

Radiation Safety Manual



Environmental Health and Safety Division
Radiation Safety Office
June 16, 2023

Intentionally Blank

Table of Contents

<u>Chapter</u>	<u>Title</u>	<u>Page</u>
	Table of Contents	iii-v
1.	Radiation Safety Program	1
	Introduction.....	1
	Responsibilities	1
	Radiation Safety Committee.....	1
	Radiation Safety Office	2
	Radiation Safety Officer (RSO)	2
	Principal Authorized User	3
	Radiation Worker.....	3
2.	Radioactive Material or Radioactive Source Authorization and Radiation Worker Registration.....	4
	Facilities Evaluation.....	4
	Research on Human Subjects	5
	Radiation Worker Registration	5
3.	Radiation Safety Principles	6
	External Radiation Exposure	6
	Internal Radiation Exposure	6
	Radiation Safety Program Objective	7
	General Radiation Safety Rules for Radioactive Material Use.....	7
	Laboratory Radiation Safety Rules	8
	Diagnostic X-ray Systems.....	9
	General Rules.....	9
	Protective Aprons.....	11
	Medical Physics Provisions	11
	Irradiators.....	12
	Responsibilities of Irradiator Users.....	12
4.	Procurement of Radioactive Materials.....	13
	Ordering	13
	Receipt of Radioactive Materials – Normal Working Hours.....	13
	Receipt of Radioactive Materials – After Normal Working Hours	13
	Package Surveys	13
	On-campus Transfers.....	14
	Off-campus Transfers	14
	Disposal of Radioactive Materials.....	15

<u>Chapter</u>	<u>Title</u>	<u>Page</u>
5.	Radiation and Contamination Surveys.....	16
	Responsibility.....	16
	Surveys Conducted by Radiation Safety Office.....	16
	Surveys Conducted by Principal Authorized User.....	16
	Instrument Surveys.....	17
	Wipe Tests for Contamination Surveys.....	17
	Action Levels.....	17
	Survey Instrument Calibration.....	18
	Laboratory Equipment Moves.....	18
	Vacating Laboratory Spaces.....	19
6.	Radiation Emergencies/Spills of Radioactive Materials.....	20
	Radiation Emergencies.....	20
	Spills of Radioactive Materials.....	20
7.	Personal Monitoring.....	21
	External Exposure.....	21
	Personnel Monitoring Procedure.....	22
	Other Personnel Monitoring Devices.....	22
	Use of Personnel Monitoring Devices.....	22
	Internal Exposure.....	23
	Bioassay.....	24
	Personnel Monitoring Reports.....	25
	Pregnant Radiation Workers.....	25
	ALARA Policy.....	25
	ALARA Action Procedures.....	25
8.	Radioactive Waste Disposal.....	27
	Definitions.....	27
	Disposal to the Sewer.....	27
	Segregation and Packaging Radioactive Waste for Pickup.....	28
	Biological Radioactive Waste.....	28
	Dry Solid Radioactive Waste.....	28
	Liquid Radioactive Waste.....	28
	Scintillation Vials.....	29
	Source Vials.....	29
	Lead Shields.....	29
	Radioactive Waste Pick-up.....	29
9.	Records Maintained by the Principal Authorized User.....	30

Radiation Safety Manual

<u>Chapter</u>	<u>Title</u>	<u>Page</u>
10.	Shipping Radioactive Materials	31
	General	31
	Requirements	31
	Shipping Assistance.....	31
	Regulatory Notifications.....	31
11.	Use of Radioactive Materials in Animals	32
Supplement	Therapeutic Use of Radioactive Material at Augusta University Health.	S-i
	and Affiliated Hospitals	

CHAPTER ONE

RADIATION SAFETY PROGRAM

The Augusta University Radiation Safety Program serves Augusta University (AU), Augusta University Health, and hospitals affiliated with AU Health 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 Manual. Radiation safety requirements for the therapeutic use of radiation that are not addressed in the basic Radiation Safety Manual are addressed in the attached supplement.

INTRODUCTION

Augusta University (AU) and AU Health are authorized by the State of Georgia to use radioactive material in patient care, education, research, and development activities under the terms of specific licenses of broad scope. The AU and AU Health Radiation Safety Committees may authorize individual staff or faculty members to use radioactive material or radiation sources based on a review of the proposed use, adequacy of facilities, training and experience of the applicant, and recommendation of the Radiation Safety Officer.

This manual summarizes the regulatory requirements most applicable to enterprise use of 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 state inspectors.

Familiarity with the provisions of this manual is required of all users of radioactive materials or radiation sources. The manual is available on-line at the AU Radiation Safety web page. Radiation users are obligated under the conditions of our state radioactive materials license to maintain radiation exposures "as low as reasonably achievable" (ALARA).

RESPONSIBILITIES

RADIATION SAFETY COMMITTEE

The AU Radiation Safety Committee is responsible for the oversight of radiation and radioactive materials used for research, education, and development 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 its chair are appointed by the President of AU.

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. Electronic review and voting are authorized.

The AU RSC has three component subcommittees, Use of Ionizing Radiation Subcommittee, the Laser Safety Subcommittee, and the Safeguards and Security Subcommittee.

