

# Radiation Safety Manual

Texas State University

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FORMS AND RECORDS

- EHSRM-RSF-01, Radiation/Contamination Survey
- EHSRM -RSF-02, Dosimetry Request
- EHSRM -RSF-03, Previous Exposure History Request Form
- EHSRM -RSF-04, Radiation/Contamination Survey Log
- EHSRM -RSF-05, Radioisotope Usage
- EHSRM -RSF-06, Radioactive Waste Disposal Logsheet
- EHSRM -RSF-07, Radioactive Material Disposal/Transfer
- EHSRM-RSF-08, Radioactive Material User Qualifications
- EHSRM-RSF-09, Analytical X-Ray Operator Qualifications

## PREFACE

RADIATION SAFETY is the responsibility of all faculty, staff, and students who are directly or indirectly involved in the use of radioisotopes or radiation producing devices.

The Texas State University at San Marcos is licensed by the state of Texas to use radioactive materials in research, development, and instruction. While this means a minimum of controls by the state, it entails the responsibility that we establish and pursue an effective Radiation Safety Program. It is the purpose of this manual to set out the guidelines of that program.

The use of radiation in a university, where a large number of people may be unaware of their exposure to radiation hazards, makes strict adherence to procedures established by federal and state authorities of paramount importance. Special efforts to ensure the safety of faculty, staff, students and the general public are essential. The Risk Management & Safety Office has the responsibility for establishing and pursuing an effective Radiation Safety Program for this University.

It is the responsibility of all faculty, staff, and students involved in radiation work to familiarize themselves with the program outlined in this manual, and to comply with its requirements. Radiation safety depends on a continuous awareness of potential hazards.

## Emergency Telephone Numbers

	<u>Ext.</u>	<u>After 5pm</u>	
Texas State University RADIATION SAFETY OFFICER			
James Frye .....	5-4129.....	5-2805	
Environmental Health, Safety & Risk Management Smith House			
Texas State University ENVIRONMENTAL, HEALTH, SAFETY & RISK MANAGEMENT			
Environmental, Health, Safety & Risk Management .....	5-3616.....	5-2805	
Smith House			
Texas State University POLICE DEPARTMENT			
Nueces.....	5-2805.....	5-2805	
ALL EMERGENCIES (Texas State University Police Dispatcher).....			911
UTILITY OUTAGES (Utilities Operations).....	5-2350.....	5-2108	
Texas DSHS BUREAU OF RADIATION CONTROL 24-HOUR RADIOLOGICAL EMERGENCY ASSISTANCE.....			512-458-7460
Routine Business.....		512-834-6688	

See next page for Texas State University RADIATION EMERGENCY PROCEDURES sign. A copy of this sign provided by the RSO must be posted in a conspicuous location in each laboratory utilizing radioisotopes.

In the event of a fire, explosion or other serious incident with radioactive or hazardous materials, call the Texas State University Police Department as soon as possible (911 on a university phone) and be prepared to provide the dispatcher with the following information-but do not delay an EMERGENCY call to accumulate this information:

Location of the fire/incident (BUILDING & ROOM/LAB NUMBER)

Hazardous materials involved (Radioactive material/ NAME/TYPE, ETC.)

If medical assistance is needed (TYPE & NUMBER OF INJURED)

## Radiation Emergency Response Guidelines

TYPE OF EMERGENCY	HAZARD	IMMEDIATE PRECAUTIONS	FOLLOW-UP
Minor Spills  Usually micro-curie amounts)	<i>Radiation:</i> No immediate radiation hazard to personnel. <i>Contamination:</i> Low	<ul style="list-style-type: none"> <li>• Notify all persons in room.</li> <li>• Confine spill immediately.</li> <li>• Notify Radiation Safety Officer (RSO).</li> </ul>	Permit no one to work in area until approved by Radiation Safety Officer (RSO).
Major Spills  (Usually milli-curie amounts)	<i>Radiation:</i> No immediate radiation hazard to personnel.  <i>Contamination:</i> Low	<ul style="list-style-type: none"> <li>• Notify others in room or area to vacate.</li> <li>• Confine spill immediately.</li> <li>• Make no attempt to clean up spill.</li> <li>• Switch OFF all fans and close all windows.</li> <li>• Vacate room or area.</li> <li>• Provide temporary barricade and warning signs.</li> <li>• Notify RSO.</li> </ul>	Decontamination of personnel and equipment (including spill) to be carried out by or under supervision of RSO.
Accident Involving: - Dust - Mist - Fumes - Vapors - Gases	<i>Radiation:</i> No immediate radiation hazard to personnel.  <i>Contamination:</i> Low	<ul style="list-style-type: none"> <li>• Notify others in room or area to vacate.</li> <li>• Switch OFF all fans and close all windows.</li> <li>• Vacate room or area.</li> <li>• Provide temporary barricade and warning signs.</li> <li>• Notify RSO.</li> </ul>	Do not re-enter until approved by RSO.
Minor Injuries Involving: - Radiation Hazard - Contamination	<i>Contamination:</i> Wounds usually greatest hazard.	<ul style="list-style-type: none"> <li>• Wash wound immediately in running water.</li> <li>• Call physician of choice.</li> <li>• Notify RSO.</li> </ul>	Permit no one involved in accident to return to work until approved by RSO and physician.
Major Injuries Involving: - Radiation Hazard - Contamination	<i>Contamination:</i> Wounds usually greatest hazard.	<ul style="list-style-type: none"> <li>• Life threatening situations take precedence over contamination control.</li> </ul>	Permit no one involved in accident to return to work until approved by RSO and physician.
Fires involving: - Radioactivity	<i>Radiation:</i> No immediate radiation hazard to personnel.  <i>Contamination:</i> Low	<ul style="list-style-type: none"> <li>• Notify others in room and building to vacate.</li> <li>• Attempt to extinguish fire if no radiation hazard &amp; can be safely done.</li> <li>• Call Campus Police ASAP (911).</li> <li>• Notify RSO.</li> </ul>	Emergency activities will be governed by or in cooperation with RSO.  Campus Police will determine if local Fire Department is to be called.

# RADIATION SAFETY MANUAL

## SECTION I – GENERAL INFORMATION

The purpose of this manual is to provide users and non-users of radioactive material, lasers, and other radiation producing equipment the more significant facts and figures about radiation. Overviews of state regulations, and direct policies and procedures concerning different areas of radiation use at Texas State University are covered. The regulations, policies and procedures set forth in this guide are written to protect Texas State University faculty, staff, students, and visitors against unnecessary and potentially harmful exposure.

### A. Definitions of Key Terms and Acronyms

1. ALARA means “as low as reasonably achievable”.
2. Authorized User means the individual, normally a Principal Investigator, who is authorized by the Texas Department of State Health Services to work with radioactive materials. The individual is listed on the Texas State University Radioactive Material License.
3. DSHS means the Texas Department of State Health Services, Division for Regulatory Services Radiation Control Program.
4. EHSRM means the Texas State University Environmental Health, Safety and Risk Management office.
5. RAM License means Texas Radioactive Material License # L03321, issued by the DSHS.
6. Registration means Texas Registration of Radiation Producing Machines # R04030, issued by the DSHS.
7. RSM means the Texas State University Radiation Safety Manual.
8. RSO means the Radiation Safety Officer
9. TAC means the Texas Administrative Code.
10. US DOT means the United States Department of Transportation

### B. Radiation Protection Program

1. Objective: This program is designed to limit occupational and public doses of radiation to “as low as reasonably achievable” to protect the staff, employees, and students of Texas State University; to protect members of the general public; and to comply with 25 TAC §289.202(e) [Texas Regulations for Control of Radiation (TRCR) 21.101].
2. Method: Texas State University has established this Radiation Safety Manual (RSM) to provide guidance to faculty, staff, and students when working with radioactive materials and x-ray producing devices.
3. Review: This program will be reviewed no less than once per year.

### C. ALARA Program – General

1. Maximum permissible dose: An Authorized User may not permit an individual in a restricted area to receive a total effective dose equivalent greater than that permitted under the guidelines of the RSM. There should not be any situations at this university where dose equivalents for external and internal exposures exceed those listed in the RSM.
2. Individual’s Dose Assessment: Before initiating work in a restricted area, the RSO shall make a determination of the total effective dose equivalent for each individual, in accordance with 25 TAC §289.202(j).

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3. Prohibition: No Authorized User or Laboratory User shall possess, receive, use, or transfer radioactive material in such a manner as to cause an individual in a restricted area to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Table II of subsection TAC §289.202(ggg)(2).
  4. Prohibition of Use by a Minor: There shall be no use of radioactive material or radiation producing equipment by employees under 18 years of age (minors).
  5. Pregnant Females or females suspecting pregnancy, should consult a doctor. The female, at her discretion, may reduce exposure by voluntarily informing the licensee, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman voluntarily withdraws the declaration in writing or is no longer pregnant.
  6. However, exceptions may be granted by the RSO, following the requirements of TAC §289.202.
- D. Radiation Safety Management – Should any operation involving radiological materials present a threat to the staff or students of the University, or to any member of the general public, the EHSRM Office has the authority to terminate any such operation until the hazard is removed or mitigated.
- E. Radiation Safety Officer (25 TAC §289.252(f))
1. Responsibilities – the Radiation Safety Officer (RSO) will be a trained professional who is responsible for compliance with these policies and the regulations. The RSO will also provide a variety of technical services necessary to maintaining radiation safety and compliance with regulatory requirements.
  2. RSO Duties - The duties of the RSO include:
    - a. Establishment and oversight of operating, safety, emergency, as low as reasonably achievable (ALARA) procedures and activities, including both personnel and environmental monitoring, and annual reviews.
    - b. Furnishing consulting services to personnel at all levels of responsibility on all aspects of radiation protection, including instruction of radiation safety classes.
    - c. Ensuring that required radiation surveys and leak tests are performed and documented in accordance with TAC §289.252 and the Radiation Safety Manual, including any corrective measures when levels of radiation exceed established limits;
    - d. Shipping all radioactive materials or radiation producing equipment departing from Texas State University property.
    - e. Monitoring all equipment and other apparatus capable of producing penetrating radiation.
    - f. Distributing and processing personnel monitoring equipment including maintaining records of internal and external personnel exposure, notifying individuals and their supervisors of exposures approaching the maximum permissible limits, and making recommendations for appropriate remedial action;
    - g. Investigation and reporting of the circumstances for each known or suspected case of radiation exposure to an individual or radiation level detected in excess of limits established by 25 TAC §289.252 and each theft or loss of source(s) of radiation, to include the cause(s), and recommended corrective action to prevent recurrence;
    - h. Investigation and reporting for each known or suspected case of release of radioactive material (s) to the environment in excess of limits established by 25 TAC §289.252;

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- i. Instructing personnel in proper procedures for the use of radioactive materials;
- j. Supervising and coordinating the waste disposal program, including keeping of waste storage and disposal records;
- k. Storage of all licensed radioactive materials not on an Authorized User's inventory;
- l. Ensuring the proper storage, labeling, transport, and use of sources of radiation, storage, and/or transport containers;
- m. Performance and/or supervision of all in-house sealed source leak tests;
- n. Maintenance of an inventory for all radioactive materials and radiation producing equipment on university property.
- o. Supervision of decontamination of radioactive material following spills;
- p. Maintenance of a continuous program of environmental radiation hazard evaluation through routine lab inspections and hazard elimination;
- q. Maintenance of radiation safety program records in the EHSRM Office.
- r. Maintenance of a thorough knowledge of management policies and administrative procedures of Texas State University.
- s. Prevention, by immediate suspension or termination of activity if necessary, of any unsafe or illegal use of radioactive material or radiation producing equipment.
- t. Maintenance of files on each Authorized User in the EHSRM Office, and provision for each Authorized User of a copy (and updates) of the "Radiation Safety Manual – Texas State University Policies and Procedures for Radiation Safety"; and
- u. Conduct necessary investigations and / or appropriate corrective action on any radiation over-exposure or spill occurrence at TEXAS STATE UNIVERSITY

## F. Environmental Health, Safety and Risk Management Office

EHSRM conducts operations and services to support the University radiation safety program.

