RADIATION SAFETY MANUAL

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

HATTIESBURG, MISSISSIPPI

January, 2013

Prepared by:

Lynn Landrum, RSO
Martha Sparrow, Alt. RSO

Approved by:

The Radiation Safety Committee of 2013

9.1 INSTRUMENTATION 25
9.2 DEPARTMENTAL RESPONSIBILITY FOR ACQUIRING REQUIRED RADIATION SAFETY INSTRUMENTATION: 25
9.3 CALIBRATION SERVICES: 25
10.0 PERSONNEL MONITORING 25
10.1 PERSONNEL REQUIRED TO WEAR DOSIMETERS AND FILM BADGES: 25
10.2 MONITORING DEVICES: 26
10.3 RECORDS: 26
11.0 AREA SURVEYS AND LABORATORY MONITORING 27
11.1 SURVEYS: 27
11.2 MONITORING: 27
11.3 CONTAMINATION: 28
12.0 LEAK TESTS ON SEALED SOURCES .....

I. GENERAL INFORMATION

1.0 INTRODUCTION

1.1

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.)

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 "private" 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 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

0Bgi0 1 265.01 405Bo(d thurg)c

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 P Of Regulations.

P L O O L F X U L H P & L & L P L F U R F X U L H & L

7.2.1.5 Roentgen

- 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 D/.ii3VI5D D/.ii3VI57-1es6e of footion 7.4.

-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 EHDULQJ WKH UDGLDWLRQ V\PERO DQG WKH ZRUGV ³&D

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- H[HPSW TXDQWLWLHV RI JDPPD KLJK HQHUJ\ EHWD (.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).

-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.

- /DERUDWRULHV XVLQJ UDGLRLVRWRSHV ZLOO EH SRVW
Radioact LYH 0DWHULDOV ´

7.3.4.2 Specialized Radioisotope and Radiation Laboratories:
In specialized laboratories

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

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

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.

8.4 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

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 - Geiger Counter Survey Meters with side-window probes (1.5 inch diameter) 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 .

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 W*nporveys,

n arEETo(n a)nDC B4D 232(r)-6dC0f*32

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 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 or radiation producing devices are being used, the user will be required to conduct weekly surveys in all labs except those using low levels (<100 mCi) where monthly surveys are required. 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.

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.
-U

-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: [(cpm{Bq} from std) - (cpm {Bq} from bkg)]
---------- x 100 = % efficiency
known standard value {Bq}

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 LQGLYLGXDO¶V ERG\ LQWR WKH EHDP RU ZKLFK FDXVHV
- 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 LQGLF-DWH 21´ ZKHQ WKH [-ray tube is energized and lights, or devices that urvey of the inst G2of the in 1 114sra, gonio42-(hts)] TJ ET BT 1 0 0 1

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 ³6$)(7< '(9,&(127 :25.,1*´

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, any blood tests or urinalysis, 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- U D \ V -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 & L & L

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- R U 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 U H J X O D W L R Q V ³ X Q F R Q W U R O O H G D U H D ´ L V D Q H T X L Y D C

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 G X U L Q J W K H L Q G L Y L G X D O ¶ V O L I H W L P H

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

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 a blood test and urinalysis 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

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 & L
Barium-133	Ba-133	(&	10.7y	II	10
Cadmium-109	Cd-109	(&	453d	IV	10
Calcium-45	Ca-45		165d	IV	10
Carbon-14	C-14		5730y	IV	100
Cesium-137	Cs-137		30.17y	III	10
Chlorine-36	Cl-36	(&	$3.00x10^5$y	III	10
Chromium-51	Cr-51	+	27.70d	IV	1000
Cobalt-57	Co-57	+	271d	IV	100
Cobalt-60	Co-60		5.27y	III	1
Europium-155	Eu-155		4.9y	IV	10
Hydrogen-3	H-3		12.33y	IV	1000
Iodine-125	I-125	(&	60.2d	III	1
Iodine-131	I-131		8.04d	III	1
Iron-55	Fe-55	EC (Mn X-rays)	2.7y	IV	100
Iron-59	Fe-59		44.6d	IV	10
Krypton-85	Kr-85		10.7y	III	

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

$33/,&$7,21)25 5(*,675$7,21 81'(5 86 NRC TRAINING AND 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-

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 1 m from surface of container in 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

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

_____

_____

_____

_____

_____

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