The 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, and the human use of Dual Energy X-ray Absorptiometers (DEXA) in research. It is the responsibility of the subcommittee to review proposed 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. 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.

The Safeguards and Security Subcommittee meets on an as-needed basis to consider issues involving the university's radioactive sources of national security concern. The Laser Safety Program is governed by a separate manual.

The AU Health Radiation Safety Committee is described in the attached supplement.

RADIATION SAFETY OFFICE

The Radiation Safety Office includes 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 (RSO) is responsible for the radiation safety program. This responsibility includes general surveillance of overall activities and areas in which radioactive materials or radiation sources are used, determination of compliance with rules and regulations, authorization stipulations 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 RSO is appointed by the President/CEO upon recommendation of the Radiation Safety Committee and is approved by the Department of Natural Resources. The RSO has authority to suspend any activity that is a radiological threat to health, property, or the environment, or is

non-compliant with state or federal regulation. 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, and comply with AU 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 submit a request to the RSO. The Radiation Safety Officer/designee will review the request 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 request, 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.
5. Provisions for shielding.
6. Provisions for safe collection, storage, and disposal of radioactive waste.
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 (including routine diagnostic procedures outside the standard of care for the management of the patient's condition) 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 application form is available on the Radiation Safety web page. The Radiation Safety Officer will distribute the application to the Human Use Subcommittee of the Radiation Safety Committee for their review along with a recommendation for approval or disapproval. Based on concurrence by a majority of reviewers, the Radiation Safety Officer forwards an ancillary approval letter to the principal investigator on behalf of the Radiation Safety Committee. 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

The Principal Authorized User informs the Radiation Safety Office of changes in personnel working with radioactive materials or radiation sources. A "Radiation Workers Registration Form" is required for all workers who meet the criteria for dosimetry (see Chapter Seven). The form is available on the Radiation Safety website or from the unit 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/designee will review the registration form and schedule radiation worker training. The original approved registration form is maintained in the Radiation Safety Office.

CHAPTER THREE

RADIATION SAFETY PRINCIPLES

EXTERNAL RADIATION EXPOSURE

External radiation doses are 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 principal 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 are 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 OBJECTIVE

The fundamental objective of the occupational radiation safety program is 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 intake 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 RULES 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. Rehearsals may be useful to familiarize personnel with the procedure, improve efficiency and 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. No one under 18 years of age is permitted in radiologically controlled areas.
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). Radioactive waste or in-process experiments shall be maintained in a laboratory area approved for such purposes.
6. Radioactive waste storage areas and other storage areas containing radioactive material or radioactive sources shall be secured when unattended.
7. Radioactive material or radioactive sources should be confined to the areas necessary for use. This simplifies confinement and shielding, and aids in limiting the affected area in the event 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. Easily decontaminated plastic or metal trays should be placed on the surface when liquids are to be used. The tray edges serve to confine spills.
10. Practice good housekeeping. Contamination is less likely in areas that are neat, clean, and free of unnecessary items
11. Never pipette by mouth.
12. Eating, drinking, smoking, application of cosmetics, or storing of food is prohibited in radioactive material 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 in the laboratory. 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. Thoroughly clean reusable glassware and tools used after radioactive material use, and separate from non-contaminated items. Store glassware and tools used in radioactive work in a marked container.

LABORATORY RADIATION SAFETY RULES

Radiation workers are responsible to protect themselves and others from radiation hazards arising from their work. Careless work 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 radioactive material areas.
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 by mouth is prohibited.

4. Wear personal protective equipment (PPE) while working with, or in proximity to someone who is working with radiological materials in the research lab. PPE requirements are designated on placards posted at the entrance to laboratories. The minimum PPE requirements are a lab coat, safety glasses, and disposable gloves worn over personal clothing that covers the legs and closed-toe shoes that cover the foot. Additional hazard-specific PPE requirements may apply.
5. Disposable absorbent pads, protective trays and remote handling devices shall be utilized when possible.
6. Wash hands thoroughly after handling radioactive materials.
7. Food items shall not be stored in radioactive material areas.
8. Personnel monitoring badges (radiation dosimeters) shall be worn in controlled areas, when directed by the RSO.
9. Dispose of radioactive waste only in the containers provided or approved by the Radiation Safety Office. Non-standard containers are prohibited.
10. Store stock vials of radioactive material in safe and secured locations.
11. Maintain good housekeeping.
12. Follow established emergency procedures for spill response.
13. Conduct and document meter surveys 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. Take corrective action to reduce contamination below action levels (200 dpm/100 cm² swiped or twice background for meter surveys).

DIAGNOSTIC X-RAY SYSTEMS

GENERAL RULES

1. Operators of a radiation producing machines shall meet requirements in State of Georgia Rules and Regulations for X-Rays, Chapter 290-5-22, and receive training in radiation safety , x-ray 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 in controlled areas except:

- When the individuals are entirely behind protective barriers while the equipment is energized.
 - When a radiation safety survey indicates 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 holding the patient, animal, or image receptor 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 image receptors 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 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.
 7. Protective aprons of at least 0.25 mm lead equivalent shall be available and used by the operator of portable radiographic equipment, other individuals in the room and within 2 meters of the patient or x-ray tube during an exposure; and all staff attending fluoroscopic procedures. 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.
 8. The exposure to the patient shall be kept to the practical minimum consistent with clinical objectives.
 9. Visitors and students in the area of work should be supervised by the equipment operator. No one under 18 years of age (other than the patient) is permitted in radiologically controlled areas.
 10. Do not leave radiation producing machines unattended in an operational mode.
 11. 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 Office before the system is placed in service.

