RADIATION SAFETY MANUAL

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

HATTIESBURG, MISSISSIPPI

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MANUAL OF RADIATION SAFETY PROCEDURES

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I. GENERAL INFORMATION

1.0 INTRODUCTION

1.1 PURPOSE:

The purpose of this manual is to establish a campus-wide radiation safety program for The University of Southern Mississippi, and to prescribe procedures for the acquisition, receipt, ownership, possession, use, transfer, and disposal of radioactive materials and radiation producing devices in a safe manner consistent with State and Federal regulations. The manual further provides for the record-keeping, training certifications, approvals, tests, inspections, reporting, and all other activities required to apply for and maintain a Specific License of Broad Scope pursuant to the Regulations for the Control of Radiation in Mississippi.

All definitions, terms, procedures, and limitations used in this document are those prescribed in the Regulations for the Control of Radiation in Mississippi. Except for summaries and tables presented in abbreviated form for purposes of instruction, the definitions and provisions of those Mississippi regulations will not be excessively repeated by this manual. All changes in the State and Federal Regulations that occur subsequent to the printing of this manual will supersede affected provisions of this manual.

1.2 SCOPE

The regulations and procedures set forth in this manual apply to all persons who acquire, receive, possess, use, control, transfer, or dispose of radioactive materials or radiation producing devices on the campus of The University of Southern Mississippi located at Hattiesburg, (Forrest County) Mississippi except to the extent that such person is directly subject to regulations of the U.S. Nuclear Regulatory Commission.

2.0 REFERENCES AND AUTHORITY

2.1 AUTHORITY:

The following laws and regulations provide for and allow the activities and procedures described in this manual through general and specific licensing programs described therein:

3.0 RADIATION SAFETY COMMITTEE

The Radiation Safety Committee (RSC) is a standing committee whose members are appointed. One member of this committee will serve as chair for a two-year period. The Radiation Safety Officer (RSO) will be an ex-officio member of the Radiation Safety Committee.

3.1 PURPOSE:

The purpose of the Radiation Safety Committee is to conduct a campus-wide radiation safety program under a specific license of broad scope.

3.2 GENERAL RESPONSIBILITIES:

3.2.1 The Radiation Safety Committee will act in an advisory capacity on major decisions concerning radiation-producing devices and facilities, and radiation hazards as they may arise during the conduct of normal teaching, research, and public service functions of the University.

3.2.2 The Radiation Safety Committee will make routine decisions on matters of radiation safety including, but not limited to the following:

3.2.3 Procuring licenses for nuclear facilities, devices, substances, and personnel, and keeping these licenses in effect. (For the purpose of these guidelines nuclear facilities shall mean special buildings or rooms and their contents where accelerators, reactors, or irradiators are housed.)

3.2.4 Developing safety procedures in compliance with State and Federal regulations and providing these to users of radiation devices.

3.2.5 Serving as liaison between the Mississippi State Board of Health and the University in matters of registration, licensing, and control of radiation devices and personnel.

3.2.6 Prescribing special conditions where radioactive materials and devices can be safely used, stored, or disposed.

3.2.7 Giving final approval to all applicant users that will be registered under the University's license.

3.2.8 The Chair of the Radiation Safety Committee and the Radiation Safety Officer or their duly authorized representatives are authorized to enforce policies established by the Radiation Safety Committee, such as unannounced inspections and surveys as well as shutting down facilities or activities found to be in violation of best radiation safety practices.

3.2.9 The Radiation Safety Committee will hold regular meetings as needed to ensure that the radiation safety program's procedures and regulations is operating in compliance with the license. The Radiation Safety Committee will also meet at the conclusion of the annual inspection by the Mississippi Department of Health, Division of Radiological Health. The committee must have a majority of the members present, which will include the RSO, chairperson, executive/administrative representative or their appointed alternate, and a representative from each scientific area (biology, chemistry, physics).

3.2.10 Actions taken by the Committee will be recorded in the minutes and a permanent file will be maintained in the RSO's office.

3.2.11 The Radiation Safety Committee will conduct an annual review of the Radiation Safety program, which will include an evaluation of all personnel, inventory, and disposal records.

4.0 RADIATION SAFETY OFFICER

4.1 AUTHORITY:
Authority for the enforcement of the Radiation Safety Committee's rules and procedures will be the Radiation Safety Officer, whose qualifications shall reflect adequate training to interpret and carry out all radiation safety procedures.

4.2 CONTROL: The Radiation Safety Committee will receive regular reports from the RSO on the status of all radiation safety matters and shall exercise control over all decisions including those involved in the routine operation of the program and those decisions involving eminent hazard to the health of individuals.

4.3 GENERAL RESPONSIBILITIES:

4.3.1 The RSO or his staff will prepare applications for licenses or registrations, and submit these through the RSC (or chair) to the Mississippi State Board of Health.

4.3.2 The RSO will have the responsibility of approving the procurement, storage (short- and long-term), and disposal of all radioactive materials as prescribed by State regulations.

4.3.3 The RSO will conduct quarterly surveys of laboratories where radioisotopes or radiation producing devices are used. He or she shall prescribe more frequent surveys by the users as needed.

4.3.4 The RSO will have the authority to immediately terminate any project(s) that are in noncompliance with establish radiation safety procedures and policies.

4.3.5 The RSO and his staff will prepare all routine forms associated with tests, inspections, surveys, and will maintain and submit all records and reports required by the State Board of Health.

4.3.6 The RSO will require registered users to attend appropriate radiation safety training sessions. These training sessions will be conducted on an annual basis, or direct individuals to approved organizations where training is available. All registered users are required to properly maintain all documentation and records.

4.3.7 The RSO will review the qualifications of new applicants under the University's license. The RSO will then either recommend approval, further training, or disapproval of registration by the RSC.

4.3.8 The RSO will serve as the official RSC liaison with the State Board of Health.

4.3.9 The RSO will inform the Mississippi State Department of Health of all suspended activities, including those projects rescinded by the RSC or President.

4.4 ASSISTANCE:

Within budget limitations, the RSO may hire qualified individuals to assist in carrying out his or her duties and maintaining required records.

5.0 AUTHORIZATION AND REGISTRATION OF PERSONNEL AS USERS OF RADIATION SOURCES

5.1 SCOPE:

All persons involved in the procurement, receipt, use, handling, storage, clean up, or disposal of radioactive materials or radiation producing devices must be authorized by the RSC. Persons seeking to use radioactive materials or radiation producing devices must complete the USM-RS-2 application form. The RSO will review this application form and recommend approval, further training, or disapproval to the RSC. Authorization to use radioactive materials or radiation producing devices will be granted to applicants who, in the opinion of the committee, demonstrate the knowledge and ability to work with radioactive materials in accordance with established University radiation safety procedures and policies.

5.2 REGISTRATION:

5.2.1 Authorization as a Registered User under the University's Specific License of Broad Scope will be granted to an applicant if:

5.2.1.1 The applicant has sufficient training and experience with radioactive materials or radiation producing devices, and will be able to carry out the proposed work in a safe manner.

5.2.1.2 The applicant agrees in writing to follow all University, State, and Federal regulations governing the use of radioactive materials or radiation producing devices, and agrees to assume all responsibility for personal injury resulting from failure to comply with regulations, and

5.2.1.3 Project Directors will be required to meet the following minimum requirements: A college degree or equivalent training in the physical or biological or engineering sciences and experience and knowledge in the safe handling of radioactive materials, the characteristics of ionizing radiation, radiation dose units, and biological hazards of radiation exposure.

5.2.2 Registration will only be granted to individuals who use properly shielded sealed and unsealed sources or radiation-generating equipment with adequate shielding and safety interlocks, which will be determined by the RSO provided:

5.2.2.1 the applicant demonstrates competence in the use of the device or material

5.2.2.2 the applicant meets the requirements of paragraphs 5.2.1.1 and:

5.2.2.3 the applicant meets any special operating conditions (such as working under qualified supervision) that may be imposed by the RSC. (Devices that qualify include: certain electron capture detectors, commercially manufactured analytical x-ray equipment with a closed beam configuration).

5.2.3 General registration will be granted to individuals for the use of sealed and unsealed sources containing exempt quantities of radioactive isotopes upon application.

5.2.4 Classroom authorization is hereby granted for students formally enrolled in laboratory courses where radioactive materials are used, provided they are under supervision of a course instructor who has met any requirements, which this manual and the RSC may impose.

5.2.5 Temporary limited registration may be granted to an applicant who, in the opinion of the committee, has not had adequate training or experience provided that:

5.2.5.1 supervised on-the-job training is available by an individual who has received regular user registration, or if the applicant is in the process of taking formal course work or training, and

5.2.5.2 the applicant meets the requirements of paragraph 5.2.1.2 and 5.2.1.3, and

5.2.5.3 the authorization shall expire after six months at which time the applicant may apply for Registered User authorization.

5.2.6 Registered Users shall refer to the detailed laboratory safety guidelines given in Section 7.3 of this manual

II. PROCUREMENT, USE, AND DISPOSAL OF RADIOACTIVE MATERIALS

6.0 PROCUREMENT OF RADIOACTIVE MATERIALS

6.1 RADIOACTIVE MATERIALS PROCUREMENT GENERAL:

All radioactive materials used at the University of Southern Mississippi, including all on and off campus facilities, must be procured through the RSO Office. This includes the so-called "license exempt" radioactive materials. Appropriate forms may be obtained from the Radiation Safety Office. The RSO may aid the user in procuring radioactive materials by phone order if time is an urgent factor. The RSO will advise the user when the radioactive materials have been delivered, or have the materials transferred to the user in an expedient fashion. The RSO or his designee will perform all package surveys. Package surveys must be performed at the package surface, at one meter, and by a contamination wipe if required unless it is a sealed source.

6.1.1 Each licensee who expects to receive a package containing quantities of radioactive material in excess of Type A quantity, as defined in the Regulations for the Control of Radiation in Mississippi, shall make arrangements with the RSO to receive:

6.1.1.1 the package when the carrier offers it for delivery; or

6.1.1.2 the notification of the arrival of the package at the carrier's terminal and to take possession of the package expeditiously.

