Table of Contents:

I. Introduction/Mission statement

II. Administrative Organization : Flow Chart
A. Institutional Radiation Safety Committee (IRSC)
B. University Radiation Safety Officer (URSO)
C. Radiation Safety Officer (RSO)
D. Authorized User (AU)
E. Radiation Worker

III. Radiation Safety Program
A. Applying to Use Ionizing Radiation
B. Approval process
C. Training Requirements
D. Procurement of Radioisotopes
E. Receipt of Radioactive Materials
F. Transfer or Shipping of Radioactive Materials
G. Laboratory Monitoring and Surveys
1. Responsibility
2. Instrument Surveys
3. Wipe tests
4. Biannual surveys
5. Action Levels
6. Annual Inspections
H. Storage of Radioactive Materials
1. Responsibility
2. Requirements
I. Radioactive Waste
1. Classification
2. Storage
3. Disposal
J. Spills and Accidents- refer to Appendix B & C
K. Record Keeping Requirements
1. Wipe tests
2. Receipt / Use log
3. Sewer disposal log
1. Quarterly Inventory
L. Information on commonly used radioisotopes
H-3; C-14; P-32; S-35; Cr-51; I-125
M. Working with Radioactive Materials
1. Attire
2. Personal Protective Equipment (PPE)
3. Identification of work areas and equipment
4. Time, Distance, and Shielding
5. Laboratory Rules
N. Decommissioning Instruments / Equipment / Laboratory
O. Pregnancy
P. Special requirements for working with radioiodine

IV. Violations of Policies and Procedures

V. Personnel Monitoring

A. Responsibility
B. ALARA
C. Dose limits
D. Bioassay Program

VI. Forms

Directory / Links

VII. Appendix

A. Labeling Requirements
B. Spill and Emergency Procedures
C. Personnel Decontamination

I. Introduction

Statement of Policy

The State of Georgia Department of Natural Resources has issued Mercer University a Specific Limited License with which to use radioactive materials for research and educational purposes. The Mercer University Institutional Radiation Safety Committee closely monitors this license and all activities involving ionizing radiation. Mercer University is committed to administrating a radiation safety program that will provide an appropriate and practical research and educational environment. In achieving such standards it is required that all individuals adhere to the conditions of the University's Radioactive Materials License and all State and Federal regulations pertaining to the use of ionizing radiation. The regulations are listed below. This manual shall be used as an interpretive tool that the university has agreed upon to meet the conditions of our license.

It is the responsibility of all individuals who elect to participate in this program to be knowledgeable of all aspects of the program and to adhere to the requirements set forth in this manual. Failure to comply with these requirements could jeopardize the University's license and therefore jeopardize the University's ability to conduct research. Any individual who fails to adhere to these standards risks retaining their authorization to participate in the radiation safety program at this institution.

President R. Kirby Godsey

---

1. Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation.
   http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/

2. Title 10, Code of Federal Regulations, Part 19, Notices, Instructions and Reports to Workers; Inspections.
   http://www.nrc.gov/reading-rm/doc-collections/cfr/part019/

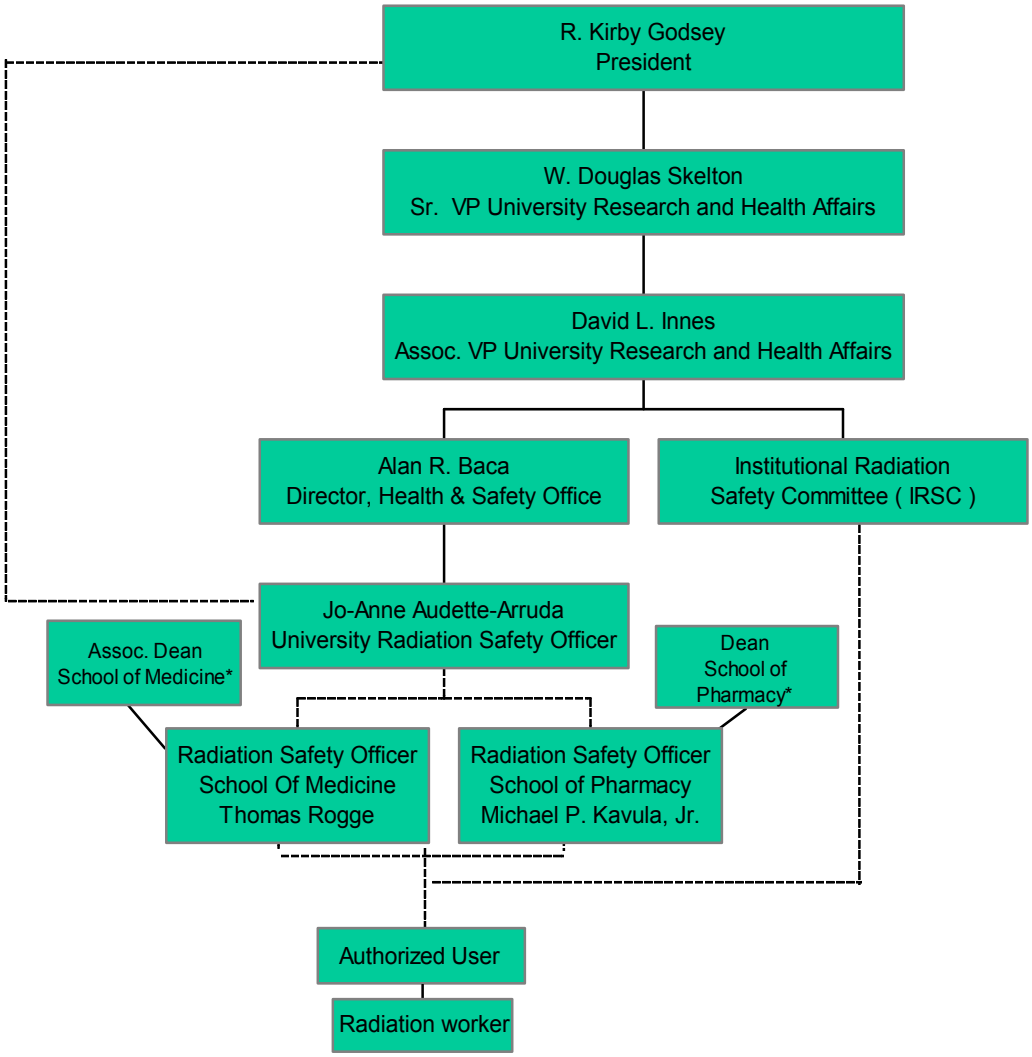
3. Georgia Department of Natural Resources, Rules and Regulations for Radioactive Materials, Chapter 391-3-17.
   http://www.ganet.org/dnr/environ/rules_files/exist_files/391-3-17.htm

4. Georgia Department of Natural Resources, Rules and Regulations for X-Ray, Chapter 290-5-22.

   http://www.ganet.org/rules/index.cgi?base=290/5/22/

II. Administrative Organization

Organizational Flow Chart for Radiation Safety Program



* Robert Moon
Associate Dean of the School of Medicine

* Hewitt Matthews
Dean Southern School of Pharmacy

A. Institutional Radiation Safety Committee (IRSC)

Membership

The President of Mercer University has designated the Senior Vice President for Health Affairs as the individual responsible for the Radiation Safety Program. The Senior Vice President of Health Affairs appoints the members of the Institutional Radiation Safety Committee annually. The voting members of the committee will elect the Chair. The committee is composed of the following: personnel with experience in radiological safety, the Radiation Safety Officers from the various schools; an authorized user from each college / school using ionizing radiation. Each school will be allowed to have two representatives on the committee. The director of the Health and Safety Office will serve as the executive secretary to the committee (non-voting member). The Senior Vice President of Health Affairs may appoint other members, as the university deems necessary.

Meetings

The IRSC will meet on a quarterly basis. The Chair may call additional meetings as necessary, or at the request of one of the members or Radiation Safety Officers (RSO). All meetings will be recorded in the form of minutes. Minutes will be distributed to all members for approval.

Quorum

In order to conduct business that requires voting, at least one half of the members must be present including the University Radiation Safety Officer (URSO).

Responsibilities

Members of the IRSC shall be familiar with the conditions of Mercer University's Specific Limited License; the Radiation Safety Manual; and the Georgia Department of Natural Resources, Rules and Regulations for Radioactive Materials, Chapter 391-3-17. Committee members must review for approval or disapproval all applications to use radionuclides including protocol / project descriptions. This process may be conducted outside of the quarterly meetings, via routing applications to all members and holding a vote electronically. The committee shall consider all situations brought forward by any member, or any concerned individual. Members will selectively participate in an annual review of the radiation safety program.

Authority

The IRSC in conjunction with the URSO has the authority to identify radiation safety problems and initiate recommendations and corrective actions.

B. University Radiation Safety Officer (URSO)

The URSO is responsible for implementing the radiation safety program and that radiation safety activities are performed according to approved procedures and regulatory requirements. The URSO has the authority to stop any operation that may present unsafe radiation safety practices.

Responsibilities / duties of the URSO are to ensure; but are not limited to the following examples:

- Licensed material possessed by the Authorized User (AU) is limited to the kinds and quantities of byproduct material listed on the license. Assure that only individuals authorized by the license use the radioactive material.

- All individuals using radioactive materials or any individual whose job duties may require them to work in the vicinity of radioactive materials are properly instructed. In addition, provide training to any individual working in the vicinity such as housekeeping, security, and maintenance personnel.

- That radiation exposures for all personnel are as low as reasonably achievable (ALARA) by implementing an appropriate radiation protection program.