12. Portable x-ray systems used in one location for one week (other than in operating rooms) are considered installed systems for shielding purposes.
13. Special care is needed when working with x-ray diffraction units. Follow the specific procedures for training, operation and emergency response for these devices.

PROTECTIVE APRONS

Protective aprons are characterized by their ability to attenuate (or shield) x-rays, expressed as “lead equivalency.” Aprons are usually sold in three lead equivalencies: 0.25 mm, 0.35 mm, and 1.5 mm. The State of Georgia requires a minimum of 0.25 mm lead equivalency for staff members who work in proximity to operating x-ray systems, and 0.5 mm lead equivalency for aprons used to protect patients during radiography. (The patients get direct beam exposure, while the staff is exposed to less intense scatter radiation). Aprons with 0.35 mm lead equivalent are generally useful for all but the most intensive radiography procedures, and a good compromise between protective properties and weight. Aprons with 0.5 mm lead equivalency are commonly recommended for pregnant staff members to provide more shielding for the developing fetus. Use, storage, and inspection of protective aprons at AUMC are governed by policy 14.107, sponsored by the Department of Radiology and Imaging.

MEDICAL PHYSICS PROVISIONS

Shielding

Diagnostic x-ray systems shall be shielded in accordance with Georgia Rule 290-5-22. Shielding associated with new construction or renovation shall be designed by a qualified expert and submitted by the Radiation Safety Officer to the state for approval. State approval should be obtained before construction, and shall be obtained before the room is placed in service.

Shielding integrity tests are conducted by the Radiation Safety Office. Shielding verification tests are conducted in conjunction with the initial medical physics survey of the x-ray system. Shielding integrity and verification tests are required before the x-ray system is placed in service.

Medical Physics Surveys of X-ray Systems

A medical physics survey (compliance inspection) shall be conducted by (or under the direct supervision of) a qualified expert:

1. As an initial inspection for newly installed or relocated x-ray systems;
2. Following major repairs that affect x-ray output or regulatory compliance (such survey should be accomplished as soon as practicable and within 30 days of repair);
3. To investigate quality control issues.
4. Periodically as part of the routine x-ray system compliance testing program.

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 web page for details.
2. Operational training - Irradiator 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 web page 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
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 and forms refer to the Radiation Safety web page.

RESPONSIBILITIES OF THE IRRADIATOR USER

Irradiator users are responsible for:

1. Conducting operations in accordance with the manufacturer's instructions and emergency procedures.
2. Reporting malfunctions to the owning organization. Additionally, report malfunctions that create a radiation safety hazard to the Radiation Safety Office. Irradiator users are not permitted to perform electrical or mechanical maintenance of any kind on the irradiator(s).
4. Ensuring that all measures are in place upon exiting the irradiator room.
5. Reporting security issues or violations to the security manager and the RSO immediately upon discovery.

CHAPTER FOUR

PROCUREMENT OF RADIOACTIVE MATERIALS

ORDERING

To order radioactive materials or radiation sources for use at the university, a PeopleSoft requisition is 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 required in the requisition for Radiation Safety review:

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

Radiation Safety will verify:

1. Principal Authorized User is approved for requested radionuclide.
2. Order does not exceed approved quantity 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 is 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 are not exceeded.

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 delivery during normal working hours.

Patient radiopharmaceutical doses for Nuclear Medicine and Radiation Therapy are delivered by the vendor directly to the using department where 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 of radioactive packages delivered to the university 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 radioactive 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, a radiation safety technician will transport the package to the lab. A Radioisotope Receipt and Disposal form is provided with each item. Receipt documentation is 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. Immediately notify the Radiation Safety Office of damaged or leaking packages.
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 (706-721-2218) within 48 hours of receipt to avoid being charged incorrectly, and reported to the Radiation Safety Office (706-721-9826). 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.

6. Document the condition of the package, comparison of packing slip and vial contents, and disposition of packing material on the Radioisotope Receipt and Disposal form and return the form to the Radiation Safety Office when all radioactive material has been properly disposed.

ON-CAMPUS TRANSFERS

Approval shall be obtained from the Radiation Safety Office to transfer radionuclides from one user or location to another. Receipt and disposal records shall be generated to maintain accurate inventory records. 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. Liquids shall be transported in sealed containers with secondary containment. The Radiation Safety Office shall confirm that the radionuclides are transferred to an approved location.

OFF CAMPUS TRANSFERS

All transfers of radioactive materials off campus shall be made through the Radiation Safety Office to ensure compliance with 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 radioactivity amount 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 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. Radiation detection devices appropriate to the isotope, 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 inspect the laboratories monthly. (The RSO may increase the frequency of inspections based on the type/quantity of radioactive materials used, results of previous surveys, and general compliance with State and AU Radiation Safety regulations and policies). Radiation exposure rates and removable contamination levels are measured, radioactive material storage is inspected, compliance with radiation safety rules is evaluated, and PAU records are reviewed during the survey.

