

Radioactive Materials License Commitments

for

The University of Texas at Austin

May 2009

July 2009

October 2009

February 2010

May 2010

August 2010

July 2013

October 2013

April 2016

FOREWORD

RADIATION SAFETY is the responsibility of all persons (faculty, students, researchers, etc.) who are directly or indirectly involved in the use of radioactive materials.

In July 1963, the State of Texas granted The University of Texas at Austin a broad radioactive materials license for research, development and instruction. While this means a minimum of controls by the state, it requires that the University establish and pursue an effective Radiation Safety Program. The Radiation Safety Committee is responsible for The University's radiation control program outlined in this manual.

The use of radioactive materials 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 for the protection of The University and the safety of members of the university community.

It is the responsibility of all persons involved in radioactive material work to familiarize themselves thoroughly with the University's radiation control program and to comply with its requirements and all applicable federal and state regulations. I hope you will always keep in mind that radiation safety depends on a continuous awareness of potential hazards and on the acceptance of no short cuts toward the achievement of negligible radiation exposures.

NOTICE

In the event that existing or future federal, state, or local regulations are found to differ from the requirements contained in this document, those legally accepted regulations shall supersede this document.

This document has been approved by the Texas Department of State Health Services during the renewal of the University's radioactive materials license and replaces all previous such documents.

TABLE OF CONTENTS

FOREWORD	i
NOTICE.....	ii
TABLE OF CONTENTS.....	iii
I. ADMINISTRATION.....	1
A. RADIATION SAFETY COMMITTEE COMPOSITION.....	1
B. COMMITTEE CHARTER.....	1
C. MEMBERS	2
D. RADIATION SAFETY OFFICER	2
II. FACILITIES AND EQUIPMENT.....	4
A. GENERAL	4
B. RADIOACTIVE MATERIALS.....	4
C. CESIUM-137 IRRADIATOR.....	4
III. OPERATIONAL PROCEDURES.....	5
A. GENERAL	5
B. RADIOACTIVE MATERIALS.....	5
C. LABORATORY SURVEYS AND INSPECTIONS	9
D. VIOLATIONS OF REGULATIONS.....	12
IV. RADIOACTIVE MATERIAL ACCOUNTABILITY	13
A. APPLICATION FOR AUTHORIZATION TO USE RADIOACTIVE MATERIALS	13
B. PURCHASING	13
C. SHIPPING.....	14
D. RECEIVING	14
E. STORING AND POSTING.....	16
F. INVENTORIES.....	17
V. INSTRUMENTATION	18
A. GENERAL	18
B. INSTRUMENTS AND DETECTORS	18
C. INSTRUMENT CALIBRATION METHODS.....	18
D. INSTRUMENT TYPE FOR USE.....	18
VI. TESTS AND RECORDS	20
A. GENERAL	20
B. LEAK TESTS.....	20
C. INTERNAL INSPECTIONS	21
D. RADIOACTIVE WASTE DISPOSAL.....	21
E. INVENTORIES.....	21
F. DOSIMETRY AND REPORTS	22
G. BIOASSAY PROGRAM ¹²⁵ I and ¹³¹ I.....	23
H. PROGRAM AUDITS.....	26
I. RADIATION WORKER TRAINING	26
J. BIOASSAY PROGRAM (³ H) TRITIUM.....	28
VII. DISPOSAL OF RADIOACTIVE WASTE.....	33