6.1.2 Each licensee will:

6.1.2.1 monitor the external surfaces of a labeled radioactive package for radioactive contamination unless the package contains only radioactive material in the form of gas or in special form as defined in the Regulations for the Control of Radiation in Mississippi;

6.1.2.2 monitor the external surfaces of a labeled radioactive package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity, as defined in the Regulations for the Control of Radiation in Mississippi

6.1.2.3 monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged.

6.1.2.4 the licensee will perform the monitoring required by the Regulations for the Control of Radiation in Mississippi as soon as possible after receipt of the package, but not later than three hours after the package is received at the licensee's facility.

6.1.2.5 the licensee will immediately notify the final delivery carrier and, by telephone and email, or facsimile, the agency when:

6.1.2.5.1 removable radioactive surface contamination exceeds the limits of defined in the Regulations for the Control of Radiation in Mississippi

6.1.2.5.2 external radiation levels exceed the limits of the Regulations for the Control of Radiation in Mississippi.

6.1.2.5.3 labeled with a radioactive white I, yellow II, or yellow III label as specified in the U.S. Department of Transportation regulations 49 CFR 172.403 and 172.436.440.

6.1.2.6 Each licensee will:
6.1.2.6.1 establish, maintain, and retain written procedures for safely opening packages that contain radioactive materials
6.1.2.6.2 ensure that the established procedures are followed and that due consideration is given to any special instructions required for the type of package being opened.

6.2 TRANSMITTAL:

The RSO or the assistant will designate the place where radioactive materials are to be forwarded or will deliver them to the user under circumstances where safety or time considerations warrant it. A transmittal sheet indicating that the RSO has received and inspected the radioactive materials will be forwarded along with the materials to the user. This transmittal sheet will indicate the amount(s) of each radioactive material transmitted, its condition, its destination, designated use area, special instructions, and the appropriate method of disposal along with a disposal record form. The RSO will retain one copy of the transmittal form and disposal record form. After the materials are used, the transmittal sheet and disposal form are to be signed by the user and returned to the RSO indicating that the materials were used properly and properly disposed of unless instructed otherwise. A disposal record will be returned to the Radiation Safety Office as required by established regulations.

6.3 TRANSFER PROHIBITED:

Radioactive materials **shall not** be transferred from one department or laboratory to another without prior approval of the RSO.

7.0 USE AND SAFE HANDLING OF RADIOISOTOPES

The safe use of radioactive materials is addressed by two concurrent sets of regulations: General Radiation Safety Standards that specify limits to doses of radiation; and Laboratory Safety Guidelines that minimize exposure to radiation through conscious efforts to prevent bodily contact with, or ingestion of radioactive isotopes, and to prevent the release of radioisotopes into the environment.

7.1 SAFETY STANDARDS AND PROCEDURES:

Each applicant under the University's Specific License of Broad Scope, and all radiation safety personnel, appropriate department chairs, and supervisors will be familiar with the Regulations for the Control of Radiation in Mississippi.

7.2 STANDARDS:

7.2.1 DEFINITIONS:

7.2.1.1 Radioactivity: The spontaneous disintegration of atomic nuclei accompanied by the emission of nuclear radiation.
7.2.1.2 Radiation: X-rays, α, β, λ-rays, neutrons, protons, positrons, and other energetic electromagnetic emissions.
7.2.1.3 Radiation Area: Any area, accessible to individuals, where there exists radioactive materials at levels that a major portion of the body could receive a dose in excess of 5 millirems (0.05 millisievert) in one hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates.

7.2.1.4 Curie: (Ci) Unit of measure of radioactivity 1 Ci = 37 x 10^9 disintegrations/sec. 1 millicurie (1 mCi) = (1/1000) Ci, 1 microcurie (1 μCi) = (1/1,000,000) Ci.

7.2.1.5 Roentgen: (R) Unit of radiation dose or exposure, 1R of radiation produces 2.58 x 10^{-4} coulomb/kilogram of air.

7.2.1.6 Roentgen Equivalent in Man: (REM) A dose of radiation which produces the same biological damage as 1 Roentgen of x- or γ-rays.

7.2.1.7 Roentgen Per Hour: (R/h) Unit of radiation level or exposure rate.

7.2.1.8 RAD: A special unit of absorbed dose. One RAD equals one hundredth of a joule per kilogram of material or 100 ergs per gram of absorber material.

7.2.1.9 Expanded Definition of REM: "REM" (Roentgen Equivalent in Man) is a measure of the dose of any radiation to body tissue in terms of its estimated biological effect relative to a dose received from an exposure to one roentgen (R) of x-rays. (One millirem (mrem) = 0.001 rem.) For the purpose of these regulations, any of the following is considered to be equivalent to a dose of one REM:

7.2.1.9.1 An exposure of 1 R of x, or gamma radiation.

7.2.1.9.2 A dose of 1 rad due to x, gamma, or beta radiation.

7.2.1.9.3 A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye.

7.2.1.9.4 A dose of 0.1 rad due to neutrons or high energy protons.

7.2.1.10 Licensee is the University of Southern Mississippi

7.2.1.11 Registered User is an individual who has requested and is authorized by the RSC to use radioisotopes in a research laboratory

7.2.2 SYNOPSIS OF RADIATION SAFETY PROCEDURES:

A one-page synopsis of radiation safety procedures is presented in Appendix 1. This served as a reminder of the major precautions, procedures, and standards contained in Chapter 4 of the State regulations. Copies of this synopsis are available from the RSO for posting in appropriate places. Perusal of Table A.1 is in no way to be construed as a substitute for careful study of Chapter 4 of the State regulations prior to registration as a user under the University's Specific License of Broad Scope.

7.2.3 A table of some commonly used radioisotopes is included in this manual (Appendix A.2) for
instructive purposes. This can be used as a quick reference for those using the particular isotopes listed.

7.3 LABORATORY SAFETY GUIDELINES

The purpose of radiation safety guidelines is to minimize human exposure to radiation and environmental contamination by radioactive isotopes. When possible, radiation levels should be kept far below the allowable limits (Radiation Standard). The following guidelines should form the central practices in achieving these goals:
Laboratories (and classrooms where radiation demonstrations are carried out) will be categorized as follows:

7.3.1 TEACHING AND DEMONSTRATION AREAS AND LABORATORIES WHERE ONLY EXEMPT QUANTITIES AND LOW-LEVEL SEALED SOURCES ARE USED:

[LIMITATION - Exempt quantities and sealed sources of 1 mCi or less.]

7.3.1.1 Instructor Qualifications: One year of physical or biological science training and a demonstrated knowledge of radiation safety.

7.3.1.2 Safety Guidelines: (These guidelines are to be posted, distributed, or instruction given to students before a radiation experiment is conducted.)

-All sealed sources will be accounted for before and after classroom or laboratory activity.

-Sealed Sources will not to be opened, punctured, or violated to extract the radioactive contents of the source.

-Sealed sources will not to be placed in pockets of clothing of persons.

-Protection principles of distance, shielding, and low-exposure times are to be practiced at all times.

-Instructor will wear a 0-200 R dosimeter, a daily exposure record will be kept, and any readings greater than 1 mR are to be immediately reported to the RSO.

-Sealed sources will be leak tested at intervals not to exceed six months, if under active use.

- A Geiger Counter or appropriate radiation survey meter should be present during any teaching activity if it is deemed necessary by the instructor or RSO.

7.3.2 RADIOISOTOPE TEACHING LABORATORIES: A radioisotope teaching laboratory is a laboratory where the principle activity is instruction is in handling and use of radioisotopes in chemical forms other than sealed sources.

Because of the wide variety of radionuclides encountered, radioisotope laboratories require some of the most stringent guidelines and safety procedures. The laboratory safety guidelines and any other reasonable precautions which the instructor may impose shall be followed explicitly:

7.3.2.1 Instructor Qualifications for a Radioisotope Laboratory: The Radioisotope Laboratory instructor or his/her supervisor shall have a minimum of a Bachelor's or Master's Degree in a physical or biological science and at least forty hours of instruction in radiation safety. Included in those 40 hours are such topics as: fundamental properties of radiation, radioactivity, radioactive decay; measurements, units, and radiation standards; the biological effects of nuclear radiation; principles of protection from radiation; Federal, State, and Institutional Regulations on Radiation Safety.

7.3.2.2 Radiation Safety Guidelines for a Radioisotope Laboratory: (These guidelines are to be posted in each Radioisotope Laboratory.)

7.3.2.3 Instructions: All students shall receive one to four hours instruction in the safe handling of radioisotopes at the beginning of any radioisotope laboratory course, which will include posted guidelines.

AVOIDANCE OF ACCIDENTAL INGESTION

- Food and drink for human consumption, smoking, and the application of cosmetics are strictly prohibited in all radioisotope teaching laboratories.

-Storage of food and/or drinks are strictly prohibited in all radioisotope teaching laboratories.

-Mouth pipetting is prohibited; automatic pipetting devices will be furnished when needed.

-Avoid contact of hands with radioisotope solutions, particularly if open cuts or wounds are present and if organic solvents are present in the solution (gloves should always be worn to avoid contamination).

-Hands or gloves should be rinsed or washed frequently during a laboratory period to avoid transport of radioisotopes to the mouth, nose, or eyes.

-Experiments and manipulations involving radioactive gases, fumes, or dusty solids shall be carried out in an approved, certified hood or glove box.

-Spills and suspected contamination areas will be cleaned up immediately or as soon as possible according to procedures given in Section 7.4.

PROTECTIVE CLOTHING AND DEVICES

-Minimum protective clothing is to be worn in all Radioisotope Teaching Laboratories, which will be a lab coat, or a lab apron.

-Gloves will be worn by all personnel, and all students handling any radioisotopes other than those in permanently sealed sources. Persons having cuts, sores, or wounds on a hand, wrist, or forearm should wear a long-sleeved waterproof lab coat extending over the upper portion of the gloves. Gloves may be of solvent resistant rubber or disposable plastic film depending on the solvent(s) being used. (The lab instructor or his assistant will specify glove type when required).

-Complete protective clothing (booties, protective suit, cap, respirator, and gloves) are required when cleaning up spills where dusts, fumes, and gases are involved in major radiation spills.

-Persons working directly with radiolabel materials are required to wear dosimeters, and record doses received during each lab period on appropriate personal Radiation Exposure Record forms.