SURVEYS CONDUCTED BY PRINCIPAL AUTHORIZED USER

Weekly contamination/radiation surveys are required in 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.

The weekly PAU survey shall consist of a wipe test and a portable instrument survey when higher energy beta emitters such as ^{32}P , or gamma emitters such as ^{125}I or ^{22}Na , are used in the laboratory. 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 ^3H , ^{14}C , ^{35}S , or ^{33}P , or small quantities of gamma emitters contained in commercial test kits are used in the laboratory, only a wipe test for contamination is required.

A statement that no radioactive materials have been used during the week may be entered into the Radiation Safety record 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 limits. The Radiation Safety Officer may increase the survey frequency based on radiological conditions, quantities or types of materials, or a Principal Authorized User's safety and compliance record.

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 ^3H , ^{14}C , ^{35}S , or ^{33}P , do not require an instrument survey. After each use of radioactive material, monitor:

1. Hands, arms, front of lab coat and other potentially contaminated areas.
2. Bench tops, floor areas, equipment, etc.
3. Hands and clothing before leaving the laboratory.

WIPE TESTS FOR CONTAMINATION SURVEYS

Wipe tests shall be taken in all areas where radioactive material is handled in unsealed form. 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 are received, or frequent pipetting occurs. Floors (particularly near doorways), lead syringe shields, and door and drawer handles should be wipe-tested frequently.

Wipe tests are more sensitive than instrument surveys and should be used especially when instrument surveys indicate possible contamination. Wipe tests are the only practical method of monitoring weakly-penetrating beta emitters, such as ^3H , ^{14}C , ^{35}S , or ^{33}P , 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 are performed by wiping a filter paper disk or a Q-tip across a 100 cm^2 surface area, and then measuring the radioactivity on the wipe in a counter calibrated for the suspect radionuclide. Measure the background count rate under the same counting conditions used with the wipes and record. Subtract background count rate from sample count rate to obtain the net count rate. Divide the net count rate by the counting efficiency to obtain dpm. (Note: Many liquid scintillation counters reduce the data automatically).

ACTION LEVELS

External Radiation: Radiation levels should be kept to less than 2 millirem/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 maintain exposures ALARA. Contact the Radiation Safety Officer if unanticipated conditions are encountered.

Contamination:

<u>Level (dpm/100 cm²)</u>	<u>Action</u>
Below 200	Record actual measurement for formal survey. Clean up recommended to as low as reasonably achievable.
200 and above	Record actual measurement for formal survey. Cleanup to less than 200 dpm/100 cm ² , and as low as reasonably achievable.

Techniques for conducting contamination and radiation surveys are taught in the state-mandated initial radiation safety course required of all radiation workers. Radioactive material may not be ordered or used prior to successfully completing the initial radiation safety course. Annual refresher training shall be completed by any individual using or responsible for radiation material.

SURVEY INSTRUMENT CALIBRATION

All instruments used for measuring exposure rates or determining the quantities of radioactivity present in samples or on surfaces (as contamination) are to be calibrated at least once a year. Calibrations are to be performed by individuals who meet the specified qualifications and using sources and procedures that assure compliance with federal and state regulations and license conditions. Portable survey instruments used in the clinical setting for measuring exposure rates from patients or for quantifying radiation doses must be calibrated by an accredited calibration laboratory.

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. Affix a Radiation Safety Clearance tag to the equipment to notify personnel that the equipment is free of radiation hazards. 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. Contact the Radiation Safety office to obtain support for relocation of potentially contaminated equipment.

VACATING LABORATORY SPACES

The Radiation Safety Office shall be informed of all changes in authorized laboratory spaces, including transfers or departures from AU. 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 for radioactive material use and a revised sublicense is issued.

The PAU is responsible for surveying all spaces and equipment, and proper removal of 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, verifying that equipment is adequate to meet regulatory requirements, and issuing a revised sublicense. The PAU should notify the Radiation Safety Office about a pending relocation as soon as possible in the planning process.

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 containment of radioactive material or radioactive contamination of facilities or personnel. For any emergency involving radioactive materials, radiation sources or radiation producing devices contact the AU Radiation Safety Office (706-721-9826) and 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. Environmental Services is not authorized to clean radioactive spills. It is the responsibility of individuals who work with radioactive materials to have a basic understanding of decontamination principles. Emergency procedures shall be posted in all radioactive material 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,
6. Document the contamination level post-cleanup.
7. Notify the Radiation Safety Office.

Radiation Safety Office Response Actions

1. Supervise cleanup or restriction of area until emergency no longer exists.
2. Verify that the area is decontaminated.
3. Follow-up on potentially contaminated personnel.
4. Notify regulatory agencies if necessary.

CHAPTER SEVEN

PERSONNEL MONITORING

EXTERNAL EXPOSURE

Personnel monitoring devices (dosimeters) are issued by the Radiation Safety Office to measure individual occupational 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 dosimeters are provided, processed and reported by a National Institute of Standards and Technology National Voluntary Laboratory Accreditation Program (NVLAP) accredited vendor. In some circumstances, the RSO may authorize an alternate dosimeter such as calibrated personal electronic dosimeter per U.S. NRC Regulatory Guide 8.34 Monitoring Criteria and Methods to Calculate Occupational Radiation Doses.