## G. Responsibilities of Principal Investigators and Supervisory Personnel

Members of the faculty or staff supervising the work of others, either in a teaching capacity, as a principal investigator, or in an administrative supervisory position, are responsible for ensuring that those under their supervision:

1. Discharge the individual responsibilities as listed in this manual.
2. Receive appropriate orientation and training as to the proper and safe use of radiation sources. This will require adequate planning. Before an experiment is performed, the supervisor should determine the types and amount of radiation or radioactive material to be used. This will generally give an indication of the protection required. The procedures to be followed must be well outlined. In many cases, before the procedure is actually performed with radioactive materials, it should be rehearsed in an attempt to preclude slip-ups or unexpected circumstances. In any situation where there is appreciable radiation hazard, the RSO should be consulted before proceeding. A formal Radiation User Training Course is available for all personnel handling radioactive materials and arrangement for the course shall be made through the RSO.
3. Complete the formal Radiation User Training Course. This course is required for all personnel handling radioactive materials. Arrangements for the course are made through the RSO. New employees and/or students who have taken a similar course can be excused if they provide a course syllabus and evidence of successful

completion and documentation indicating that the course covers Texas regulations. Taking the Radiation User's Training course at another university is an acceptable substitute. Failure to complete the course satisfactorily will prevent an individual from handling radioactive materials at TEXAS STATE UNIVERSITY. Students in a teaching situation must also take the radiation safety course training. Non-radiation workers need to know enough to safely conduct themselves in the specific laboratory environment. Admonishing non-radiation workers to avoid touching marked items/areas or lingering near posted areas is usually sufficient if other policies in this manual are rigorously followed.

4. Have knowledge of the harmful effects of radiation to which they may be exposed.
5. Are instructed in safe techniques, the application of approved radiation safety practices and the proper use of radiation detection instruments.
6. Have thorough knowledge of this manual and the regulations the manual requires.
7. They are further responsible to ensure that:
  - a. All radiation sources under their control have been properly approved and that all potential hazards are brought to the attention of the RSO.
  - b. Appropriate radiation surveys are conducted.
  - c. Experiments or procedures using  $^{125}\text{I}$ ,  $^{131}\text{I}$ , radioactive gases, labeled DNA precursors and/or labeled materials that have radioactive levels of 100 mCi or more are performed in a fume hood specifically identified for this purpose. Prior approval by the RSO must be obtained for these experiments to insure compliance with the Texas DSHS regulations regarding effluent release of radioactive materials.
  - d. All necessary records are maintained
  - e. The RSO is notified when new personnel are added or (in advance) when personnel under their supervision terminate (or, in the case of students, conclude activities that involved radiation).
  - f. Local laboratory safety procedures are established, with the assistance of the RSO if necessary.
  - g. Areas and materials are properly posted and labeled, and that materials are secured against unauthorized removal and fire.
  - h. Prepare and maintain a written laboratory procedure for handling isotopes particular to their lab and provide a copy to the RSO. Those directly or indirectly under their supervision are provided equipment and training as required for their specific location and use.
  - j. Prevent unauthorized access to and removal of isotopes by assuring that personnel are following required security measures. Notify the RSO before vacating premises to allow a thorough closeout survey before the premises are cleaned or occupied by anyone else.

## H. Responsibilities of Individual Laboratory User

Individuals are responsible for:

1. Complete the Texas State Radiation Safety Course
  - a. Workers (Technicians, students, graduate assistants, post doctoral researchers, etc.) must attend the Texas State Radiation Safety Course.
  - b. The course will be one hour for workers who can prove by appropriate certificate that prior radiation safety training was completed within the last five years.
  - c. The course will be two hours for workers with prior experience but who have not had recent training (within the last five years). The worker must challenge and pass a competency exam with a score of at least 80%.

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- d. For workers who have not had prior training, the training will consist of a combination of classroom and on the job training. A passing score of 70% on a comprehensive exam will be required.
- e. Completion of training is documented using form EHSRM-RSF-08 "Radioactive Material User Qualifications".
2. Following generally accepted procedures of safe practice such as those specified in this manual.
3. Knowing and adhering to the sections of this manual that are applicable to their work.
4. Knowing and adhering to the specific laboratory procedures as documented in the initial proposal submitted to the RSO for evaluation and approval.
5. Keeping exposures to radiation as low as possible.
6. Wearing appropriate dosimetry and strictly following the regular badge change schedule.
7. Immediately reporting to the RSO any suspected exposure in excess of permissible limits.
8. Reporting any contamination to a dosimeter to prevent any cross-contamination of other dosimeters.
9. Wearing appropriate protective clothing and using proper techniques and facilities in operations involving radioactive materials.
10. Monitoring for, and removing radioactive contamination before leaving the lab.
11. Reporting wounds involving radioactive materials, inhalation or ingestion accidents and spills promptly to the RSO.
12. Cleaning up contamination for which they are responsible after first having consulted with the RSO if necessary.
13. Proper storage and labeling of radioactive materials for which they are responsible.
14. Packaging and labeling articles for waste disposal and maintaining records of such disposals.
15. Furnishing information to the RSO concerning new activities in their area, particularly alterations of operations that might lead to personnel exposures or contamination.
16. Performing appropriate surveys for external radiation, decontamination and maintaining records of results or requesting assistance from the RSO.
17. Contacting the RSO at least ONE WEEK before terminating employment or association with The University.
18. Assuring that acquisitions and transfers of radioactive materials are made in accordance with the provisions of this manual.
19. Complying with requests from the RSO for bioassay. Requests for these tests will be made in the case of workers using significant quantities of radioisotopes.
20. Read and be knowledgeable about the lab procedure for handling isotopes particular to the labs they work in.
21. Prevent unauthorized access to and removal of isotopes. Assure stock material is put away, the work area is acceptably clean, and the door is locked before leaving the lab unattended.

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## I. Personnel Monitoring Procedures

Introduction - This section will give information regarding the initiation, requirements, use, and termination of personnel monitoring for radiation exposure at Texas State University.

1. Requirements - The regulations require that personnel monitoring devices (i.e. film badges) be provided and records be kept for an individual who receives, or is likely to receive, a dose in any calendar year in excess of 10% of the values discussed in manual. Exemptions may only be granted by the Texas Department of State Health Services (DSHS).
2. Method - The radiation reaching the badges, being worn for monitoring, exposes the badge or chip. Special filters in the badge holder allow distinguish between varying degrees of radiation penetration, thus indicating the exposure received by the person wearing the badge. The only purpose of the badge is to record the exposure of an individual. The badge does not protect an individual from radiation.
3. Monitoring periods: vary according to badge type and use. Each individual should check to see the length of the monitoring period they will be following. A general rule to follow will be: film badge - monthly, TLD badge - quarterly. ANY individual not returning a badge of any type will be subject to a dose assessment in accordance with 25 TAC §289.202. The dose assessed could result in the maximum permissible exposure for that time period, possibly resulting in the loss of the right to work with radioactive material and/or radiation producing equipment.
4. Personnel Monitoring Procedures:
  - a. Requests for Dosimetry:
    - 1) Any person likely to receive 10% or more of the applicable annual allowable dose limit is required to file a "Dosimeter Request" form EHSRM-RSF-02. The RSO will make a determination from the information given on the "Request" as to the type of monitoring needed for that particular individual. Personnel exempted from badge-type dosimeters will be those who work only with pure alpha emitters, or beta emitters having a maximum energy of less than 0.2 MeV, in which case an internal dosimetry program is required if the committed effective dose equivalent exceeds 10 percent of annual limits of intake (ALI) as listed in Columns 1 and 2 of Table I of 25 TAC §289.202(ggg)(2). The RSO will determine who will be issued badge-type dosimeters.
    - 2) Whole body badges and ring badges do not respond to weak beta radiation from H-3, C-14, or S-35. Workers who use H-3 or C-14, and less than 1 mCi a month of S-35 or P-32, are not required to wear a radiation badge, but may request one. Workers using 1 mCi a month or more of P-32 or other high-energy beta emitters must wear a whole body badge. Workers that use 10 mCi or more of P-32 or other high energy beta emitter at a time are required to wear a whole body dosimeter and ring badge.
    - 3) Any person filing a "Dosimetry Request" form EHSRM-RSF-02 that has worked with radioactive material, radiation producing equipment, or has been previously monitored for radiation exposure at a previous institution(s) within the current calendar year will be asked to fill out the information needed on the "Dosimetry Request" form and the previous exposure history request form EHSRM-RSF-03 for each employer/institute.
    - 4) After receiving the "Dosimetry Request" the RSO will order the dosimetry (if needed). No use of radioactive material or radiation producing equipment will be allowed until confirmation from RSO has been received.

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- b. Termination of Service: The following rules should be followed for dosimetry service termination:
  - 1) Individual user should give a minimum 30 day notice of his/her intent to be deleted from the service. This should be done in advance of a new monitoring period, therefore allowing enough time to ensure that deletion will be completed without a new badge being issued.
  - 2) Individual user will return badge to the Authorized User or RSO upon completion of work with ionizing radiation or before leaving the University.
  - 3) All individuals are urged to request their permanent exposure history from Texas State University. The EHSRM Office will forward permanent exposure histories in accordance with 25 TAC §289.202. Please allow enough time for final badge to be developed, interpreted, and results sent to the University.
- c. Procedures for Wearing of Badges: Rules regarding the wearing and use of personnel monitoring devices:
  - 1) Attach the badge holder to the area of your garment most likely to be exposed to the radiation.
  - 2) When not in use, leave the badge in a radiation free area. DO NOT take the badge home, leave it in your car, or other areas subject to exposing the badge to significant changes in heat, humidity, or light, unless on official business for the University involving ionizing radiation.
  - 3) NEVER wear another person's badge.
  - 4) Report the loss of a badge or holder to the RSO immediately.
  - 5) NEVER put a badge in a situation where it could become contaminated by radioactive material or exposed to unnecessary radiation. Specifically, never wear ring badges on the outside of gloves, never leave badges lying near radioactive material or radiation producing equipment, even for short periods of time.
  - 6) THE BADGE ISSUED TO YOU IS YOUR RESPONSIBILITY.
  - 7) Take care not to send your badge to the laundry with your lab coat.
  - 8) NEVER puncture, remove, or alter in anyway the badge holder or its contents.
  - 9) REMEMBER - A rule cannot be written to cover every possible situation, contact the RSO with any questions.
  - 10) Reports of exposure to ionizing radiation are kept by the Radiation Safety Officer. Any individual may request (in writing) to review his/her exposure reports at any time. However, the request should indicate the report(s) needed for review.

### J. Bioassay Procedures

- 1. Requirement: Staff and students must submit to the appropriate bioassay procedure if indicated by any of the conditions described below. It is conceivable, although not likely, that a person not involved in any operation using radioactive materials might be exposed. In that event, those individuals must also have the appropriate bioassays performed.
- 2. Urinalysis:
  - a. Any person who uses 8 mCi (millicuries) or more of hydrogen-3 (tritium) in any single operation or within a one (1) week period will submit to a urinalysis. Urine samples will be taken before work begins and weekly during use. Results will be provided to the person, regardless of outcome.
  - b. Any person who uses 20 mCi (millicuries) or more of carbon-14 in any single operation will submit to a urinalysis. Urine samples will be taken before work

begins and weekly during use. Results will be provided to the user, regardless of outcome.

3. Additional Requirements:
  - a. Periodic bioassays may be necessary for any individual who is suspected of having ingested, inhaled, or absorbed any radioactive material. The type of bioassay will be determined by the RSO upon consultation with appropriate regulatory agencies or health physics consultants, if necessary.
  - b. In vitro bioassays, other than urinalysis, will be performed when determined by the RSO, after consultation with appropriate regulatory agencies or health physics consultants.
4. Records: all results of bioassays will be recorded and filed in the individual's personnel monitoring file.

### K. Maximum Permissible Doses, Dose Limits

1. Like other materials with potential health hazards, regulatory control is applied to exposures involving radiation workers throughout the nuclear industry as well as medical and research facilities. Workers exposed to ionizing radiation as part of their normal duties assume an occupational risk and therefore are regulated under a "maximum permissible dose". The Texas Regulations for Control of Radiation and Title 10 Code of Federal Regulations Part 20 currently accepts the following as "maximum permissible dose":
2. No Authorized User or employee shall possess, use, receive, or transfer sources of radiation in such a manner as to cause any individual in a restricted area to receive in any period of excess of the limits specified as follows:
  - a. The annual occupational dose shall not exceed the more limiting of:
    - 1) the total effective dose equivalent being equal to 5 rems (0.05 sievert); or
    - 2) 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).
  - b. The annual occupational dose to the lens of the eye, to the skin, and to extremities will not exceed:
    - 1) an eye dose equivalent of 15 rems (0.15 sievert), and
    - 2) a shallow dose equivalent of 50 rems (0.5 sievert) to the skin or to any extremity.
  - c. The annual occupational dose to minors will not exceed 10 percent of the limits specified in (a.) and (b.) above [reference 25 TAC §289.202(l)].
  - d. The annual occupational dose to an embryo or fetus during the entire pregnancy of a declared pregnant woman will not exceed 0.5 rem (0.005 sievert). Refer to 25 TAC §289.202(m).
  - e. The total effective dose equivalent to individual members of the public will not exceed 0.1 rem (1.0 millisieverts) in a year, and that the dose rate in any unrestricted area from external sources will not exceed 0.002 rem (0.02 millisieverts) in any one hour.