-Each person is responsible for monitoring him/herself upon leaving a laboratory for any reason (except fire, explosion, chemical burns, or other emergency), and for discarding or

decontaminating any contaminated clothing he/she might be wearing as well as washing contaminated skin surfaces clean.

-Approved auxiliary storage and waste containers, blotters, and cleaners should be present for decontamination of equipment and personnel.

-Contaminated equipment, glassware, tools, or clothing will be cleaned as well as possible and returned to stock if successfully decontaminated or discarded in a radiation waste container if a corrected count of 100 counts per minute remains on 10 cm of area.

7.3.3 Radiation Safety Guidelines for X-ray Analytical Laboratories and Analytical Laboratories Having Electron Capture Gas Chromatography Detectors

Laboratories having x-ray Analytical Instruments such as x-ray diffraction and x-ray spectrometers with adequate shielding and safety interlocks or laboratories having shielded radioactive sources in electron capture detectors usually have very minimal levels of radiation in the vicinity of these instruments during normal usage. The following precautions are required in these laboratories:

7.3.3.1 X-ray Laboratories

-A radiation survey is required during and immediately after installation of the equipment in a laboratory. Furthermore, the Mississippi State Board of Health may require their safety survey during the same time. Annual surveys will be conducted thereafter.

-Film badges are to be worn by operators and read on a quarterly basis during the first year of operation. This requirement may be removed after 1 year if, in the opinion of the RSO, and the Mississippi State Department of Health Division of Radiological Health, it is safe to do so.

-Operators will demonstrate a thorough knowledge of the operation of x-ray instruments, and knowledge of radiation safety principles, devices, and measures for that particular instrument.

-Interlocks on instruments ***will not*** be bypassed for any reason.

-The doors of laboratories containing x-ray equipment will have signs bearing the radiation symbol and the words, “Caution: X-ray Equipment” or “Caution: Radiation Area.”

7.3.3.2 Gas Chromatography Laboratories with Instruments Having Electron Capture Detectors:

-A radiation survey of any Gas Chromatography instrument is required during and after installation of an Electron Capture Detector. The RSO or his assistant will conduct the survey.

-Personal radiation monitoring devices will be required of all operators of the Electron Capture Gas Chromatography instrument, only if the levels of radiation emanating from the instrument in operation warrant such measures.

-The operator(s) will be required to demonstrate a knowledge of radiation safety as well as safe operating procedures for the instrument.

-Radiation survey instruments will be present and used when the electron capture detector is being dismounted, dismantled, or cleaned, and radiation levels one inch from the various parts will be reported.

-Worn out or inoperative electron capture detectors will be disposed of by the RSO.

-Doors to laboratories containing electron capture detectors will be posted with a sign bearing the radiation symbol and the words, "Caution: Radioactive Materials."

7.3.4 Research Laboratories where Radioisotopes, Irradiators, and Other Sources of Ionizing Radiation are Present and Being Used.

Research laboratories may engage in a variety of activities where radioactive materials and radiation producing devices are needed. The main thrust of radiation safety practices established for these laboratories is to ensure compliance with NRC, Mississippi State Department of Health, Division of Radiological Health, and USM radiation safety standards and procedures. This requires thorough familiarization with all three sets of regulations as they apply to each particular laboratory.

Referring to the Laboratory Classification Table (next page) all operating Radioisotope Research Laboratories at The University of Southern Mississippi are currently classified as either Class C (low) or D (very low). Safety guidelines for these laboratories will be the same as for Radioisotope Teaching Laboratories, with the following additions:

7.3.4.1 Radioisotope Research Laboratories:

-Laboratory personnel working with non-exempt quantities of gamma (γ) emitters, and high energy beta (β) emitters (.25 MeV or greater) on a regular basis will be required to wear dosimeters or film badges.

-Laboratory personnel working in Class C Radioisotope Laboratories with only Tritium, ^{3}H, or ^{14}C, are not required to wear personal monitoring devices (dosimeters or film badges).

- Research laboratories are required to keep track of radiation stocks and perform working surveys to avoid potential contamination. This activity must be logged using form USM RS-7 Compliance Calendar (see Forms pg. 47) Surveys and or wipe tests must be performed on a specific schedule as follows:

1. Research laboratories using radioactive isotopes are required to perform area surveys at the end of each day or at the end of a radiation working period.
2. If radiation has been used within the week a final radiation survey must be performed at the end of the week.

This will result in at least 2 to 8 surveys performed during the week if using radiation. All surveys must be logged. If no radiation is used during the week the radio active material should be stored securely and no surveys are required.

- Accurate records of radio active material usage must be kept by research labs. Usage amounts in curries must be logged during radio active experiments daily and weekly. Totals of radio active material remaining will be calculated for the month. All of these parameters need to be logged on form USM-RS-7 Compliance Calendar

-Waste Disposal General Requirements: A licensee shall dispose of radioactive material only by transfer to an authorized recipient as described in of Regulations for the Control of Radiation in Mississippi, or to the U. S. Department of Energy; or by decay in storage.

- Disposal of solid waste containing radioactive isotopes will be performed only by commercial disposal firms that are licensed to dispose of low-level radioactive wastes, except when the radioisotopes involved have half-lives that are short enough (e.g., ^{32}P) such that they can be held until they decay to background levels. These shall be segregated from long-lived isotopes whenever possible. Solid wastes that have decayed to background levels may be disposed of as garbage only after a thorough survey of the materials is made and recorded, and the disposal record is approved by the RSO.

- Laboratories using radioisotopes will be posted with signs reading, "Caution: Radioactive Materials."

7.3.4.2 Specialized Radioisotope and Radiation Laboratories:
In specialized laboratories, the Laboratory Director should prescribe specific safety guidelines for review and approval of the RSO and RSC. These may consist of the Operating Instructions for a particular device or instrument. Any further precautions considered necessary by the Lab director, the RSO, the RSC, or the Mississippi Department of Health, Division of Radiological Health, will be adopted and made available to all laboratory personnel.

7.3.4.3 Future Additions to Radioisotope Research Laboratory Safety Guidelines:
New safety guidelines will be developed as prescribed in 7.3.4.2 above, if new research or teaching programs evolve where radioactive materials are used.

TABLE 7.3.5 LABORATORY CLASSIFICATION TABLE

A. CLASSIFICATION OF RADIONUCLIDES BY TRANSPORTATION GROUP

Class	Description	Examples
I	Very high radiotoxicity	Ra-226, Po-210, Pu-239
II	High radiotoxicity	Sr-90, Ba-133
III	Moderate radiotoxicity	Co-60, I-125, I-131, Cs-137
IV	Low radiotoxicity	H-3, C-14, P-32, S-35, Ca-45, Cr-51, Rb-86

B CLASSIFICATION OF RADIOISOTOPE LABS USING OTHER-THAN-SEALED SOURCES

Class	A(High)	B(Inter.)	C(Low)	D(Very Low)
	greater than	up to	up to	
I	1 mCi	1 mCi	10 μCi	
II	10 mCi	10 mCi	100 μCi	Exempt
III	100 mCi	100 mCi	200 μCi	Quantities
IV	1000 mCi	1000 mCi	200 μCi*	
Survey Frequency	Daily	Weekly	Monthly	Quarterly

(when radioisotopes in the above quantities are actually used during the period)

C. MODIFYING FACTORS FOR CLASSIFICATION OF RADIOISOTOPE LABORATORIES

Use	Modifying Factor
Storage only	x 100
Simple wet operation	x 10
Normal chemical operations	x 1
Complex chemical operation with high spill risk	x 0.1
Simple dry operations	x 0.1
Dry dusty operations	x 0.01

D. Laboratories using sealed sources with appropriate radiation protection measures are not required to do monthly laboratory surveys. The semiannual leak tests are considered sufficient to detect hazards unless the leak test is positive. If a positive leak test is found, then an appropriate laboratory survey is required.

*Except isotopes with larger exempt quantities, for example, tritium 1000 μCi.

7.4 RADIATION EMERGENCY PROCEDURES

THE RADIATION SAFETY OFFICER OR HIS/HER QUALIFIED ASSISTANT WILL SUPERVISE CORRECTIVE CLEANUP AND SAFETY MEASURES FOR ALL RADIATION EMERGENCIES, EXCEPT THOSE IMMEDIATE RESPONSES REQUIRED TO PROTECT PERSONNEL AND CONFINE REMAINING ITEMS IN THIS SECTION (7.4). The best qualified Registered User or his/her laboratory assistant is responsible for immediate response.

7.4.1 SPILLS OF RADIOACTIVE MATERIALS:

Emergencies resulting from accidents in laboratories using radioactive materials may range from minor spills, involving relatively no personal hazard, to major radiation incidents and spills involving extreme hazards and possible bodily injury. Because of the numerous complicating factors that may arise, an all encompassing set rules of emergency procedure cannot be made to cover all possible situations. In any emergency, however, the primary concern must always be the protection of personnel from radiation hazards. This should be followed, if possible, by the immediate confinement of contamination to the local area of the accident.

7.4.1.1 Minor Spills Involving No Radiation Hazard to Personnel; the Person in Charge Will:

- Notify all other persons in the room at once.
- Permit only the minimum number of persons necessary to deal with the spill into the area.
- Confine the spill immediately.
- Liquid Spills: Wear protective gloves, Drop absorbent paper on spill,
- Dry Spills: Wear protective gloves. Dampen thoroughly with appropriate dampening, Agent, taking care not to spread the contamination.
-Collect waste materials in a bag and label as radioactive waste
-Notify the RSO as soon as possible.
-Permit no one to resume work in the area until approval of the RSO is secured.

7.4.1.2 Major Spills Involving Radiation Hazards to Personnel; the Person in Charge Will:

- Notify all other persons in the room at once of the hazard.
- Request all persons not involved in the spill to immediately vacate the room.
- Make no attempt to clean up the spill. If spill is liquid, and the hands are protected, right the container to stop spillage.
- If the spill is on the skin, flush thoroughly with water. If the spill is on clothing, discard outer clothing at once.
- Switch off all fans.
- Vacate the room and prohibit entrance to the contaminated area.
- Notify the RSO as soon as possible and provide details of the spill.
- Persons who are contaminated or suspected to be contaminated from a radioisotope spill should be monitored (if possible), and should be restricted to a safe area to prevent the spread of contamination unless clinical treatment or hospitalization is required. Such

persons should have their movements restricted until the RSO or other qualified personnel has prescribed and initiated safe decontamination procedures.
- No persons will be allowed to work in the area until approval of the RSO is secured.
- Under no circumstances should untrained personnel attempt to examine or clean up radioactive material.