Dosimeters are issued to personnel who:

1. Are deemed likely by the Radiation Safety Officer to receive an occupational radiation dose in excess of ten percent (10%) of annual regulatory limits.
2. Have declared a pregnancy;
3. Enter a High Radiation Area (exposure to greater than 100 millirem in any one hour at 30 cm from the source of the radiation);
4. Meet other issuance criteria as determined by the Radiation Safety Officer.

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.

PERSONNEL MONITORING PROCEDURE

Each individual who works with radiation or radioactive materials and meets the monitoring criteria for dosimeter assignment, or is uncertain of monitoring requirements, shall file a Radiation Worker Registration Form. The information provided on the 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 monitored individuals to demonstrate compliance with State regulations. Personnel monitoring devices are ineffective for monitoring exposure from low energy beta emitters such as ^3H , ^{14}C , and ^{35}S or

very small quantities of radioactive material such as ^{125}I in-vitro testing kits, and are not normally issued to individuals who work only with these materials.

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 are maintained 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 worn at the collar, outside the apron.

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

Do not remove dosimeters 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 have a significant risk of personnel uptakes. Some procedures do incorporate radionuclide form and activity combinations which warrant bioassay monitoring to assure that safety measures remain effective.

Bioassay requirements are established by the Radiation Safety Officer. Bioassays are required 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. Existing programs are periodically reviewed through radiation worker registrations, surveys, inventory records and a verification of radiation staff and radionuclide use limits.

Tritium (^3H)

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 (^{125}I , ^{131}I)¹

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) ^{131}I . An external thyroid bioassay is required within 72 hours of performing a research procedure using either unsealed ^{125}I or ^{131}I 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

¹ U.S. NRC Regulatory Guide 8.20 *Applications of Bioassay for ¹²⁵I and ¹³¹I*.

Other Radionuclides (¹⁴C, ³²P, ³⁵S, ⁴⁵Ca, ⁵¹Cr, 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.

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

PREGNANT RADIATION WORKERS

The Pregnant Radiation Worker Policy incorporates safety practices and radiation dose limits to ensure 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 from the Radiation Safety Office.

Following a worker’s voluntary declaration of her pregnancy, the Radiation Safety Officer (or 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 (if any) to restrict or change job assignments during pregnancy.
4. Issue and use of fetal dosimeters.
5. Need (if any) for bioassay.
6. Reference material on fetal exposure.

A worker may withdraw her declaration of pregnancy at any time for any reason by notifying the Radiation Safety Officer in writing. A form is available from the Radiation Safety Office for this purpose. Once the declaration is withdrawn the lower dose limit for the embryo/fetus no longer applies, and supplemental dosimetry will be discontinued.

ALARA POLICY

AU 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 manual, such as survey requirements for investigators using radionuclides in research, and an extensive survey and quality control program for x-ray devices.

Procedures for responding to occupational radiation doses which exceed ALARA Level I or ALARA Level II in the following table have been established.

Quarterly ALARA Action Levels

Measure	ALARA I (mrem)	ALARA II (mrem)
Whole body	125	375
Eyes	375	1125
Extremities and skin of the whole body	1250	3750

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.

The Radiation Safety Officer or designee shall prepare a formal report of an ALARA II exposure. The report shall be provided to the worker; the supervisor; and the Radiation Safety Committee. Conclusions drawn from the report 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 in consultation with the Radiation Safety Committee.

The Radiation Safety Officer notifies regulatory agencies of exposures that exceed regulatory limits.

CHAPTER EIGHT

RADIOACTIVE WASTE DISPOSAL

It is important to dispose of radioactive wastes in accordance with radiation safety regulations to avoid exposure to personnel and releases to the environment. 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 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 mixed hazardous waste is 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 (^3H), carbon-14 (^{14}C), and iodine-125 (^{125}I) in concentrations less than 0.05 uCi/g.

Biological wastes are 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-1002. Call Radiation Safety to gain access to the freezer.

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 as miscible or non-miscible. Use carboys provided by the Radiation Safety Office. Carboys shall have secondary containment. Observe the following packaging rules:

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.
4. Carboys shall be labeled with a Radioactive Waste Tag.

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). Written approval by the Radiation Safety Officer is required for the use of non-biodegradable scintillation fluids (e.g., toluene or xylene based cocktails). The cost of disposal of any mixed hazardous waste resulting from the use of non-biodegradable scintillation fluid is the responsibility of the Principal Authorized User.

Source Vials

Source (stock solution) 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. Contact Radiation Safety to pick up lead pigs. The lead is surveyed for contamination and recycled. The survey results are documented and results shall be non-detectable, with a minimum counting sensitivity not to exceed 200 dpm/100 cm².

Radioactive Waste Pickup

The Radiation Safety Office picks up of radioactive waste by appointment. Schedule an appointment at the Radiation Safety web page, or by calling 706-721-9843.