- Appropriate administration of dosimetry program in accordance with Rule .03(7)(b).

- Provide consulting services to faculty and staff on all aspects of radiation protection.

- Review new construction and remodeling of facilities in which radioactive materials will be used.

- Review and approve, if acceptable, all ***Applications for A Permit to Use Radionuclides***. Provide written notification of approval to applicant.

- Approve all radioactive material orders.

- Provide support to RSO's in the use of the HP Assistant database. Ensure that all records are entered in a prompt manner, therefore maintaining a current centralized database.

- That radioactive material is properly secured against unauthorized removal or use.

- Suspend use of radioactive material that poses immediate danger to employees or the public.

- That licensed material is disposed of properly.

- Conduct annual audits of the radiation safety program in accordance with the ***Standard Operating Procedure for Internal Radiation Safety Inspections.*** *SOPs are available from RSOs.*

- That the proper authorities are notified in the case of accident, fire or theft involving radioactive material.

- That all incidents, accidents, and personnel exposure to radiation in excess are investigated and reported to the necessary authorities as appropriate.

- That the license is amended whenever there are changes in licensed activities, responsible individuals, or information or commitments provided to the State in the licensing process.

- That the all license fees, permit fees and other costs associated with the radiation safety program are processed as necessary and in a timely manner.

- Provide annual activity and fiscal reports to the President of the University.

C. Radiation Safety Officer (RSO)

Responsibilities / duties of the RSO are to ensure; but are not limited to the following examples:

- Proper implementation of the Radiation Safety Program (RSP).
- Provide support to all users of radioactive materials (RAM) as applicable to the radiation safety protection program.
- Provide training to all new users of RAM, document the training and enter into HP Assistant.
- Ensure that radiation exposures for all personnel are as low as reasonably achievable (ALARA) by implementing an appropriate radiation protection program.
- Responsible for dosimetry program: film badge applications of new workers, obtain prior occupational dose records, provide occupational dose records as requested within 30 days, provide terminal film badge records to individuals no longer participating in the dosimetry program.
- Responsible for monitoring and ensuring proper use of radiolabeling facility in accordance to the ***Standard Operating Procedure for the Use of the Radiolabeling Facility.*** *SOPs are available from RSOs.*
- Perform thyroid bioassays on all individual utilizing ^{125} I and ^{131}I in a volatile form and will be in accordance with Regulatory *Guide 8.20 Applications of Bioassays for ^{125} I and ^{131}I.*
- Review and approve all requisitions in the Financial Record System (FRS).
- Receive all radioactive packages according to the ***Standard Operating Procedure for Receiving Radioactive Packages & Receipt / Use Log*** , (*SOPs are available from RSOs.)* log all information into the HP Assistant database.
- Ensure that all RAM shipments and transfers comply with the ***Standard Operating Procedure for Shipping of Radioactive Materials***. *SOPs are available from RSOs.*
- Ensure that all incidents, accidents, and personnel exposure to radiation are investigated, documented and reported to the URSO.
- Periodic inspections of laboratories as well a review of records may be performed at the discretion of the RSO.
- Provide waste storage and removal service for all RAM, log information into HP Assistant database. Separate waste accordingly. The two main categories will be: ***decay in storage (radioisotopes with half lives less than 100 days) or waste to be shipped out (isotopes with half lives greater than 100 days).*** Once waste has decayed for ten half lives, perform an appropriate survey to determine that radiation is no longer detectable. Record survey information and information pertaining to the instrument used for the survey, i.e. model number, calibration date etc.

FREQUENCY OF DUTIES

Monthly:

- Dosimetry program: change film badges and Thermoluminescence dosimeters (TLD's) for the date in which they are issued.

- Sewer disposal calculation - file copy with URSO **Rule.03(12)c.**

Quarterly:

- Provide all Authorized Users (AU's) with quarterly inventory reports.

- Update HP Assistant database to accurately reflect all information provided to RSO from AU's on quarterly inventory reports.

- Perform inventory of all sealed sources.

- Arrange for disposal of radioactive waste to licensed and approved Low Level Radioactive Waste disposal firm.

B*iannually:*

- Perform leak testing of all sealed sources as required.

- Perform surveys of restricted and non-restricted areas; document all corrective actions taken, post results for all individuals working in restricted and non-restricted areas to review.

Yearly:

- Perform calibrations of all survey instruments, as the instrument approaches its yearly calibration date.

- Provide annual training for all users of RAM, and all individuals working in the vicinity of RAM, i.e. housekeeping, security and maintenance personnel. Document training session by requesting that all attendees print name, sign in, and provide a social security number; enter data in HP Assistant program and file a copy of all annual training records with URSO.

- Calculate effluent concentrations; file a copy with the URSO

- Dosimetry program: provide reports of yearly exposure to participants, provide documentation to support that the public receives less than 100 mrem/yr exposures. See Annual Exposure form sample. ***Note: This can be achieved by monitoring unrestricted areas throughout the year.***

- Perform annual inspections of the facilities in accordance with the ***Standard Operating Procedure for Internal Radiation Safety Inspections.*** *SOPs are available from RSOs.*

D. Authorized User

An authorized user (AU) is *a faculty or staff member* who has obtained permission to use radioactive materials from the IRSC and the State of Georgia Department of Natural Resources Environmental Protection Division .

* Note other university committees may refer to the AU as the PI.

Responsibilities

1. The AU is required to be in compliance with the conditions set forth in the Radioactive Materials License of the university.

2. The AU is responsible for ensuring supervision to all individuals working under the issuance of their radioactive material license. This includes but is not limited to: research scientists, post-doctoral students, graduate students, medical students, undergraduate students, work-study students, and volunteers. *Minors are not allowed to work with radioactive materials unless they have been given permission by the IRSC*. See Sec V. Personnel Monitoring.

3. Ensuring that all personnel who are under their supervision have received proper training and instruction specific to the activities in the laboratory.

4. Inform URSO/RSO of new techniques, changes in operational procedures and or in the physical facilities. Any such changes could lead to increased personnel exposure of contamination levels in the facilities of surrounding environment.

5. Maintaining appropriate records of receipt, use, waste, wipe surveys, quarterly inventory reports.

6. The AU is responsible for working with the RSO in determining the optimum procedure for segregating and storing all radioactive waste. Waste must be stored in appropriate containers as recommended in this manual and by the RSO. See Appendix A Labeling Requirements.

E. Radiation Worker

Any individual who has willingly accepted a position in which he/she is required to work with or in an area where radioactive materials exist.

Responsibilities

1. Adhere to the instructions of the Authorized User, RSO and work in compliance with University, State, and Federal regulations concerning the use of radioactive material.

2. Always wear the required personnel monitoring equipment.

3. Maintain good housekeeping practices in the laboratory.

4. Adhere to all laboratory practices, such as no eating, drinking, smoking, or application of cosmetics in the laboratories.

5. Report all spills and or accidents involving radioactive material to the RSO.

III. Radiation Safety Program

A. Applying to Use Ionizing Radiation

A faculty member, or Principle Investigator who wishes to use radioactive material regardless of quantity **(exempt quantities are not excluded)** or any instrument that generates ionizing radiation must follow the procedure outlined below.

1. A Statement of Training and Experience in Radioisotope Handling form must be completed.
2. An Application for a Permit to Use Radioisotopes must be completed.

Note: The training and experience form is only required if you are applying for the first time. However, an application for a Permit to Use Radioisotopes must be completed for requests for new radioisotopes and or protocol or project descriptions. These forms are available in section VI.

B. Approval Process

1. Institutional Radiation Safety Committee (IRSC) Review:

These forms must be remitted to the University Radiation Safety Officer, who will then review prior to releasing them for final review to the IRSC. This initial review is to identify deviations from Mercer University's standard operating procedures. Once the application has been reviewed and all deviations corrected the application will be routed to the IRSC committee for review and approval. This process typically takes 3-10 business days. If an application is rejected, the applicant will be provided with the committee's concerns and recommendations. The applicant may then revise the application and resubmit. The time necessary to process the re-application is again 3-10 business days. The applicant will be notified of the IRSC's decision.

2. State of Georgia Department of Natural Resources Radioactive (GA DNR) Materials Program Review:

Upon the acceptance of the proposed Statement of Training and Experience and Application for a Permit to Use Radioisotopes by the IRSC, the application documents will be forwarded to the GA DNR for approval. Once the State has approved the application, a license amendment will be issued to the University identifying these changes. The University Radiation Safety Officer will notify the Authorized User (AU) in writing of the GA DNR's approval.

C. Training Requirements

The following categories describe the various levels of radiation training requirements and identify various positions that qualify for each level. If it is unclear as to the level of training which you or anyone working with you should receive, please contact the school's Radiation Safety Office (RSO) or University Radiation Safety Officer (URSO) in order to determine the appropriate level of training which is suitable for the duties of that position.

Level I

This level of training is provided to individuals who work in the laboratory environment. Examples are: support staff not directly handling radioactive material, facility support staff (e.g. custodial, maintenance, delivery, and work study students. The training will include at a minimum:

Introduction & review of program and license requirements
Landauer Training CD and or Radiation Safety & Common Sense

Level II

This level of training is necessary for all individuals, including Authorized Users working directly with radioactive materials in a laboratory.

Introduction & review of program and license requirements. Review of record keeping forms and requirements. Landauer Training CD; Videos: Radiation Protection Standard; Fundamentals of Radiation Safety; Pregnancy, A Decision to Declare

Individuals participating in a nuclear pharmacy advanced practice experience will review program requirements, license conditions, forms and record keeping requirements at their practice site. In addition training in instrumentation, radiopharmaceuticals, radiation biology, and Pregnancy and a Decision to Declare will be covered.

