

## **Radiological Safety Manual**

**Summary/Purpose:** The Radiological Safety Manual details the minimum requirements for operations involving Radioactive Materials or Radiation Generating Devices.

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### **University Health and Safety Policy**

As a responsible institution of higher education, this University's laboratories, offices and other facilities shall be maintained as clean and healthful places of employment. Every effort shall be made to design and operate all University facilities in compliance with the spirit and letter of federal, state and local health and safety regulations. The University shall endeavor to promptly provide current and comprehensive information on potential adverse health and safety effects as well as appropriate handling procedures for all hazardous materials handled by both our employees and our students.

It is a basic responsibility of all University employees and students to make the health and safety of fellow human beings a part of their daily concern. This responsibility must be accepted by each one who conducts the affairs of the University, no matter in what capacity he/she may function.

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In order to implement this policy, the rules and regulations given in the University Safety Manuals shall be complied with by all University personnel. Assistance with specific health and safety problems may be obtained from the Laboratory Services.

Dr. Jeffrey S. Vitter  
Chancellor

## INTRODUCTION

### Purpose of this Manual

The purpose of this manual is to set radiation safety policies for the University of Mississippi Oxford campus. This manual contains only regulations and procedures specific to the use of radioactive materials and radiation producing devices at the University. In general, specific Nuclear Regulatory Commission (NRC) and Mississippi State Department of Health (MSDH) regulations are not restated. However, all such regulations are applicable and binding on personnel working with or using radioactive materials or ionizing radiation generating devices at the University. The regulations given in the University's current policies, Biosafety Manual, Chemical Safety Manual, and Laser Safety Manual must also be followed.

The State of Mississippi is an NRC Agreement State, operating a State program of radiation safety which satisfies the requirements of Federal laws and regulations. The control of radiation in Mississippi is under the regulatory direction of the Division of Radiological Health (DRH) of the MSDH as mandated by State law. According to the Mississippi Radiation Protection Law of 1976, the regulations set forth by the DRH have the force of law.

This manual, part of the University's Broad Scope License, contains procedures for acquiring authorization to use, purchase, possess, or have radioactive material or radiation generating devices; procedures for ordering or otherwise acquiring radioactive materials; safety precautions to follow when using radioactive materials, sealed sources, or other ionizing radiation producing devices; emergency procedures for handling accidents involving radioactive materials, sealed sources, or other radiation producing devices; and procedures for requesting the disposal of radioactive materials or radiation generating devices.

**AT NO TIME ARE RADIOACTIVE MATERIALS OR RADIATION GENERATING DEVICES, e.g., X-RAY GENERATING UNITS, ELECTRON CAPTURE DETECTORS, X-RAY FLUORESCENCE UNITS, ETC., TO BE ACQUIRED, USED, TRANSFERRED, SOLD, PURCHASED, OR DISPOSED OF, WITHOUT PRIOR WRITTEN AUTHORIZATION FROM THE RADIATION PROTECTION SPECIALIST (RPS) IN LABORATORY SERVICES.**

Failure to adhere to this regulation is in direct violation of the University's Broad Scope License and published state and local regulations.

### **Scope of these Regulations**

These regulations and procedures apply to all persons, who receive, possess, use, or seek to dispose of radioactive materials or radiation producing devices or sealed sources on the University of Mississippi's Oxford campus, with the exception of the persons working for the University Student Health Services.

### **RADITION SAFETY COMMITTEE**

The Radiation Safety Committee (RSC) is a committee of technical and administrative personnel charged with the responsibility of establishing and maintaining a comprehensive radiation protection and safety program at the University. The Radiation Safety Committee (RSC) reports directly to the Research and Environmental Compliance Officer on all matters pertaining to the use of radioactive materials and radiation generating devices on the Oxford campus.

The Radiation Safety Committee is comprised of individuals with demonstrable expertise in the use of radioactive materials or radiation generating devices, and the Radiation Protection Specialist. The Radiation Safety Committee will advise the Radiation Protection Specialist and make specific recommendations to the Chancellor of the University through the Research and Environmental Compliance Officer on all matters pertaining to radiological safety at the University of Mississippi.

- The Chairman of this committee is elected by the members, with the concurrence of the Chancellor, to serve for a two-year term. Election of the Chairman will take place in the spring of even years for a term beginning July of that year.
- The Radiation Safety Committee meets in the Spring and in the Fall of every year. The RSC can meet more often at the request of any member of the committee, at the direction of the Chancellor, or at the request of the Research and Compliance Officer.
- All members of the RSC have the right to vote on any action brought before the committee. A quorum must be present at any meeting requiring any action of the committee. A quorum is defined as more than 50% of the assigned members. Actions are passed by the committee when a simple majority greater than 50% of the members present vote in favor of the action.
- An action can be introduced during regular or special committee meetings and may be voted on during the meeting or deferred to a specific subsequent meeting. Additionally, actions of the committee may be introduced and voted on by E-mail, providing that more than 50% of the members return a ballot. Actions are passed by mail ballot when a simple majority, greater than 50% of the returned ballots vote in favor of the action. All E-mail ballots must be returned to the Chairman of the RSC within seven working days of the mail date to be counted.

**The Radiation Safety Committee performs the following:**

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- Advises the Radiation Protection Specialist, when necessary or requested, on all matters pertaining to the radiological safety of all University programs involving radioactivity, ionizing radiation exposure, or radiation producing devices, except as noted above.
  - Radioactivity refers to the spontaneous emission of ionizing radiation from any material (solid, liquid, or gas).
  - Ionizing radiation describes high energy photons (x- ray and gamma) and other high energy particles (alpha, beta, and other nucleons) which are capable of producing ionization in substances they pass through.
  - Radiological Safety refers to the safe use and handling of radioactivity or ionizing radiation on the University's Oxford campus; including, but not limited to, teaching, research, development and use.
- Reviews user applications, extraordinary proposals, and research protocols for the use of radiation or radioactivity within the institution from the standpoint of radiological safety.
- Approves or disapproves the applications, protocols, and proposals based upon user competence, training, and experience so as to assure regulatory compliance and radiological safety.
- Reviews and prescribes special conditions, requirements, and restrictions as necessary to protect University personnel and the general population from health hazards associated with the use of radioactivity and radiation generating devices at the University, including, but not restricted to, x-ray devices, sealed sources, and Gas Chromatograph electron capture detectors. Conditions, restrictions, and requirements in all cases will be made in accordance with any and all applicable Federal and State regulations. RSC approval must be obtained in writing before any project involving radioactivity or radiation producing devices are initiated.
- Prescribes such special conditions and requirements as necessary in connection with the ordering, handling, usage, storage, and disposal of radioactive material, radioactive waste, and contaminated equipment, radiation generating devices, laboratories, and storage areas so as to promote radiological safety.
  - These conditions and requirements may include, but are not limited to, physical examinations, additional training, designation of a limited area of use, disposal methods, survey requirements, and any other conditions or requirements deemed reasonable and prudent by the committee.