7.4.1.3 Accidents Involving Radioactive Dusts, Mists, Fumes, Organic Vapors, and Gases:
- Notify all other persons to vacate the room immediately.
- Hold breath and close all windows, escape valves; switch off air circulating devices, if time permits. (Air-Handling equipment in the Johnson Science Tower and the Technology Center can be turned off by tripping a fire alarm.)
- Vacate the room.
- Notify the RSO and the Mississippi State Department of Health, Division of Radiological Health.
- Ensure that all access doors to the room are closed and locked. If necessary, post guards to prevent entry.
- Do not re-enter the room until approval of the RSO is secured.

7.4.1.4 Injuries to Personnel Involving Radiation Hazard:
- Wash minor wounds immediately (within 15 seconds if possible) under running water, while spreading the edges of the gash (NOTE: Light tourniquet action to stop venous return, but not to restrict arterial flow, may be desirable to stimulate bleeding.)
- Report all radiation accidents (wounds, over-exposure, ingestion, inhalation) immediately to the RSO, who will also notify the Mississippi State Department of Health, Division of Radiological Health.
- Call a physician (e.g., Student Health Services) at once, or request medical aid through the campus police emergency phone number.
- Permit no person involved in a radiation injury to return to work without the approval of the RSO and the attendant physician.

7.4.1.5 Occupational Dose Limits
- The licensee or applicant shall control the occupational dose to individual adults, except for planned special exposures to the following dose limits:
- An annual limit defined as, whichever is the more limiting of: the total effective dose equivalent being equal to 5 rems (0.05 sievert); 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 sievert).
- The annual limits to the lens of the eye, to the skin, and to the extremities that are: an eye dose equivalent of 15 rems (0.15 sievert), and a shallow dose equivalent of 50 rems (0.5 sievert) to the skin or to any extremity.

7.4.2 FIRE, EARTHQUAKE, EXPLOSION, OR OTHER NATURAL DISASTER:

In the event of fire or other destructive force, all reasonable precautionary measures should be taken to prevent the spillage of hazardous levels of radiation into the environment if there is sufficient warning or safe access to radioactive materials. Such procedures will be posted near radiation devices and radioactive materials representing a

significant environmental hazard and will be approved by the RSC and RSO in advance. The Mississippi State Department of Health, Division of Radiological Health must be notified of all disasters and emergencies involving radioactive materials.

8.0 RADIOACTIVE WASTE DISPOSAL

All radioactive waste will be collected by the RSO or Assistant RSO. It is acceptable for the laboratory to dispose of the shipping box only after all radioactive symbols and labels have been removed. Radioactive waste disposal by the RSO or Assistant RSO will be accomplished by one of four methods: 1) Discarding low level, low toxicity solid wastes into the normal garbage collection system, 2) discarding low level water soluble or miscible wastes into the sanitary sewer system, 3) Holding short lived isotopes (half lives less than 100 days) until their activity is sufficiently low (a minimum of 10 half lives) to discard as above. 4) Return devices, sources, and chemicals with activities greater than above to the RSO for commercial disposal.

8.1 DISPOSAL GUIDELINES:

8.1.1 The RSO will specify the method of disposal of all radioactive materials received at USM after January 1, 1982 on the transmittal sheet (Form USM-RS-1) and on the disposal record form (USM-RS-3). After an initial inventory, disposal records will be prepared on all existing stocks of radioactive materials indicating the disposal method to be used

8.1.2 **The RSO is responsible for the proper disposal of all radioactive materials, and will execute certification of proper disposal on the disposal record form.**

8.2 DISPOSAL RECORD FORMS:

The disposal record form will be filled out either as a running account of disposal lots or as the complete batch disposal completed on a given date. The date of each disposals will be recorded. This may be the last day where a series of measurements/experiments is completed. Interim disposal record forms will be filled out as often as needed, but no less than annually if a shipment of a radioisotope is used over a period of more than one calendar year.

8.3 DISPOSAL INTO THE SANITARY SEWER SYSTEM:

8.3.1 The RSO or Assistant RSO may discharge licensed material into sanitary sewerage if each of the following conditions are satisfied:

8.3.1.1 The material is readily soluble, or is readily dispersible biological material, in water; and

8.3.1.2. The quantity of licensed radioactive material that the licensee releases into the sewer in 1 month divided by the average monthly volume of water released into the sewer by the licensee does not exceed the concentration listed in Table III of Appendix B of this section; and

8.3.1.3 If more than one radionuclide is released, the following conditions must also be satisfied: the RSO or Assistant shall determine the fraction of the limit in Table III of Appendix B of this section represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the licensee into the sewer by the concentration of that radionuclide listed in Table III of Appendix B of this section; and the sum of the fractions for each radionuclide does not exceed unity; and

8.3.1.4 The total quantity of licensed radioactive material that the licensee releases into the sanitary sewerage in 1 year does not exceed 5 curies (185 gigabecquerels) of ^{3}H, 1 curie (37 gigabecquerels) of ^{14}C, and 1 curie (37 gigabecquerels) of all other radioactive materials combined.

8.3.2 DETERMINATIONS:

Disposal into the sanitary sewer by the RSO or Assistant will include the following determinations:

8.3.2.1 The substance being disposed has a solubility of at least .5 g/l or a miscibility of .5 ml/l in water.

8.3.2.2 The activity of the sample (s) is no greater than 0.05 μCi/ml if H-3 or C-14, will be diluted to that mean daily value specified of state regulations by the average daily flow of the sewer line.

8.3.2.3 The disposal is not prohibited by the Resource Conservation and Reclamation Act because of other toxic substances in solution.

8.3.2.4 The sink drain line has no serious leaks.

8.3.3 FLUSHING DOWN SEWER:

8.3.3.1 Once these determinations have been made the waste containers are emptied directly into the drain one by one with copious amounts of tap water flushing the waste down (at lest enough to completely dissolve the waste, or about 10 parts water to 1 part disposed solution if completely miscible). Do not pour radioactive waste into the corner of a sink where little or no mixing is occurring!!

8.3.3.2 After emptying the last container, flush for five minutes with tap water or with a volume of water calculated to dilute the activity of the last few samples added by a factor of 1000. Flush off all surfaces of the sink, and allow to drain completely.

8.3.3.3 Survey the sink with a thin end window Geiger counter when dry. The next day will often be the earliest time that the sink will be dry.

8.3.3.4 Counts of greater than 100 CPM's (.04 mR/h) one inch above the surface should be further flushed or treated like a spill.

8.3.3.5 Post the sink as a Restricted Area or Area of Contamination until a satisfactory survey is achieved.

8.3.3.6 Sinks that frequently present problems associated with radioisotope disposal procedures should not be used if better sinks are available.

8.3.3.7 The RSO or his/her assistant will provide assistance in sanitary sewer disposal when requested. The RSO may request to be present during some disposals.

8.4 DISPOSAL OF SOLIDS INTO GARBAGE COLLECTION SYSTEMS:

Discarding radioactive solid waste into garbage cans designated for radioactive disposal is the usual method of collection of low-level wastes. All chemicals, solids, wipes, and contaminated clothing having a greater activity than background shall be collected in a separate liner or container for pick up by the RSO. These will be collected by Radiation Safety Office personnel and shipped to a licensed disposal site. When only short-lived radioisotopes are being used, the solid waste may be collected by the RSO and stored until it has decayed to background levels. A survey and assay of the material, a survey record and a disposal record shall be conducted, filled out, and approved by the RSO before pick up and disposal by the RSO.

8.5 MINIMIZING DISPOSAL OF CONCENTRATED RADIOISOTOPE SOLUTIONS:

A CONSCIOUS EFFORT SHOULD BE MADE BY ALL USERS TO KEEP STOCK ISOTOPE CONCENTRATIONS TO A MINIMUM, IF POSSIBLE WITHOUT IMPEDING THE PROGRESS OF SCIENTIFIC RESEARCH. THIS WILL ENSURE THAT DISPOSAL OF MATERIALS WILL BE SIMPLE AND AND DISPOSAL COSTS WILL BE KEPT TO A MINIMUM.

8.6 DISPOSAL OF SEALED SOURCES, DEVICES, AND SUBSTANCES WITH MODERATE TO HIGH RADIOTOXICITY BUT STILL LOW LEVEL WASTES FOR DISPOSAL PURPOSES:

All sealed sources, irradiators, devices, electron capture detectors, and all other waste will be disposed by Radiation Safety Office personnel in accordance with Mississippi State Department of Health and Department of Transportation regulations. Materials will be converted into solid form and contracted for disposal at an approved disposal facility.

III. SUPPORTIVE SAFETY SERVICES

9.0 ISTRUMENTATION AND CALIBRATION SERVICES

9.1 INSTRUMENTATION

The Radiation Safety Office will make available the following survey instruments and personal monitoring devices to users. These instruments and monitoring devices will be maintained in a state of readiness (calibrated annually), and can be checked out by users on a temporary basis until users purchase instruments for laboratory use.
3 -β, γ, Geiger Counter Survey Meters with rugged side window probe 0 - .5 to 0 - 50 m R/h in 3 ranges. These meters can be used to detect beta and gamma rays with energies greater than 0.2 MEV and measure low-level radiation exposure levels in milliRoentgens per hour.

1 - Portable Scaler with pancake probe (thin window) for laboratory and field use. The instrument is used as a backup for the α, β, γ, survey meter.

9.2 DEPARTMENTAL RESPONSIBILITY FOR ACQUIRING REQUIRED RADIATION SAFETY INSTRUMENTATION:

All academic departments engaging in radiation-related work are responsible for acquiring instrumentation and personnel monitoring devices (film badges, dosimeters, etc.) to ensure adequate safety of personnel. The Radiation Safety Office will provide assistance as available to meet these requirements on an interim basis; however, the registered user and his/her department will be
responsible for establishing and enforcing effective long-term safety protocols and monitoring in radiation-use laboratories.