Level III

This level of training is required for all Radiation Safety Officers (RSOs).

Successful completion of a Radiological Safety Officers' Training course (40 hours) and or Certification recognized by the NRC or Agreement States.

Level IV

This is required of all individuals who work directly or indirectly with radioisotopes.

Annual Training (subject matter TBA)

D. Procurement of Radioisotopes or instrumentation generating ionizing radiation

ALL radioactive material or instrumentation which generates ionizing radiation must be entered into the FRS, even if the material is purchased by a funding or supporting company such as: the Medical Center of Central Georgia, or Merck Pharmaceuticals etc. or is a gift, or a replacement. ***Radioactive material is not to be purchased with any credit card, such as VISA, MC, etc.*** This process is necessary to ensure compliance with the conditions of the radioactive materials license, such as; individual authorization, isotope, and activity.

Below are highlights when ordering radioactive material or an instrument that generates ionizing radiation.

1. FRS screen 250: ***Requisition type - enter RA*** for radioactive material. Proceed to enter all standard information that is requested.

2. The following information ***must be*** provided for the order to be approved:

Screen 254 } Identify radioactive isotope and amount of activity to be ordered.
Screen 258 } For example, ^{32}P (Phosphorus 32) 250 uCi or (250 microcuries).

Screen 251 Ship To: RSO (name) /Authorized User (name)
Building where material will be used with proper shipping address; for example:
School of Medicine
1550 College Street
Macon, GA 31207
Note make sure correct zip code is used.

Screen 251 Requisition text: list as 111
Call secretary name or RSO with PO #
Provide a copy of the PO to secretary or RSO
GA License number

Screen 254 UPO Code
Enter "N" for no cost if the item is a gift, replacement order or if the item will be ordered through the Medical Center of Georgia or by any other means.

3. Once a PO# has been assigned the secretary or RSO places the order. Next, this individual proceeds to inform the RSO, Authorized User and technician when the material will be arriving, so that necessary arrangements may be made to properly receive the order.

4. When ordering radioactive material, specify the mailing address and account number. A Company will assign a specific account number to each delivery address. Including this information is critical to ensure that the material arrives at the proper location

E. Receipt of Radioactive Materials

The Physical Plant receiving personnel or designated Physical Plant employee or the courier, e.g. Fed-Ex, shall deliver all radioactive material packages directly to the school RSO or their designee. If the Physical Plant receiving department is to provide the delivery service of the package, than the standard operating procedure for the receipt of radioactive materials at the Physical Plant must be followed. Upon receipt of the package, the school RSO or his / her designee shall process all radioactive material packages within three hours of receipt if the package is received during normal working hours, or no later than 3 hours from the beginning or the next working day if the package is received after working hours.

Standard Operating Procedure for Receipt of Radioactive Material Packages

1. The RSO or their designee must complete this procedure within 3 hours.

2. Complete a Receipt/Use Log form, assigning the new material the next chronological number as the inventory number. Macon inventory # will begin their numbering sequence with M followed by 4 digits starting with M0001 etc. Atlanta inventory # will begin their numbering sequence with A0001 etc.

3. Perform a visual check of the package to assess package integrity. Perform a wipe and survey of the shipping container, inner container and the final container package (i.e. vial). If contamination is within acceptable limits continue below. If removable contamination is detected proceed to either step 5, 6 or 7 depending on the amount and location of contamination. All necessary materials should be located on the receiving station.

4. Label the sample and the storage unit, for example the refrigerator, with an I.D. label containing the following information:
   Investigator
   Inventory number
   Isotope / Chemical form
   Amount of activity
   Date

   Note: A Radioactive Material label must also identify the Storage areas/unit.

5. If the outside of the package reveals removable contamination that exceeds the limits of Rule 391- 3-17-.06(15)(i); beta / gamma emitters is 220dpm/cm^2, the RSO shall immediately notify the final delivery carrier and the Department of Natural Resources, Radioactive Materials Program. The RSO will store the contaminated package(s) as radioactive waste. *Note: In all instances where contamination is noted, documentation must be provided that indicates proper decontamination procedures or disposal. It is the responsibility of the RSO to ensure that proper procedures were implemented.* .

6. If the vial / final container reveals removable contamination, i.e. counts greater than 3 x background, it is the responsibility of the RSO to ensure that the vial is properly decontaminated and that the process is documented. However, not all counts above background may be removable after completing the decontamination process 3 times. If this occurs, this must be noted and the recipient of the vial / final container must be informed of measures to reduce the possible spread of contamination that must be implemented. *Note: In all instances where contamination is noted, documentation must be provided to indicate proper decontamination procedures or disposal. It is the responsibility of the RSO to ensure that proper procedures were implemented.*

7. If the packing material reveals contamination, it must be treated as radioactive waste. It is the responsibility of the RSO to ship the material as radioactive waste or complete the decay in storage process by retaining the material for 10 half-lives. Note: *It is the responsibility of the RSO to ensure that proper procedures were implemented and that process is documented*.

8. Make a copy of the ***Receipt / Use Log*** form, wipe test print out, and packing slip give the copy to the investigator, and retain the original in a central location, preferably a binder.

9. The Authorized User must account for the use and distribution of the material on this log; such as: waste disposal, dry waste, liquid waste, LSV (Liquid Scintillation Vials), animal carcasses etc.

10. The RSO or his / her designee is responsible for entering the received radioisotope data into the Health Physics Assistant database in a timely manner.

F. Transfer or Shipping of Radioactive Material or Instrumentation Generating Ionizing Radiation

Mercer University's Specific Limited License does **NOT** allow for any individuals covered by the license to transport radioactive materials themselves. Therefore, all radioactive materials requiring transfer from one location to another must be shipped via an authorized package carrier, eg. Federal - Express.

THIS PROCESS IS ONLY TO BE COMPLETED BY THE RSO OR URSO.
The Standard Operating Procedure or SOP is available from RSO.

G. Laboratory Monitoring and Surveys

1. Responsibility

All laboratories and facilities in which radioactive materials are used or stored must be monitored for contamination. This process will ensure that contamination is not spread and that radiation workers do not receive unnecessary exposure. It is the responsibility of the Authorized User (AU) to ensure that this task is accomplished and that records are maintained as required. In addition, it is the responsibility of the AU to ensure that the necessary equipment for laboratory monitoring is available to the lab personnel and provide them with training on how to use the instruments properly.

Work utilizing high-energy beta or gamma radioisotopes requires the use of a Geiger meter to perform routine surveys of laboratory areas and personnel during and after an experiment. The frequency of wipes is determined primarily, by the half-life of the radioactive material.

2. Instrument Survey

The monitoring of work areas and personnel shall be performed after each use of radioactive materials which are capable of being detected with a Geiger Meter / Survey Meter in order to detect contamination. **(This is not a wipe test!)** This is a common sense practice including work areas and personnel. Completion of this survey is to be noted on the Receipt/ Use log.

a. If contamination is suspected or a spill occurs a contamination survey is to be performed after the procedure in order to document the level of contamination.
b. Document all findings on laboratory wipe / survey form.

Note: It is imperative that prior to leaving the laboratory environment that shoes and hands are monitored to avoid spreading contamination!
Geiger Meter / Survey Meter are calibrated annually. A calibration sticker is located on each counter; verify the currency of the calibration. The RSO maintains current calibrations of all radiation detection equipment.

3. Wipe Test

Definition: ***the wiping of a 100 cm^2 area with filter paper, cotton tipped applicator, or other suitable material in order to detect the presence of removable contamination.***

Wipe tests shall be conducted within the half-life of the radioisotope or monthly which ever comes first. A map of the floor plan identifying the locations to be wiped must be on file in the laboratory. The results must be kept on file, signed and dated with the original print out (if available) from the instrument used to count the wipes. The documentation shall include: date, individual performing wipe test, radionuclide, instrument used, serial number, calibration date, back ground results (cpm/dpm), action level (cpm/dpm), wipe location (cpm/dpm) and corrective actions taken and rewipes if needed.

4. Action Levels

A. Surface Contamination

An action level refers to quantities of contamination that are above acceptable limits. Results are in disintegration per minute (dpm) for an area of 100 cm^2.(Note some contamination may not be removable.) All wipe results and corrective actions taken are to be documented on the appropriate form.

Action level	**Corrective action to be taken**
Unrestricted Areas	
>200 dpm	Decontaminate area or personnel to less than 200 dpm or to as low as practicable, preferably to background levels
Restricted Areas	
> 500 dpm but < 2000 dpm	Decontaminate area to below 500 dpm, or to as low as practicable, preferably to background levels within 24 hours (required).
> 2000 dpm	Decontaminate area to below 500 dpm, or to as low as practicable, preferably to background levels within 24 hours (required). **Notification to the RSO within 24 hours is required.** Additional safety precautions such as booties, step off pads may need to be implemented at this point.

B. Ambient Dose Rate in mR/hr

Unrestricted Areas
> 2 mR/hr

Restricted Areas
>10 mR/hr

Useful conversions and equations

$1\mu Ci = 2.2 \times 10^6$ DPM

EFFICIENCY = CPM / DPM

DPM = CPM / EFFICIENCY

CPM = Counts Per Minute
DPM = Disintegration Per Minute

5. Biannual Wipes & Surveys

Shall be conducted of all facilities in which radioactive materials or instrumentation that generates ionizing radiation is used. The school RSO shall conduct this process. Results will be posted for review. Areas to be wiped and surveyed are both restricted and unrestricted regions.