### **The Chairman of the Radiation Safety Committee performs the following:**

- Keeps a record of the actions taken by the Radiation Safety Committee in approving, disapproving, or regulating the use of radioactivity and radiation producing devices and of other transactions, communications, and reports involved in the work of the RSC. Submits timely reports and minutes to the Research and Environmental Compliance Officer, and the MSDH as required.
- Under policies established by the RSC, the Radiation Protection Specialist acts for the committee between meetings and reports all actions taken to the committee for review at appropriate intervals.

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- In the event of the absence of both the Radiation Protection Specialist and the Research and Environmental Compliance Officer from the campus, the Chairman of the RSC will assume the duties of acting Radiation Protection Specialist until one or more return.

### **Radiation Safety Officer (RSO):**

At the University, the Radiation Protection Specialist assumes the duties of a Radiation Safety Officer when necessary to comply with State or Federal regulations or policies. The functions, duties, and responsibilities of the RSO are the same as those described below for the RPS.

### **Radiation Protection Specialist (RPS):**

The Radiation Protection Specialist has the authority and responsibility to:

- Disseminate information on radiation health physics,
- Implement or execute policy decisions regarding radiological safety made by the MSDH, the RSC, or the Chancellor of the University,
- Review and approve all proposals, protocols, and user applications involving the use of radioactive materials or radiation generating devices,
- Submit all extraordinary protocols, procedures, and all user applications to the RSC review and approval,
- Perform unannounced inspections and radiation contamination surveys of any University facility,
- Perform or supervise declassification surveys of all areas and equipment, when requested,
- Review all construction plans of new radioisotope and radiation facilities subject to these regulations from the standpoint of radiological safety,
- Recommend approval or disapproval of such plans based upon radiological considerations to the Research and Environmental Compliance Officer, order, receive, monitor and inventory all radioisotopes and sources of radiation purchased or otherwise procured for use at the University, dispose of all radioactive waste in accordance with applicable Federal, State, and local laws and regulations,
- Administer the personnel monitoring program for the University, including the Student Health Service,
- Maintain appropriate records and to provide timely and necessary reports of exposure to all persons assigned dosimetry,
- Obtain, and maintain all licenses and registrations necessary for the use of radiation and radioactive material at the University,
- Exercise emergency powers in accordance with the University of Mississippi Hazardous Material Contingency Plan, order the evacuation of areas, or the immediate cessation of work in areas, where the use of radioactive material or radiation generating devices pose an immediate threat to life and health, or where it is evident that the health hazards of continued work would result in violation of existing Federal, State, or local regulations,
- Order remedial actions to alleviate violations of regulation, license, or law, and,

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- To provide overall administrative direction for the radiation safety program of the University.

Remedial actions taken by the RSC or the RPS may be appealed to the Research and Environmental Compliance Officer (RECO), or to the Chancellor for a final decision. During the appeal process, the all associated work will terminate until a resolution is provided by the RECO or the Chancellor. The Chancellor of the University has final authority and responsibility for the execution of all applicable rules, regulations, and laws in the area of radiological controls. During this process, the RECO or the Chairman of the RSC, will act as liaison between the MSDH.

Upon receipt of any request or application to use radiation or radioactive materials or to operate a radiation generating device for a purpose which is inconsistent with existing University policy, or involves unusual amounts or kinds of radiation or radioactive materials, or requires an amendment to the Broad License, the RPS will convene a special meeting of the RSC to consider the request.

In the event of a conflict or dispute between the RSC and the RPS over a policy or direction not covered by this manual, the matter will be referred to the RECO for resolution.

### **AUTHORIZATION OF PERSONNEL**

All personnel (faculty, staff, guests, visiting faculty, and students) working with or handling radioactive materials or operating radiation producing devices are required to be authorized users. Authorization may be granted to individuals by the RSC provided that the applicable requirements of this section are met.

The qualifications of each applicant or user of radioactive material or radiation producing devices will be evaluated by the RPS and the RSC. Authorization to use radioactive materials or radiation producing devices may be granted to applicants who, in the opinion of the RSC, demonstrate the necessary ability to work with radioactive material or radiation generating devices in a safe manner. Personnel should apply for authorization using [DHS Form 27, Application for Authorization to Use Radioactive Materials or Radiation Generating Devices](#) which can be obtained from the University website.

### **Regular Authorization (RA)**

- Regular Authorization (RA) is requested by the applicant through completion of [DHS Form 27](#).
- RA is only granted to persons who are considered permanent employees of the University and is therefore restricted to full-time faculty and staff.

- Maintaining RA requires that the individual complete the annual Radiation Safety Retraining as specified in Rule and that the applicant pass either the "Radiation Safety Exam - Materials," or the "Radiation Safety Exam - Devices," with a grade of 90% or better.
- RA is of indefinite duration, and does not need to be renewed unless revoked under extraordinary circumstances of documented poor or errant safety performance; unless voluntarily surrendered by the user; or unless employment of the user is terminated for any reason.
- RA approval requires that the applicant document adequate previous training and experience with radioisotopes to indicate proficiencies in the areas of safe handling of radioactive materials, in regulatory compliance, and in the area of the proposed research or work involving the use, the handling of radioactive materials, or any radiation generating devices.
- RA approval requires that the applicant submit a history of past occupational exposures. In addition, the applicant must also submit a history of any exceptional medical exposures, and meet any other special medical requirements that the RSC may stipulate.

### **Classroom Authorization (CA)**

Classroom Authorization (CA) may be obtained from the RPS if the following provisions are met:

- The classroom supervisor must obtain and maintain Regular Authorization.
- At no time is radioactive material to be left in a classroom or laboratory unattended by the supervisor. All classroom radioactive materials are to be securely locked up after use to prevent inadvertent or intentional use, misuse, or theft of the radioactive material by unauthorized or unsupervised persons, including students.
- The radioactive material to be used by the students must meet one of the following requirements:
  - The materials are encapsulated sources of low activity.
  - The radioactive material will not be directly manipulated by any student enrolled in the class, but will be used by an instructor with the proper authorization, for the purpose of demonstration only, observing all appropriate radiological controls procedures and safety precautions.
  - The radioactive materials generate radiation of low enough energy that personnel monitoring devices are not required.
- The instructor of a class requesting the Classroom Authorization provision of these regulations will send a list of the persons who participate in the class to the RPS. The class roll is to contain the Social Security Numbers of the persons named on the roll.

### **Temporary Authorization (TA)**

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Temporary Authorization (TA) is obtained initially from the RPS. Renewal of TA is normally obtained from the RPS, except as provided below.