# RADIATION SAFETY MANUAL

## SECTION II – AUTHORIZED USER PROGRAM SAFETY

Introduction - This section will detail the procedures and requirements for obtaining Authorized User status for radioactive material, actions necessary for deactivation and termination of active status, the Authorized User inspection program, and responsibilities of the Authorized user.

### A. Authorized User Application Process

#### 1. Qualifications for Authorized User

The applicant must have sufficient training and experience in the use of the radioactive material requested to ensure that proposed work is conducted and/or supervised in a safe manner.

#### 2. A memorandum must be sent to the RSO covering the following items in the order listed:

- a. Name and title of applicant (project supervisor).
- b. Curriculum Vitae
- c. Building and room. Include a SKETCH (building drawings can be obtained from Physical Plant) of the room showing facilities to be used.
- d. Names and titles of technically trained faculty or staff or students participating in the project (excluding students enrolled in courses). Note the completion date of the TEXAS STATE UNIVERSITY Radiation Training course or equivalent.
- e. If material is to be used in class work, indicate whether persons under 18 years of age may be present and the anticipated exposure. Also arrange for class to take the training sequence.
- f. [Radioisotope(s)] The source of radiation, if a radioisotope, then:
  - 1) Chemical form
  - 2) Maximum quantity to be used per experiment and frequency of experiments.
  - 3) Maximum quantity to be obtained per order
  - 4) Maximum to be possessed at any time
  - 5) Estimate potential exposures to gamma and strong beta emitters
  - 6) Proposed use. Briefly outline the procedures to be followed; describe the procedures to be followed in sufficient detail to permit a radiation safety evaluation to be made by the RSO. Allow sufficient time for this review.
- g. List protective equipment (e.g., fume hoods, shielding, etc.) to be used.
  - 1) Include plans for handling and storing radioactive materials, care of radioactive animals, disposal of radioactive wastes, etc.
  - 2) Also, list survey instruments that are available for personnel protection. As a matter of policy, each project is required to have at its disposal suitable monitoring instrumentation for detection of the radiation that may be present in the laboratory.
  - 3) If a fume hood is to be utilized, a detailed protocol is required and must include:
    - a) Isotope, maximum activity in the experiment, frequency of experiment.
    - b) Physical and chemical form(s) of the isotope during the experiment.
    - c) Procedure for monitoring the effluent (and/or containment)
    - d) Estimated minimum and maximum effluent given off during the experiment.

#### NOTE:

A specially designated fume hood must be utilized for iodination experiments involving  $^{125}\text{I}$ ,  $^{131}\text{I}$ , radioactive gases, labeled DNA precursors and/or labeled materials in excess of 100 mCi.



## RADIATION SAFETY MANUAL

- b. All radioactive sources shall be stored in their designated location and secured against use.
  - c. All radioactive waste shall be disposed of in accordance with Texas State procedures.
  - d. All equipment labeled as potentially contaminated will be stored in designated areas and secured against use.
  - e. The Authorized User will provide copies of the results of an IN-DEPTH contamination survey of the laboratories, equipment, storage and waste areas to be deactivated. If excessive contamination levels are found, the contaminated areas and/or equipment will be decontaminated until allowable limits are reached.
  - f. At this point, further use of radioactive material is strictly prohibited.
  - g. All equipment and personnel monitoring equipment (i.e. survey meters, shielding, film badges, etc.) not belonging to the deactivating Authorized User will need to be returned at this time.
2. Reactivation – when an Authorized User intends to restart use radioisotopes perform the following.
- a. At the end of a deactivation period the Authorized User may request, in writing, to renew the deactivated status of the laboratory(s).
  - b. If the protocols have changed or the radioisotope to be used has changed it may require the Authorized User to resubmit authorization documentation.

### D. Procedure for Termination of an Authorized User

The following procedure shall be used should an Authorized User desire to terminate their use of radioactive material.

1. A letter of intent to terminate the use of radioactive materials will be submitted to the RSO. This letter will include:
  - a. The date of termination.
  - b. The listing of the Authorized User's authorized laboratories, including storage and waste areas. A diagram of all these areas should accompany this letter of intent.
  - c. A statement that all radioactive materials, and radioactive wastes used and/or stored will be removed. They must be transferred either to the RSO for storage or disposal, or properly transferred to another Authorized User who is authorized to possess the materials and activities under consideration, without exceeding his/her limits.
  - d. The terminating Authorized User will provide copies of the results of an IN DEPTH contamination survey on the laboratories, equipment, storage and waste areas authorized. If contamination levels greater than those listed in 25 TAC §289.202(ggg)(6) are found, the contaminated areas and/or equipment will be decontaminated until allowable limits are reached.
  - e. Upon receipt of the letter of intent, the RSO will conduct a close-out survey of the affected areas and equipment.
  - f. Based on a review of the letter of intent, the results of the close-out survey, and the disposition of the radioactive material, the RSO will submit a request to the Texas DSHS to remove the Authorized User and laboratory facilities from the RAM License.
  - g. Upon termination, all signs and labels, indicating that the areas were authorized for use of radioactive material, shall be removed. The areas are now considered for unrestricted use. Areas with radiation producing equipment may or may not qualify for unrestricted use.



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## F. Authorized User Programs and Procedures

1. Authorized User/Authorized User Responsibilities
  - a. Each authorized user has the following obligations:
    - 1) Ensuring that the individual user responsibilities are discharged by those under their control and supervising their work;
    - 2) Working within the limits of authorization;
    - 3) Instructing those employees for whom they are responsible in the use of safe Techniques and in the application of approved radiation safety practices and ensuring attendance at required radiation safety courses;
    - 4) Furnishing the RSO with information concerning individuals and activities in their areas;
    - 5) Ensuring that all surveys and safety checks required for their particular area of interest are carried out and recorded properly;
    - 6) Contacting the RSO whenever major changes are anticipated in operational procedures, new techniques, alterations in physical plant, or when new operations that might lead to personnel exposure;
    - 7) Complying with the regulations governing the use of radioactive materials as established by the Texas Regulations for Control of Radiation, and Texas State University Policies and Procedures for Radiation Protection;
    - 8) Keeping stocks of stored radioactive material to a minimum;
    - 9) Complying with proper procedures for terminating the use of radioactive material;
    - 10) Complying with the proper procedures for handling radiation incidents;
    - 11) Obtaining prior approval, by completing and submitting an application for amendment/renewal form, for the addition/deletion of rooms, radioisotopes, or personnel, for the increase/decrease of radioactive material, or for additions or changes to procedures.
  - b. Responsibilities of Authorized Users - Authorized users (workers, employees, etc.) faculty, students, other professionals, as well as technicians and other workers engaged in education, laboratory research, and research support activities, which involve actual use and handling of materials. These personnel will work under the supervision of an Authorized User.

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## SECTION III – RADIATION SAFETY PROCEDURES

Policies and Procedures for Radioactive Material Use – This section will outline specific policies and procedures for the use of radioactive material. Pertinent facilities, record keeping, handling of radioactive material, radiation contamination surveys, custodial service for radioactive material areas, neutron meters, radioactive material in animals and radioactive waste.

### A. Facilities

1. Work areas(s) (benches, hoods, trays, etc.) will have a non-absorbent surface.
2. Laboratories will have wall coverings of a washable, hard, heat-chemical resistant paint (i.e. epoxy).
3. Laboratories will have protective floor coverings and ventilation capable of handling and storing the isotopes and activities being requested.
4. Storage areas, work areas, refrigerators, freezers, fume hoods, and lab entrances will be posted with the correct warning signs.
5. Storage areas (cabinets, refrigerators, freezers, fume hoods, laboratories, etc.) will be secured to prevent unauthorized removal of radioactive material.
6. Storage containers will have radioactive material labels with date, type, and activity of isotope(s). This will apply to any container with radioactive material that will be in use more than one (1) working day.
7. Work area air levels shall be kept below 10% of those limits given in 25 TAC (§289.202(ggg)(2)). If circumstances require concentrations in air to exceed 10% of the above, then the RSO must be notified.
8. All signage (Authorized User, Notice to Employees, emergency numbers, etc.) shall be posted in prominent view.
9. Remote handling devices will be used when handling energetic beta or gamma sources. In general this refers to sources above approximately two-tenths of one MeV (0.2) that might be indirectly unshielded or potentially contaminated. If a person is unsure as to the proper action to take consult the RSO.
10. Each laboratory will have a [calibrated] survey meter capable of detecting radioactive material (s) used in that particular laboratory if the radioisotopes and activities of those isotopes are detectable with a meter. This survey meter is not to be used for actual contamination surveys, only for dose level surveys, spot contamination surveys, and personnel exit surveys.
11. NOTE - All costs for procurement, calibration (annually), and repair will be assumed by the Authorized User. Survey meters may be available (limited number) from Radiation Safety Officer for short-term loan.
12. Work areas may need a fume hood in order to comply with regulatory limits. The following lists some minimal features the fume hoods should have:

**NOTE:**

Fume hoods should be used anytime a person is handling unsealed, potentially volatile forms of radioactive material. Operations involving the use of more than 0.1 millicuries of Iodine-125 or Iodine-131 in volatile form shall be conducted within a properly operating fume hood.

- a. Fume hoods shall be labeled if radioactive materials are to be used or stored in the hoods.
- b. The velocity of the air flow shall be such that there can be no escape of air into the work place from the fume hood under normal conditions, including opening

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- of doors and windows, suction of other fume hoods, and air conditioning systems. The velocity of the air flow shall be no less than 80 fpm.
- c. The gas, water, and electrical controls should be operable from the outside of the fume hood.
  - d. The fume hood shall have a counter-balanced sash made of tempered safety glass.
  - e. The fume hood should have a layer of absorbent paper with water-proof backing covering the entire work surface.

### B. Record Keeping

1. Swipe survey results - Survey records shall be in accordance with 25 TAC requirements. Surveys shall be in proportion to isotope use; hence the records shall be the same. Surveys are documented on form EHSRM-RSF-04, "Radiation/Contamination Survey Log". During periods of inactivity, an explanation of why no survey was performed is recorded at the normal survey interval.
2. Radioisotope Use Forms - All isotope use forms "Radioisotope Usage" EHSRM-RSF-05 shall be kept by the sub licensee. The forms shall be separated from those in use and those exhausted. The form is used to indicate, and verify the Authorized User's use and disposal of radioactive material. At such time when the radioactive material is no longer useful or is exhausted, the total amount used, disposed, or released to atmosphere must be written on the "use form".
3. "Radioactive Waste Disposal Logsheet" form EHSRM-RSF-06, shall be kept by the Authorized User. The form is used to comply with Texas Regulations for Control of Radiation, Dept. of Transportation Regulations, Code of Federal Regulations Part 49, Environmental Protection Agency Regulations, Texas Water Commission, and Disposal Site Regulations.
4. "Radioactive Material Disposal/Transfer" form EHSRM-RSF-07 - All Requests for radioactive material transfer/disposal shall be kept by the Authorized User.
5. Inventory - all Authorized Users will keep a copy of the most recent semi-annual radioactive material inventory.
6. Inspection Reports - All Authorized Users should keep their inspection reports
7. Amendment/renewals - All Authorized Users should keep a copy of their amendments and renewals.
8. Organization - All survey records shall be kept in format so as not to confuse routine inspections or audits. Records shall be sectioned so as to separate use forms, inventories, survey records, etc. Use forms should be separated by isotope and kept in chronological order by date received.
9. Availability - Records shall be kept in an area of the laboratory free of contamination and shall be available during routine monitoring of the lab by the Radiation Safety Officer and/or regulatory agencies.

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## C. Control of Radioactive Material

1. Ordering Radioactive Material – General Procedure
  - a. Requestor calls the Radiation Safety Officer  
Phone: (512) 245-3616
  - b. The requestor shall have the following information for the Radiation Safety Officer:
    - 1) Authorized User name
    - 2) Isotope
    - 3) Activity (in millicuries ONLY)
    - 4) Chemical form
    - 5) Requestor's phone number
    - 6) Local point of contact
    - 7) Vendor
  - c. The Radiation Safety Officer will;
    - 1) Check the Authorized User's current inventory to verify that the isotope and requested activity does not exceed the Authorized User's limit.
    - 2) Check the Texas State University Broad License to verify that the isotope and requested activity does not exceed the Texas State University Broad License Limit.
    - 3) Check the compliance, records, and violations of the Authorized User.