A. GENERAL	33
B. DRY SOLIDS.....	34
C. LIQUID SCINTILLATION VIALS	34
D. SHARPS.....	34
E. SEALED SOURCES.....	35
F. SPECIFIC EXCESS MATERIALS AND SEPARATION AND DISPOSAL.....	35
G. ANIMAL TISSUE AND CARCASSES.....	38
H. RELEASE INTO THE ATMOSPHERE	38
I. RECORDS.....	38
VIII. EMERGENCY PROCEDURES.....	40
A. GENERAL	40
B. SPILLS OF RADIOACTIVE MATERIALS.....	40
C. EMERGENCY NOTIFICATION.....	43
D. EMERGENCY PHONE NUMBERS	44
APPENDIX I – Radiation Safety Committee Membership Roster	45
APPENDIX II – Procedure for Remote Site Use of Radioactive Materials.....	46
APPENDIX III –Procedure for Calibration of Radiation Survey Meters.....	48
APPENDIX IV – Bioassay Program Procedures.....	49
APPENDIX V – Radioactive Material Laboratory Audit Form.....	51
APPENDIX VI – Application to Use Radioactive Material.....	54
APPENDIX VII - Procedures for Laboratory Animal and Veterinary Medicine Uses	59
APPENDIX VIII - Sealed Source Inventory	61
APPENDIX IX - Periodic Intervals.....	64

License Commitments

for
The University of Texas at Austin

I. ADMINISTRATION

A. RADIATION SAFETY COMMITTEE COMPOSITION

The Radiation Safety Committee (the “Committee”) of The University of Texas at Austin (the “University”) shall be composed of a Chair and at least four additional members. The Committee and Chair shall be appointed by the President of the University or the President’s delegate. The Committee shall include at a minimum a representative from Executive Management with signature authority to commit University resources, three persons who are radioactive material Authorized Users at the University, and such other members as deemed appropriate. The Radiation Safety Officer shall be an ex-officio member of the Committee.

A.1 Quorum

A simple majority of members shall constitute a quorum, except a quorum may not be declared without the presence of the Chair or Vice-Chair, the representative from Executive Management or his/her delegate, and the Radiation Safety Officer.

A.2 Meeting Frequency

The Committee shall meet at a minimum of three times per calendar year on a called basis. The Committee may meet at other times on request of the Chair, the representative from Executive Management, or the RSO. A meeting may be conducted in person or via teleconference.

B. COMMITTEE CHARTER

B.1 Charge

The Committee shall establish policies:

- a) That licensed radioactive materials are used safely. This includes review as necessary of training programs, equipment, facilities, supplies, and procedures;
- b) That licensed radioactive materials are used in compliance with Title 25 Texas Administrative Code §289 (25 TAC §289) and the License issued to The University of Texas at Austin;
- c) That the use of licensed radioactive materials and exposure to radiation emitted is consistent with the ALARA principle;
- d) To establish a program to control individual occupational radiation exposures; and

- e) To identify program deficiencies and assure corrective actions are implemented.

B.2 Responsibilities

The Committee shall:

- a) Retain expertise to be familiar with all pertinent regulations, the License, and amendments to the License;
- b) Review the training and experience of proposed Authorized Users and the Radiation Safety Officer to determine qualifications in accordance with regulatory and License requirements;
- c) Review and approve all requests for Authorization to Use radioactive materials under the University's license to assure the safe use of the materials;
- d) Prescribe any special conditions for authorizing uses of radioactive materials;
- e) Review the RSO's report on exposures of all personnel, and, when necessary, require modifications to the operations of the Radiation Protection Program to decrease the levels of exposure;
- f) Review the RSO's annual summary report of the Radiation Protection Program.
- g) Recommend and cause to be implemented remedial action to correct deficiencies identified in the Radiation Protection Program;
- h) Review and approve minutes of all Committee meetings, including members present, members absent, agenda items, discussions, actions, recommendations, decisions, and results of all votes; and
- i) Establish policies so that the University's License Commitments and License are amended as required by 25 TAC §289.

C. MEMBERS

Proposed members of the Radiation Safety Committee shall be submitted to the Texas Department of State Health Services per 25 TAC §289.252(h)(1)(c). A list of the members appears as Appendix I to this Manual.

D. RADIATION SAFETY OFFICER

The Radiation Safety Officer (RSO) is charged with implementing the University's Radiation Safety Program and directing the Radiation Safety staff. The RSO is within the Office of Environmental Health and Safety (EHS) and reports directly to the Director. The Director, EHS,

reports indirectly to the Vice President for University Operations through the Associate Vice President for Campus Safety and Security.