- TA may be granted to an applicant who meets any of the following criteria:
  - The applicant is not a permanent employee of the University, or,
  - In the opinion of the RSC, the applicant has not had adequate training or experience in the areas of radiation safety, handling radioactive material or operation of radiation generating devices, or,
  - The applicant is a student of the University.
- TA requires completion of [DHS Form 27](#) which should include the signature of the supervisor in charge of the research and training of the individual.
- TA requires that the applicant satisfy the requirements above.
- TA approval may be granted by the RSC only after the individual has completed the radiological training mandated by the RSC, and if the applicant passes either the "Radiological Safety Exam-Devices," or the "Radiological Safety Exam- Materials," with a grade of 80% or better.
  - For Temporary Authorization to be renewed, the applicant must complete the annual Radiation Safety Training Program.
  - Temporary Authorization will expire after one year.
- After initial Temporary Authorization of one year, the applicant can do one of the following:
  - The applicant can request a renewal of TA in writing. Requests for renewal will be evaluated and approved by the RPS. If the RPS determines that there is a reason renewal should be denied, the renewal request will be submitted to the RSC for a final decision.
  - The applicant can request an upgrade authorization from TA to RA if the above requirements are met and sufficient documentation of proficiency is made available to the RSC for evaluation.
  - The Applicant can do nothing and the Temporary Authorization will automatically expire.

### **Maintaining Authorization**

All authorized users must complete the Annual Radiation Retraining. It is currently made available by the RPS via Blackboard only once per year, typically during the Fall semester.

- The Authorized User must:
  - Complete Annual Radiation Retraining for each approved authorization (Radioactive Materials and/or Radiation Generating Devices),
  - Successfully pass an exam, and,
  - Follow all guidelines for working in Radiation Labs as specified in this Manual.

The RPS has the authority to terminate authorization of personnel that fail to complete retraining and/or demonstrate a lack of compliance to the requirements of the Radiological Safety Manual.

All retraining records are maintained in Laboratory Services.



## **Radiation Protection Specialist Temporary Authorization**

The Radiation Protection Specialist is empowered to grant Temporary Authorization to individuals for the use of radioactive materials or radiation producing devices between meetings of the RSC, if applicants can provide suitable documentation of adequate training or experience in the handling and use of radioactive material or radiation generating devices. Applicants must satisfy the above noted requirements. Radiation Protection Specialist Temporary Authorization will expire after six months.

## **PROCUREMENT OF RADIOACTIVE MATERIALS**

The State of Mississippi does **not** recognize NRC "**LICENSE EXEMPT**" quantities of radioactive materials. ALL procurement of radioactive materials, whether by purchase, loan, transfer, or gift, **MUST** receive authorization from Laboratory Services through the RPS.

### **Method of Procurement**

\* see also: [How to Purchase Radioactive Materials](#)

- To procure radioactive materials or radiation generating devices, the principal investigator must be an authorized user with Regular Authorization. The principal investigator must complete DHS Form 26, [Radioactive Material Purchase Application](#).
- If the request is approved after evaluation by the Laboratory Services, the RPS will obtain a Purchase Order and will place the order with the vendor specified on the Purchase order.
- The approved user making the request will be notified of the status of the procurement request.
- If the procurement request is turned down for any reason, the user making the request will be notified in writing of the reasons for denial, and all application forms will be returned to the user.
- All radioactive materials will be delivered to Laboratory Services for leak testing (as applicable), inspection, inventory control, radiation surveys (as applicable), and storage arrangements, if necessary.
- When radioactive material is ready to be released to the user, the RPS will notify the user and will fill out and provide to the user DHS Form 29, "Approval for Use of Radioactive Materials."
- Radioactive materials are delivered directly to the location of use by the RPS.
- Purchasers of Radiation Generating Devices must satisfy regulatory requirements noted above. Such purchases generally involve considerable sums and require facilities with suitable shielding which have to be validated prior to installation of the equipment. Therefore, all purchases of Radiation Generating Devices (e.g., x-ray machines, electron microscopes) require prior consultation with and approval from the RPS and/or the MSDH.

- Radioactive materials and radiation generating devices will not be transferred from one department or authorized laboratory to another or off campus without prior approval of the RPS, since approval for use of such materials is given only for the original working area.
- When ordering Liquid Scintillation Cocktail, to be used with Radioactive Materials, you must select a Non-Flammable, High Flash Point Scintillation Cocktail (flash point > 60° C or 140° F). Contact the RPS for details.

## PROCEDURES FOR RADIOACTIVE WASTE DISPOSAL BY THE USER

\*See also: [Radioactive Waste Disposal Procedures Flow Chart](#)

- All disposal of radioactive materials, radioactive wastes, sources of ionizing radiation, and radiation generating devices will be handled through the RPS and Laboratory Services.
- Radioactive materials may NOT be disposed of by an authorized user or an unauthorized person directly into the sanitary sewage system, into the atmosphere, into laboratory drainage systems, or into regular trash baskets.
- All Radioactive Wastes must have proper documentation, which includes chemical and radiological identification of the components of the waste stream to within 1% of the weight or volume, whichever is applicable.
- All radioactive wastes prepared for disposal by the user will be accompanied by DHS Form 14, ["Request for Disposal of Radioactive-Materials."](#)
  - Radioactive chemical waste is waste from radioactive materials to solely or biochemical processes involving non-etiological cell cultures which have been destroyed in the course of research.
  - Radioactive biological waste is waste generated from the introduction of radioactive materials either to living multi celled organisms, or organisms which have disease producing capabilities.
  - For the purposes of these regulations, liquid scintillation fluids containing solvents which destroy the disease-producing capability of living organisms will be treated as radioactive chemical wastes.
  - Radioactive liquid wastes offered for disposal will be homogeneous in nature and will not contain visible tissue, animal, or plant parts. Such visible parts will have to be strained or filtered out of the liquid by the User or Generator and offered separately as dry solid radioactive waste.
- Any waste stream or package, of any weight or volume, which does not conform to the description of the waste provided on the [Request for Disposal of Radioactive Materials - DHS Form 14](#), will be returned to the user or generator for correction, verification, or repackaging.
- Any questions concerning the completion of [DHS Form 14](#) will be referred to the RPS in Laboratory Services.
- Stock solutions of radioactive material and high activity wastes will not be included in low level waste for disposal.

### **Waste Packaging:**

- The following instructions are subject to regulatory revision. Laboratory Services may amend these local regulations governing the packaging and preparation of waste streams as necessary to remain in compliance with Federal or State regulations governing wastes and disposal. Such changes will be submitted to the RSC at its next regular meeting for incorporation into the local University regulations. Due to the constantly changing status of disposal regulations and conditions, only one radioisotope may be contained in any one package offered for disposal, without prior approval by the RPS.
  - Due to the difficulty with the disposal of radioisotopes which do not appear in the [List of Approved Radioisotopes](#) at the end of this manual, all users planning to utilize these radioisotopes are required to consult with the RPS prior to waste production to ensure that adequate and cost-effective methods of disposal are available.

