or physicians) are responsible for disposing of contaminated articles and performing a survey of the area after the administration. Any contaminated area shall be immediately decontaminated. Radiation Safety should be called to supervise and monitor decontamination if necessary.

Minor therapeutic doses at the Radiation Therapy Center are administered by an AUP. A radiation safety technician is responsible for monitoring the area, decontamination (if necessary), and disposing of radioactive waste.

**Major Therapies**

Patients receiving major therapeutic doses of $^{131}$I are admitted to the hospital unless the Principal Authorized User, with concurrence of the RSO, determines otherwise. The patient shall have a private room with bath approved by the Radiation Safety Officer. Radiation safety technicians prepare the room to limit contamination. The dose is usually administered with the patient sitting on the edge of the bed. The bedside table should be covered with an absorbent pad. A physicist or technician from Radiation Safety shall be present during administration and is responsible for disposing of the waste.

The patient shall remain hospitalized until the activity is less than 30 mCi or the measured dose rate at one meter from the patient is less than five millirems per hour.

The nursing instruction form contains specific rules for care of the patient by nurses, visitor’s restrictions, and handling waste, linens, and eating utensils.

Patient rooms used for major therapies may not be released for use by other patients until documented surveys by Radiation Safety staff demonstrate that there is no removable contamination in excess of 200 dpm/100 cm². Repeated decontamination or decay time is sometimes necessary to achieve the release limit in significantly contaminated rooms.

**Bioassays**

Individuals involved in clinical applications of $^{131}$I doses exceeding 30 millicuries of $^{131}$I shall have bioassays performed. The Radiation Safety Officer or the Radiation Safety Committee may establish additional bioassay requirements.

**THERAPY PROCEDURES OTHER THAN $^{131}$I**

A syringe shield shall be used during any radiopharmaceutical therapy injection, unless the use is medically contraindicated.

Radiopharmaceutical therapy procedures at GRMC are performed in the Nuclear Medicine clinic or the Cancer Treatment Center. The actual administration is made by an AUP or by a radiology resident, nuclear pharmacist, or nuclear medicine technologist under the supervision of an AUP. Nuclear Medicine personnel (technologists or physicians) are responsible for disposing of contaminated articles and performing a survey of the area after the administration. Any
contaminated area shall be immediately decontaminated. Radiation Safety should be called to
supervise and monitor the cleanup if necessary. Radiopharmaceutical transport requirements
apply for doses transported from Nuclear Medicine to the Cancer Treatment Center (see
Transportation section, Chapter 2, above).

Radiopharmaceutical therapy doses at the Radiation Therapy Center are administered by a
Radiation Therapy Resident or Authorized User in the presence of a representative from the
Radiation Safety Office or a therapy physicist. The Radiation Safety representative is
responsible for monitoring the area, decontaminating if necessary and disposing of radioactive
waste.

\(^{89}\text{Sr} \) shall be ordered and administered in unit doses only.