9.3 CALIBRATION SERVICES:

All survey instruments used by The University of Southern Mississippi will be calibrated on at least an annual basis by an instrument calibration service approved by the NRC, an Agreement State, or the Division of Radiological Health of the Mississippi State Department of Health, State of Mississippi.

10.0 PERSONNEL MONITORING

Personnel monitoring devices will be used to insure that individuals working with radioactive materials are not overtly exposed to radioactive contamination. When needed, accurate records of accumulated dosages of individual users will be kept.

10.1 PERSONNEL REQUIRED TO WEAR DOSIMETERS AND FILM BADGES:

10.1.1 A personnel monitoring device will be required by the following users:

Any user working in a restricted radiation area where he/she will receive in one year, or is likely to receive, a dose exceeding 10% of the allowed exposure (refer to Table 7.1).

Any minor under age 18 that enters a restricted radiation area where he/she will receive in any one year, or is likely to receive, a dose exceeding 10% of the allowed exposure (refer to Table 7.1).

10.1.2 In addition to the requirements specified in 10.1.1, any user will be required to wear a personnel monitoring device if:

They will be working with beta or gamma emitters with emission energies greater than 0.25 MEV. Ring film dosimeters must be worn by high-energy beta users, such as ^{32}P.

They will be working with non-exempt neutron sources.

They will be working with x-ray producing machines unless exempted by the RSC and the Mississippi State Department of Health

They will be working with accelerators or devices used to accelerate particles.

They will be working in any high radiation area.

10.1.3 The RSO and his/her assistant are required to wear personnel devices, usually a film badge or a pocket dosimeter, when conducting surveys, performing leak tests, or upon entering any restricted radiation area.

10.2 MONITORING DEVICES:

10.2.1 Monitoring devices are to be worn at all times when the user is in a restricted radiation area. The monitoring device is not to be worn when not in use, and should be stored away from excessive radiation.

10.2.2 Film badges are to be worn by users working with x-ray producing machines unless exempted. The film badges should be worn in such a way as to indicate whole body exposure (e.g. attached to the belt or breast pocket).

10.2.3 Finger or wrist dosimetric devices will be provided to and used by:
Analytical x-ray equipment workers using systems having an open-beam configuration, which are not equipped with a safety device. Any personnel maintaining analytical x-ray equipment if the maintenance procedures require the presence of a primary x-ray beam when x-ray system is disassembled or removed.

10.2.5 Other monitoring devices may be required in situations deemed necessary by the RSO.

10.3 RECORDS:

Records of each registered user's radiation dosage shall be maintained by the Radiation Safety Office, and updated quarterly.

11.0 AREA SURVEYS AND LABORATORY MONITORING

Surveys and monitoring of radioactive laboratories and restricted radiation areas will be conducted to insure protection from radiation exposure or contamination, and to comply with state and federal regulations. Surveys will be conducted on a routine basis by the RSO or his/her assistant.

11.1 SURVEYS:

11.1.1 The RSO or his/her assistant will conduct surveys of laboratories using radioisotopes or radiation producing devices and other restricted radiation areas on a quarterly basis. A GM counter will be used to measure the level of radiation. A level of no greater than 100 counts per minute above background on a 100 cm^2 area is considered acceptable.

11.1.2 The RSO or his/her assistant may conduct spot checks in restricted areas to insure that radiation levels are within the acceptable range.

11.1.3 In areas where radioisotopes are being used, the user will be required to conduct weekly surveys in all labs. The surveys will be done with calibrated GM-type survey instruments or by scintillation wipe test.

11.1.4 The operation of an x-ray producing device creates a possibility of increased radiation exposure. As a consequence, surveys beyond those specified above will be required. Radiation surveys, conducted by the RSO or the user, shall be performed:
- upon installation of equipment and at least once every twelve months thereafter.
- following any change in the initial arrangement, number, or type of local components in the system.
- following any maintenance requiring the disassembly or removal of a local component in the system.
- during the performances of maintenance and alignment procedures if the procedures require the presence of a primary x-ray beam when any local component in the system is disassembled or removed.
- anytime a visual inspection of the local components in the system reveals an abnormal condition.
- whenever personnel monitoring devices show a significant increase over the previous monitoring period or if user dosage readings are approaching the limits specified in 10.1 of these regulations.

11.1.5 In coordination with RSO quarterly surveys, there will be an internal audit of laboratories using radioactive materials. The audit will include weekly usage logs, materials used/retained logs, weekly surveys of labs, meter information for meters used in surveys,

newly trained approved users, any inquiries/concerns and dosimeter reports of recent quarter. Research labs will use the RM Compliance Calendar Log form to record their in-house weekly surveys, meter information as well as radioactive materials log. This calendar log form will be submitted to EHS/RSO monthly to be compiled for the quarterly audit. All audit records will then be sent to RSC for review and comments. RM Compliance Calendar Form (below, or in appendix) is available on the EHS website on both the Radiation Safety page and the Resource page.

- Notification of labs failing to comply with RM Calendar requirement will be reported to the RSC and Vice President of Research and possibly lose their RM use privilege.

11.2 MONITORING:

In areas where it is deemed necessary by the RSO or user to maintain a constant reading of radiation levels (e.g. rooms containing x-ray producing machines), a monitoring device will be placed. The user will check the monitoring device each time after the machine has been used.

11.3 CONTAMINATION:

If contamination is detected during a routine survey by either the user or the RSO, the area must be contained, and the cause of the contamination isolated. The following clean-up is carried out under the direction of the RSO (refer to 7.4).

12.0 LEAK TESTS ON SEALED SOURCES

12.1 QUARTERLY LEAK TESTS FOR LEAKAGE OR CONTAMINATION:

Quarterly leak tests on sealed sources will be performed by personnel specifically authorized by the Agency, an Agreement State, a Licensing State, or the U.S. Nuclear Regulatory Commission to perform such services.

12.1.1 Test results will be recorded in units of microcurie or becquerel and maintained for inspection by the Agency.

12.1.2 The following shall be considered evidence that a sealed source is leaking:
-The presence of 0.005 microcurie (185 becquerels) or more of removable contamination on any test sample.
-The presence of removable contamination resulting from the decay of 0.005 microcurie (185 becquerels) or more of radium.
-The licensee shall immediately withdraw a leaking sealed source from use and will take appropriate action to prevent the spread of contamination. The leaking sealed source shall be repaired or disposed of in accordance with this section.

12.1.3 Reports of test results for leaking or contaminated sealed sources will be recorded and maintained.

12.2 PROCEDURE FOR PERFORMING LEAK TESTING AND ANALYSIS

12.2.1 Leak tests will be conducted initially, on removal of a sealed source from storage, and at intervals not to exceed six months thereafter.

12.2.2 Procedure for Performing Leak Testing and Analysis.

-All leak tests will be performed using on a liquid scintillation counter.
-For each source to be tested, list identifying information such as manufacturer, model number, serial number, radionuclide, and activity.
-Use a survey meter to monitor exposure.
-Prepare a separate wipe sample (e.g. filter paper) for each source by wiping the outside of each source with a one inch filter paper disk.
-Number each wipe to correlate with identifying information for each source.
-Wipe the most accessible area (but not directly from the surface of a source) where contamination would accumulate if the sealed source were leaking.
-Place each filter paper disk in a 20 ml scintillation vial with approximately 2 ml SintiVerse.
-Ensure that the calibration of the liquid scintillation counter is current.
-Using a liquid scintillation counter, count the wipe-test sample against a NIST C-14 standard of known activity and record background count rate.
-Calculate efficiency of the detectorfor each protocol used. A sample calculation is shown below.
-The activity of the sample (of less efficiency than C-14) may then be extrapolated back to actual activity.

SAMPLE CALCULATION

For example: $\frac{[(\text{cpm}\{\text{Bq}\} \text{ from std}) - (\text{cpm } \{\text{Bq}\} \text{ from bkg})]}{\text{known standard value } \{\text{Bq}\}} \times 100 = \%\ \text{efficiency}$

activity of std in Bq
where: cpm = counts per minute {Bq}
std = standard
bkg = background
Bq = becquerels

Count each wipe sample; determine net count rate in becquerels.

For each sample, calculate and record estimated activity in becquerels (or microcuries one microcurie equal 37 bequerels).

For example: [(cpm {Bq} from wipe sample) - (cpm {Bq}from bkg)] = Bq on wipe sample x efficiency

Sign and date the list of sources, data and calculations. Retain records for 3 years (10 CFR 20.2103(a)).

If the wipe test activity is 185 Bq (0.005 mCi) or greater, notify the RSO immediately, so that the source can be withdrawn from use and disposed of properly. Also notify NRC.

IV. X-RAYS, REPORTS AND RECORDS,

13.0 REGULATIONS FOR THE USE OF X-RAY EQUIPMENT

X-ray equipment is divided into two general categories for radiation safety considerations: medical x-ray equipment and scientific instrumentation/apparatus. These differ primarily in that medical x-ray equipment exposes the patient to x-ray doses for diagnostic and therapeutic purposes, while scientific instrumentation is usually designed to irradiate non-living matter and minimize exposure to individuals. Only scientific equipment and laboratories will be treated in detail here.

13.1 MEDICAL X-RAY EQUIPMENT AND FACILITIES:

Medical x-ray equipment and facilities are regulated under Regulations for the Control of Radiation in Mississippi by ?. The RSC will have sole authority for policies concerning the use of medical x-ray equipment, facilities, and the use of radioisotopes in clinical practice; however, responsibility for compliance will be vested in the Director of the Clinic, a Medical Doctor licensed as a user. The Director of the Clinic will be in direct liaison with the appropriate unit of the Mississippi State Department of Health.

13.2 ANALYTICAL X-RAY EQUIPMENT:

Commercially marketed analytical x-ray equipment is usually designed with adequate shielding and safety interlocks to protect the operator. Damage to these instruments in shipping, failure of interlocks and modifications by the scientist or operator require that a thorough radiation survey of the instrument be made after installation. The type of x-ray analytical instrumentation in use at USM or anticipated in the future include x-ray diffraction, x-ray spectrometers, and x-ray fluorescence equipment.