### **Identification:**

- All wastes are to be identified conspicuously on the outside of the outermost package with the following information:
  - The supervisor's name and department,
  - The packer's name and department, if different from the supervisor's name,
  - The radioisotope contained in the package,
  - The quantity of radioactivity contained in the package offered for disposal,
  - Volume of the waste material (cubic inches, cubic cm, gallons or liters).

### **Separation:**

- All wastes are to be separated into solids, liquids, or gases by the user for pickup as follows:
  - Solid waste should not contain any free standing liquids. Additional information on separation of radiological wastes is located on the [Sharps and Biological Waste Disposal Flow Chart](#)
  - Liquids are to be separated into aqueous (water-based materials containing no other hydrocarbon solvent capable of flammability) and organic (hydrocarbon solvents capable of being burned) and segregated according to the [List of Approved Radioisotopes](#) at the end of this manual.
    - Aqueous liquids are to be bulked up into suitable containers which have secure, leak proof seals (caps) and are properly labeled. Each container can contain only one radioisotope without prior approval by the RPS.
    - Scintillation fluids are to be left in individual scintillation vials, tightly capped, if the radioisotope appears in the [List of Approved Radioisotopes](#) at the end of this manual. Other organic liquids containing radioisotopes will have to be evaluated on a case by case basis by the RPS to determine the best method of packaging.
    - When ordering Liquid Scintillation Cocktails, you must select a Non-Flammable, High Flash Point Scintillation Cocktail (flash point > 60° C or 140° F). See the RPS for details.

### **Animal Carcasses:**

- Additional information on separation of radiological wastes is located on the [Sharps and Biological Waste Disposal Flow Chart](#).
- Animal carcasses contaminated either internally or externally with radioactive material will be sealed in plastic bags. Each animal carcass will be packaged as described in the section on waste packaging, with an additional marking, describing the activity per gram of the animal carcass.
- Individually identified and packaged carcasses containing the same radioisotope are to be consolidated into larger plastic bags. The aggregate weight is not to exceed 25 lbs (< 11 kg). The larger bag is to be sealed as identified as in "[Sharps and Biological Waste Disposal Flow Chart](#)", and frozen until arrangements are made for disposal. All animal carcasses submitted for disposal must be triple bagged in yellow "Radioactive" waste bags provided by Laboratory Services. At the time the animals are picked up for disposal, DHS Form 14, "[Request for Disposal of Radioactive-Materials](#)" must be completed and given to the RPS.
- **RADIOACTIVE WASTES CONTAMINATED WITH A BIOHAZARD ARE TO BE RENDERED HARMLESS PRIOR TO REQUESTS FOR DISPOSAL, AND ARE NOT TO BE OFFERED FOR DISPOSAL TO THE RPS IN BIOHAZARD LABELED BAGS OR CONTAINERS.** Biohazardous waste containing radioactive material is NOT currently being handled by disposal companies. Such waste generated on the campus will remain the responsibility of the generator until approved disposal can be accomplished. All generators of such wastes are cautioned to consult with the RPS prior to waste production.

### **Additional Hazards:**

- Wastes which contain Physical or Chemical Hazards must be identified in advance. Chemical Wastes must be identified in advance of preparation so that proper communication can be conducted with the Laboratory Safety Specialist, if necessary.

### **RADIOACTIVE WASTE DISPOSAL BY LABORATORY SERVICES**

Waste disposal by Laboratory Services will be handled by the RPS in accordance with the provisions and instructions contained in the "Radiation Safety--Standard Operating Procedures". The final disposition of accumulated wastes will be in accordance with all applicable Federal, State, and local laws, ordinances, and regulations.

### **PERSONNEL MONITORING**

- The University and all people covered by this manual shall use, whenever practical, any procedure or control that will allow the occupational and public doses to radiation to be As Low as Reasonably Achievable (ALARA).
- Occupational Dose Limits for Adults
  - The RSC and Laboratory Services, working through the RPS, shall ensure that the occupational dose to adults at the University meets the following dose limits, as given in the "Regulations for Control of Radiation in Mississippi,"
  - An annual limit, which is the more limiting of:

- The total effective dose equivalent to being equal to 5 rems (0.05 Sv), or,
  - The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 Sv).
- The annual limits to the lens of the eye, to the skin, and to the extremities which are:
  - An eye dose equivalent of 15 rems (0.15 Sv), and
  - A shallow dose equivalent of 50 rems (0.5 Sv) to the skin or to any extremity.
- Occupational Dose Limits for Minors
  - **PERSONS UNDER 18 YEARS OF AGE WILL NOT BE ALLOWED TO ENTER, OR TO WORK IN, AN AREA WHERE RADIOACTIVE MATERIALS OR RADIATION PRODUCING DEVICES ARE USED, STORED OR OPERATED.**
- Dose to an Embryo/Fetus, shall meet or exceed the requirements of the current version of the Regulations for Control of Radiation in Mississippi.
  - A Declared Pregnant Woman-means a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception. A Declared Pregnant Woman is defined as a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

## Dosimetry

- Required Dosimetry: In addition to the requirements specified above, personnel will wear an appropriate monitoring device (Dosimeter) when any of the following apply:
  - Any person entering an occupational radiation environment in which he or she is likely to receive in excess of 10% of the Maximum Permissible Dose allowed by regulation of penetrating ionizing radiation will be required to wear a Dosimeter appropriate to the type and energy of the radiation to be encountered.
  - Any person working with Beta emitters of energy greater than 0.25 MeV, which does not include Low Energy Radioisotopes such as H-3, C-14, S- 35, C1-36, Ca-45, and Ni-63.
  - Any person working with Neutron sources of any type.
  - Any person working with Gamma Emitters of any type.
  - Any person working with X-ray producing devices or sources.
- Dosimeters:
  - Persons are to wear only the dosimeters assigned to them by Laboratory Services.
  - Dosimeters are to be stored away from sources of radiation, excessive heat, and moisture when not being worn by personnel for monitoring purposes.
  - Dosimeters assigned by Laboratory Services for occupational exposure monitoring are to be worn only when the assignee is engaged in the occupation which requires monitoring. Except for medical personnel engaged in the performance of their duties involving radiation exposure, persons assigned dosimetry are not to wear dosimeters assigned by Laboratory Services during diagnostic or therapeutic radiation exposure.