**NOTE:**

Should the purchase exceed either the Authorized User or Texas State authorized limits the RSO will call the requestor and ask him/her to amend the order to an acceptable limit or amend his/her current inventory by resubmitting Radioactive Material Inventory.

- 4) The Radiation Safety Officer will call the requesting Authorized User and give approval for purchase.
    - 5) All radioactive material shipments must be shipped to the address specified on the purchase order.
    - 6) If a purchase order form is used, the requestor will then complete the form. The requestor shall type or write (legibly) the words "Radioactive Material" on the purchase order form.
2. Receipt of Radioactive Material
  - a. After receipt, the University Distribution Center will set aside the package and notify the RSO.
  - b. The Radiation Safety Officer will perform the following:
    - 1) Inspect the packing slip of all packages received to determine that the correct isotope, chemical form, and amount of material has been received.
    - 2) All packages will be examined for signs of damage, such as being crushed, open, or wet.
    - 3) All packages will be surveyed for external radiation levels with a hand-held meter equipped with a thin end-window G-M probe, Ion chamber, or a NaI crystal detector. Radiation levels must not exceed 200 millirems/hr at the surface or 10 millirem at 1 meter [25 TAC §289.202(ee)].
    - 4) All packages will also be swipe tested at various locations over a total of ~300 cm<sup>2</sup> for removable external contamination. Contamination levels must not exceed 22 dpm/cm<sup>2</sup>.
    - 5) Results shall be documented on a "Radiation/Contamination Survey" form EHSRM-RSF-01 or equivalent.

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- 6) When the package is certified as acceptable, the authorized user requesting the material will be notified.
  - 7) The Radiation Safety Officer will deliver the package to an authorized use location.
  - 8) For packages that are damaged and contaminated or exceed the limits on external radiation or removable contamination, the package will be held for return and the final delivery carrier and the Bureau of Radiation Control will be immediately notified by telephone and in writing (e.g., facsimile).
- c. Opening and inspection by user.
- 1) The user will be responsible for inspecting the contents inside the package once it has been transported to the user's area and certifying the actual contents.
  - 2) The user will put on gloves to prevent hand contamination. The package will again be inspected for signs of visible damage at the point of opening and the RSO will be notified if damage is observed at any time during opening and no further handling will be done.
  - 3) The radiation level at 1 meter and the package surface will have already been checked by the RSO but the user may wish to confirm the determination of the RSO.
    - a) For Yellow II and Yellow III labeled packages, the dose rate expected at 1 meter from the package surface is that indicated by the "transport index" on the label. The dose rate at the surface should not exceed 200 millirems/hr.
    - b) The dose rate for "White I" labeled packages should not exceed 0.5 millirems/hr at the surface.
    - c) If external radiation levels are greater than expected or exceed these limits, stop and notify the RSO.
  - 4) Remove and read the Material Safety Datasheet and the copy of the packing slip provided by the RSO.
  - 5) Open the inner package and verify that the contents agree with the information provided and the material ordered.
  - 6) Check the integrity of the final source container. Look for broken seals or vials, loss of liquid, condensation, or discoloration of the packing material. If anything is other than expected, stop and notify the RSO.
  - 7) Perform a swipe test on the final source container. Until the results of the wipe test are obtained, assume that the materials received may be contaminated and take precautions to prevent the potential spread of contamination.
  - 8) Monitor the packing material and the empty packages with a survey meter before discarding.
  - 9) If contamination is discovered for any packing material, it must be treated as radioactive waste.
  - 10) If not contaminated, remove or obliterate all radiation labels before discarding in in-house trash. **DO NOT DISCARD NON-RADIOACTIVE MATERIALS IN RADIOACTIVE WASTE.**
  - 11) Record the amount and type of radioisotope received and begin a "Radioisotope Usage" form EHSRM-RSF-05 (or equivalent) for the material in that package (put the Material Safety Datasheet in the Radiation Log notebook along with the swipe test result)

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- d. Acquisition of "No-Charge" Radioactive Materials  
The Radiation Safety Officer must be notified and give approval prior to the acquisition of "no-charge" radioactive materials. Only those persons with official authorization may obtain such materials if there is an immediate need and the material will not become a disposal problem.
  - e. General License Materials  
For research or diagnostic purposes small quantities of certain isotopes can be purchased without a specific license. However, these General License materials are subject similar requirements for record keeping, contamination control, and waste disposal accounting.
3. Accountability of Radioactive Material
- a. A "Radioisotope Usage" form EHSRM-RSF-05 will be prepared by the Authorized User upon receiving the shipment.
    - 1) The form is used to document the use and disposal of that particular shipment.
    - 2) When the material is no longer useful or exhausted the Authorized User will verify that all use and disposal has been recorded on the form.
    - 3) It shall be the responsibility of the Authorized User to apply mathematical decay calculations in order to determine the amount used and/or disposed.
  - b. Upon final use the Authorized User shall verify the aforementioned, then date, sign and return a copy to the RSO.
  - c. After receiving the copy the RSO will audit the "use form" and if filled out correctly will delete the shipment from the Authorized User's and the Texas State University inventory.
  - d. Semi-annual radioactive material inventories are required of all Authorized Users.
    - 1) Authorized Users will submit the inventory as requested by the RSO.
    - 2) Remember - It is the responsibility of the Authorized User to apply any mathematical decay calculations.
4. Transfer and Shipping of Radioactive Material
- a. Transfer -
    - 1) There shall be no transfer of radioactive material from one Authorized User to another, nor outside of Texas State University, without the approval of the RSO.
    - 2) Complete a "Radioactive Material Disposal/Transfer" request form EHSRM-RSF-07 prior to requesting transfer.
  - b. Shipping -
    - 1) If radioactive material is to be shipped from Texas State University, the shipper must notify the Radiation Safety Officer.
    - 2) The RSO will then assist the shipper in preparing the package for shipment according to Department of Transportation Regulations, Texas Regulations for Control of Radiation, and Nuclear Regulatory Commission (NRC) Regulations.

## NOTE

The recipient of any regulated radioactive material to be shipped from Texas State University must provide evidence of an NRC (or agreement state license) by furnishing a copy of his/her license to the Radiation Safety Officer. This must be done prior to shipment.

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5. Storage of Radioactive Material
  - a. Radioactive material shall be stored only in approved areas.
  - b. The storage container shall be of such construction to prevent unneeded external exposure to radiation present therein. Furthermore, the container shall be "double contained" meaning the container shall be able to hold/or absorb twice the volume of the material therein.
  - c. Storage of radioactive material, animals containing radioactive material and parts thereof shall be such as to prevent unauthorized removal.
  - d. All refrigerators and freezers for storage of radioactive material shall be equipped with hasps and combination locks. A copy of the combination shall be forwarded to the Radiation Safety Officer.

## D. Surveys

1. Each Authorized User shall perform or have performed by individuals listed on Authorized User, laboratory surveys where radioactive material or radioactive waste is being used or stored.
2. Routine Surveys

Daily when radioactive materials are used, a survey of the affected work areas shall be performed.

  - a. This survey should consist of a direct scan of areas where radioactive materials were handled. Provided radioisotope used can be detected via this method.
  - b. Any areas found to be contaminated shall be decontaminated and then resurveyed.
  - c. The survey shall be documented in the laboratory logbook and should include the following:
    - 1) Date and time of survey
    - 2) Instrument used to perform survey
    - 3) Calibration due date of instrument
    - 4) Survey results
    - 5) Name of person performing survey
3. Detailed Contamination Survey
  - a. These surveys shall be performed in direct proportion to isotope use. Generally, surveys should be conducted based on the quantity of radioisotope used per experiment.
    - 1) Less than 10  $\mu\text{Ci}$  – once per month
    - 2) Greater than or equal to 10  $\mu\text{Ci}$  and less than 100  $\mu\text{Ci}$  – weekly
    - 3) Greater than or equal to 100  $\mu\text{Ci}$  - daily
  - b. Survey method:
    - 1) Using filter paper (Whatman 1 - 4.25cm or equivalent), swipe an area of 100 cm<sup>2</sup>.

### NOTE:

Using an "S" motion of about 12-16 inches will give approximately this area. Although there is no set minimum or maximum for the number of wipes for a laboratory, one should make sure the number of swipes taken show radioactive material use areas, radioactive material storage areas, radioactive-waste storage areas, and heavy traffic areas (door knobs, floors, phones, cabinets, etc.).

- 2) Count the swipes with a radiation detection system capable of monitoring the desired radiation energy and type.

**NOTE**

Survey meters are not capable of being used for quantitative analysis (i.e. counting purposes). They should only be used for routine surveys, personnel lab exit surveys, and contamination location.

- 3) Results of the smear surveys should be corrected for efficiency and reported in units of activity (i.e., dpm, Bq, etc.).
- 4) Using The following shall be maintained in the laboratory logbook:
  - survey date and name of surveyor
  - counts per minute
  - results in units of activity
  - map of laboratory
  - swipe locations
  - efficiency of counter
- 5) All results shall be recorded whether positive or negative.
- 6) If results show removable contamination of more than 1000 dpm for beta emitters (Hydrogen-3, Carbon-14, Phosphorus-32, Phosphorus-33, Sulfur-35, Calcium-45, Zinc-65), or 200 dpm for Iodine-125, notify the Radiation Safety Officer and begin decontamination procedures.

**NOTE:**

Be sure to always do a background count with each survey and indicate on your machine copy results which sample is the background count

4. Equipment in a radiation laboratory shall not be removed from that laboratory until demonstrated to the RSO to be free of radioactive contamination.
5. Equipment to be repaired by persons outside the laboratory shall be demonstrated to be free of radioactive contamination by the RSO. Emergency equipment repair by outside personnel shall be supervised by the RSO. It is the responsibility of the laboratory personnel to request this supervision from the RSO.
6. Routine surveys by the RSO in no way release a Authorized User from his/her obligation to their surveys.
7. In general, NO radioactive contamination can be tolerated. Exceptions to this will include certain hood trays, dry boxes, stainless steel trays, absorbent paper, or other equipment which is used frequently for active work and which will be clearly marked with standard radiation caution signs and stickers. However, these items shall be decontaminated or disposed of after experiment or use and before deactivation or termination of Authorized User.
8. Decontamination - ALL decontamination will be carried out by the Authorized User responsible for the contamination under the supervision of the RSO. All costs for decontamination shall be assumed by the Authorized User.
9. Detailed surveys should be documented on a "Radiation/Contamination Survey" form EHSRM-RSF-01 or equivalent. The form is an Excel spread sheet and is available from the RSO. The spreadsheet will automatically calculate contamination levels in dpm.

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## E. General Services for Radiation-Use Laboratories

All laboratories must be surveyed (swipe tests and visual inspection) for any possible radioactive contamination within 24 hours of the scheduled cleaning or other services. The lab shall remain clean until after the services, and it is the responsibility of the Authorized User to assure this. Records of these surveys must be kept. Unacceptable removable contamination or radiation exposure rates will result in the suspension of general services. Supervision by the Authorized User or radiation safety personnel is required during all services with the exception of after hours, routine, custodial services. Any laboratory found (during routine inspections) not to be performing required periodic surveys will be suspended from general services.

1. Custodial Service for Radiation Use Areas
  - a. To obtain special custodial service (i.e., scrubbing, stripping, and finishing floors), call Custodial Operations (52181).
  - b. Prior to scheduling the cleaning, the following preparations must be made:
    - 1) The floor must be cleared of all obstacles such as boxes, books, containers, and radiation-labeled items. This must be done by authorized personnel. Visual surveys of the lab must accompany the wipe tests.
    - 2) Custodial Operations will schedule the work and call to confirm the date with the requester.
    - 3) The Authorized User or a radiation worker IS REQUIRED to be in the lab during the cleaning.
  - c. Routine custodial service includes only sweeping floors, emptying trash containers, and replacement of paper in dispensers.
    - 1) The Authorized User or a radiation worker IS NOT required to be in the lab during the routine cleaning.
2. Building, Maintenance And Construction Services
  - a. The Authorized User or RSO can give clearance for BM&C to perform work in an authorized use/storage area. The laboratory must be surveyed within 24 hours of the scheduled work.
  - b. All "hot" items (marked with radiation tape) to be serviced must be surveyed and cleared prior to the requested work to be done. The items must be released by the RSO, or documented and released by the Authorized User.
  - c. The Authorized User or a radiation worker is required to be in the lab during the BM&C services.
3. Other Services
  - a. Departmental Technicians can occasionally enter and perform routine duties provided they do not handle "hot" (labeled with radiation tape) items, and provided the Authorized User grants them permission.
  - b. Company Technicians and servicemen servicing or checking items in controlled areas must have the permission of the RSO. The Authorized User will be required to have the lab surveyed within 24 hours of their visit. All "hot" items that will be serviced must be checked, and cleaned and rechecked if necessary. Records of these surveys must be kept.
  - c. The Authorized User or a worker is required to be in the lab during the services.