6. Unannounced Inspections

The RSO or his designee has the right to conduct periodic reviews or walkthroughs of any laboratory or facility in which radioactive material or radiation is used.

7. Annual Inspections

Inspections will occur at least annually and may or may not be announced. The procedure for this process will follow the **Standard Operating Procedure** listed below. In addition, the forms identifying categories and items reviewed are provided below.

Authorized Users (AU)

All AUs who are currently using, have used in the past year or have a current inventory will be inspected annually. The following form is used during the inspection.

Internal Radiation Safety Laboratory Inspection Form *(see below)*

Radiation Safety Office

The Radiation Safety Office for each school / campus will be inspected annually using the **Internal Radiation Safety Office Inspection Form** below

Standard Operating Procedure for Internal Radiation Safety Inspections

1. All radioactive material users and school / campus radiation safety offices will be inspected once a year.

2. It is preferable to have the licensed Authorized User (AU) present during the inspection in order to answer any questions regarding policy or procedure. If this is not possible, a trained technician / user of radioisotopes is the second choice. If neither are available, the RSO, (Radiation Safety Officer) for that school shall act as their representative.

3. Laboratories will be inspected utilizing the Internal Radiation Safety Laboratory Inspection Form. Radiation safety offices will be inspected utilizing the Internal Radiation Safety Office Inspection Form. Inspections will include the following: record review, isotope storage, general safety & laboratory procedures, laboratory postings, laboratories, and storage facilities. In addition, wipe tests will be conducted as part of the inspection process.

4. Inspections will either be announced or unannounced.

5. Minor deficiencies that can be corrected during the inspection will be noted as such on the inspection form as well as the inspection report.

6. Minor deficiencies that cannot be corrected during the inspection will be noted on the inspection form as well as the inspection report.

7. Major deficiencies would be considered acts that are in direct violation of the University's Radioactive Material License. All major deficiencies will be reported.

8. Inspection reports will be generated utilizing the Internal Radiation Safety Laboratory/Office inspection forms.

9. Formal reports will be issued to the following by the inspecting RSO:
   RSO of the school / campus
   Investigator
   Chairman of the department and or Research Coordinator
   Institutional Radiation Safety Committee
   Associate VP for University Research and Biosafety

10. Reports will be issued to the parties listed above with in 10 days to 2 weeks of the inspection.

11. Investigators with deficiencies, minor or major, will take corrective actions and report them to the RSO who conducted the inspection in writing or via electronic mail within the specified time, typically 10 days to 2 weeks.

12. Failure to respond to the deficiencies will result in further action from the Institutional Radiation Safety Committee. See sec. IV.

13. The RSO is responsible for retaining the report and corrective actions.

Internal Radiation Safety Laboratory Inspection Form

Investigator: _____ **Date:** _____
Building/Room: _____ **Signed:** _____
Satisfactory = S
Minor Deficiency Corrected = MC
Minor Deficiency Uncorrected = MU
Major Deficiency = MD
NA =Not applicable

A. Records	**S**	**MC**	**MU**	**MD**	**NA**
1. Survey diagram available	___	___	___	___	___
2. Monthly surveys up to date	___	___	___	___	___
3. Contamination below acceptable levels, i.e. background	___	___	___	___	___
4. Quarterly inventories to date	___	___	___	___	___
5. Receipt / Use logs to date	___	___	___	___	___
6. Sewer / Drain logs to date	___	___	___	___	___
B. Laboratory Postings					
1. Radiation Warning signs posted at all entrances	___	___	___	___	___
2. Standards for Protection Against Radiation posted at all entrances	___	___	___	___	___
3. Emergency contacts & phone numbers posted at all entrances	___	___	___	___	___
4. Dosimetry report posted	___	___	___	___	___
5. No eating, drinking, or smoking signs posted in restricted area	___	___	___	___	___
C. Isotope Storage					
1. Lab locked when personnel are not present	___	___	___	___	___
2. Materials securely stored in lab	___	___	___	___	___
3. Storage unit &radioactive materials labeled properly	___	___	___	___	___
4. Radioactive materials accurately reflect records	___	___	___	___	___
5. Food / products for human consumption not stored in lab refrigerator	___	___	___	___	___
D. General Safety & Laboratory Procedures					
1. Film badges, TLD rings as needed	___	___	___	___	___
2. Lab coat & gloves on if working in the laboratory	___	___	___	___	___
3. No eating, drinking, or smoking in restricted area	___	___	___	___	___
4. Radioisotope use area delineated by special markings	___	___	___	___	___
5. Work area lined with adsorbent material	___	___	___	___	___
6. All equipment & sinks used with radioisotopes labeled	___	___	___	___	___
7. Use of remote handling devices available when working with hard beta / gamma isotopes	___	___	___	___	___
8. Proper shielding for type of radioisotopes used	___	___	___	___	___
9. GM available for use/ proper calibration date	___	___	___	___	___
10. Proper storage and labeling of all radioactive waste	___	___	___	___	___
11. Other	___	___	___	___	___

E. Surveys, and or Wipe Tests - see attached
Inspection performed by (signature) :
Name: _____
Phone number: _____
E-mail address: _____

Internal Radiation Safety Office Inspection Form

RSO: _____ **Date:** _____
Building/Room: _____ **Signed:** _____
Minor Deficiency Corrected = MC
Minor Deficiency Uncorrected = MU
Major Deficiency = MD
NA =Not applicable

	S	MC	MU	MD	NA
A. Records					
1. Biannual surveys performed for restricted & non-restricted areas	___	___	___	___	___
2. Biannual surveys w/i acceptable ranges, & or corrective actions taken	___	___	___	___	___
3. Quarterly inventories to date	___	___	___	___	___
4. Annual sewer reports to date	___	___	___	___	___
5. Receipt, transfer, & disposal records on file	___	___	___	___	___
6. Personnel radiation monitoring (dosimetry) records in order	___	___	___	___	___
7. Declaration of pregnancy records in order	___	___	___	___	___
8. Training records in order	___	___	___	___	___
9. Annual training up to date	___	___	___	___	___
10. Meter calibrations performed annually	___	___	___	___	___
11. Annual meter calibration certificates on file	___	___	___	___	___
12. Copy of license, & state regulations on file	___	___	___	___	___
13. Sealed source leak tests available	___	___	___	___	___
B. Laboratory Postings					
1. Radiation Warning signs posted at all entrances	___	___	___	___	___
2. Standards for Protection Against Radiation posted at all entrances	___	___	___	___	___
3. Emergency contacts & phone numbers posted at all entrances	___	___	___	___	___
4. Dosimetry report posted	___	___	___	___	___
5. No eating, drinking, or smoking signs posted in restricted area	___	___	___	___	___
C. Waste Room					
1. Radiation Warning signs posted	___	___	___	___	___
2. Standards for Protection Against Radiation posted	___	___	___	___	___
3. No eating, drinking, or smoking signs posted in restricted area	___	___	___	___	___
4. Emergency contacts & phone numbers posted at all entrances	___	___	___	___	___
4. Dry solid waste labeled properly & stored in containers	___	___	___	___	___
5. Liquid waste labeled properly & stored in secondary containers	___	___	___	___	___
D. Iodination Room					
1. Radiation Warning signs posted	___	___	___	___	___
2. Standards for Protection Against Radiation posted	___	___	___	___	___
3. No eating, drinking, or smoking signs posted in restricted area	___	___	___	___	___
4. Area meter calibration up to date	___	___	___	___	___
5. Air samples taken and recorded monthly or after each use	___	___	___	___	___
6. Fume hood on, face velocity within range (150-200 LFM)	___	___	___	___	___

Inspection performed by (signature) :
Name: _____
Phone number: _____
E-mail address: _____

H. Storage of Radioactive Materials

1. Responsibility

The AU is responsible for the proper storage and security of all radioactive materials and or instruments that generate ionizing radiation. In addition, it is required that the location of all-stock solutions or instruments be identified in the Radioisotope Receipt/ Use log. This can be accomplished on the Quarterly inventory form or as a separate document in a central radiation log or notebook that remains in the laboratory.

2. Requirements

*********All radioactive materials must be kept secure at all times. This requires that all research labs, storage areas, or rooms in which any radioactive material or instruments that generate ionizing radiation are kept locked when they are not occupied. See section IV.**

Stock: All stock solutions shall be kept secured unless the responsible individual is in attendance.

Waste: All waste that has been used with or is contaminated with radioactive material must be treated as radioactive waste. See Appendix A Labeling Requirements.

I. Radioactive Waste

1. Classification

All material that is used directly with radioactive materials is considered to be waste. It is not acceptable to mix radioisotopes in the same container unless they have a similar half-life. ***The only time that it will be permitted to combine radioisotopes is if the protocol requires more than one radioisotope to be used in the same experiment***. The form and the isotope of the waste will determine storage and disposal methods. Waste categories will be described by the half-life of the radioisotope.

Radioisotopes with a half-life > 100 days

Radioisotopes with a half-life greater than 100 days must be shipped out for disposal, with the exception of aqueous liquid waste such as ^{3}H or ^{14}C.
The radioisotopes that Mercer University is licensed to use which fall into this category are:
^{109}Cd , ^{22}Na, ^{3}H, ^{14}C, ^{90}Sr, , ^{36}Cl, ^{45}Ca

Radioisotopes with a half-life < than 100 days

Radioisotopes with a half-life less than 100 days are held in storage for decay for a period of at least 10 half lives. The radioisotopes, which fall into this category, are:
^{32}P, ^{33}P, ^{125}I, ^{35}S, ^{51}Cr, ^{203}Hg, ^{67}Ga, ^{123}I, ^{131}I, ^{111}In, ^{99}Mo, ^{86}Rb, ^{99m}Tc, ^{201}Tl,

All radioactive labels or symbols must be destroyed or obliterated prior to being placed in the waste. Waste will not be accepted if this has not been successfully completed.