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- All dosimeters will be processed by an approved National Voluntary Laboratory Accreditation Program (NVLAP) processor, as specified in Rule 1.4.17(3) of the Regulations for Control of Radiation in Mississippi.
- Annual Exposure Reports:
  - In accordance with the “Regulations for Control of Radiation in Mississippi,” an annual report will be provided to monitored personnel for any portion of a fiscal year if:
    - The individual’s occupational dose exceeds 1mSv (100mrem) TEDE or 1 mSv (100 mrem) to any individual organ or tissue, or,
    - The individual requests their annual dose report.
  - The annual exposure report will be distributed on DHS Form 87, "Annual Report of Radiation Exposure" within 30 days of the request, or within 30 days after the dose has been determined, whichever is later.
  - Terminated personnel, who were monitored under the University dosimetry program during the calendar year of their termination, will be provided one final notice of exposure upon request or on the same schedule given for current personnel.

A copy of the exposure data is permanently maintained by the University.

## SURVEYS AND MONITORING

- Area Monitoring: Laboratories in which there are sources capable of delivering whole body exposures in excess of 5 mr/hr (0.05 mSv/hr) must have on hand in the laboratory and in good operating condition, a calibrated monitoring instrument capable of measuring the exposure or dose rate for the radiation type to be encountered. Consult with the RPS on matters involving the selection or calibration of monitoring instruments.
- Routine surveys for contamination or radiation exposure will be conducted in laboratories and areas approved for use with radioactive materials or radiation generating devices by the RPS or his delegate. Records of survey results will be maintained by Laboratory Services in accordance with current laws and regulations. In addition, the following requirements will be met:
  - Routine survey frequency will be determined by the RPS and will depend upon the classification of the area. Classification of an area will be based upon the criteria expressed in the section on [Classification and Declassification](#), below.
  - Contamination surveys will be carried out using the procedures specified in "Radiation Safety--Standard Operating Procedures." Survey points which exceed the prescribed Action Level assigned to the area containing the points will be considered evidence of contamination. The area supervisor will be notified of the presence of contamination, the levels, and the locations of the contamination in writing by the RPS, except in cases where contamination exceeds the Action Level by a factor of 10.
  - In cases where areas of contamination exceed the Action Level for the given location by a factor of 10, the area supervisor will be notified as soon as possible.

All work will cease in the area by order of the RPS, if deemed necessary, until all contamination is removed and area surveys indicate removable activity below the Action Level for the given location.

- In cases of known or suspected airborne contamination in excess of the limits in the "Regulations for Control of Radiation in Mississippi," the location will immediately be evacuated. Ventilation will be stopped, and personnel exposure will be assessed. Further immediate actions are stated in the section on [Radiation Emergency Procedures](#) below.
- Areas closed because of a radiological hazard cannot be reopened without the written approval of the RPS or the Research and Environmental Compliance Officer from Laboratory Services.
- Surveys of equipment and areas by Authorized Lab Personnel:
  - Equipment, tools and work areas will be monitored daily following their use with radioactive materials. Appropriate surveys will be performed by authorized personnel providing that work involving the use of radioactive tracers, radiation generating devices, or other radioactive materials or equipment was performed during that particular day in the location specified.
  - Written records of daily surveys will be made available for inspection upon the request of the RPS or his representative.
  - All records of daily surveys will be reviewed quarterly by the RPS.
  - All personnel authorized to handle radioactive materials in an approved location or facility will be trained to perform the appropriate surveys necessary for contamination and exposure control. All training of persons requesting authorization will be the responsibility of Laboratory Services.
  - Each building in which radioactive materials are used will have appropriate calibrated survey instrumentation for the use of authorized users in performing contamination and/or radiation surveys. All surveys will be performed in accordance with applicable sections of "Radiological Safety--Standard Operating Procedure".

## CLASSIFICATION AND DECLASSIFICATION

Location classification will be made by the RPS in accordance with the following instructions:

- All laboratories and areas where radioactive material and/or radiation generating devices are used or stored must be approved by the RPS prior to use. Classification of an area or laboratory may be made by submitting the completed application section of DHS Form 30, ["Application for Radioisotope Use Location,"](#) to the RPS.
- No room, location, or equipment used for radioactive work or storage may be returned to general use until satisfactory declassification has been certified by the RPS. Declassification of rooms, location, or equipment, will be conducted in accordance with the "Radiological Safety--Standard Operating Procedures." Certification of declassification will be deemed appropriate when all survey points indicate activity less than the limit for uncontrolled access as established by the "Regulations for Control of Radiation in Mississippi".



## SEALED SOURCES

In accordance with the special conditions of the University's Broad Scope License, all Sealed Sources except those exempted by the MSDH Regulations cited in the Broad Scope License, will be tested for leakage and contamination at intervals not to exceed six (6) Months. The RPS, or a representative, in accordance with SOP 7- Procedures for Leak Testing Sealed Sources, will perform leak tests.

All sealed sources will be physically inventoried at intervals not to exceed six (6) months.

A report will be filed within 5 days with the Mississippi State Department of Health if the test for leakage or contamination indicates a sealed source is leaking or contaminated. The report will include the equipment involved, the test results and the corrective action taken.

Any incident of a lost or stolen licensed and/or registered source of radiation will be reported immediately to the Mississippi State Department of Health.

## USE OF CAUTION SIGNS AND LABELS

- Posting of laboratories, areas and containers containing radioactive materials, or of laboratories or areas containing radiation producing devices must be in accordance with the "Regulations for Control of Radiation in Mississippi".
- [Mississippi State Department of Health Form RH-5, "Notice to Employees,"](#) will be conspicuously displayed near every entrance and exit in each area where radiation generating devices or radioactive materials are used.
- Each location where Radioactive Materials are used will have a copy of ["Emergency Procedures for Spills Involving Radioactive Material"](#) posted near every entrance and exit.

## RADIATION GENERATING DEVICES

- All ionizing radiation producing devices must be registered with the MSDH.
- Individuals employed by, and/or departments of the University obtaining or planning to obtain radiation producing devices will be required to make application for registration of such devices through Laboratory Services. Laboratory Services will be notified in writing within five calendar days of the receipt of ionizing radiation producing devices. Such equipment cannot be used, altered, installed, or energized, without written permission of the RPS.
- This category of ionizing radiation producing devices will include, but not be limited to:
  - X-ray generating units
  - X-ray diffraction apparatus
  - Electron microscopes
  - X-ray fluorescence units
- All persons seeking to use, operate, or possess ionizing radiation producing devices must have prior approval from the RSC as prescribed in this manual.



- Personnel monitoring devices will be assigned to all authorized users of x-ray devices in accordance with the Personnel Monitoring Section of these regulations.
- All x-ray generating devices will be inspected annually for radiation hazards by the RPS in accordance with the "Radiological Safety--Standard Operating Procedures."
- The supervisor of an ionizing radiation producing device will remain solely responsible for the safe use and operation of the device under his or her supervision. The RPS will exercise emergency authority to cause the cessation of operation of any x-ray equipment which is being operated in an unsafe manner.