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## F. Radioactive Material in Animals

The following procedures are to be used by researchers using radioactive materials in animals.

1. Prior approval to use animals in research shall be obtained by application or amendment through the RSO. Procedures must be outlined in detail showing activities, disposal procedures, surveys, potential problem areas, etc.
2. Policies concerning animal use:
  - a. Animal cages are to be labeled with warning stickers.
  - b. After the animal carcass is no longer needed the researcher or his technician shall wrap the animal in some type of absorbent paper, the animal shall then be placed in double bags and then frozen.
  - c. All bedding and food shall be placed separately in double bags.
  - d. The bags should be sealed with yellow tape and SHALL BE labeled with the following information:
    - 1) Isotope
    - 2) Total microcuries
    - 3) Date of administration
    - 4) Total gram weight

**NOTE:**

Bags and tape shall be kept near animal housing.

- e. The animal carcasses, bedding, and food shall be stored in a freezer until Radiation Safety Officer receives it for disposal.
- f. At least 24 hours notice shall be given to the Radiation Safety Officer or his designee for a pick up time.
- g. Contaminated cages, feeders, and water bottles must be washed separately from normal cleaning. If a suspended rack is used then the entire unit must be cleaned.

**NOTE:**

Gloves are to be worn during cleaning operations and disposed of as radioactive waste.

- h. Surveys shall be performed and recorded in accordance with Item D of this section.
- i. All cages, feeders, racks, and water bottles must be demonstrated to be free of contamination, by the researcher, to the RSO.

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## SECTION IV - RADIOACTIVE WASTE DISPOSAL PROGRAM

Radioactive Waste materials, which includes solid, bulk liquid, liquid scintillation vials, and animal carcasses resulting from the use of radioactive material in laboratories shall be stored in designated containers and retained for collection by the RSO. All radioactive wastes shall be disposed of in such a manner as to prevent the occurrence of a hazard to the health of Texas State University personnel, to the value of property, and to the welfare of the public. Final disposal of all radioactive wastes, with the exception of trace amounts through the sanitary sewer system, will be accomplished by the RSO.

### A. Waste Types

There are basically four types of waste generated that could be generated at TEXAS STATE UNIVERSITY: dry solid, bulk liquid, liquid scintillation vials (LSV), and animal carcasses. In rare cases some predetermined operations may develop gaseous wastes.

1. Dry solid wastes containing radioactive materials are non-hazardous or hazardous. Dry solid radioactive waste that contains a hazardous component (mixed waste) cannot be generated without permission from the RSO. Otherwise, all dry solid waste must be in the chemical form that is non-hazardous and acceptable for disposal in the local landfill.
2. Liquid wastes are separated into two categories: (a) aqueous bulk liquids and (b) mixed waste (organic) bulk liquids.
3. Aqueous radioactive bulk liquids:
  - a. pH between 5 and 9
  - b. Contains no biological, pathogenic, or infectious material, and have no hazardous characteristics.
  - c. Aqueous biodegradable scintillation cocktails fall within this category.

**NOTE:**

Organic non-biodegradable scintillation fluids, hazardous liquids, as well as oils, other organic fluids, strong acids and bases are NOT considered aqueous fluids and should never be mixed with them.

4. Mixed (organic) radioactive bulk liquids:
  - a. Contain a hazardous component and meet the characteristics of hazardous material.
  - b. Bulk liquids are considered mixed if they consist of hazardous chemicals such as toluene, xylene, or other flammable, toxic, or reactive fluids.

**NOTE:**

Regulations mandate that the generator (Authorized User) be able to verify the contents of all wastes and their associated hazard classification.

5. Liquid scintillation vials:
  - a. Glass or plastic vials with a capacity of less than 50 ml each.
  - b. Contain, or have contained, liquid scintillation fluid.
  - c. Biodegradable scintillation cocktails such as Opti-flour, Aqua-sol, Ready-Safe, etc. should be used unless there is absolutely no way to avoid using the non-aqueous scintillation cocktails.
  - d. NO blood or aqueous non-scintillation vials are to be placed in the LSV containers.

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- e. Stock solution vials (NEN, ICN, etc.), liquid scintillation counter standards, or vials with non-scintillation fluids are not acceptable in LSV containers.
- f. NEVER mix dry solid or biological wastes in LSV containers.

**NOTE:**

If any non-scintillation material is found in a LSV container, the container will be returned, or if found during an inspection the generator will be responsible for correction of the situation. If the hazard is considered not in the best interest of ALARA the generator may be held responsible for additional broker or disposal sites fees.

6. Animal carcasses - This would consist of any animal used and/or sacrificed (during research) that contains radioactive material. This would include all parts of these animals (e.g. body, internal organs, etc.).

### B. Responsibilities of the Generator (Authorized User):

1. Proper collection and storage of all radioactive waste.
2. Compliance with state and local regulations and control of the wastes until removal by the RSO.
3. Insurance that all radioactive waste materials are separated according to liquid, scintillation vials, or dry solid and half-life.
4. The generator will be responsible for accurately filling out the "Radioactive Waste Disposal Logsheet" form EHSRM-RSF-06.
  - a. The form details information needed for accurate disposal of the waste.
  - b. Each type of waste (physical state) will require a separate form.
4. Completion of all necessary paperwork prior to removal of wastes by the RSO.
5. The generator shall not at any time permit the disposal of radioactive material or radioactive waste into general waste pathways, other than trace amounts into the sanitary sewer system.
6. If one wishes to retain and re-use glassware containing radioactive material the following procedure shall be followed:
  - Pour off radioisotope(s) into an approved storage bottle.
  - Rinse and pour this into the waste storage bottle.
  - Repeat Step 2.
  - Further rinses may be placed in the sewer followed by an adequate dilution of tap water in a designated and labeled sink only.
7. Regardless of the frequency of disposal and the individual concentrations, the total activity disposed into the sewer by each individual Authorized User SHALL NOT EXCEED ONE  $\mu\text{Ci}$  PER DAY.

### C. Laboratory Waste Handling and Storage

1. The RSO will provide small sturdy cardboard boxes (i.e., 10"x10"x15") and 4 mil plastic bags for dry solid wastes and animals, and polyethylene carboys (1 to 5 gallons) for liquid waste. These containers shall be labeled with "radioactive material" labels.
2. Wastes will be separated by the generator and stored according to physical form (dry solid, animal, liquid, scintillation vials) and half-life (less than 88 days and greater than 88 days). Chemically hazardous wastes should be held to a minimum.
3. Wastes must be stored only in restricted areas where they can be secured against unauthorized removal.

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4. Liquid wastes shall be stored in unbreakable polyethylene carboys and provided double containment.
5. Aqueous liquid wastes shall be neutralized prior to deposition in a waste container to prevent any violent or hazardous chemical reactions.
6. Each laboratory having radioactive waste containers shall display a "radioactive waste" sign in the area designated for radioactive waste.
7. Any material that could cause puncture of the skin (i.e. syringe needles, broken glass, razor blades, etc.) shall be placed in puncture-resistant containers and labeled as such before placement into dry solid containers.
8. All animal carcasses and parts thereof containing radioactive material or contaminated with radioactive material shall be stored frozen.
9. Waste Records are required to assure that the radioisotopes and activities determined for the disposal purposes of each container are accurate. An inventory log sheet (developed by each Authorized User) or the radioisotope use form on or near waste receptacles is a practicable way to account for the contents. NOTE: It is the responsibility of the generator to keep an accurate isotope and activity log for each waste container. Routine pickups, inspections and record keeping audits by the RSO are used to evaluate a generators (Authorized User) waste management controls.

### D. Animal Carcasses and Waste

Dead animals containing radioactive material shall be prepared and stored frozen. The Authorized User is responsible for the storage (frozen) of the animals until such time that the RSO can arrange for animal disposal through a contracted radioactive waste broker or landfill disposal according to procedures accepted by TAC requirements.

### E. Waste Pickup

1. Contact the RSO for removal of radioactive waste from the laboratory. Contact may be made by either telephone (53616) or email at ehs@txstate.edu (in the subject line enter "Radwaste Pickup").
2. The generator (Authorized User) will complete a "Radioactive Material Disposal/Transfer" request form EHSRM-RSF-07 and will be responsible for accurately filling out the "Radioactive Waste Disposal Logsheet" form EHSRM-RSF-06.
  - a. The form details information needed for accurate disposal of the waste.
  - b. Each type of waste (physical state) will require a separate form.

**NOTE:**

Wastes will not be picked-up without these forms filled out completely and signed by the generator. It is the responsibility of the generator to indicate any known or suspected hazardous characteristics. This would include ignitability, corrosiveness, reactivity, toxicity, or other hazardous characteristics.

3. NO radioactive waste having bio-hazardous characteristics shall be released from a laboratory for pick-up prior to autoclaving or otherwise suitable deactivation of any infectious agent(s).

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## F. Disposal through Natural Decay

Long-term retention of short-lived radioactive material for the purpose of decay is authorized by the RSO on a case by case basis. After retention for a suitable time interval (ten half-lives), evaluate the remaining activity and properly document the evaluation. If the evaluation demonstrates that the activity(s) are below the "exempt quantities of concentrations" [reference 25 TAC §289.202(ggg)(2) – Table II], the RSO may authorize the disposal of the material as conventional waste, provided all radioactive material labels, symbols, etc. are removed and the waste contains no hazardous characteristics.

## G. Sanitary Sewer Disposal

1. Disposal of radioactive materials through the sanitary sewer is authorized by the RSO on a case by case basis.
2. All sanitary sewer disposals shall be in accordance with 25 TAC §289.202(gg). Furthermore, these disposals shall be made a part of the disposal records.
3. Any liquids containing radioactive material with hazardous characteristics will not be disposed of by this manner. These will be disposed of as mixed waste or hazardous waste.

## H. Other Disposal Information

1. The generator (Authorized User) is responsible, upon receipt of the isotope, for recording the use and recording the disposal of radioactive material on the Radioisotope Usage form (EHSRM-RSF-05).
2. The generator (Authorized User) shall maintain copies of all disposal forms with other required record keeping.
3. Tritium (H3) stored in a closed plastic bag will produce HTO and be released through the plastic. Tritium contaminated objects should be temporarily stored in an open tray pending placement in a waste disposal barrel.
4. Lids shall remain on all waste containers at all times.
5. Plans for proper disposal of infectious agents or highly toxic or hazardous substances shall be made early in the design stage of the experiment. Proposed procedures involving unusual waste disposal problems will be considered individually by RSO.
6. The RSO shall maintain proper disposal records for all Texas State University campus-wide radioactive waste disposals in accordance with the 25 TAC §289.202.
7. Bulk liquid waste that contains greater than or equal to 75% water, less than or equal to 15% methanol, less than or equal to 10% acetic acid, and a less than 88 day half-life radioisotopes (i.e., S-35 and P-32) may be stored and decayed. After the radioisotope component has decayed, the liquid may be tested for its hazardous characteristic and then disposed of accordingly.
8. Prior to removal or disposal of empty uncontaminated containers to unrestricted areas, ALL radiation labels, signs, tape, symbols, etc. indicating there was radioactivity in the waste shall be removed or defaced [reference 25 TAC §289.202(cc)(2)].

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## SECTION V - ADDITIONAL POLICIES AND PROCEDURES

### A. Use of Radioactive Materials

1. Posting of laboratories, areas, and equipment.
  - a. A "CAUTION RADIOACTIVE MATERIALS" sign must be conspicuously posted on the doors to laboratory areas where radioactive materials are being used or stored in accordance with 25 TAC §289.202(z) and §289.202(aa). The signs must not be removed from any room except by the RSO following a deactivation or termination inspection or survey.
  - b. Storage areas shall be conspicuously marked with a "CAUTION RADIOACTIVE MATERIALS" label.
  - c. A "CAUTION RADIATION AREA" sign(s) shall be posted for any area where radiation levels could result in an individual(s) to receive a dose equivalent in excess of 5 millirem in any one hour at 30 cm from a radiation source or surface from which radiation penetrates.
  - d. A "CAUTION HIGH RADIATION AREA" sign(s) shall be posted for any area where radiation levels could result in an individual(s) to receive a dose equivalent in excess of 100 millirems in any one hour at 30 cm from any source of radiation or from any surface from which radiation penetrates.
  - e. All equipment contaminated with radioactive material shall be marked with signs, decals, or other conspicuous means. Equipment labeled as contaminated SHALL NOT be removed for unrestricted use, disposal, or transfer as uncontaminated. Labeling will not be required of equipment used transiently in laboratory procedures during the presence of the user.
  - f. All radioactive refrigerators and freezers shall be posted with "Caution Radioactive Material" labels and "Food Must Not Be Stored In This Refrigerator" labels.
  - g. All signs needed for proper labeling of the laboratory are available from the RSO. All Authorized Users are responsible for equipment, source, and area labeling tape, as well as work area absorbent paper, and any other specialized signage needed.
2. Shielding of Sources
  - a. Radioactive sources or stock solutions in the laboratory shall be shielded in such a manner to keep exposures ALARA, never to exceed 100 mrem in any five consecutive days.
  - b. A beta shield will be required for procedures involving greater than 1 mCi of P-32.
  - c. Proper shielding materials shall be obtained by each Authorized User for their particular use so as to comply.
3. Aerosols, Dusts, and Gaseous Products
  - a. Procedures involving aerosols, dusts, or gaseous products, or procedures which might produce airborne contamination shall be conducted in an approved hood, dry box, or other approved closed system.
  - b. All releases from such systems into the work place shall not exceed 10% of the applicable annual limit on intake (ALI) listed in Columns 1 and 2 of Table I of 25 TAC §289.202(ggg)(2). However, when practical, traps should be incorporated to ensure that environmental releases are ALARA.