2. Storage

Note: Waste that creates undue radiation exposure or clutter or cannot be secured should not be stored in the AU's lab. It is preferable to remove the waste frequently to provide the safest working environment for all laboratory personnel. The RSO is responsible for decay in storage or for storage of the waste until it is shipped out.

All containers used to store radioactive waste must be identified as: **Caution Radioactive Material** and properly labeled**. See Appendix A**. Storage containers must be capable of shielding radiation that is generated by the particular waste. Or the container must be shielded in an enclosure that is capable of providing the necessary barrier. In addition, distance to the radiation work area and worker should be considered to further reduce any unnecessary exposure.

Note: See Appendix A for all labeling requirements.

a. Solid Waste:

Shall be stored in lined, heavy gauge containers. Consult with RSO for appropriate container material. Due to the very high energy emitted from ^{32}P, all waste should be stored in plexi-glass or lucite containers. Waste must always be labeled in accordance with the labeling requirements as specified in Appendix A. The container must be kept closed at all times unless in use. Glass and /or household containers are not acceptable for waste storage.

b. Liquid Waste:

Shall be stored in a chemical resistant plastic bottle with cap on. **No empty food containers or household containers are allowed!** The primary container must be held in a secondary container that is capable of containing the liquid in the primary container. The container must be kept closed at all times unless in use. Glass and /or household containers are not acceptable for waste storage.

c. Liquid Scintillation Vials (LSV): Note only Biodegradable LS Cocktail is recommended.

LSVs must be stored separately from all other waste, in plastic pails, or trashcans with a lid. The AU may use cardboard trays for storage. However, these will not be accepted by the RSO as appropriately packaged for waste disposal.

LSVs containing $\leq$ 0.05uCi / gm of medium of either ^{3}H or ^{14}C can be disposed of as Deregulated LSV's. These may be stored in the same container.

LSVs containing radioisotopes other than ^{3}H or ^{14}C must be stored separately. LSVs containing isotopes with a half-life < 100 days will be decayed in storage by the RSO, then shipped out with the Deregulated LSVs.

d. Sharps Containers

All "sharps" (syringes, needles, scalpel blades, etc.) that are contaminated with radioactive material shall be placed in a sharps container. Sharps must be properly identified: **Caution Radioactive Material.** Sharps containers must be stored behind the proper shielding if external exposure is present at the surface of the container.

Use separate sharps containers for each radioisotope used. Do not mix radioisotopes in sharps!

e. Animal: Carcasses, tissues, waste products, bedding, cages, and racks

See SOP for Animal Protocols Utilizing Radioactive Materials**:**

Carcasses / Tissues

Must be stored in plastic bags that are capable of containing all body fluids. Grocery bags are not suitable containers. Ideally, carcasses must be stored separately by radioisotope. Carcasses should be turned over to the RSO for storage and disposal. Animal carcasses are disposed of in the same manner as solid waste.

Note: Animal carcasses containing $\leq$ .05uCi of ^{3}H , ^{125}I, or ^{14}C per gram of tissue, which is averaged over the weight of the entire animal may be disposed as non radioactive.

Waste Products: Urine, Feces

Urine must be stored in a chemical resistant plastic bottle with a cap. **No empty food containers or household containers are allowed!** The primary container must be held in a secondary container that is capable of containing the liquid in the primary container. The container must be kept closed at all times unless in use. In addition the container should be stored to properly shield any external radiation exposure. Glass and /or household containers are not acceptable for waste storage. Store the container behind shielding if external exposure is evident.

Feces should be treated as solid waste.

Bedding / Cages / Cage Racks

All cages used to house animals that have been dosed with radioactive materials must be handled as potentially radioactive. All bedding should be surveyed prior to removal. If survey results reveal contamination, dispose of as radioactive waste. If survey results reveal no contamination, the material may be disposed of as solid waste. Wipe and survey the cage, rack and tray. If no removable contamination is found, proceed with animal care SOP for cleaning cages. If radioactive

contamination is found, the cages must be decontaminated with a commercial de-con agent (e.g. Lift-Away). Rewipe and survey to document that any contamination has been removed. Once wipe test results ensure that the cage is not contaminated with radioactive materials it may then be released to the animal care staff to commence normal cleaning procedures. Document all wipes, surveys, clean up and corrective action.

f. Biohazardous waste: AU's must receive permission prior to generating any biohazardous waste.
Previous solid and liquid waste rules apply. In addition the waste must be identified with the Biohazard symbol. The RSO will remove the waste from the AU's lab; hold it for decay in storage, and dispose of it according to disposal procedures. Waste will be autoclaved once it has decayed.

3. Disposal Procedure

The following process is standard disposal process for radioisotopes with **T ½ < 100 days**. This process is to be completed by the RSO once the waste has been released to him or her.

1. Contact RSO for waste pickup once the properly labeled container is closed from further use.
2. Waste is stored in the Radioactive Materials Waste Storage facility.
3. Enter waste receipt information into the HP Assistant database.
4. Store for the calculated 10 half-life (T ½) period.
5. At the end of 10 half lives, survey the waste to verify that radiation exposure is at or below ambient background levels.
6. Obliterate or remove all radiation labels, signs, and wording prior to disposal.
7. Enter pertinent information into the HP Assistant Program including date, RSO name, waste, meter used, calibration date, background, and survey results.
8. The waste is now treated as non-radioactive waste and can be disposed of in the normal waste stream.

a. Solid Waste:
T ½ < 100 days: Decay in storage follow procedure outlined above.
T ½ > 100 days: Ship out to authorized broker for disposal.

b. Liquid Waste:
T ½ < 100 days: Decay in storage follow procedure outlined above.
T ½ > 100 days: Ship out to authorized broker for disposal.
***Liquid waste containing ^{3}H, ^{14}C, ^{35}S in a soluble aqueous form may be disposed of in the sewer if activity is sufficiently low – see RSO for acceptable levels.**
Please refer to the SOP for Sewer Disposal of Water Soluble Aqueous Liquid

c. Liquid Scintillation Vials (LSV)
LSVs are shipped out for disposal. See section III. . I. 2.c.

d. Sharps Containers
T ½ < 100 days: Decay in storage follows procedure outlined above to step number 6. Once completed, the sharps will be placed in the Biohazard box for incineration with other biohazard items.
T ½ > 100 days: Ship out to authorized broker for disposal. Disposal is according to their guidelines.

e. Animal
T ½ < 100 days: Decay in storage follows procedure outlined above. Once process has been completed, the carcasses are released to the Animal Care Staff and are incinerated along with other research carcasses.
T ½ > 100 days: Ship out to authorized broker for disposal. Disposal is according to their guidelines.
Note: Animal carcasses containing ≤ .05uCi of ^{3}H , ^{125}I, or ^{14}C per gram of tissue, which is averaged over the weight of the entire animal may be disposed as non radioactive.

f. Biohazardous
T ½ < 100 days: Decay in storage follows procedure outlined above to step number 6. Once completed, the biohazardous material will be autoclaved and then disposed of as normal waste.
T ½ > 100 days: Ship out to authorized broker for disposal. Disposal is according to their guidelines.

J. Spills, Emergencies, and Personnel Decontamination refer to Appendix B and C

K. Record Keeping Requirements

1. **Wipe Tests:**
   Definition: ***the wiping of a 100 cm^2 area with filter paper, cotton tipped applicator, or other suitable material in order to detect the presence of removable contamination.***

   Wipe tests shall be conducted within the half-life of the radioisotope or monthly which ever comes first. A diagram identifying the zones to be wiped must be on file in laboratory. The results must be kept on file, signed and dated with the original print out (if available) from the instrument used to process the wipe tests. A background or blank must always be run with the samples. The documentation shall include: date, individual performing wipe test, radionuclide, instrument used, serial number, calibration date, back ground results (cpm/dpm), action level (cpm/dpm), wipe location (cpm/dpm) and corrective actions taken and rewipes if needed.

2. **Receipt / Use Log** **See III. E.**
   Upon receipt of radioactive materials the AU will be issued a Radioisotope Receipt/ Use Log that will have all pertinent information applicable to that particular radioisotope. One side of this form provides basic receipt information, as well as an area to record use. It is imperative that the AU maintains complete records documenting all use in units of radioactivity and or volume. The reverse side of the form provides the user with a method of tracking waste generated from the use of the radioactive material. Complete use and disposition of the material must be documented in this section. Package receipt information, use log, and waste log information is to be maintained on this form. This form is available in section VI.

3. **Sewer disposal log**

   ******ONLY THE FOLLOWING ISOTOPES ARE ALLOWED TO BE DISPOSED VIA THE SEWER AT THE DISCRETION OF THE RSO: ^{3}H, ^{14}C, ^{35}S***

   Prior to disposal of Water Soluble Radioactive Liquid Waste, the AU, technician or designee is required to complete the Sewer Disposal of Water Soluble Radioactive Liquid Waste form. This form must be signed and approved by the RSO prior to any sewer disposal. This form is available in section VI.

4. **Quarterly Inventory report**
   The State of Georgia Department of Natural Resources requires that an inventory report be completed each quarter. This report must account for all activity from the prior quarter. In addition, the report should identify where each stock vial is located. The RSO will provide each AU a print out of their prior quarterly inventory report according to the RSO's records. The AU is responsible for reviewing this document and ensuring its accuracy. In addition, the AU is responsible for reporting all activity during the last quarter.