## **CALIBRATION OF INSTRUMENTS**

- All survey and monitoring instruments used for compliance purposes will be calibrated annually in accordance with applicable sections of the "Radiological Safety--Standard Operating Procedures." Laboratory Services will maintain information on calibration vendors for survey meters and area monitors.

## **GENERAL SAFETY RULES FOR LABORATORIES**

- Preventing Contamination: Extreme personal cleanliness and careful techniques are the primary means of preventing contamination and protecting against ingestion of loose radioactivity. To minimize contamination and prevent entrance of activity into the body, the following rules must be observed in radioisotope laboratories where unsealed sources of radioactive materials are present or in use.
- Eating, drinking, smoking, the use of cosmetics, food preparation, and the storage of items for these purposes will not be permitted in laboratories where radioactive material is used or stored.
- The storage of human food items, such as milk, eggs, cheese, bread, meat, and the like, to be used as part of an experimental procedure and not intended for human consumption is permitted in a restricted or prohibited area containing radioactive material provided that the following provisions are met:
  - The food item is not stored in its original container, but is stored in a different suitable container not labeled as human food; and
  - The item is clearly, legibly, and permanently marked to indicate what the item is, what the item is used for, who is using the item, and the date of storage in the restricted or prohibited area, and additionally marked with the following words:

### **EXPERIMENTAL FOOD ITEM - NOT FOR HUMAN CONSUMPTION**

- If there is a specific radiological hazard associated with the food item, appropriate radiological markings are to be added to the outside of the container in accordance with this manual.
- Food items discovered in restricted or prohibited areas not satisfying these criteria will be immediately confiscated and disposed of by the RPS according to the hazards involved.
- The use of milk bottles or other food containers for handling or storing radioactive materials is strictly prohibited.

- The presence of empty cups, food wrappers, containers or any waste associated with food will not be allowed inside of any Laboratory where Radioactive Materials are used or stored.
- The pipetting of radioactive materials and/or solutions by mouth is strictly prohibited. Auto-pipettes, pipette controls, and similar devices are commercially available and mandatory for such applications.

#### **ADDITIONAL SAFETY PRECAUTIONS**

- Dry runs involving all facets of an experimental procedure except the actual use of radioactive material are to be completed prior to commencement of experimental protocols involving the use of radioactive material. Such practice runs should be performed until the procedure is reproducible. Any modifications made along the way which enhance radiological controls should be incorporated into the protocol.
- Any work which can expose radioactive material to atmospheric distribution will be done in a suitable containment device approved by the RPS. Specifically, complete containment is required when working with tritium in amounts in excess of 100 mCi (3.7 Gbq), and for all loose alpha emitters.
- Personnel are not permitted to work with radioactive material if there are open cuts, wounds, or abrasions on the body. Extreme precautions must be taken to avoid the introduction of radioactive materials into the body through puncture wounds or cuts, especially when working with materials of high radiotoxicity or high specific activity.
- Care must be taken when using organic solvents to avoid skin contact with radioactive materials. Solvents may make the skin more permeable.
- Appropriate protective clothing and/or devices will be used for all manipulations of unsealed sources. Surgical glove techniques are to be used when putting gloves on and removing gloves to avoid contaminating the inside surfaces of the gloves and/or the skin of the user.
- All personnel will perform personal monitoring of hands and feet upon preparation to leave a radioactive material work area.
- Laboratory protective clothing and equipment used in radioisotope work areas will be monitored routinely during the course of work and when work with radioactive material is temporarily or completely halted. Contaminated disposable clothing and equipment will be disposed of as radioactive waste unless contamination surveys determine that there is no contamination present. Contaminated non-disposable items will be decontaminated, decayed to background, or disposed of as radioactive waste.
- Approved auxiliary storage and waste containers, blotters, and covers will always be used where danger of spills or personnel and equipment contamination is possible.
- Contaminated equipment, or equipment that has been used and is suspected of contamination, will be appropriately labeled and isolated in designated areas within the laboratory or in suitable, approved storage areas.
- Tools, equipment, and apparatus, that may be contaminated should be placed in non-porous metal trays or pans lined with absorbent disposable paper. Trays, paper, and/or pans should be monitored frequently, and appropriate disposal or decontamination performed when contamination exceeds 10 times the Action Level of the location.

- The declared and labeled radioactive material use area will remain free of unnecessary tools, equipment, and/or clutter to prevent contamination and to minimize the generation of waste.
- Removable contamination above the limits for uncontrolled access for the type of radiation in question will not be allowed to remain on the floors. Where floors are known or suspected to be contaminated above the limits for uncontrolled access, traffic in the area involved will immediately be halted by the person in charge of the area. The location will be declared a restricted access location until decontamination can be completed. The RPS will be notified immediately.

## **RADIATION EMERGENCY PROCEDURES**

Emergencies resulting from accidents in radioisotope use locations may range from minor spills of radioactivity involving relatively little personal hazard, to major radiation incidents and spills involving extreme hazards and possible bodily injury or life threatening situations. Because of many complicating factors which may arise in any given accident involving radioactive material, and because of the variety of additional hazards normally found in facilities located at the University, regulations for handling emergencies involving radiation cannot be made for all possible situations.

**In any emergency involving radioisotopes, always remember to protect personnel from radiation hazards and confine or contain the contamination to the area of the accident and restrict the movement of potentially or actually contaminated individuals.**

**IN ANY ACCIDENT OR INCIDENT INVOLVING PERSONAL INJURY, THE FIRST CONSIDERATION SHOULD BE FOR THE INJURED PARTY, AND NOT THE SPREAD OF CONTAMINATION. Contamination can be cleaned up after the fact.**

### **Minor Spills**

- The term minor spill will be defined for the purposes of these regulations to mean a total spill of less than 100 uCi (3.7MBq) of loose radioactive material, wet or dry, outside the confines of a controlled area, and which does not constitute a direct radiation hazard or a significant airborne hazard. A controlled area is an area within an approved use location which is specifically identified by the supervisor as the radioactive work area and is correctly labeled with appropriate signs, tapes, and/or insignia as described in the MSDH Regulations.
- **The immediate actions for handling a minor spill are as follows:**
  - **Notify all persons in the area** that a minor spill has occurred.
  - **Prevent the spread of contamination** by using the minimum number of personnel necessary to adequately confine the spill.
    - **Liquid Spills:**
      - Put on protective gloves
      - Cover the spill area with absorbent material.
    - **Solid Spills:**
      - Put on protective gloves

- Dampen the area of the spilled material with an appropriate dampening agent, taking care not to spread contamination or create an airborne hazard.
- Cover the spill area with absorbent material.
- **Clean up the spill.**
  - Using protective gloves, and remote handling tongs if necessary, to place the absorbent material into a plastic bag.
  - Remember to place other contaminated materials, such as gloves into the plastic bag.
  - Dispose of the bag in the radioactive waste container.
- **Survey** with a low range thin-window G-M Survey meter or a wipe test, to check for contamination in the cleaned area, on hands and clothing.
- **Report the spill** to the RPS, phone 915 - 5433, and the area supervisor as soon as possible.