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

Records and references are maintained by the PAU as part of the institution's program for cradle-to-grave accountability of radioactive materials. These records and references include, but are not limited to, the following:

1. References:
 - AU Radiation Safety Manual (available electronically at the AU Radiation Safety Office web page).
 - Authorized User's Sublicense and Application to use Radiation Sources or radioactive materials.
 - Research protocols involving the use of radioactivity.

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.

Records are maintained for three years unless otherwise specified by the RSO.

CHAPTER TEN

SHIPPING RADIOACTIVE MATERIALS

GENERAL

Radioactive materials are shipped from AU in full compliance with Department of Transportation, Nuclear Regulatory Commission, and Georgia Department of Natural Resources requirements. The Radiation Safety Office provides assistance with shipping radioactive materials.

REQUIREMENTS

1. Ship only to persons who are licensed to receive radioactive materials. The consignee's license must be on file in the Radiation Safety Office prior to shipping.
2. Shipments shall be arranged in accordance with the recipient's procedures for receiving radioactive materials.
3. 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/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 specified time frame.

CHAPTER ELEVEN

USE OF RADIOACTIVE MATERIALS IN ANIMALS

The AU Radiation Safety Committee authorizes investigators to administer radioactive materials to animals for research approved by the Institution Animal Care and Use Committee. Laboratory Animal Services shall be notified well in advance of plans to house radioactive animals. The following rules apply to radioactive animals:

1. Isolate radioactive animals from other animals that do not contain radioactive material.
2. Label cages with a radioactive materials warning sign.
3. Post "Notice to Employees" and "Emergency Procedures" in a conspicuous place within the husbandry facility.
4. Line the bottom of the cage with absorbent paper pads with plastic backing or other 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 maintained by the Principal Authorized User.
8. Double bag Animal carcasses (inner clear bag, outer yellow bag) and store in a designated freezer. Contact the Radiation Safety Office for specific instructions.

Intentionally Blank



Clinical Use of Radioactive Material at Augusta University Health System and Affiliated Hospitals

Supplement to the Radiation Safety Manual

Intentionally Blank

Table of Contents

<u>Chapter</u>	<u>Title</u>	<u>Page</u>
	Table of Contents.....	ii
1.	Radiation Safety Program.....	1
	Responsibilities.....	1
	Radiation Safety Committee.....	1
	Human Use of Therapeutic Radiation Subcmte	1
	Authorized Users	2
	Written Directives.....	2
	General Requirements	2
	Location of Patient	2
	Patient Care.....	3
	Emergencies	3
	Use of Radioactive Material and Radiation Sources	3
	Location of Use	3
	Transfer of Radionuclides	3
	Surveys and Inventory.....	4
	Personnel Monitoring	4
	Waste Disposal	4
2.	Procedures and Nursing Instructions.....	5
	General Procedures.....	5
	Transportation.....	5
	Instructions to Patients	5
	Records	5
	Warning Signs	6
	Brachytherapy	6
	Radiopharmaceutical Therapy	8
	¹³¹ I Therapy Procedures.....	8
	Therapy Procedures other than ¹³¹ I.....	9
	Nursing Instructions – ¹³⁷ Cs Brachytherapy	10
	Nursing Instructions – ¹³¹ I Therapy	12

CHAPTER ONE

RADIATION SAFETY PROGRAM

The Augusta University Radiation Safety Program serves the Augusta University enterprise and hospitals affiliated with Augusta University Health 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 Manual. This supplement includes radiation safety requirements for the clinical uses of radiation that are not addressed in the basic Radiation Safety Manual.

RESPONSIBILITIES

RADIATION SAFETY COMMITTEE

The AU Health 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 AU Health.

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 proposed clinical uses 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. Electronic review and approval are authorized. 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 AU Health and other hospitals affiliated with AU Health 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 Radiation Safety Committee, or work under the direct supervision of an individual who is authorized. 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. Applications for authorized user status may be obtained from the Radiation Safety Officer.

When an investigator desires to use therapeutic radionuclides in a research protocol, the investigator shall complete an ancillary approval request form (available at the Radiation Safety web page) and submit it and supporting documentation to the Radiation Safety Officer for distribution to the Human Use of Therapeutic Radiation Subcommittee. 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.

WRITTEN DIRECTIVES

A written directive is an authorized user physician's written order for the administration of radioactive material, or radiation from radioactive material, to a specific patient or human research subject.

A written directive must be signed and dated by the authorized user physician before the administration of ^{131}I sodium iodide greater than 1.11 megabecquerels (30 microcuries); any therapeutic dosage of unsealed byproduct material; or any therapeutic dose of radiation from byproduct material, unless a delay would jeopardize the patient's health, in which case an oral order is sufficient when followed within 48 hours by a written directive.

Procedures for written directives for Nuclear Medicine and Radiation Therapy are posted to the Radiation Safety web page.

GENERAL REQUIREMENTS

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 limits 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.

EMERGENCIES

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.

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.

USE OF RADIOACTIVE MATERIALS AND RADIATION SOURCES

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.

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 storage room. 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^{131} in volatile form shall have a bioassay performed after administration (see specific instructions in the basic Radiation Safety Manual).

WASTE DISPOSAL

The Radiation Safety Office is responsible for disposing of 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 AU Health 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 or radioactive source implant.