The Radiation Safety Officer has authority, delegated by the President through the Vice President for Research to the Radiation Safety Committee, to take such actions as needed, including, but not limited to the cessation of the use of radioactive material, to safeguard the public welfare with regard to radiation and radioactive materials.

II. FACILITIES AND EQUIPMENT

A. GENERAL

The University of Texas at Austin is required to possess a license to possess and use certain radioactive materials per the Title 25 Texas Administrative Code §289 (25 TAC 289) and its successor legislative acts and rules. These radioactive materials must be controlled under the terms of the license. The University has developed a Radiation Safety Program to ensure this control. The License Commitments document addresses commitments made to the Radiation Control Program of the Texas Department of State Health Services as part of the application to possess and use radioactive materials.

B. RADIOACTIVE MATERIALS

The use of radioactive materials is authorized by a Radioactive Materials License, # L00485, issued to The University of Texas at Austin by the Texas Department of State Health Services. This specific license with broad authorizations covers possession of any radioactive material with atomic number less than 84 in a maximum total amount specified by the terms of the License. Certain specific isotopes are covered in quantities greater than these amounts on an individual basis. Possession and use of radioactive materials with Atomic Numbers 84 or greater are licensed in maximum amounts of any single isotope. A copy of the License is available for inspection in the offices of Radiation Safety and at the Environmental Health and Safety website. The License is granted to authorize use at the following sites:

SITE	LOCATION
000	Austin - Main Campus, The University of Texas at Austin
002	Port Aransas - Marine Science Institute
003	Austin - J.J. Pickle Research Campus
004	Austin - Dell Pediatric Research Institute
005	Port Aransas – Fisheries and Mariculture Laboratory

In addition, certain specific isotopes in limited quantities may be used at specifically designated locations throughout the State of Texas or in its waters without release to the environment.

C. CESIUM-137 IRRADIATOR

The University possesses a XXXXXXXXXXXX Cesium-137 GAMMACELL 40 irradiator. XXXXXXXXXXXX Cesium-137 XXXXXX is doubly encapsulated in stainless steel and is held in a source drawer. The drawers move in cylindrical tubes located within the steel encased biological shield. The system is designed to physically extend the source drawers, therefore removing the sources from the shield, when the specimen tray is closed. When the sources are extended, the source drawers engage slots in the specimen tray, which prevents the specimen tray from opening. The GAMMACELL 40 was designed to meet the needs of medical and life science research and is self-shielded for installation in a conventional laboratory.

III. OPERATIONAL PROCEDURES

A. GENERAL

An Authorized User of radioactive materials is a person who has been extended a sub-License, or Authorization, by The University of Texas at Austin to use radioactive materials. Each person who uses radioactive materials is responsible for the safe use of such materials. The Authorized User (AU) shall:

- 1) Establish a local radiation safety program,
- 2) Carry out the required administrative and safety procedures,
- 3) Select those laboratory practices which are applicable to the work,
- 4) Ensure proper training of personnel,
- 5) Supervise all operations carried out under the Authorization,
- 6) Maintain a record which documents the receipt, use, transfer, storage, and disposal of radioactive materials, and the radiation surveys conducted as part of the local program,
- 7) Ensure the laboratory is properly posted as required by 25 TAC §289, and
- 8) Immediately notify the Radiation Safety Officer if any unexpected difficulties arise which might affect the safety of personnel, procedural violations, health hazards, or danger to the community.

A current copy of the University's Radioactive Materials License shall be made available to the Authorized User upon request. All personnel shall be trained and acquainted with proper radiation safety practices and supervised to see that these practices are observed.

The maximum permissible level for unrestricted areas and maximum permissible dose for individuals as stated in the 25 TAC §289 are to be considered as **absolute maxima** and every effort is to be made to conduct experiments and operations at levels which will result in radiation exposures to workers and members of the public as low as reasonably achievable (**ALARA**).