## Major Spills

- The term major spill will be defined to mean a spill of 100 uCi (3.7 MBq) or more of loose radioactive material, a spill of loose radioactive material which constitutes a significant direct radiation hazard, a spill of loose radioactive material which can result in an airborne radioactivity hazard, or a spill of any amount of radioactive material outside the physical boundaries of an approved use location.
- **The immediate actions required in the event of a major spill** are as follows:
  - **Clear the Area:** Notify all persons not involved in the spill to evacuate the room or area.
  - **Prevent the Spread:** Cover the spill with absorbent material. Do not attempt to clean up the spill. Confine the movement of all personnel potentially contaminated. If the spill can create an airborne hazard, switch off any fans, to minimize air dispersal.
  - **Shield the Source:** If possible the spill should be shielded, but only if it can be done without further spread of contamination or without significantly increasing your radiation exposure.
  - **Close the Room and Secure the Area:** Leave the room and lock the door to prevent entry until emergency personnel arrive. If the spill occurs outside an approved location, withdraw a safe distance from the spill and maintain watch over the spill area, warning all passersby to stand clear of the spill.
  - **Call for Help:** Notify the RPS as soon as possible (phone 915 - 5433), or call the Univ. Police Department campus phone 4911, also notify the location supervisor, if known.
  - **Personnel Decontamination:** If the spill is on the skin, flush thoroughly with water and then wash with mild soap and lukewarm water into a leak-proof catch basin, and not down sewage drains. If clothing is contaminated, remove and store affected clothing for further evaluation.

## Airborne Radioactivity Accidents

- **Accidents involving radioactive mists, dusts, fumes, organic vapors, and gases** require special equipment and training. In the event of a spill of radioactive material which can reasonably be believed to have created an airborne hazard, the following immediate actions are required.
  - **Clear the Area:** Notify all persons not involved in the spill to evacuate the room or area.
  - **Prevent the Spread:** If appropriate respirators are immediately available for the material encountered, put on the respirator, switch off any fans, or air circulating equipment and close any windows or doors. Do not waste time in indecision. Vacate the room as soon as possible. If respirators are not available, evacuate the room immediately.
  - **Close the Room and Secure the Area:** Leave the room and move all personnel potentially exposed to the airborne contaminants to a safe single location. Lock any doors to prevent entry until emergency personnel arrive.
  - **Call for Help:** Notify the RPS as soon as possible (phone 915 - 5433), or call the Univ. Police Department campus phone 4911, also notify the location supervisor, if known.
  - **Additional Precautions:** Secure all ventilation into and out of the airborne contamination location from power panels outside the airborne hazard perimeter if possible. Ensure all entrances and exits are closed, locked, and posted with signs prohibiting access. If necessary, post guards at doors to prevent entrance by unauthorized persons.
  - **Do Not Reenter:** Do not enter the airborne hazard location until approval of the RPS is secured.

### **Radiation Hazard Accidents with Injuries**

- Wash minor wounds with little or no bleeding immediately under running water. If the wound is a puncture, let it bleed freely for a few minutes to wash out any contaminants.
- If the wound is bleeding heavily, apply direct pressure using a gloved hand, if possible, and a dry sterile dressing over the wound.
- Get competent medical attention immediately. Immediate help may be available from the Student Health Service or Baptist Memorial Hospital-North Mississippi.
- Report all accidents with injuries involving radiation hazards to the RPS as soon as possible, including, but not limited to, puncture wounds, cuts, abrasions, suspected overexposure, ingestion, and/or inhalation accidents.
- Permit no person with a radiation injury to return to work without expressed written approval from the RPS and the attending physician.

### **Overexposure or Ingestion Injuries**

- Any person who suspects overexposure, which is defined as whole body exposure in excess of 1.25 rem (0.0125 Sv) in 13 calendar weeks, is required to report this fact to the RPS immediately.
- Any person who ingests, absorbs, inhales, or has skin or eye contact with radioactive materials, in the workplace, must immediately report the incident to the RPS in person or

by messenger. Persons undergoing medical diagnosis or therapy involving ingestion of radioactive materials will not be required to report such ingestion to the RPS.

### **Bioassays**

- Persons working with I-125 and/or I-131 are required to have bioassays performed to determine if an intake occurred in the thyroid during the handling of the radioactive iodine.
- A baseline bioassay is required on all individuals before beginning work with radioactive iodine.
  - Per the Nuclear Regulatory Commission NUREG 8.20, for laboratories that only work with I-125 in radioimmunoassay (RIA) kits, the quantities of I-125 are very small and in less volatile forms; thus, the limit of 100 mCi during any 3 month period will be used for bioassay requirements.
  - When an individual routinely handles and works near unsealed quantities of less than 10 percent of the limit of 100 mCi during any 3 month period, a routine bioassay is not necessary.
- Bioassays will be performed at Laboratory Services at the following intervals:
  - Quarterly intervals (routine)
  - Emergency
  - Post-Operational
  - Diagnostic
- Results of bioassays performed will be documented on Form DHS-80 "Bio-Scan. Report for I-125/I-131." All records will be maintained in Laboratory Services.
- The annual limit on intake (ALI) for the thyroid is 40  $\mu$ Ci for oral ingestion and 60  $\mu$ Ci for inhalation.
- In the case of internal exposure or contamination, persons on the campus of the University of Mississippi may be required to submit to blood or urine tests for bioassay analysis.

### **Radiation Hazards in Fires**

- Attend to injured persons and remove them from harm.
- Alert all personnel: Notify all people in the immediate area to evacuate and activate the nearest fire alarm (or call 9-911).
- Close all doors and windows to confine the fire.
- Call Laboratory Services (phone 915 - 5433).
- Evacuate to a safe area or exit the building. Do not use the elevator.
- Have a person knowledgeable of the incident and laboratory report to the emergency personnel.

### **PERSONNEL DECONTAMINATION**

The standard procedures to be followed in personnel decontamination are outlined in the "Radiological Safety--Standard Operating Procedures." All cases of personnel contamination will be documented on DHS Form 90, "Personnel Contamination Report," which is available from Laboratory Services. The following general rules and precautions will be observed in any decontamination of personnel procedure.