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 AND INSTRUCTIONS

During inpatient therapy the Radiation Safety Technician (RST) shall post a radiation warning sign on the door to the patient's room. The RST shall post nursing instructions at the entrance to the room and in the patient chart.

BRACHYTHERAPY

A list of individuals permitted to handle brachytherapy sources at the Radiation Therapy Center shall be posted in the storage 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 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 storage 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. A radiation warning sign is posted on the door to the patient's room.
4. The brachytherapy nursing instruction form shall be completed in duplicate. One copy is placed into the patient's chart (or scanned into an electronic medical record) as a permanent record.
5. The second copy of the form shall be posted on the door to the patient's room. After removal of the sources, the second form is 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 radiation survey is 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 storage 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 storage room. The following information shall be included in the log:

Date and time of check-out

Number and activity of sources removed from storage

Number and activity of sources in storage container after the removal

Patient's name
Destination (hospital and room number)
Initials of the individual who removed the sources from storage
Date and time of return
Number and activity of sources returned to storage
Number and activity of sources in storage container after return
Initials of the individual who returned the sources to storage

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 (RTC) 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 storage room and kept as a permanent record. If the number of sources and/or activity differs for the return trip a new tag is completed and attached to the transport container.

5. Prior to the implant, the AUP shall prepare a written directive, 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 written directive 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 storage 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 and long-handled tongs or tweezers shall be left in the patient's room during the treatment for recovery of dislodged sources.
10. Sources shall be returned to the storage container in the storage 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 storage 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 storage room; when the sources are taken from the storage 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 storage room an inventory of the container is documented and the results reconciled with the logout entry. Any discrepancy shall be reported to the Radiation Safety Officer immediately.

RADIOPHARMACEUTICAL THERAPY

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

A pre-therapy negative serum β -hCG pregnancy test is required for all females of reproductive potential within 24 hours prior to radiotherapeutic treatment, and:

- if negative pregnancy is based on patient-declared hysterectomy or on patient-declared bilateral tubal ligation, the treating physician shall obtain Medical Record historical pathological (uterus, 2 fallopian tubes sections) confirmation before omitting a pre-procedure pregnancy test in a woman of childbearing age.
- if hysterectomy/bilateral tubal ligation Medical Record historical pathological confirmation of negative pregnancy is not available, a β -hCG serum pregnancy test shall be performed to exclude pregnancy within 24 hours pre-procedure.
- if a serum sample is submitted to a Laboratory but results are not available within 24 hours, as the procedure is in-progress with Thyrogen IM injections 24 and 48 hours prior to radioiodine, to avoid treatment delay or interruption, a β -hCG urine pregnancy test is acceptable to exclude pregnancy prior to radioiodine treatment delivery. A β -hCG serum pregnancy test shall be obtained with results in Medical Records within 7 days after the patient being discharged from this hospital treatment, as confirmation of negative urine test.
 - In this exceptional circumstance, the possibility of adverse risk with interruption of therapy justifies very high negative predictive value 98% in both qualitative urine and serum tests (-test-pregnancy/all -tests); sensitivity (+test+pregnancy/all +pregnancy) 99% serum, 97% urine.

IODINE-131 THERAPY PROCEDURES

Definition of Major and Minor Therapies

Minor therapies of ^{131}I are prescriptions for single doses of 30 mCi or less.

Major therapies of ^{131}I are prescriptions for single doses greater than 30 mCi.

The administered dose may vary from the prescribed dose by + 10%, to account for inherent

variations in the manufacturing and measuring processes. All doses are verified by dose calibrator measurement; the manufacturer's measurement is considered the definitive measurement.

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.

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

Minor Therapies

Minor therapies at AUMC may be performed in either the Nuclear Medicine clinic or at the Radiation Therapy Center.

At the Nuclear Medicine Clinic, the minor 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 or a radiation oncology resident under the supervision of an AUP. A radiation safety technician is responsible for monitoring the area, decontamination (if necessary), and disposing of radioactive waste.

Major Therapies

Major I-131 therapy administrations may be performed on an outpatient basis at the Radiation Therapy Center if the patient meets pre-established criteria to ensure the total effective dose equivalent to any other individual from exposure to the released individual is not likely to exceed 0.5 rem. If the patient meets these criteria, the process for the administration at the Radiation Therapy Center would be the same as described above for minor therapies.

If the criteria cannot be met, patients receiving major therapeutic doses of ^{131}I will be 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 I-131 therapy dose is received and assayed in the Nuclear Medicine Hot Lab and the paperwork prepared by the Nuclear Medicine Technologist for the dose to be available to be delivered by a Radiation Safety Technician from the Hot Lab to the patient's room when needed.

The dose is usually administered with the patient sitting on the edge of the bed. 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. 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 internal radioactivity is less than 30 mCi or the measured dose rate at one meter from the patient is less than five millirems per hour, unless the Radiation Safety Officer approves release based on alternative measures described in US Nuclear Regulatory Commission Regulatory Guide 8.39, *Release of Patients Administered Radioactive Materials*.

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.

THERAPY PROCEDURES OTHER THAN ¹³¹I

Radiopharmaceutical therapy procedures at AU Health 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 Authorized User Physician or a radiation oncology resident under the supervision of an AUP, with support from a Radiation Safety Technician. The Radiation Safety Technician is responsible for monitoring the area, decontaminating if necessary and disposing of radioactive waste.