   An example of a quarterly inventory report and directions for completing it are available in Appendix D.

L. Information on commonly used radionuclides: ^{32}P ^{35}S ^{3}H ^{14}C ^{125}I ^{51}Cr

Radioisotope	T 1/2	Decay mechanism	Maximum energy	Contamination monitoring	Shielding	Dosimetry
^{32}P	14.3 days	Beta (-) emission	1.709 MeV	GM, Liquid scintillation counter –wipes	Lucite & lead	Personal dosimeter, ring –TLD
0 ^{35}S	87.4 days	Beta (-) emission	0.167 MeV	Thin window GM, scintillation counter –wipes	Lucite	Urinalysis bioassay
1 ^{3}H	12.3 years	Beta (-) emission	0.019 MeV	Liquid scintillation counter –wipes	Glass, plastic	Urinalysis bioassay – when working w/ 100mCi or >
^{14}C	5730 years	Beta (-) emission	0.156 MeV	Thin window GM, scintillation counter –wipes	Glass, plastic	Urinalysis bioassay
^{125}I	60.1 days	Gamma Electron Capture(EC)	γ = 0.035 Mev (9.8%) αXrays=0.027MeV(112.5%) βXrays=0.031MeV(25.4%) E_{max}=0.177 MeV	Thin crystal NaI detector	Lead	Personal dosimeter, ring-TLD, thyroid bioassay
^{51}Cr	27.7 days	Gamma EC	γ = 0.320 Mev (6.5%) Xray=0.005MeV(22.3%) Auger Electron= 0.004MeV (66.9%)	Thin crystal NaI detector	Lead	Personal dosimeter, ring-TLD,

Note : These are only a sample of the most commonly used radioisotopes.
Refer to Handbook of Health Physics and Radiological Health, Third Addition, edited by Bernard Shleien, Lester Slaback, Jr., and Brian Kent Birky Copyright 1998

TLD Thermoluminescence dosimeter

M. Working Safely with Radioactive Materials

1. Attire

While working with radioactive materials, appropriate clothing optimizes personnel safety. **Knee length laboratory coats, gloves, and monitoring badges are mandatory. Eye protection is encouraged.** Therefore the following items are not permitted: **open toed shoes, sandals, high-heeled shoes, or shoes that do not have non-skid soles, and shorts.**

For additional information and guidance please refer to the Science Laboratory Operations manual.

Personal dosimeters
It is mandatory that dosimeters (film badges, TLD badges, etc.) be worn at all times when working with radioactive material or working in an area where radioactive material is used. Badges should be worn at the chest or waist level depending on how you handle radioactive material and **on the outer most layer of clothing**. Placement of the badge is important and should be determined prior to commencing work with radioactive materials. Consult with RSO for appropriate placement for your situation. Badges / rings are to be stored in a designated area when it is not being worn.

Personal dosimeters must only be worn when working with radioactive materials or ionizing radiation or when you are in a signed restricted area!

2. Personal Protective Equipment (PPE)

Laboratory coats
Laboratory coats or other protective clothing must be worn while working in the research laboratory where radioactive material is used or stored. Knee length coats are preferred and must be buttoned.

Gloves
Disposable gloves are to be worn while working with unsealed sources radioactive material. Gloves may be doubled in order to reduce the risk of contamination. The practice of double gloving is strongly recommended when using millicurie amounts of radioactivity.
Gloves are to be removed prior to entering a non-restrictive area.

Eye / Face protection
Safety eyeglasses, goggles, or face shield is recommended as needed while working with radioactive materials.

3. Identification of work areas and equipment

Laboratories:
All laboratories or rooms in which work with radioactive materials occurs or rooms which house equipment or instruments which generate ionizing radiation must be clearly identified at the entrance with a sign noting: CAUTION RADIOACTIVE MATERIAL or CAUTION HIGH RADIATION AREA. Consult with the RSO for appropriate signage. Access to restricted areas is for authorized personnel only. These areas must be secured or locked when authorized personnel are not present.

Work surfaces:
Work areas and equipment which are used for work with radioactive materials must be clearly identified with radioactive material tape, or "Caution, Radioactive Material" tags. Yellow and magenta colored tape may also be used to identify work areas and equipment. All work surfaces should be lined with absorbent poly-backed disposable paper. The poly-backed side should be down with paper side up.

Waste containers
Radioactive waste containers must be placed in an area that is clearly outlined or identified as radioactive material. In addition, adsorbent material or poly-backed paper must be placed under all storage or waste containers to contain any contamination, which may be accidentally released. ****Radioactive waste containers must also be identified as containing radioactive material.

Equipment:
Any piece of equipment, whether it be a refrigerator or a pencil, which is used while working with radioactive materials, must be identified with radioactive material tape, yellow or magenta colored tape, or labels that identify it as "Caution, Radioactive Material". In addition, these materials **should never** be found outside of a "caution, radioactive material" area. All items that are used with or while working with radioactive material should be regarded as contaminated.

4. Time, Distance and Shielding are three factors affecting external exposure.

Time
The longer you are exposed to radioactive materials or radiation, the greater your exposure will be. When working with radioactive materials it is extremely important to use time effectively and efficiently.

Distance
The greater the distance between a person and a source will result in less exposure. Use remote handling devices such as tongs or hemostats to increase the distance and reduce the exposure. **The Inverse Square Law**: double the distance from a source, reduces the exposure by ¼.

Shielding
Shielding is the easiest and most practical method of reducing exposure. Use shielding whenever possible; such as bench top shields constructed of either plexi-glass, Lucite, or lead lined; storage boxes for stock solutions; storage boxes for pipette tips or other materials which have high activity; waste (liquid and solid) should also be stored in an appropriate shielded container. Appropriate shielding is specific to the type of radiation. One half-value layer (HVL) will reduce the exposure by 50 %. 10 HVL approximately reduces the exposure by a factor of 1000 (1/1000 or 0.001). Consult the RSO for appropriate shielding and thickness

5. Laboratory Rules

- Optimize Time, Distance and Shielding to reduce personnel exposure.
- Before the procedure is actually performed with radioactive material, perform a "dry run" or practice run prior to performing the experiment with radioactive materials. This will optimize the Time, Distance and Shielding approach to reducing exposure.
- Absolutely no food or drink allowed in the laboratory.
- Application of cosmetics is prohibited in the laboratory.
- Never pipette by mouth.
- Wear a buttoned laboratory coat or other acceptable protective clothing at all times while working in the laboratory.
- Wear a film badge or other issued dosimeter while working in the research laboratory. This badge must be placed at chest or waist level.
- Wear a ring badge while working with high-energy beta or gamma emitters.
- Wear disposable gloves, preferably double gloves, while working with radioactive materials. Gloves must be removed when leaving the work area.
- Wear protective eyewear or face shield when appropriate while working with radioactive material.
- Always monitor hands, feet, and clothing prior to leaving restricted areas. If contamination is found, decontamination must be performed immediately.
- Line work area with poly-backed absorbent material.
- Identify work area with acceptable radioactive material labels or tape.
- When possible and practical shielding should be utilized. In addition, remote-handling devices should be used. This will reduce personnel exposure.
- Contain and confine all radioactive material, solutions, and or waste-solid or liquid, in covered containers that are labeled as radioactive material, identify radioisotope, activity, date and investigator, and in-house number.
- Transport radioactive materials using a cart and appropriate shielding and or secondary containers.
- Perform contamination and laboratory surveys as directed by the project protocol.

N. Decommissioning of Instruments / Equipment / Laboratory

It is mandatory that any instrument, equipment or laboratory space that has been used for work with radioactive materials be decommissioned prior to releasing it as non-radioactive.

Decommissioning requires that the instrument, equipment or area be thoroughly cleaned of all potential contamination. To achieve this task, the item or area must first be wipe tested, next the item or area must be cleaned with a de-con agent if results show evidence of contamination, and finally, if contamination was present the item or area must be cleaned until contamination is no longer present. This information must be retained for documentation. In addition, if contamination still exists the area must continue to be cleaned with a de-con agent until levels are below the sited action levels. If this can not be achieved, notify the RSO.

All decommissioning information must be retained in the radiation log with surveys, signed and dated.

O. Pregnancy

Any woman who becomes pregnant while working in a restricted radiation area has the option of declaring her pregnancy in writing to the RSO. This formal declaration of pregnancy sets radiation limits for the embryo / fetus of the pregnant woman. At this time, the RSO will request that the pregnant woman declare this pregnancy in writing, with an estimated date of conception. This information is required in order to determine the fetal monitoring period, i.e. the time of declaration to birth. The declared pregnant woman will be issued a fetal badge that is to be worn at waist level while working in an area in which radioactive materials are used. In addition, the RSO can provide additional information concerning radiation and pregnancy.

If a worker is planning a pregnancy and has concerns regarding potential biological effects on the embryo / fetus, they may wish to discuss these concerns with the RSO in advance. The RSO can provide them with additional training and information addressing radiation workers and pregnancy.

A declared pregnant woman can not exceed exposure limits of 500 mRem for the entire gestation period. In addition, their exposure should not exceed 50 mRem /month.

P. Special requirements for working with Radioiodine

Working with volatile or dispersible ^{125}I and ^{131}I requires compliance with the guidelines set forth in the NRC Regulatory guide 8.20 Applications of Bioassay for ^{125}I and ^{131}I be followed.