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- c. Radioactive gases or materials with radioactive gaseous products must be stored in gas tight containers and must be kept in areas having approved ventilation.
- d. Microcentrifuge tubes placed in heat blocks must be done within a hood if the activity of the isotope in the microcentrifuge tube is  $>20 \mu\text{Ci}$ . I.E., if there are 10 tubes per heat block, then the total activity must be  $\leq 20 \mu\text{Ci}$  for this procedure to be performed in the open.

### B Gas Chromatographs

1. Radioactive material in gas chromatography units (GC) shall be regulated the same as any other radioactive material at Texas State University.
2. In addition, each gas chromatograph containing a radioactive foil must have a label showing the radiation caution symbol with the words "Caution Radioactive Material", and the type and activity of the radioactive material.
3. The radioactive foil shall not be removed or transferred from its identifying cell or laboratory without prior RSO approval.
4. The Principal Investigator shall post the following notice on the outside of each gas chromatograph unit: "This equipment contains a radioactive source registered with the EHSRM Office. Notify the RSO before removing the source from this equipment or area, or upon change in area responsibility."
5. Individuals using radioactive material components in gas chromatography equipment should vent the cell exhaust through plastic tubing into a hood, or radiation safety approved trap to avoid contamination of work areas from the release of radioactive tagged samples introduced into the system.
6. The RSO will perform leak tests at the minimum of every 6 months, store radioactive foils, and maintain necessary records.

### C. Sealed Sources

Sealed sources of radioactive material, unless otherwise noted in this manual shall be tested for leakage of radiation on a semi-annual basis [reference 25 TAC §289.201(g)].

### D. Use of Hoods

1. Hoods used for radioactive work should be tested by the EHSRM Office to ensure the fume hood meets the minimum requirements for air velocity at the face of the hood.
2. Hoods should be checked at least annually for radioactive material contamination by performing a smear survey of the interior and if either P-32 or I-125 are used in the hood, a scan with a survey meter should be performed.
3. No more than 10 mCi of any volatile isotope should be used in a hood without first contacting the RSO.

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## E. Safety Procedures for Individual Users and Radiation Workers

Each individual user shall work under an Authorized User and SHALL use the following procedures to assure safety in the work environment and compliance with Texas State University radiation safety policies and practices.

1. ALL users of radiation sources SHALL fulfill Texas State University radiation safety training requirements PRIOR to using radiation sources.
2. Radiation exposure of all individuals shall be maintained ALARA.
3. The prescribed personnel monitoring devices (such as film badges and pocket dosimeters) SHALL BE WORN in radiation areas and while using radiation sources.
4. Personnel monitoring devices shall be protected from inadvertent exposure and damage and shall be returned to the Radiation Safety Officer as scheduled.
5. When working with unsealed radioactive material, the user's hands, shoes, clothing and body SHALL be surveyed for radioactive contamination at the conclusion of the work (Note: periodic surveys should be performed during operations using radioactive materials).
6. If radioactive contamination is detected on an individual's hands, shoes, clothing or body, the contamination will be removed before the individual is permitted to leave the restricted or laboratory area.
7. The following protective equipment shall be worn, and protective procedures followed, at all times when working with radiation sources:
  - a. Wear protective clothing, gloves, and (in some cases) shoe covers when working with unsealed radioactive materials;
  - b. Use protective barriers and shields whenever possible -- also protective eyewear;
  - c. Use mechanical devices (tongs, remote handling tools, etc.) to assist in reducing exposure;
  - d. Perform all work with radioactive materials within the confines of an approved fume hood or glove box – except where a safety review has determined it is safer to work in an open area;
  - e. PIPETTING BY MOUTH IS STRICTLY PROHIBITED when working with radioactive materials AND/OR with chemically and biologically hazardous substances; and
  - f. Respiratory protection may NOT be used as a safety function.

**NOTE:**

Procedures involving radioactive materials that rely on respiratory protection devices require specific approval from the Bureau of Radiation Control, Texas Department of State Health Services. Approval will require participating individuals to receive training in use of respiratory protective devices, passing a respiratory physical, and fit testing by the Risk Management and Safety Office.

8. Eating, drinking, smoking, applying makeup, etc. in radiation laboratories and areas where unsealed radioactive materials are stored or used is STRICTLY PROHIBITED.
9. Radiation use and storage areas SHALL NOT be used jointly for storage of radioactive material and material for human consumption.
10. Each user shall maintain good personnel hygiene and occupational safety habits (such as not working with radioactive material if there is a break, cut, scratch, etc. in the skin below the wrist and always washing hands and arms thoroughly before handling any object near the face).

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11. Areas where radioactive material and/or radiation producing equipment are used, shall be periodically surveyed and checked for contamination, excessive radiation levels (ionizing), and proper operation of all warning devices and interlocks according to the procedures required in this manual. Records of these surveys and checks shall be maintained for review and inspection by the Texas State University RSO and regulatory agencies.
12. Radiation use/storage areas, devices, and containers shall be periodically inspected for proper display of required warning signs and labels.
13. Each radiation use laboratory and work area:
  - a. Shall be maintained neat and clean;
  - b. Shall be free from unnecessary equipment and material;
  - c. Shall store and transfer/transport radioactive materials in a manner that prevents breakage or spillage (use double containers, for example);
  - d. Shall provide for adequate shielding;
  - e. Shall have work areas covered with absorbent material and/or stainless steel trays or pans to limit and collect spillage in case of accident.
  - f. Laboratory equipment (such as glassware), stock radioactive material, and radioactive waste, shall be labeled and isolated appropriate storage facilities. Equipment that has been used in work with unsealed radioactive materials shall not be used for other work and shall not be sent from the area to central cleaning facilities, repair shops, or to surplus, until it has been demonstrated and certified by the RSO to be free of radioactive contamination.
14. Emergency repair of contaminated equipment by shop personnel or by commercial service contractors will not be performed except under the direct supervision of the RSO or his/her designee. Timely requests for such supervision shall be made to the RSO to allow for scheduling.
15. A member of the laboratory staff shall be present to provide specific information when service personnel are permitted to work on equipment in radiation areas.
16. Each user/individual SHALL:
  - a. IMMEDIATELY REPORT accidental exposure, inhalation, ingestion, or injury involving radioactive materials to his/her supervisor AND to the RSO;
  - b. IMMEDIATELY conduct the required/recommended corrective measures and procedures – unless otherwise directed by the RSO. The individual(s) shall cooperate in any and all attempts to evaluate his/her exposure.
  - c. Perform emergency decontamination procedures, when required or necessary, and take the necessary precautions to prevent the spread of contamination to other areas and equipment.
  - d. Comply with requests from the RSO for bioassays, body burden measurements and/or the submission of urine samples for internal radio assay.

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## F. General Laboratory Radiation Safety Rules

The following rules are to be used with the ALARA concept in mind. The Texas State University Radiation Safety Manual, in addition to the state and federal regulations and guidelines, are minimal requirements that are designed to enable ALARA controls and keep exposures well under the maximum limits. This list should be posted conspicuously in each laboratory area:

1. NO PIPETTING BY MOUTH
2. No open toed shoes (i.e. sandals, flip-flops, etc.) in radioactive material laboratories.
3. Wear appropriate protective clothing.
3. All radioactive material containers must be labeled as to isotope, activity, and date.
4. NO eating, drinking, smoking, food storage, application of cosmetics, or food preparation in radiation labs.
5. Place radioactive-waste in appropriately labeled waste receptacles.
6. NEVER mix different forms of radioactive-wastes.
7. Remove protective clothing and gloves before leaving radiation lab.
8. Monitor hands, shoes, and clothing before leaving radiation lab.
9. Personnel exposures shall be kept ALARA by using time, distance, and shielding calculations.
10. Use the fume hood when needed.
11. Perform all required surveys and safety checks.
12. All spills and accidents must be reported immediately to the RSO. If you are unsure as to the proper course of action to take in any given situation, always consult your supervisor or call the RSO (512) 245-3616.

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## SECTION VI – X-RAY DEVICE SAFETY PROGRAM

### Introduction

This section will outline policies and procedures for radiation producing equipment. The equipment referred to will be analytical X-Ray equipment, research accelerators, and other ionizing radiation producing equipment. These policies and procedures, established with the utmost concern for ALARA, are in addition to Texas Regulations for Control of Radiation Parts 34, 35, and other applicable regulations.

**NOTE:**

The Student Health Center is not required to adhere to the requirements of this section. SHC is a separate entity within Texas State University. The SHC is duly registered with the Department of State Health Services, Bureau of Radiation Control with a separate Certificate of Registration for radiation producing machines.

### A. Registration

1. The Texas Regulations for Control of Radiation require that radiation producing machines be registered with the Bureau of Radiation Control, Texas Department of State Health Services.
2. Registration of proposed devices must be conducted through the RSO.

### B. Personnel Protection

1. Personnel Monitoring: If required, all operating personnel and personnel in the immediate area shall wear a film badge or other personnel monitoring device, as supplied by the RSO.
2. Personnel Safety - Personnel specifically responsible for such equipment shall:
  - a. Used or to be used;
  - b. Ensure that all rules and regulations (Texas State University, federal, state and local) have been implemented and are followed; and
  - c. Ensure that all users have attended the Texas State University Radiation Safety Course (given by the RSO) for radiation producing equipment prior to using the radiation producing equipment.
  - d. Complete the required training as per EHSRM-RSF-09 "Analytical X-Ray Operator Qualifications" and forward completed document to the RSO.

### C. Facilities Posting and Labeling

1. Areas: Areas in which radiation producing equipment are located or are being used shall be posted with a standard "CAUTION – X-RAY RADIATION" sign.
2. Devices: The controls of each radiation producing device shall bear a label or decal with the statement: "CAUTION RADIATION - THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED." Signs, labels and decals are available from the RSO.

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## D. Radiation Surveys And Record Keeping Requirements

1. Record of Operation: A logbook and a copy of the operating procedures (for that particular instrument or area) shall be attached to each instrument or near the control panel.
2. Radiation surveys:
  - a. Radiation surveys will be conducted after every change that might increase radiation exposure hazard.
    - Following any change in initial arrangement, number, or type of local component.
    - Following maintenance requiring disassembly or removal of a local component.
    - During maintenance and alignment if the primary X-Ray beam is present when any local component is disassembled or removed.
    - Visual inspections reveal abnormal conditions.
    - Individual monitoring devices show a significant increase over previous monitoring period.
  - b. The results of each radiation survey shall be recorded in the log book.
  - c. Radiation surveys shall be performed using only the appropriate instrument.
3. Interlocks, visual and audible warning devices, and shutter mechanism checks shall be conducted at the same time as the radiation surveys and the results shall be recorded in the log book.
4. Log book: Each log book (record) shall contain the following information:
  - a. Users log (user, date, start, finish, power settings)
  - b. Survey Records (date, surveyor, instrument used, drawing or photograph of instrument/area, particular area surveyed, and results of the survey recorded in proper units.
  - c. Safety device records (date, surveyor, drawing or detailed photograph of the instrument - indicating the location of the safety devices, results of the checks as to whether the devices were Operative (O) or Inoperative (IO).
5. Written Safety Procedures:
  - a. Safety and Operating Procedures shall be written and updated as changes in that particular instrument or area warrant the need for revision.
  - b. The written safety and operating procedures shall be available to all users.
6. Personal Safety Devices:
  - a. Personal safety devices such as a lead apron or lead thyroid shield shall be identified and inspected on an annual basis. These devices are commonly used with Open Beam X-ray devices.
  - b. These devices shall be inspected and documented in accordance with the Lead Apron Policy.