13.2.1 SAFETY INTERLOCKS:

All analytical x-ray equipment will be provided with safety interlocks designed to prevent accidental exposure to the primary x-ray beam. These shall include:
- For open beam configurations, any device that prevents entry of a portion of an individual's body into the beam or which causes the beam to be shut off upon entry.
- Shutters that automatically close x-ray beam ports when the receiving apparatus (diffraction camera, goniometer, etc.) is removed or moved from a safe alignment.
- Warning lights or signs that indicate "X-RAY ON" when the x-ray tube is energized and lights, or devices that indicate shutter status "Shutter Open" when open.

13.2.2 SHIELDING:

Each x-ray generator shall be constructed with adequate shielding so dose rates will not exceed:
- 2.5 m rem/h at a distance of 5 cm (2 in.) from any surface of the x-ray tube housing (with ports closed).
- 0.25 m rem/h 5 cm (2 in.) from any cabinet surface.

13.2.3 WARNING SIGNS:

All x-ray equipment will be labeled with a sign bearing the radiation symbol and words to the effect, CAUTION RADIATION - THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED. The room or area where x-ray equipment is located will be posted with a sign bearing the radiation symbol and words to the effect, CAUTION - X-RAY EQUIPMENT IN USE.

13.3 PERSONNEL AND MONITORING REQUIREMENTS:

13.3.1 Persons operating x-ray machines will have adequate training and background in the methodology and safe operation of x-ray equipment that they are using, whereupon they may be authorized as registered users by the RSO and RSC.
13.3.2 Normal operating instructions will be provided by the manufacturer or registered user to all operators, and the equipment will be operated according to these instructions.
13.3.3 No operator or registered user shall by-pass any safety interlock without approval of the RSO. When a safety interlock is by-passed under this provision it will be posted "SAFETY DEVICE NOT WORKING".
13.3.4 Persons operating x-ray equipment will wear film badges as outlined in Section 10. In some cases the RSO may require additional finger or wrist dosimeters to be worn by the operator(s). Film badges dose readings will be reported to the RSO quarterly.
13.3.5 The area around an instrument will be surveyed upon installation, annually, and when any discernable change or configuration is made.

14.0 RECORDS AND REPORTS

14.1 Records and reports will be maintained by the office of the RSO. Records will be kept for a minimum of two years, but a longer time may be required by the RSO or the State Agency. For more details or clarification of specifications or records or reports, the user should refer to the State regulations or the RSO.
14.2 The following records or reports will be maintained by the Office of the RSO:
14.2.1 Applications for User Registration reflecting training and experience of users and potential users of radioactive materials.
14.2.2 Radiation exposure levels of all personnel that require personnel monitoring devices. Periods of monitoring times listed shall not exceed one calendar quarter. All personnel monitoring device readings or any other pertinent information shall be included. These records shall be kept on permanent file in the Radiation Safety Office, and a copy will be furnished to all departing employees when requested.
14.2.3 All survey results, including spot and quarterly area surveys, and all leak tests of sealed sources.
14.2.4 Procurement, Receipt, and Transmittal forms indicating the date, place, and condition in which radioisotopes are received and delivered to the user.
14.2.5 An inventory of radioisotopes and radiation producing equipment.

14.2.6 Records of all disposals, which will include full descriptions of the radioactive materials, quantities and kinds of radioactivity, levels of radioactivity involved, the manner and conditions of disposal, and any other pertinent information.
14.2.7 Calibration records of all equipment used routinely in radiation safety surveys.
14.2.8 Any occurrence of thefts or loss of radioactive material must be reported to the RSO who will contact the State Agency.
14.2.9 Any occurrence of over-exposure (radiation levels noted in excess of allowed exposures) must be reported to the RSO.
14.2.10 Minutes of the RSC meetings.
14.2.11 The total maximum possession limits on radioactive materials maintained at the University of Southern Mississippi campus and possession limits for each authorized user.
14.2.12 The RSO will post or direct users to posted any special instructions, regulations, or notices that are required under State or Federal Regulations.

15.0 Distribution List: USM Manual of Radiation Safety Procedures

Vice President for ResearchDean of the College of Science And Technology Safety Officer
Chairs of the following Departments:

Biological Sciences
Chemistry and Biochemistry
Polymer Science
Physics

Each of the following USM personnel has been forwarded one copy of this manual effective April, 2013.

Signed: _____
Radiation Safety Officer

Appendix A

TABLE A SYNOPSIS OF RADIATION SAFETY PROCEDURES

A.1 DEFINITIONS:

RADIOACTIVITY: The spontaneous disintegration of atomic nuclei accompanied by the emission of nuclear radiation.

RADIATION: X-rays, α, β, γ-rays, neutrons, protons, positrons, and other energetic electromagnetic emissions.

CURIE: (Ci) Unit of measure of radioactivity 1 Ci = 37 x 10^9 disintegrations/sec. 1 millicurie (1 mCi) = (1/1000) Ci, 1 microcurie (1 μCi) = (1/1,000,000) Ci

RESTRICTED AREA: An area, access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation. Restricted area does not include areas used as residential quarters, but separate

ROENTGEN: (R) Unit of radiation dose or exposure, 1 R of radiation produces 1 ESU of charge in 1 cc of dry air at S.T.P.

ROENTGEN EQUIVALENT IN MAN: (REM) A dose of radiation which produces the same biological damage as 1 Roentgen of x- or γ-rays.

ROENTGEN PER HOUR: (R/h) Unit of radiation level or exposure rate.

UNRESTRICTED AREA: Any area access to which is neither limited nor controlled by the licensee or registrant for purposes of protection of individuals from exposure to radiation and radioactive material, and any area used for residential quarters. For purposes of these regulations, "uncontrolled area" is an equivalent term.

LICENSEE: The University of Southern Mississippi

REGISTERED USER: A user of radioisotopes approved by the RSC for use in research laboratories

A.2 ESSENTIALS OF RADIATION SAFETY:

A.2.1 No radioactive material or radiation-producing device shall be used, transported, stored, or disposed in such a manner as to cause exposures to individuals or their parts exceeding the standards below:

A.2.2 Occupational Dose Limits for Minors. The annual occupational dose limits for minors are 10 percent of the annual occupational dose limits specified for adult workers. A minor is a person under 18 years of age.

A.2.3 Occupational Dose Limits for Adults.
The licensee or registrant shall control the occupational dose to individual adults, except for planned special exposures pursuant to the following dose limits:

A.2.3.1 An annual limit, which is the more limiting of:
The total effective dose equivalent being equal to 5 rems (0.05 sievert); 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 sievert).

A.2.3.2 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 sievert), and a shallow dose equivalent of 50 rems (0.5 sievert) to the skin or to any extremity.

A.2.3.3 Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, shall be subtracted from the limits for planned special exposures that the individual may receive during the current year and during the individual's lifetime.

A.2.3.4 The assigned deep dose equivalent and shallow dose equivalent shall be for the portion of the body receiving the highest exposure determined as follows: The deep dose equivalent, eye dose equivalent, and shallow dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the region of highest potential exposure, or the results of individual monitoring are unavailable;

A.2.4 Dose to an Embryo/Fetus.

A.2.4.1 The licensee or registrant shall ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 millisieverts).

A.2.4.2 The licensee or registrant shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in specified in the regulations

A.2.4.3 The dose to an embryo/fetus shall be taken as the sum of: the deep dose equivalent to the declared pregnant woman and the dose to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman. The National Council on Radiation Protection and Measurements recommended in NCRP Report No. 91, "Recommendations on Limits for Exposure to Ionizing Radiation," (June 1, 1987) that no more than 0.05 rem (0.5 millisievert) to the embryo/fetus be received in any one month.

A.2.4.4 If by the time the woman declares pregnancy to the licensee or registrant, the dose to the embryo/fetus has exceeded 0.45 rems (4.5 millisieverts), the licence or registrant shall be deemed to be in compliance with 801.400.13(1) if the additional dose to the embryo/fetus does not exceed 0.05 rem (0.5 millisievert) during the remainder of the pregnancy.

A.3 ADDITIONAL RADIATION SAFETY MEASURES:

A.3.1 Registered user is responsible for radiation safety of persons, substances and devices under his or her control.

A.3.2 Radiation areas and non-exempt radiation sources must be clearly marked with standard radiation symbol.

A.3.3 Radiation surveys and tests as often as needed: User – daily with use; RSO - spot, and quarterly.

A.3.4 Personnel monitoring dosimeters worn in restricted areas, and personnel surveys done immediately on exiting.

A.3.5 Proper collection, storage, and disposal of wastes by method prescribed by the RSO or RSC.

A.3.6 Accurate, continuous, exposure-record, survey-record, and disposal-record keeping with periodic reporting.

A.4 PROCUREMENT, RECEIPT, AND DISPOSAL OF RADIOACTIVE MATERIALS

A.1 The PURCHASE of all radioactive isotopes used as the University must be approved by the RSO.

A.2 All radioactive isotopes RECEIVED on campus will be delivered to the RSO within three hours of receipt of the materials and inspected for leaks or spillage, or within three hours of the beginning of the next working day if received on a holiday.

A.3 The RSO will prescribe the method of DISPOSAL of all non-exempt quantities of radioactive materials.

A.5 REGISTRATION OF USERS OF RADIOACTIVE MATERIALS AND RADIATION PRODUCING DEVICES

A.5.1 All persons wishing to use non-exempt quantities of radioactive materials must apply to the RSO and be approved and registered by the RSO or the RSC before using radioactive materials.

A.5.2 Persons who will work in restricted areas may be required to have medical testing before registration at the discretion of the RSO.

A.5.3 Training in the use, handling, monitoring, clean-up, and disposal of radioactive material will be available through the RSO. Training must be provided to employees before beginning work with or in the vicinity of materials. Individuals must also receive annual refresher training.