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- Decontamination of personnel will be done only under the supervision of the RPS or a delegate.
- Instruments used must be checked for proper operation and must be within calibration dates.
- Personnel assisting in decontamination will use necessary precautions and protective clothing to prevent the spread of contamination to themselves or the surrounding area.
- Decontamination will be performed in a manner which will not spread contamination to other parts of the body.
- When washing a contaminated area of the body, care must be taken to prevent abrasions, cuts, or other invasions of the skin to prevent internal contamination.
- When drying an area of the skin which has been decontaminated by washing, do not rub the skin. A gentle patting of the skin with drying material is recommended.
- Never use water that is warmer or colder than body temperature for washing.
  - Warm water opens up pores. Cold water closes pores. Body temperature water is recommended for decontamination.
- Several gentle washes using mild soaps and the techniques outlined above are much better than one severe scrubbing.
- In the event that decontamination does not occur using the techniques above, further decontamination efforts will be determined by competent medical authority.

## RECORDS

Laboratory Services will maintain records as required by the MSDH. In addition, Laboratory Services reserves the right to maintain other records to protect the interests of the University, the local community, and the personnel associated with the University. A complete listing of records, required by the Division of Radiological Health, is contained in the "Radiological Safety--Standard Operating Procedures."

## NEUTRON MOISTURE GAUGE

The following rules and regulations apply to the operation, use, and maintenance of the Troxler Model 3216 Neutron Moisture Gauge, a product of Troxler Electronic Laboratories, Inc. The gauge is currently in the custody of Laboratory Services of the University of Mississippi. The University RPS will:

- Assure the safe use of the gauge at all times.
- Assure compliance with the regulations as published in all references.
- Assure by-product materials possessed under the Broad Scope License are in conformity with the materials listed on the license.
- Assure that the gauge is only used by persons certified by competent authority in its safe use.
- Assure that the gauge is properly secured against unauthorized removal at all times.
- Carry out, or cause to be carried out, the required leak tests according to schedule.

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- Serve as point of contact and give assistance in case of an emergency.

### Operating Procedures for the Neutron Moisture Gauge.

- The source will always be kept in the "safe" position when not being used in procedures to test moisture content in accordance with manufacturer's instructions.
- The operator will keep all unauthorized persons away from the instrument in operation at a minimum distance of 15 feet (5 meters).
- The gauge source lock will be in place and engaged in the locked position when the instrument is not being used in procedures to test moisture content in accordance with manufacturers' instructions.
- The gauge will be stored only in its approved storage case and location, and both the case and storage location will remain locked at all times of storage.
- The operator will operate the gauge in a manner so as not to expose himself or others to the unshielded source.

### Security of the Neutron Moisture Gauge

The storage area and storage container will be physically secured to prevent unauthorized personnel from tampering with or removing the instrument or source. Locks will be maintained on the equipment to prevent accidental exposure of the sealed source when not under the direct supervision of approved personnel engaged in operating the gauge for the purpose of measuring moisture, or when not under the direct supervision of the RPS. When the gauge is being used on a project site remote from the campus storage location, a storage room fixed with a lock will be provided and located at least 15 feet (5 meters) from any work site. Only approved University personnel and the RPS will have access to the storage room.

### Transportation of the Neutron Moisture Gauge

The Neutron Moisture Gauge will be secured within the transporting vehicle, but not inside the passenger's compartment, at all times during transportation. The Gauge will be transported at all times while locked in its marked shipping container. The Gauge will not be transported off the University campus without specific written authorization from the RPS. The Neutron Moisture Gauge will always be transported in accordance with applicable Federal, State, and local regulations.

### Repairs and Maintenance

All repairs and maintenance of the gauge electronics and source will be performed by the manufacturer, except that the RPS will perform, or cause to be performed, the semiannual leak tests and inventory.

### Accidents and Incidents

- If the neutron gauge is lost or stolen, the operator will immediately notify the University RPS. The RPS will then notify the following agencies and/or personnel:



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- Local area Police and Sheriff's office, 911.
- Mississippi State Department of Health, Division of Radiological Health  
601-987-6893 (Weekdays from 8 am to 5 pm).
- National Response Center, 800-424-8802.
- In the event of physical damage to the gauge, an exclusion area with a radius of 15 feet (5 meters), minimum, will be set up around the gauge, and will be maintained until the extent of source damage is determined by the RPS. If the damage occurs inside a vehicle, the vehicle must be stopped, warning devices available should be energized, and the vehicle vacated until the extent of the contamination is determined by competent authority. If a visual inspection of the instrument, inside the case or out, indicates the source was probably damaged, the exclusion area will be maintained, and the Radiation Emergency Procedures for a "[Major Spill](#)," will be invoked.
- The Only Persons Authorized to Investigate Damage to the Troxler Neutron Gauge is the RPS, or an Authorized Factory Representative.
- A written report of all accidents or incidents involving the Troxler gauge will be prepared after investigation of each incident by the RPS, and will be maintained in the files of the Laboratory Services.

### LIST OF APPROVED RADIOISOTOPES

#### ELEMENT AND MASS NUMBER CHEMICAL SYMBOL AND MASS NUMBER

Carbon 14 -  $^{14}\text{C}$   
Calcium 45 -  $^{45}\text{Ca}$   
Cadmium 109 -  $^{109}\text{Cd}$   
Cerium 141 -  $^{141}\text{Ce}$   
Chlorine 36 -  $^{36}\text{Cl}$   
Cobalt 57 -  $^{57}\text{Co}$   
Chromium 51 -  $^{51}\text{Cr}$   
Copper 64 -  $^{64}\text{Cu}$   
Iron 59 -  $^{59}\text{Fe}$   
Gallium 67 -  $^{67}\text{Ga}$   
Gadolinium 153 -  $^{153}\text{Gd}$   
Germanium 68 -  $^{68}\text{Ge}$   
Gold 195 -  $^{195}\text{Au}$   
Hydrogen 3, (Tritium) -  $^3\text{H}$   
Mercury 203 -  $^{203}\text{Hg}$   
Iodine 125 -  $^{125}\text{I}$   
Iodine 131 -  $^{131}\text{I}$   
Indium 111 -  $^{111}\text{In}$

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Sodium 22 -  $^{22}\text{Na}$   
Phosphorus 32 -  $^{32}\text{P}$   
Phosphorus 33 -  $^{33}\text{P}$   
Rubidium 86 -  $^{86}\text{Rb}$   
Sulfur 35 -  $^{35}\text{S}$   
Scandium 46 -  $^{46}\text{Sc}$   
Selenium 75 -  $^{75}\text{Se}$   
Tin 113 -  $^{113}\text{Sn}$   
Tin 119 -  $^{119}\text{Sn}$   
Technetium 99 -  $^{99}\text{Tc}$   
Zinc 65 -  $^{65}\text{Zn}$

The radioisotopes listed above are suitable for bulk liquid and liquid scintillation vial disposal through the University of Mississippi's current waste broker. Contact the RPS prior to waste generation if your radioisotope of interest does not appear on this list.

The Waste Liquid Scintillation Materials Generated must have an Average Specific Activity Less than 0.05 Ci per gram of medium.