- Any individual handling 1 mCi of unsealed, volatile, radioactive iodine or sufficiently close to the process should participate in the thyroid bioassay program.
- Baseline Thyroid Bioassay: Prior to commencing work with material.
- Routine Thyroid Bioassay: Bioassay should be performed no sooner than 6 hours after the exposure, but within 10 days from the exposure.

It is the responsibility of the Authorized User to ensure that all individuals who meet these qualifications participate in the bioassay program. It is the responsibility of the Radiation Safety Officer to conduct the baseline and routine thyroid bioassays and retain all results.

Radiolabeling procedures must be performed in the Radiolabeling Room located on the first floor in the East Wing of the School of Medicine. See RSO to obtain a copy of the standard operating procedure for the use of this facility.

IV. Violations of Policies and Procedures

1. Definition of Violation
A deficiency of radiation safety program requirements and license conditions.

2. Examples, not totally inclusive:
Failure to: perform routine wipe test, contamination surveys or complete quarterly inventory reports; or eating, drinking or application of personal care products in the laboratory.

3. Actions to be taken

First Offense
Authorized User (AU) will be notified in writing of the violation by the Radiation Safety Officer(RSO) or University Radiation Safety Officer (URSO). Notification will include instruction addressing proper procedures, and requirements for corrective actions. The AU will have 10 working days to correct all violations and respond in writing as to how the violations were corrected.

Second Offense
The AU will be notified in writing of the violation by the URSO. Notification will include all necessary corrective actions. The Institutional Radiation Safety Committee (IRSC) and the AU's Department Chair will be copied as well. The AU will have 10 working days to respond to the URSO in writing, acknowledging the notification and how the corrective actions were implemented. At a given time after the violation, the URSO will re-inspect the laboratory to verify that all previous violations have been corrected.

Failure to respond or comply with the corrective actions for the first or second offense will immediately result in the following:

1. ***Cessation of usage, i.e. confiscation of stock solutions***
2. ***Cessation of procurement of materials***
3. ***Re-training of AU and all lab personnel***

V. Personnel Monitoring

Mercer University has established its dose limits based on the dose limits recommended by the National Council on Radiation Protection (NCRP) and the Nuclear Regulatory Commission and Agreement States. The following guidelines provide the necessary information for determining the need for personnel monitoring. All dosimeters are provided and processed by a commercial company which meets the certification requirement of the Technology National Voluntary Laboratory Accreditation Program (NVLAP).

- If an **adult** is likely to receive an external radiation dose in excess of 10 % of the total occupational dose limit of **5000 mRem** in one year, the institution is obliged to provide a personal dosimeter.

- If a **minor**, under the age of 18 years old, or a **declared pregnant woman**, is likely to receive and external radiation dose in excess of 10 % of their occupational dose limit of **500 mRem,** the institution is obliged to provide a personal dosimeter.

Note: If other individuals who may be periodically exposed to radiation wish to be monitored, such as maintenance or delivery personnel, they should be advised to meet with the RSO to discuss this option. Typically, the individual will be badged for a period of 6 months to determine the need for continuing the monitoring.

A. Responsibility

1. Authorized User (AU)

It is the responsibility of the AU to identify all radiation workers to the RSO. Once the RSO has been notified, it is the duty of the RSO to determine the need for monitoring devices and to provide the radiation worker with the necessary monitoring device(s).

2. Radiation worker

It is the responsibility of all radiation workers to always wear their dosimeter in the research laboratories at the chest or waist level. In addition, if a ring badge has been issued it is required that it be worn when working with radioactive material. All dosimeters shall be stored outside the laboratories in a designated area, or other appropriate location when they are not being worn.

3. Radiation Safety Officer (RSO)

The RSO is responsible for training all radiation workers and providing them with the necessary dosimeters in a timely manner. The RSO must attempt to obtain previous exposure history on any new radiation worker who has been previously monitored elsewhere. In addition, the RSO is responsible for providing the radiation worker with a cumulative annual exposure report.

B. **ALARA = A**s **L**ow **A**s **R**easonably **A**chievable

Mercer University is committed to maintaining exposure levels as low as reasonably as achievable to all personnel within practical and economical limits. This commitment is accomplished in the following manner:

INSTITUTIONAL RADIATION SAFETY COMMITTEE (IRSC) through program review.

RADIATION SAFETY OFFICER (RSO) achieves this through monthly, and annual review of all exposures. In addition, the RSO presents the ALARA Program in all orientation and refresher training with radiation workers.

AUTHORIZED USER (AU) fulfills their commitment by evaluating their procedures, properly training their workers and their commitment to maintaining exposures ALARA in their labs.

RADIATION WORKERS carry through their commitment by properly using personnel monitoring dosimeters, protective clothing and shielding when necessary. Workers achieve the ALARA assurance by performing instrument and wipe surveys in a timely manner, in order to detect unexpected contamination that could lead to additional exposure.

C. Dose Limits

As an integral part of the ALARA program, Mercer University is committed to maintaining all exposure as low as reasonably achievable. In addition, every effort will be made to determine the reason for the exposure, as well as trying to eliminate this occurrence in the future.

The following are dose limits that have been established by the National Council on Radiation Protection (NCRP) and the Nuclear Regulatory Commission and Agreement States

1. Occupation Dose Limits

SITE	LIMIT (mrem/yr)
Whole Body	5000
Lens of Eye	15000
Extremities/Skin	50000
Pregnant, Fetus	500 mrem/term

2. Occupational Dose Limits For Minors

* limits are 10 % of the occupational dose limits

SITE	LIMIT (mrem/yr)
Whole Body	500
Lens of Eye	1500
Extremities/Skin	5000

3. Pregnant Workers / Fetal Dose Limits

*Women who declare their pregnancy in writing have the following dose limits:
500 mRem /term; and 50 mRem per month.

4. Non-Occupational Dose Limits / Members Of The Public

100 mRem per year
Note: This figure represents exposure from terrestrial, celestial, and medical sources such as x-rays.

D. Bioassay Program

Bioassays are performed to measure internal exposure doses. Bioassays determine kind, concentration, and location of material in the body. The most common type of bioassay performed measures material that is excreted from the body such as urine. Another common type of bioassay is the thyroid bioassay for detecting the uptake of radioiodine. The need for bioassays is determined during the protocol / project review of the URSO and IRSC. However, other circumstances may require that bioassays are performed; the RSO or URSO can determine this. The following are two common bioassays that are performed.

Tritium Bioassay

Individuals working with 100 mCi or more of an unsealed form of ^{3}H are required to have a bioassay by urinalysis performed with in one week following a single operation and at weekly intervals for continuing operations.

Bioassay by urinalysis must be performed whenever a radiation worker is likely to receive in one year, an intake in excess of 10 % of the Annual Limit on Intake (ALI) for ^{3}H which is 8 mCi.

Thyroid Bioassay

Individuals working with volatile or dispersible ^{125}I and ^{131}I are required to participate in the thyroid bioassay program as per the NRC Regulatory Guide 8.20 Applications of Bioassay for ^{125}I and ^{131}I, Revision 1 September 1979. Listed below are a few key points that are applicable to the thyroid bioassay program. This reference is available upon request.

- Any individual handling 1 mCi of unsealed, volatile, radioactive iodine or sufficiently close to the process should participate in the thyroid bioassay program.
- Baseline Thyroid Bioassay: Prior to commencing work with material.
- Routine Thyroid Bioassay: Bioassay should be performed no sooner than 6 hours after the exposure, but within 10 days from the exposure.

VI. Forms

***** Please note that the forms have not been included in the PDF version of the Radiation Safety Manual. They are available on the web.**

Directory

1. Application for Permit to Use Radionuclides
2. Statement of Training and Handling Experience
3. Request for Personnel Monitoring
4. Occupational Radiation Exposure History
5. Annual Occupational Radiation Exposure
6. Prenatal Exposure Statement
7. Declared Pregnant Woman Information
8. Declaration of Pregnancy
9. Radioisotope Receipt / Use Log
10. Use & Waste Log Page 2
11. Transfer of Radioactive Material
12. Sewer disposal for Radioactive Water Soluble Liquid Waste
13. Internal Radiation Laboratory Safety Inspection
14. Internal Radiation Safety Office Inspection
15. Wipe & Survey

VII. Appendix

A. LABELING REQUIREMENTS

1. Storage

Stock

Each stock vial must be labeled with the following information: Inventory #, Radionuclide, AU, Date, Activity, & Chemical form. This label is also required to be visible on the outside storage unit such as a refrigerator or cupboard, in the approximate location of where it can be located inside.

Samples

All samples which contain radioactive material must also be labeled with the following information: Inventory #, Radionuclide, AU Name, Date, Activity, & Chemical form. This label is also required to be visible on the outside storage unit such as a refrigerator or cupboard, in the approximate location of where it can be located inside. A similar label may be used inside the storage container to further identify the location. **Note:** If samples are stored in a single unit, for example a box, it is acceptable to only label the box, rather than each tube.

Waste

All waste that has been used with or is contaminated with radioactive material must be treated as radioactive waste. Waste must also be labeled with the following: Inventory #, Radionuclide, AU, Final Activity, & Chemical form and Start date and Closed date.

2. Waste & Waste Containers

Waste must always be labeled with the following: AU, start date, radionuclide, final activity, inventory number(s), chemical form, date closed. The container must be kept closed at all times unless in use. Glass containers and /or household containers are not acceptable for waste storage.

Radioactive waste containers must also be identified with labels stating: Caution Radioactive Material or Radioactive Material.