NOTE: THIS SYNOPSIS IS PREPARED FOR QUICK REFERENCE, AND IN NO WAY SUBSTITUTES FOR A THOROUGH STUDY OF STATE REGULATIONS

Appendix B
Research Organizational Chart

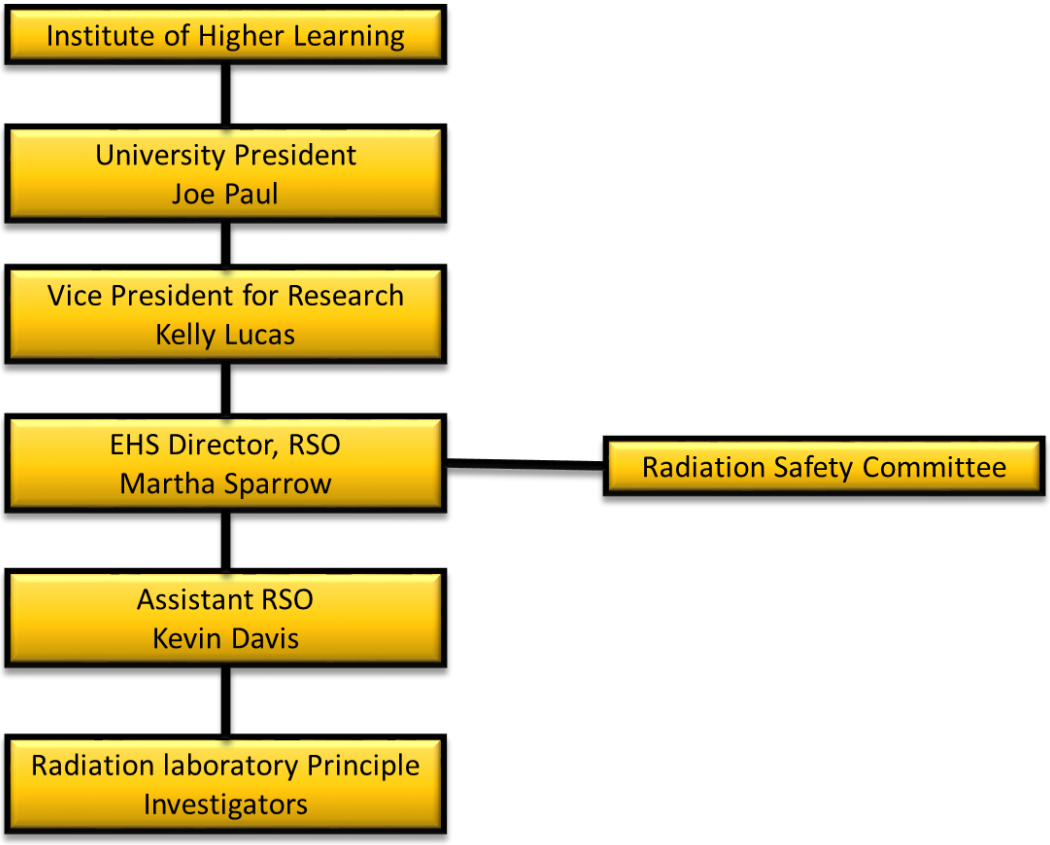

TABLE A.2 TABLE OF SOME COMMON RADIOISOTOPES

(for isotopes not listed, refer to Regulations for the Control of Radiation in Mississippi

ISOTOPE	SYMBOL	RADIATION & (ENERGY MEV)	HALF-LIFE	TRANSPORT GROUP (TOXICITY)	EXEMPT QUANTITY (μCi)
Barium-133	Ba-133	EC, γ(.36, .30, .081)	10.7y	II	10
Cadmium-109	Cd-109	EC, γ(.088)	453d	IV	10
Calcium-45	Ca-45	β(.254)	165d	IV	10
Carbon-14	C-14	β(.155)	5730y	IV	100
Cesium-137	Cs-137	β(.523, 1.17), γ(.661)	30.17y	III	10
Chlorine-36	Cl-36	β(.714), EC	$3.00x10^5$y	III	10
Chromium-51	Cr-51	β^+, γ(.32)	27.70d	IV	1000
Cobalt-57	Co-57	β^+(.26), γ(.12, .14)	271d	IV	100
Cobalt-60	Co-60	β(.306), γ(1.3, 1.1)	5.27y	III	1
Europium-155	Eu-155	β(.154, .243), γ(.06, .09, .11, .132)	4.9y	IV	10
Hydrogen-3	H-3	β(.018)	12.33y	IV	1000
Iodine-125	I-125	EC, γ(.035)	60.2d	III	1
Iodine-131	I-131	β(.61, .33, .26), γ(.365, .64, .28)	8.04d	III	1
Iron-55	Fe-55	EC (Mn X-rays)	2.7y	IV	100
Iron-59	Fe-59	β(1.57, .48, .27), γ(1.1, 1.29)	44.6d	IV	10
Krypton-85	Kr-85	β, γ(.514)	10.7y	III	100
Lead-210	Pb-210	β(.018), γ(.0467), α	22.3y	II	-
Manganese-54	Mn-54	γ(.84) EC	312d	IV	10
Nickel-63	Ni-63	β(.067)	100y	IV	10
Phosphorus-32	P-32	β(1.71)	14.28d	IV	10
Plutonium-239	Pu-239	α(.516, .515, .511), γ(.52, .39, & others)	$2.41x10^4$y	I	-
Polonium-210	Po-210	α(5.30), γ(0.80)	138.4d	I	0.1
Promethium-147	Pm-147	β(.223)	2.623y	IV	10
Radium-226	Ra-226	α(4.77), γ(.186)	$1.60x10^3$y	I	-
Sodium-22	Na-22	β^+(.542, 1.8), γ(1.277)	2.602y	III	10
Sodium-24	Na-24	β(4.17, 1.39), γ(1.37, 2.79)	15.02h	IV	10
Strontium-85	Sr-85	EC, β(.008, .225, .15), γ(.85, .513)	64.8d	IV	10
Strontium-90	Sr-90	β(.546)	28.8y	II	0.1
Sulfur-35	S-35	β(.167)	87.4d	IV	100
Thallium-204	Tl-204	β(.765), EC	3.77y	III	10
Tin-113	Sn-113	EC, γ(.39, .26)	115.1d	IV	10
Tritium-3	H-3	β(.018)	12.33y	IV	1000
Uranium-238	U-238	α(4.2), β, γ	$4.468x10^9$y	III	-
Zinc-65	Zn-65	β^+(.325), γ(1.12)	244d	IV	10

V. FORMS

USM-RS-1 USM RSO NO. _____

The University of Southern Mississippi, Radiation Safety Office P.R. No. _____

P.O. No. _____

RADIOACTIVE MATERIALS PROCUREMENT, RECEIPT, AND TRANSMITTAL FORM Date _____

I. REQUEST FOR AUTHORIZATION TO PROCURE AND USE RADIOACTIVE MATERIALS

1. Name of Principal User: _____ SSN: _____

2. Status: ☐ Student; ☐ Staff; ☐ Prof. (Registered under USM License?: _____)

(NOTE: USM-RS-2 required to be on file with RSO, attach completed USM-RS-2 if needed)

3. Department: _____, Phone: _____, Box: _____

4. Office room number: _____, Lab room number: _____

II. RADIOACTIVE MATERIAL AND QUANTITY REQUESTED (Attach completed purchase requisition)

QUANTITY	DESCRIPTION	FORM	ACTIVITY	EXEMPT OR NON-EXEMPT

III. FACILITY TO BE USED (if the facility has not previously been approved for radioisotope use, inspection and approval by the RSO the required):

1. Building and room(s): _____ _____, USUAL Designation: _____ _____
   Duration of Experiment: _____
2. Other: _____

IV. Other individuals who will be using above materials (USM-RS-2 required) (Students exempt)

NAME	SOCIAL SECURITY NUMBER	DEPARTMENT

CERTIFICATION OF PRINCIPAL USER: I have read the University Regulations of Radiation Safety and agree to abide by them, waiving all rights of claim because of failure to do so.
Signature of Principal User: _____ Date: _____

V. TRANSMITTALS

1. Purchase Requisition Received ☐ Date: _____ Forwarded ☐ Date: _____
2. Materials Received ☐ Date: _____ Leak Test Performed ☐ Date: _____
3. Materials Forwarded ☐ Date: _____ RSO Initials: _____
4. Materials Received ☐ Signature of User: _____ Date: _____

VI. SAFETY PROCEDURES: To be circled by the RSO Initials: _____

1. A film badge or dosimeter (is) (is not) required when using this isotope.
2. Working area surveys: (2/day) (daily) (weekly) (monthly) (quarterly) (6 months)
3. Personnel surveys: (upon exiting) (daily) (weekly) (monthly) (quarterly) (6 months)
4. Radiation Area: (posted) (not necessarily)

VII. Radioactive material disposal was completed as directed on Waste Disposal Form USM-RS-3.

Signature: _____ Date: _____

USM-RS-2 REGISTRANT NO._____

The University of Southern Mississippi ☐ Student ☐ Faculty ☐ Staff

APPLICATION FOR REGISTRATION UNDER USM'S LICENSE-TRAINING AND AGREEMENT FORM

1. Name: _____ Social Security Number: _____
2. Department: _____ P. O. Box No. _____ Phone: _____
3. Probable isotopes to be used: _____
   _____
4. Estimated Maximum Quantity to be used each semester: _____mCi, hrs. x-ray _____

TRAINING:	TYPE	INSTITUTION	DURATION (hrs. wks.)	FORMAL COURSE	ON THE JOB
A.	Principles and Practices of Radiation Protection				
B.	Radiation Measurements				
C.	Radiation Calculations				
D.	Biological Effects				
E.	Other				

FORMAL COURSES:

	TITLE	INSTITUTION	DURATION	CONTENT (ABCD above)
1)				
2)				
3)				
4)				

EXPERIENCE:

ISOTOPE OR X-RAYS	RADIOACTIVITY MAXIMUM (mCi)	WHERE USED	DURATION	USE: (Tracer, Radiochem., Sealed

AGREEMENT:

I, _____, have read and I understand the Manual of Radiation Safety Procedures and hereby agree to comply strictly with all such rules and regulations waiving any right or recourse against The University of Southern Mississippi for any damage resulting from failure to conform with said regulations:

Date: _____ Signed: _____

RADIOLOGICAL SAFETY OFFICER'S RECOMMENDATION:

☐ Approval
☐ Disapproval
☐ Temporary
☐ Registrant under USM broad scope license
☐ Exempt Quantities
☐ Student

Date: _____ RSO Signature: _____

Date: _____ Department Chair: _____

Date: _____ Chair, RSC: _____

USM-RS-3 ISOTOPE _____
The University of Southern Mississippi DATE _____
RADIOACTIVE WASTE DISPOSAL RECORD

Instructions: Use one set of disposal record forms for each radioisotope received in each shipment lot (or for each different date of receipt). Materials are to be disposed of according to The University of Southern Mississippi's Manual of Radiation Safety Procedures, and instructions from the Radiation Safety Officer. A single shipment of a single radioisotope may be disposed in smaller lots than the original shipment so long as every disposal is accounted for on this form or additional forms if needed.