## E. Radiation Safety Officer Requirements

1. A radiation survey of all radiation producing devices shall be conducted on a 12 month interval by the RSO.
2. All interlocks, visual and audible warning devices, and shutter mechanisms shall be inspected for proper operation on a 12 month interval by the RSO.

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## F. Additional Rules And Requirements

1. The RSO, may require additional safety devices or procedures (beyond the minimum TAC requirements) to ensure conformance with ALARA. The following criteria will be used to determine the need for additional safety devices or procedures:
  - a. The number of persons involved with the use of the x-ray producing devices.
  - b. The need to reduce the chance of any unneeded exposures.
  - c. The amount of personnel traffic in and out of the lab.
  - d. The age of the x-ray producing devices.
  - e. The current safety devices in use.
  - f. Number of x-ray producing devices located in a single area.
  - g. Previous compliance during local and state inspections.
  - h. Previous exposure reports.
2. The structural shielding requirements of any new installation, or an existing one in which changes are contemplated, shall be reviewed with the RSO.
3. No person shall be permitted to operate radiation-producing equipment in any manner other than specified in the procedures unless such person has obtained written permission from the RSO.
4. No person shall bypass a safety device unless such person has obtained written permission from the.
5. All log books and current Operating Procedures shall be readily available to each radiation-producing device or near the control panel.
6. Each Authorized X-Ray User must maintain portable radiation monitoring device(s) capable and calibrated for the measurement of X-Ray radiation in beams of a small cross-section.
7. The local components of any radiation producing equipment system shall be located and arranged and shall include sufficient shielding or access control such that no radiation levels exist in any area surrounding the local component group which could result in a dose to any individual present therein in excess of the dose limits given in this manual. These levels shall be met at any power rating.
8. The RSO must be notified in advance of the procurement, transfer, or donation (received or given) of ALL radiation producing equipment.
9. Radiation producing equipment transferred within Texas State University must be coordinated with the RSO.
10. The RSO shall be notified of any instrument taken out of use and placed into storage or prior to disposal.

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## SECTION VII - EMERGENCY PROCEDURES

### Introduction

This section outlines basic emergency procedures. An emergency situation or accident can arise from the use, storage, or transfer of radioactive material or from the misuse or abuse of equipment that produces X-Ray radiation or other forms of ionizing radiation. This section is intended to enhance each Authorized User, Authorized X-Ray User, and worker's ability to react properly to radiation accidents.

Due to the broad scope of possible accidents at Texas State University, listing every step that must be followed for each type of accident would be impracticable. Instead, one must use the following basic procedures and apply them to his/her individual situation. The best advice for protection against radiation accidents is to prepare for them.

### A. General Information

A radiation incident at Texas State University should be defined as any unintentional accident or any single exposure or suspected exposure in excess of 45% of the maximum allowable exposure as set forth in 25 TAC §289.202, the ingestion of radioactive material in the form of liquid, gas, or dust in excess of limits set forth in 25 TAC §289.202(ggg)(2), any radioactive material spill regardless of activity and size.

#### NOTE:

If persons involved in a radiation incident are unsure as to the extent of exposure, ingestion, or magnitude of the spill, those persons shall proceed with the assumption that an overexposure (internally or externally) or major spill has occurred, unless otherwise noted. Users will report all radiation incidents.

### B. Organization and Authority

1. The RSO shall have responsibility for incident investigation.
2. The RSO will promptly report all investigation findings to the Texas DSHS [reference 25 TAC §289.202(xx)] for direction and action.
3. If preliminary findings of an incident indicate there is probable cause of neglect or violation of state, federal, or local regulations or policies, the Authorized User involved will be asked to answer questions and present his/her account of the incident.
4. In the event of a major emergency situation the RSO shall have the authority to bring the situation under control. It should be noted that this may not follow the Texas State University Policies and Procedures Statements. However, this will only be used in extreme emergencies where this is immediate radiological danger to individual(s) or possible major building contamination.
5. It is the responsibility of each Authorized User to see that personnel working under their supervision have practical and easily understood plans for an emergency, and control of an emergency in their respective laboratory.
6. The RSO has the responsibility to see that each radiation Authorized User/worker knows how to:
  - a. Recognize a radiation emergency.
  - b. Prevent or confine the accident.
  - c. Exclude all personnel from possible risk of exposure.
  - d. Immediately contact his/her supervisor, the RSO, and/or other emergency personnel for assistance.

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7. Each Authorized User will be responsible for assisting the RSO in controlling and/or investigating the accident. Furthermore, the Authorized User is responsible for assisting the victim(s) in obtaining medical attention, if necessary, as soon as practicable.

## C. Fires, Explosions, or Major Emergencies

1. Notify all persons in the area to leave at once.
2. Notify the Texas State University Police Department and the RSO as well as other supervisory personnel. Give them the address and the location of the fire.
3. If firefighters arrive before the RSO, caution them that radioactive material is present in the area. Be ready to advise them on location, isotope(s), activity(s), type of storage, and any other information that may be needed to avoid radioactive contamination of personnel, building, or equipment.
4. The Authorized User and/or workers will need to be available to evaluate or help evaluate the extent of damage to radioactive material and/or survey emergency personnel and equipment for radioactive material contamination.
5. All Authorized Users and workers will be required to file an incident report with the RSO.
6. MINOR FIRES - If the fire is minor (individual decision) and there are no radiation or chemical hazards involved, a Authorized User or worker may attempt to put out the fire with approved firefighting equipment.

## D. Accidents Involving Possible Radiation Overexposure

If a radiation overexposure has occurred, or is suspected to have occurred, proceed as follows:

1. Immediately remove affected person(s) from the area and notify the RSO.
2. Secure the area.
3. Take the affected persons(s) to the nearest emergency center immediately for clinical observation. Be sure to inform the attending medical personnel that it is a radiation accident. Be prepared to answer any questions that may arise concerning the accident or type of radiation involved.
4. Assist the RSO in obtaining all details of the incident.
5. The RSO will obtain the dosimetry readings of all involved person(s). The RSO will then forward the dosimetry readings for emergency processing.
6. Persons involved in the incident will not be permitted to work with radiological materials until exposure results have been received and the RSO has determined that exposure limits have not been exceeded.
7. The RSO will provide reports to the Texas DSHS and regulatory agencies.

## E. Accidents Involving Significant Releases of Radioactive Materials

1. Notify all other persons in the area of the accident.
2. If possible, hold breath and close all air vents.
3. Vacate the room and seal off the area, if possible.
4. Notify the RSO immediately.
5. Secure access to the area.
6. Monitor all involved persons for contamination.
7. Assist and/or submit to any bioassay deemed necessary by the RSO or the Texas DSHS.
8. Assist the RSO in hazard evaluations and decontamination procedure.

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## F. Personnel Injuries

Persons should not work with uncontained radioactive material when they have a break in the skin (cut, scrape, etc.) below the wrist. If a person is cut by an article contaminated with radioactive material the following should be used as a guide:

1. Cleanse the wound immediately by placing it under running water. If possible, retain any cotton balls, paper towels, fluids, etc. for radiological analysis. Contact the RSO as soon as practical.
2. If necessary take the person(s) for emergency treatment. Be sure to tell the attending medical personnel that radioactive material was involved in the accident.
3. Follow the necessary steps in Item D of this section, under the direction of the RSO.
4. Contact the RSO before proceeding with more severe methods of decontamination.

## G. Policies for Radioactive Spills

1. Minor Spills (i.e. at the microcurie level)
  - a. Notify other persons in the laboratory and minimize radioactive material ingestion, inhalation, etc.
  - b. Prevent the spread of contamination of the accident.
  - c. Contact the RSO.
  - d. Survey all persons involved, decontaminate if necessary, and release unneeded persons.
  - e. Begin decontamination procedures.
  - f. Submit incident report to the RSO.
2. Major Spills
  - a. Notify all persons in the laboratory and minimize radioactive material ingestion, inhalation, etc.
  - b. Prevent the spread of contamination of the accident.
  - c. Contact the RSO.
  - d. If possible, block all air vents to avoid creation of airborne contamination.
  - e. Vacate the laboratory and avoid spreading the contamination.
  - f. Survey all persons involved, and decontaminate if necessary. Do not release persons directly involved, except for emergency medical treatment. Wait for the RSO to authorize release.
  - g. If deemed necessary by the RSO specific steps in Items D, E., or F. of this section may need to be initiated.

## H. Loss or Theft of Radiation Equipment

1. Any loss or theft of radioactive material, a device containing radioactive material, or a radiation-producing device, shall be immediately reported to the RSO.
2. The RSO will provide required notification to the Texas DSHS.
3. The RSO will determine the extent of damage and analyze the recovery plan.

### NOTE

Repair of any encapsulated radioactive material source IS PROHIBITED. Radiation sources involved in an accident, fire, flood, etc. MAY NOT BE USED until tested by the RSO and found to be in proper and safe operating condition.

# RADIATION SAFETY MANUAL

## I. Malfunction of Radiation Producing Equipment

1. Any radiation device (X-Ray, etc.) believed to be defective shall be locked into a safe position and made inoperative immediately. In emergency situations the individual user, authorized user, and/or the RSO can take such action as to shield the source, deactivate the equipment, or retrieve the source.
2. The responsible user must restrict access to the area until the RSO arrives.
3. The RSO will evaluate the incident thoroughly, and if necessary report the incident to the AGENCY within 30 days.

## J. Vehicle Accident During RAM Transportation

If a vehicle accident occurs during the transportation of radioactive material and there are no fires or injuries the following procedure should be used:

1. If a minor accident and it can be visually determined that the radioactive material is safely stored in its DOT container then no restricted area is required, otherwise establish a safe perimeter around the source assuming the radioactive material is in an exposed position.
2. If a survey meter is available, and no radiation hazard exists, and the vehicle is movable, proceed to destination after release by law enforcement (if applicable).
3. If the source cannot be found, does not appear to be safe, vehicle is not moveable, etc. have a responsible person notify the RSO and/or the AGENCY as well as local emergency services. Proceed to isolate the vehicle and area.
4. Other parts of the emergency procedures may need to be instituted before the RSO or emergency personnel arrive.

## K. Reporting of Radiation Incidents

1. IT IS THE RESPONSIBILITY OF THE AUTHORIZED USER to report all incidents involving radioactive materials or radiation producing equipment in his/her approved facilities to RSO, by telephone, as soon as practicable. In addition, he/she must also report all incidents involving his/her radioactive materials or radiation producing equipment that may occur outside his/her approved facilities.

# RADIATION SAFETY MANUAL

## SECTION VIII –SURVEY GUIDELINES

### A. Radiation Levels Surveys

1. General Information - There are several types of radiation detection equipment for monitoring areas that are subjected to radioactive contamination, monitoring radiation producing equipment, and sealed sources of radioactive material. Each type is best suited for a particular application and should be used in conjunction with one another. The most common type is the GM survey rate meter, which is used for monitoring low-level radiation areas (most common in radioactive material labs). For high-level areas, accelerators, analytical x-ray instruments, etc. an ion chamber type is recommended over the GM survey rate meter type. It has two basic, yet important advantages: higher radiation levels can be measured (up to 5,000 mR/hr or more); also, it will not saturate in high radiation fields. That is GM tube type meter may saturate and read zero - when exposed to high radiation levels. Therefore, personnel could be subjected to dangerously high radiation levels in belief that no radiation hazard existed.

**Note:**

Survey rate-meters are required in all installations using radioactive material or radiation producing equipment.

2. Survey Information – Because a direct radiation survey is time consuming if properly done; a preliminary evaluation should be performed. A properly calibrated survey meter (GM or scintillator as appropriate) with audible signal should be used. Be sure the survey meter has a range capable reading the radiation fields that are most commonly encountered in that particular area. In other words make sure the meter will not zero out as described above.
3. Performing a Survey
  - a. First find a radiation free area or make sure that all radiation producing equipment is turned off or not generating x-rays; then with the meter on its lowest scale take a general or average background reading (usually 0.01 - 0.05 mR/hr or 0 - 150 cpm in clean areas); this reading should be recorded on the survey map or in the log book.
  - b. While listening for changes in the audible output signal the individual conducting the survey will perform a thorough scan of all areas within the area covered by the survey map and/or equipment involved. Any area indicating an average reading of more than 3 times the recorded average background reading will be marked on the survey map. If there are no areas where direct radiation levels exceed 3 times background, direct radiation levels may be recorded as "0.1 mR/hr" unless this level (0.1) exceeds recorded background. Then the actual levels should be recorded.
  - c. The surveyor will immediately re-measure areas where readings were greater than 3 times recorded background to identify excessive radiation levels. This survey should be conducted with an ion-chamber type instrument; the reading properly recorded on the map or in the logbook (i.e. mR/hr, cpm, etc.).