A syringe shield shall be used during any radiopharmaceutical therapy injection, unless the use is medically contraindicated. ⁸⁹Sr shall be ordered and administered in unit doses only.

Nursing Instructions - Cesium-137 Brachytherapy Patients

In brachytherapy, small, sealed sources of radiation are positioned near the patient's cancer site. While the source holders are implanted in the operating room, the radiation sources themselves are inserted in the patient's room. Radiation exposure is the primary concern when working with brachytherapy patients. Exposure levels at the patient's bedside can be as high as 50 to 100 millirem/hour. Radioactive contamination is not of concern as the radiation sources are "sealed." No radioactivity is retained inside the patient once these sources are removed. Cesium-137 sources are nickel-coated, approximately 20 mm long and 3 mm wide, and sometimes are color-coded at the end.

The following procedures should be observed when working with brachytherapy patients:

Individuals that provide routine care for these patients will typically be issued a radiation dosimeter (radiation badge).

- Always wear your dosimeter badge when attending the patient. Wear the badge between your waist and collar and make sure that the badge worn is the one issued in your name for the current monitoring period. Do not share badges with other workers. Do not take your badge home with you. When you are not wearing your dosimeter, store it in a controlled area away from all radiation sources.

- Provide all necessary care, but try to minimize time spent with the radioactive patient. Try to work behind mobile shields whenever possible, and work no closer to patient than necessary.
- Observe nursing stay times and instructions on the “Caution Radiation” signs and instruction sheets posted by the door to the patient’s room. Read and observe any Radiation Safety instructions written in the patient’s chart.
- If you are the primary contact for matters of the patient’s care, be prepared to answer questions from other nurses, physicians, technical staff members, and visitors. Note the following:
 - Other hospital staff members are allowed in patient room if stay times and other instructions are observed. (Exception: Personnel who do not routinely work with radiation therapy patients may not be required to wear a personnel monitoring device. Contact Radiation Safety with questions.)
 - Visitors are not permitted in the patient room.
 - Housekeeping and Dietary staff are not permitted in brachytherapy patient rooms.
- No room items are to be removed without clearance from radiation safety or medical physics personnel responsible for the implanted sources.
- Brachytherapy patients are to stay in rooms designated by the Radiation Safety Officer only.
- The room and patient are not to be released until Radiation Safety conducts a clearance survey.
- If a source becomes dislodged from the patient:
 - Do not touch the source! If possible, use a broom or some long handling tool to move it to a room corner
 - Remove all unnecessary personnel from source area and call Radiation Safety and Radiation Oncology.
 - If possible, using long tweezers, place source in the shielded container normally provided and located in the patient’s room along a far wall
 - If you cannot get the source into the shielded container, try to get the source to the corner of the room via remote handling tool, yardstick, broom, etc.
 - Do not leave source near patient or attempt to re-insert source in patient

Notify Radiation Safety and Radiation Oncology if a source becomes dislodged, or if there is a medical emergency (including patient death).

Nursing Instructions - Iodine-131 Therapy Patients

Radioactive iodine-131 is used to treat patients with thyroid carcinoma or hyperthyroidism. ¹³¹I is generally administered orally in a liquid, capsule, or caplet form. Treatments involving large quantities of radioactive iodine are done on an inpatient basis. Following administration the patient remains hospitalized until the radioactivity decreases to levels suitable for discharge. Radiation exposure and radioactive contamination are both concerns when working with ¹³¹I patients. The following procedures should be observed:

- ¹³¹I therapeutic procedures may only be performed in rooms designated by the Radiation Safety Officer.
- Always wear your personnel monitoring badge (dosimeter) when attending the patient. Wear the badge between your waist and collar and make sure that the badge worn is the one issued in your name for the current monitoring period. Do not share badges with other workers. When you are not working, store your badge in a controlled area away from all radiation sources.
- Provide all necessary care, but:
 - try to minimize time spent with patient
 - work no closer to patient than necessary
 - wear disposable gloves, gowns, and booties when attending patient
- Carefully note instructions posted with the “Caution Radiation” sign and any radiation safety instructions written in the patient’s chart.
- As primary contact for matters of the patient’s care, be prepared to answer questions from other nurses, physicians, technical staff members, and visitors. Note the following:

Other hospital staff members are allowed in patient room if stay times and other instructions are observed. (Personnel who do not routinely work with radiation therapy patients may not be required to wear a personnel monitoring device. Consult Radiation Safety.)

Visitors are not permitted in the patient’s room.

Housekeeping and Dietary staff are not permitted in ¹³¹I patient rooms. ¹³¹I patients are to be provided with disposable plates and eating utensils
- Do not remove room items from the room without clearance from Radiation Safety.
- Radiation Safety will survey the patient daily and will notify the nursing staff when the patient is below release criteria.
- Notify Radiation Safety and Nuclear Medicine (see posted emergency numbers) if there is a spill of patient urine, the patient vomits or if there is a medical emergency (including patient death).
- Radiation Safety will inform the nursing staff and the bed coordinator when the room has been decontaminated and released for general use.