3. Laboratory

Laboratories:

All laboratories or rooms in which work with radioactive materials occurs or rooms which house equipment or instruments which generate ionizing radiation must be clearly identified at the entrance with a sign noting: CAUTION RADIOACTIVE MATERIAL or CAUTION HIGH RADIATION AREA. Consult with the RSO for appropriate signage. Access to restricted areas is for authorized personnel only. These areas must be secured or locked when authorized personnel are not present.

Work surfaces:

Work areas and equipment which are used for work with radioactive materials must be clearly identified with radioactive material tape, or "Caution, Radioactive Material" tags. Yellow and magenta colored tape may also be used to identify work areas and equipment. All work surfaces should be lined with absorbent poly-backed disposable paper. The poly-backed side should be down with paper side up.

Equipment:

Any piece of equipment, whether it be a refrigerator or a pencil, which is used while working with radioactive materials, must be identified with radioactive material tape, yellow or magenta colored tape, or labels that identify it as "Caution, Radioactive Material".

B. EMERGENCY PROCEDURES

In the event of an accident involving the release of significant quantities of radioactive material, the objectives of all remedial action are to:

a. Minimize the amount of radioactive material entering the body by ingestion, inhalation, or through any wounds.

b. Prevent the spread of contamination from the area of the accident.

c. Remove radioactive contamination on personnel.

d. Start area decontamination procedures under qualified supervision. Inexperienced personnel should not attempt unsupervised decontamination.

1. Minor Spills: A minor spill is defined as equal to a less than 1.0mCi.

a. Notify persons in the area that a spill has occurred.

b. Put on gloves to prevent contamination of hands. (Wash hands first if they are contaminated as result of accident.)

c. Drop absorbent paper or cloth on spill to limit spread of contamination.

d. Mark off contaminated area. Do not allow anyone to leave contaminated area without being monitored.

e. Notify the radiation safety officer of the accident.

f. Start decontamination procedures as soon as possible. Normal cleaning agents should be adequate. Keep cleaning supplies to the minimum needed to do the job and place into sealed bags after use. Proceed from the outermost edges of the contaminated area inwards, reducing systematically the area that is decontaminated.

g. Put all contaminated objects into containers to prevent spread of contamination.

h. Assign a person equipped with a survey meter to follow the work and to watch for the accidental spread of contamination.

i. Perform contamination survey and record the results.

Note: A spill may require more than one decontamination process.

2. Major Spills: A major spill is defined as greater than 1.0mCi of activity.

a. Notify the radiation officer of the accident and all persons in the area of the spill. Decontamination of highly radioactive areas requires the direct supervision of the radiation safety officer.

b. Put on gloves to prevent contamination of hands. (Wash hands first if they are contaminated as result of accident.)

c. Drop absorbent paper or cloth on spill to limit spread of contamination.

d. Mark off contaminated area. Do not allow anyone to leave contaminated area without being monitored.

e. If possible, cut off the release of radioactive materials from the source to the environment but avoid breathing in high concentrations of radioactive material. Close windows.

f. Evacuate room and close doors. Remove contaminated shoes and laboratory coats at laboratory door to avoid tracking radioactive material around.

g. If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure.

h. Lock or guard the doors and post appropriate signs warning against entry.

i. Assemble in nearby room with other personnel suspected of being contaminated. Wash off possible exposed area of the skin, if there is a delay in performing a survey. Do not leave the control area until you have been thoroughly surveyed for contamination. (Personnel decontamination measures should be instituted promptly if significant contamination is found).

j. RSO will give the specific instructions for decontaminations of major spills dependent upon the type of spill (e.g., gaseous), potential airborne radioactive contaminants and dose rates.

k. Further description of accident plans are listed in subsection 4.

3. Reporting Procedures for Minor and Major Spills

An in-house evaluation – including corrective actions – will be made, for minor spills, by the RSO and documentation retained in the facility. All major spills will be evaluated and documented in a report to the Radiation Safety Officer and facility administration.

Any event that exceeds the Agreement State reporting requirements will be reported. Any event that affects the general public or could cause media attention (e.g., a traffic accident) will be reported. Any event that has the potential of the above will be reported by telephone, unofficially, with an official report to follow if requested.

4. Emergency Procedures in Case of a Fire

IMMEDIATE ACTIONS IN THE EVENT OF A RADIATION INCIDENT INVOLVING A FIRE

a. Keep all persons as far away as possible from the incident scene.

b. Perform any life saving rescue and first aid necessary.

c. Summon assistance from the nearest fire department.

d. Keep upwind of the incident, when fire is present.

e. Notify the radiation safety officer. Notify the State of Georgia Department of Natural Resources Radioactive Materials Division.

f. Avoid contact with radioactive material and suspected contaminated material.

g. Detain all persons involved with the incident or potentially contaminated by the incident, except injured individuals, at the scene until the emergency team arrives.

h. Record names, addresses, destinations, and phone numbers of any persons who cannot be persuaded to stay at the incident scene.

i. Eating, drinking, and smoking in the incident area shall be prohibited.

j. Employees and fire fighters will not leave the general area until approved to do so by the Lab Manager or the Radiation Safety Officer.

k. The Lab Manager or Radiation Safety Officer will assist the Fire Chief in the monitoring of all fire fighters.

l. Notify proper regulatory agencies.

Contact Numbers:

RSO Macon Campus: Mr. Thomas Rogge 478-301-4051
Atlanta Campus: Dr. Michael Kavula 678-547-6213
URSO: Ms. Jo-Anne Audette- Arruda 478-301-2545

C. PERSONNEL DECONTAMINATION

If personnel contamination is suspected, first identify contaminated areas with survey meter. Do not use decontamination methods which will spread localized material or increase penetration of the contaminant into the body (e.g., by abrasion of the skin).

Wound Decontamination:

a. A physician should supervise decontamination of wounds.

b. Irrigate wounds profusely with tepid water, gently clean with swab.

c. Gently scrub with soap or detergent. Do not use highly alkaline soaps or organic solvents that may result in fixation or penetration of contaminant.

Intact Skin:

a. Wet hands and apply detergent.

b. Work up good lather, keep lather wet.

c. Work lather into contaminated area by rubbing gently for at least 3 minutes. Apply water frequently.

d. Rinse thoroughly with lukewarm water (limiting water to contaminated areas).

e. Repeat above procedures several times, gently scrubbing residual contaminated areas with a soft brush, if necessary.

f. If the radiation level is still excessive, initiate more powerful decontamination procedures after consultation with the radiation safety officer.

g. Cutting fingernails may also reduce measured contamination

DECONTAMINATION INCIDENT REPORT

Type of Spill: Liquid ☐ **Date:** _____
Solid ☐
Gas ☐

Radionuclide _____

A. **Personnel Decontamination Required:** ☐ Yes ☐ No

1. **Initial Personnel Survey Reading:** _____mR/hr _____cpm/dpm
   Corrective Actions:

B. **Personnel Survey Reading After Decontamination:** _____mR/hr _____cpm/dpm
Time span _____ min.

1. **Surface Decontamination Required:** ☐ Yes ☐ No

2. **Location:** Floor ☐ **Surface Type**: Rough ☐
   Wall ☐ Smooth ☐
   Countertop ☐
   Equipment ☐ **Respirator Required:** ☐ Yes ☐ No
   Glassware ☐

3. **Action Level:** GM survey – 0.5mR/hr.; wipe test – 2 x background
   Initial GM Survey Reading: _____mR/hr. Background: _____mR/hr.
   Initial Contamination Smear: _____cpm/dpm Background: _____cpm/dpm

4. **Decontamination Attempt #1 Describe Action**
   GM Survey: _____mR/hr. Smear Survey: _____cpm/dpm

5. **Decontamination Attempt #2 Describe Action:**
   GM Survey: _____mR/hr. Smear Survey: _____cpm/dpm

6. **Decontamination Attempt #3 Describe Action:**
   GM Survey: _____mR/hr. Smear Survey: _____cpm/dpm

7. **If disposal by sewage:** Sink Trap Survey _____mR/hr

8. **Comments:**

C. **Instruments Used**:

Survey Meter:
Model No.:
Serial No.:
Calibration Date:

Pulse Height Analyzer:
Model No.:
Serial No.:
Calibration Date:

D. **Individual Performing Surveys and Wipes:** _____

_____ _____

Signature Radiation Safety Officer

II. PERSONAL DECONTAMINATION

Method*	Surface	Action	Technique	Advantages	Disadvantages
Soap and water.	Skin and hands.	Emulsifies and dissolves contaminate.	Wash 2-3 minutes and monitor. Do not wash more than 3-4 times.	Readily available and effective for most radioactive contamination.	Continued washing will defat the skin. Indiscriminate washing of other than affected parts may spread contamination.
Soap and water.	Hair.	Same as above.	Wash several times. If contamination is not lowered to acceptable levels, shave the head and apply skin decontamination methods	N/A	N/A
Lava soap, soft brush, and water.	Skin and hands.	Emulsifies, dissolves, and erodes.	Use light pressure with heavy lather. Wash for 2 minutes, 3 times. Rinse and monitor. Use care not to scratch or erode the skin. Apply lanolin or hand cream to prevent chapping.	Same as above.	Continued washing will abrade the skin.
Tide or other detergent (plain).	Same as above.	Same as above.	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to erode the skin.	Slightly more effective than washing with soap.	Will defat and abrade skin and must be used with care.

*****Begin with the first listed method and then proceed step by step to the more severe methods, as necessary.

Reference: Radiological Health Handbook, U.S. Department of Health, Education, and Welfare, Public Health Service, Rockdale, MD, January, 1970.