SECTION I: To be filled out by the Radiation Safety Officer or his/her qualified representative.

1. ISOTOPE _____ 2. QUANTITY _____ mCi, μCi, pCi, Ci 3. DATE RECEIVED _____
   (eg. C-14) (activity when shipped - circle appropriate unit)

4. FORM _____ 5. SAMPLE VOLUME OR MASS _____
   (eg. C-14 α carbon atom in glycine, water soluble) (approximate)

6. TRANSMITTED TO REGISTERED USER (NAME) _____ DATE _____

7. TO BE USED IN (ROOM #) _____ EXPECTED FINAL FORM _____

8. DISPOSAL INSTRUCTIONS: RSO Initials: _____
   METHOD: (Circle one or more instructions)

1. Flush into sanitary sewer with copious quantity of water (see attached instructions)
2. Dispose as ordinary chemical or solid waste, BUT COMPLETE THIS DISPOSAL FORM.
3. Collect and store for _____ months, then dispose by method 1 2 4 5 6
4. Collect (waste) and return to RSO for disposal.
5. Other: _____
6. See attached instructions.

SECTION II. To be filled out by Registered User Name: _____ Initials: _____

CERTIFICATION: I have read the above information and agree with the description of the materials and their use and I agree to follow disposal instructions explicitly.

Signature: _____ Date: _____

DISPOSAL RECORD (to be filled out by Registered User or his/her assistant)

Date	Isotope	Form	Volume or Mass	Disposal Method	Radioactivity (when disposed)	Radioactivity (when received)	Ins.

This quantity must total the same as item 2, Section I or start a new Disposal Record Form

Disposal was accomplished as indicated in 8 above. _____ _____
Signature Date

USM-RS-4

RSO INVENTORY NO. _____
RESULT: ☐ Clean ☐ Contamination
DATE: _____

RADIATION SAFETY RECORD
(FOR PACKAGING MATERIALS AND SEALED SOURCES CONTAINING NON-EXEMPT RADIATION SOURCES)

LEAK TESTS ON SEALED SOURCES ☐ AND/OR PACKAGING MATERIALS ☐
(Conducted in accordance with Regulations for Control of Radiation in Mississippi,

1. SURVEYOR _____ (RSO OR ASST); SURVEY METER, Model _____ RSO # ____
2. Background Radiation (Measured in same building or room, but remote from radiation sources.) _____ CPM _____ mR/h
3. Uncontaminated working area background radiation (Tabletop, countertop, or lab bench top where wipe test or packaging material survey is to be conducted) measured 1 in. above surface _____ CPM _____ mR/h
4. Background Radiation level of clean wipe(s) to be used in leak test(s) _____ CPM _____ mR/h

[Omit 5 and 6 if only conducting a wipe test on a sealed source received on a prior date]

5. Radiation level on outside surface of package as received _____ CPM _____ mR/h

NOTICE - A CORRECTED COUNT (DPM)* IN EXCESS OF 22,000 DPM REQUIRES IMMEDIATE NOTIFICATION OF FINAL DELIVERING CARRIER AND THE MSDH.

6. Radiation level of packaging material taken from immediately around container and laid out on surveyed working area. _____ CPM _____ mR/h
7. Record any visible evidence of leakage from sealed container:

_____

_____

8. Maximum radiation level one inch from surface of container or pig. _____ CPM _____ mR/h

PERFORM THE WIPE TEST ON SURFACE OF RADIATION SOURCE OR CONTAINER AND ON SHIELDING MATERIAL, OR ON INSIDE AND OUTSIDE OF LEAD PIG

9. RESULTS OF WIPE TEST:

SURFACE WIPED	RADIATION LEVEL ON WIPES	
_____	_____ CPM	_____ mR/h
_____	_____ CPM	_____ mR/h
_____	_____ CPM	_____ mR/h

NOTICE: A CORRECTED COUNT IN EXCESS OF 100 CPM ON A WIPE FROM A SEALED SOURCE REQUIRES THE CORRECTIVE ACTION OF CLEANUP AND RESEAL, OR DISPOSAL OF THE SOURCE AS WASTE IN ACCORDANCE WITH SECTION 8 OF USM'S MANUAL.

10. CORRECTIVE ACTION(S) TAKEN ON: LEAKING PACKAGE ☐ ; or LEAKING SEALED SOURCE ☐

(1) _____
(2) _____
(3) _____
(4) _____

Signed: _____(RSO) Date: _____

*DPM = CPM (Dc)
Survey Meter Efficiency at Dc (includes geometry factor)

USM-RS-5 Building _____, Room _____, Source _____

AREA SURVEY RECORD Result ☐ satisfactory ☐ unsatisfactory Date _____

1. SURVEYOR(S): _____ INSTRUMENTS: _____

_____ _____

_____ _____

2. TYPE OF SURVEY:

☐ Spot Check ☐ Monthly ☐ Weekly ☐ Quarterly ☐ Installation ☐ 1st Operation

SURVEY REQUESTED BY: (RSO) (MSDH) (RSC) (Other) _____

3. DESCRIPTION OF AREA TO BE SURVEYED 4. DIAGRAM

_____

_____

_____

_____

_____

_____

5. EXPOSURE RATE READINGS

	Place	Time	mR/h or CPM			
1.	_____		_____			
2.	_____		_____			
3.	_____		_____			
4.	_____		_____			
5.	_____		_____	11.	_____	_____
6.	_____		_____	12.	_____	_____
7.	_____		_____	13.	_____	_____
8.	_____		_____	14.	_____	_____
9.	_____		_____	15.	_____	_____
10.	_____		_____	16.	_____	_____

6. PRECAUTIONS
   (A) CIRCLE MAXIMUM READING(S)
   (B) ARE READINGS BEYOND INSTRUMENT HOUSING OR CONTAINER GREATER THAN 5 MR/h?
   ☐ YES ☐ NO, SPILLS GIVING 100 CPM?
   (C) IF ANSWER TO (B) IS YES IS THE AREA PROPERLY RESTRICTED AND POSTED?

7. OTHER OBSERVATIONS:

8. ACTIONS TAKEN:

Signature _____RSO or Asst. Date _____

USM-RS-6 CHECKLIST FOR DECOMMISSIONING LABORATORIES Date _____

I. Instructions: The following actions are to be taken by the Laboratory Director or a Principal Registered User of any laboratory in which non-exempt quantities of radioactive isotopes have been used or in which exempt quantities have been used repeatedly over a period in which a non-exempt quantity could have accumulated in the laboratory, before the laboratory is devoted to another use, when radiochemical operations cease, or when the director or principal user is soon to depart and turn the laboratory over to a successor.

II. Collect and transfer all radioisotope reagents, standards, solutions, and sealed sources to the Radiation Safety Office, to successor laboratory personnel, or to the manufacturer for dismantling. Fill out forms RS-3 for all radioactive materials except waste, indicating quantity transferred to successor, RSO, or manufacturer.

A. ☐ We have examined inventories, USM RS-1 forms, and disposal records and believe the isotopes totaling _____Ci described on the attached USM RS-3 forms to be the total inventory of useful radioisotopes at the time of this transfer.

_____ _____

Laboratory Director of Registered User Radiation Safety Officer Date

B. ☐ As recipient of radioisotope described in II A and the attached transfer forms and as successor of the person certifying II A, I accept responsibility for the safe use and handling of these radioisotopes and affirm that I will abide by State and University regulations governing their use and disposal.

_____

(Successor) Registered User or Laboratory Director

III. Liquid and gaseous radioactive waste will be disposed of in accordance with University and State Regulations. Disposal forms USM RS-3 will be completed and attached.

IV. A. Thorough Cleaning of all Laboratory Surfaces. All working surfaces, cabinet shelves, inside of hoods, walls and outside surfaces will be examined for cleanliness and absence of chemical residue. A thorough cleaning of the laboratory using appropriate cleaning solutions and materials will be accomplished as needed and all cleaning materials monitored for radioactivity. All solid waste found radioactive will be collected for disposal. Complete form RS-3.

B. A thorough survey of the laboratory for radioactive materials will be made under the RSO's supervision to include: (Area survey forms USM RS-5 completed and attached). Initials

1. Working surfaces: α, β, γ ☐ satisfactory; wipe tests ☐ satisfactory _____
2. Dry sinks and troughs: α, β, γ ☐ satisfactory _____
3. Hoods inside and out: α, β, γ ☐ satisfactory; wipe tests ☐ satisfactory _____
4. Walls & cabinets: α, β, γ ☐ satisfactory _____
5. Floors: α, β, γ ☐ satisfactory; wipe tests ☐ satisfactory _____

C. Collection devices such as hood filters, and air conditioning filters will be replaced. Sink traps will be cleaned out and the contents assayed for radioactivity. Radioactive solids will be properly disposed, USM RS-3.

D. Any other measure deemed necessary by the RSO to assure the future safety of personnel working in the laboratory will be accomplished:
Other: _____
_____

V. Certification: I certify that all reasonable measures have been taken to assure that this laboratory presents no radiological threat to the health and safety of personnel (other than those radioactive materials accepted by the successor in section II B) from residual contamination. The laboratory is hereby certified for:

☐ General use ☐ Continued use as a radioisotope laboratory

_____ _____ _____ _____

Radiation Safety Officer Date Chairman RSC Date

USM-RS-7 Compliance Calendar

Building: ________

Room: ________

Isotope: ________

Received date: ________

Initial Quantity: ________

Month/Year ____________

Laboratory/Group ________ ____________

Form USM RS-7 Compliance Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Weekly Survey	Radiation Used (Total)
Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used		
Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading		
Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used		
Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading		
Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used		
Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading		
Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used		
Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading		
Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used	Amount Used		
Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading	Survey reading		

Meter Information

Model: ________

SN: ________

Calibration Date: ________

Total radiation used: ________

Radiation remaining: ________