**NOTE**

Survey meters require annual calibration. Contact the RSO if your meter has not been calibrated within the past year. There should be a calibration sticker attached to the meter indicating the last calibration and the due date for the next one.

3. Results/Reporting – Record all results in the proper units (mR/hr and/or cpm) in your logbook or on the survey map. If surveys show areas that are greater than 2 mR/hr for radioactive material laboratories contact the RSO. For radiation producing equipment surveys that indicate areas more than 3 times the normal recorded reading.

**NOTE**

In general it is very hard to put exact numbers on excessive levels(readings) since much of the older analytical x-ray equipment will have radiation levels that are relatively high compared to most radioactive material use areas or the newer closed beam analytical x-ray equipment. However, if there is ever a question concerning the radiation levels around a particular instrument or area call the RSO immediately.

## B. Surface Contamination Surveys (i.e. Smear/Swipe Survey)

1. General Information - the routine monitoring for radioactive contamination in radioactive material laboratories is a necessary and required part of the radiation safety program at Texas State University. Failure to control surface contamination may cause unnecessary internal or external radiation exposure to individuals, costly decontamination of equipment, laboratories or buildings and/or the loss of equipment, laboratories or building, if gross contamination were found and could not be decontaminated to acceptable levels. Generally, the primary concern is to avoid internal exposure resulting from the intake of loose radioactive material via inhalation, ingestion, or skin absorption. However, external radiation levels from radioactive contamination may at times be hazardous. Another major concern is limiting contamination to areas or equipment where it can be controlled or properly disposed and/or maintaining levels of contamination at/or below acceptable levels listed in 25 TAC §289.202(ggg)(6).
  - a. Removable Contamination - Is that fraction of contamination present on a surface that can be transferred to a smear test paper by rubbing with moderate pressure.
  - b. Fixed Contamination - Is generally defined as radioactivity remaining on a surface after repeated decontamination efforts have failed to significantly reduce the contamination level.
  - c. Equipment - Instrument used in surface contamination surveys should be sufficiently sensitive to detect the nuclides being monitored. Also uniform methods of collecting and analyzing these smears should be used over extended periods of time in order to evaluate trends.
  - d. The equipment used to count (analyze) the smear samples shall be properly calibrated, maintained, and shall be capable of detecting the radiation from the smears.

EXAMPLE - Smears of H-3, C-14, S-35, or other beta emitters should be analyzed with a liquid scintillation counter or internal proportional counters.
  - e. Method - The methodology in conducting smear tests varies greatly from institution to institution, from researcher to researcher, and from individual to individual. Keeping this in mind the following is a general guideline for smear testing.
    - 1) The purpose is to find ANY contamination that might be present. Continual, aggressive monitoring will almost always give the surveyor confidence in certifying his/her area is CLEAN.

- 2) Prepare for the survey by; looking over previous survey records; find out what radiation sources are in the lab; identify problem areas (fume hoods, radiological sinks); identify previous problem areas.
- 3) The next step in the smear process is to obtain a map (diagram) of the area or sketch it out on a piece of paper.

NOTE -This should only have to be done on a first survey only: after that a good diagram should be kept on file, unless the physical layout of the area significantly changes.

- 4) When needed the diagram may be replaced or written on to include a detailed list of specialized items or equipment surveyed. In addition to this the surveyor might find it beneficial to specify key areas on the diagram that are smear tested at each survey.
- 5) Before beginning the surveyor should prepare him/herself with the proper equipment to conduct a routine survey: smear paper (Whatman 4.25 cm #1 or equivalent) , rubber gloves, diagram, writing instruments, vials or some other apparatus to prevent cross-contamination of the smears.
- 6) CAUTION - The surveyor should mentally and physically go about his/her survey in a method that would prevent the unnecessary spread of contamination. What this means is to start in the "coldest" area (least area of probable contamination) and progressively proceed to areas of greater probable contamination.
- 7) If the surveyor is conducting a survey in his/her own area or in another the following questions might be asked of him/herself or the lab workers to get a better idea of where to smear and how many smears should be taken:
  - a) What isotopes have been used since the last survey?
  - b) Where are/were they used?
  - c) Where are they stored?
  - d) Where is the waste stored?
  - e) Have there been any contamination problems in surveys conducted by the lab personnel?
- 8) The surveyor then decides on a representative sampling of the area (i.e. where and how many) usually based on three areas of input: individual idiosyncrasies, materials and processing, and traffic patterns.
- 9) Idiosyncrasies - Look for information regarding habits and misplaced items around the lab; foot marks on the desks, misplaced books and equipment, etc.
- 10) Materials - Look for changes in work areas, changes in previously recorded storage location, or waste storage areas, non-radioactive use of storage containers, etc.
- 11) Traffic - Look for high traffic areas. Particularly worn areas on the floor, high use equipment, floors near a desk, phone, sink, hood, etc, etc.
- 12) Where to Smear; Where Not to Smear - Probably the biggest problem associated with smear surveys is "what is proper to smear and what is not". Many manuals and institutions are very vague about this, but few good points to remember are:
  - a) Areas of known contamination need not be smeared. This does not mean anything can be treated as contaminated. It is for certain hood trays, absorbent paper, or other equipment which is frequently used for radioactive material work and which is CLEARLY marked with standard caution signs, and stickers.

**NOTE:**  
 These items SHALL be decontaminated or disposed of after the experiment or use and BEFORE deactivation or termination of the Authorized User.

b) Some DO'S and DON'TS

<ul style="list-style-type: none"> <li>• DON'T smear the inside of a working or holding tray.</li> </ul>	<ul style="list-style-type: none"> <li>• DO smear: the counter around the tray, the floor around and/or below the tray, and the walls around the tray.</li> </ul>
<ul style="list-style-type: none"> <li>• DON'T smear used vials or lab ware containing radioactive material.</li> </ul>	<ul style="list-style-type: none"> <li>• DO smear: surfaces where the vials were placed, rings on surfaces where the containers may have been located.</li> </ul>
<ul style="list-style-type: none"> <li>• DON'T smear the inside of radiological waste containers.</li> </ul>	<ul style="list-style-type: none"> <li>• DO smear: the exterior of the container and any suspicious looking streaks, the floor or countertop around the container, and walls or vertical areas near the container.</li> </ul>

c) Other Items and Special Areas to Pay Attention to:

- Telephone;
  - Doorknobs;
  - Refrigerators/freezers (inside; shelves, bottom, shelf guards. outside; flat tops, suspicious streaks, handles, locks);
  - Base cabinet doors (inside and outside);
  - Drawers - inside (where contaminated equipment may have been placed);
  - Instruments - knobs, on-off switches, keyboards, etc;
  - Floors - entrances, near hoods, refrigerators/freezers, sinks, work stations, worn areas; and
  - Any area where equipment has been moved from -walls, floors, etc.
- f. Taking the Smear - Here is the second problem associated with the smear surveys "What constitutes a smear or swipe?". Fundamentally the surveyor applies (using rubber gloves) moderate pressure to the back of the smear and rubs it over the surface to be surveyed (some surveyors like to use a No. 8 or No. 10 rubber stopper) usually no more than 100 cm<sup>2</sup> or 16 square inches. Most institutions advocate an "S" motion of about 12-16 inches on a large open surface (eg, walls, floors, countertops, etc). The smear is then placed either in separate vials or something to prevent cross contamination. It is a good idea to change gloves periodically to prevent cross contamination from the gloves.

- g. The smears are then transported to a counter capable of monitoring the radiation surveyed.
2. Frequency of Surveys
  - a. General Information- The frequency of surveys depends on the nature, quantity, and use of radioactive material as well as equipment and procedures that are designed to protect the workers from unnecessary exposure. Routine surveys are necessary to control the containment of radioactive material within specified areas and to ensure the reliability of protective equipment, containers and procedures. For any process involving any type of "loose" radioactive material (i.e. gas, liquid, finely divided form) the surveys shall be designed to monitor the containment and control of radioactive material involved.
    - 1) Frequency - Surveys should be performed in direct proportion to isotope use.
    - 2) Refer to Section III.D.3 (page 19) for required frequency and recommended survey method.
3. Records of Surveys
  - a. Records shall be maintained either in logbooks or on special forms as long as they are clear, legible, understandable, and reviewed by authorized individuals.
  - b. Maintain the following information in the logbook or on a special form:
    - date of survey
    - counts per minute
    - diagram of laboratory
    - smear location
    - machine copy of results
    - dpm or standard reference source count
  - c. Each batch of survey samples should include a standard reference source and a background sample count.
  - d. Refer to 25 TAC §289.202(ggg)(6) for contamination action levels and release limits.

## C. Decontamination Procedures

There are many different methods of decontamination procedures depending on the isotope and activity, items or material contaminated, and other influencing circumstances. One must also consider the amount of waste to be generated in decontamination and whether the decontamination is cost effective.

1. Preoperational Decontamination Procedure
  - a. Contact the RSO.
  - b. Plan the decontamination operation thoroughly and obtain adequate supplies.
  - c. Provide adequate protection for all personnel involved in the decontamination process. If necessary be prepared to allow for replacement personnel.
  - d. Provide for storage of all radioactive wastes and decontamination supplies.
2. Operational Decontamination Procedure
  - a. Always work toward center of contaminated area.
  - b. Monitor frequently.
  - c. Cover clean areas to avoid recontamination of the area.
  - d. Monitor all personnel involved before allowing them to proceed to clean areas or leave the laboratory.
3. Post-Operational Decontamination Procedure
  - a. Monitor all cleaning supplies and equipment before release.
  - b. Use proper disposal procedures for all radioactive wastes.

4. General Procedures for Handling Minor Spills
  - a. Put on extra gloves and protective clothing to prevent unneeded personnel contamination.
  - b. Monitor all persons first to ensure he/she is not contaminated as a result of the accident.
  - c. Drop absorbent paper, cloth or other suitable containment material on or around spill to limit the spread of contamination.
  - d. Monitor and mark off the contaminated area. DO NOT let any person out of the laboratory without being monitored. It is a good idea to assign monitoring responsibilities to one person.
  - e. Using normal cleaning agents, proceed from the outermost edges of the contained area inwards, systematically reducing the contaminated area.
  - f. Keep cleaning supplies to a minimum needed to do the job and place into sealed bags after use.
  - g. Put all contaminated objects and material into proper waste containers. If the above method does not work after 3 or 4 tries, contact the RSO before proceeding to more extreme methods of decontamination.
5. Personnel Contamination
  - a. Prompt removal of surface contamination is necessary to prevent possible transfer of radioactivity to internal organs by ingestion, absorption, through wounds, cuts, or abrasions, and also to prevent possible radiation overexposure of the skin. It is imperative that the methods used to effect decontamination should not spread initially localized material or assist the contaminant in entering the body. Report personnel contamination to the RSO at once.
  - b. Decontamination of an open wound shall only be accomplished by a physician. **WARNING - AVOID THE USE OF HIGHLY ALKALINE SOAPS** (may result in the fixation of radioactive material) or **ORGANIC SOLVENTS** (may increase skin penetration of radioactive material).
  - c. The following procedures have been used for removal of a wide variety of contaminants from personnel. (More drastic methods must be performed only under medical supervision.)
    - 1) Remove contaminated clothing and place it in a suitable container.
    - 2) Monitor the person carefully to determine the level and location of contamination.
    - 3) Decontaminate in the following manner:
      - a) Unless a large amount of radioactivity is involved (millicuries), carefully rinsing the affected area with running water in a sink may be the most rapid and effective way of rapidly removing contamination, preventing possible absorption through the skin.
      - b) For solid contamination, if possible, use masking or adhesive tape to remove loosely attached contamination. Often most of the contamination can be removed in this manner without risk of spreading the material or dissolving it into the skin, as can happen with the use of solvents.
      - c) If the above methods fail, cleanse the contaminated areas with mild detergent and water -- giving special attention to hair and fingernails.

**NOTE:**

If the contamination is localized, it is often more practical to mask off the affected area before risking the danger of spreading the contamination by general washing.

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- 4) If the procedures outlined above fail to remove the contaminants, soft brushes may be used for cleansing.
- 5) Use copious amounts of water. However, use caution to avoid contaminating minor cuts or breaks in the skin.
- 6) Where readily available, special (dry) hand cleansers may facilitate decontamination.
- 7) Apply hand cream or lanolin to the areas to prevent chapping.

**NOTE:**

If contamination is at a wound site, medical personnel should monitor or perform the cleansing of the wound area. REMEMBER - If your initial efforts at decontamination DO NOT produce encouraging results; cover the contaminated area and seek the proper assistance.