B. RADIOACTIVE MATERIALS

Radioactive materials may be present in two physical configurations: Sealed Sources and Open Form. Sealed Sources shall be sealed in accordance with applicable regulations of the U.S. Nuclear Regulatory Commission or Agreement States. Open Form radioactive materials may be in liquid or solid form. Radioactive gases may be used only with express consent of the University's Radiation Safety Officer or the Radiation Safety Committee on a case-by-case basis. In order to maintain compliance with the 25 TAC §289, the University's Radioactive Materials License, and to ensure protection for all personnel, the following procedures shall be incorporated into each local radiation safety program by the Authorized User:

- 1) Signs shall be posted where radioactive materials are present per 25 TAC §289.
- 2) Radioactive materials shall be secure at all times. Specifically, all radioactive materials shall be stored in a locked cabinet, refrigerator, freezer, or room, and when not in a locked device or room shall be accompanied by trained personnel at all times.
- 3) Indirect and/or direct reading dosimeters shall be worn by personnel pursuant to Section VI. F. of this document, and dosimetry reading records shall be maintained per 25 TAC §289 by Radiation Safety.
- 4) The Radiation Safety Officer shall be notified before entry into a high radiation area and special procedures (such as wearing direct reading dosimeters) may be required at the discretion of the RSO.
- 5) Working areas shall be surveyed as necessary after the use of Open Form radioactive material to determine the presence of contamination. Contamination levels should be determined using an instrument capable of detecting the radiation in question. The counting efficiency of this instrument should be known in order to convert the counts per minute (cpm) to disintegrations per minute (dpm). Direct surveys and/or wipe testing will be performed as appropriate. If surveys indicate contamination levels of 1000 dpm beta/gamma or 100 dpm alpha activity per 100 cm² of surface area, the area shall be cleaned until the contamination is reduced significantly below these levels.
- 6) Radiation survey instruments should be checked before beginning use to ensure proper operating conditions.
- 7) Minor spills as defined in Section VIII. shall be cleaned up immediately. If a major spill occurs do not attempt decontamination. Isolate the area and notify the Radiation Safety Officer or his/her designee immediately.
- 8) Protective clothing and hands shall be monitored upon completion of laboratory work involving the handling of unsealed radioactive materials.
- 9) Smoking, drinking or eating shall not be allowed in the same area where Open Form radioactive materials are used, or where the area is posted prohibiting such activity.
- 10) Employees shall wash their hands thoroughly before leaving an area where unsealed radioactive materials are being used.
- 11) Mouth pipetting of liquid radioactive materials is strictly forbidden.
- 12) Calibrated radiation detection instruments shall be used at all radioactive material use areas when applicable. The instrument shall be capable of detecting the type of radiation in question.

- 13) Long-handled tongs, gloves, smocks, shoe covers, and other equipment shall be used when such safety measures are needed. When in doubt as to whether special equipment is necessary, contact the Radiation Safety Officer for assistance.
- 14) Gloves and smocks shall be worn by individuals when working with Open Form radioactive materials. The Radiation Safety Officer shall be contacted prior to using gaseous form radioactive materials.
- 15) Radioactive materials shall not be handled with bare hands, nor shall sealed sources be opened.
- 16) Control of access into restricted areas is the responsibility of the individual supervising the laboratory. A restricted area is one which is posted per 25 TAC §289.
- 17) Radioactive materials producing a radiation dose rate in excess of 2 mrem/hr (0.02 mSv/hr) at a distance of 30 cm (~one foot) from the source shall be stored within shielding (typically Plexiglas for high energy beta emitters and lead for gamma emitters) sufficient to reduce the dose rate to less than 2 mrem/hr (0.02 mSv/hr) at a distance of 30 cm (~one foot). Radiation dose rates shall not exist in an unrestricted area that could result in a personnel exposure which exceeds 100 mrem (1 mSv) per year or 2 mrem (0.02 mSv) in one hour. Radiation areas shall be posted pursuant to Section IV.E. of this document and 25 TAC §289. Routine use of shielding is not required for H-3, C-14, S-35, Ca-45, P-33, I-125, and other low energy emitters as determined by the RSO.
- 18) Open Form radioactive materials should be stored in non-breakable, leak-proof containers.
- 19) Work involving liquids containing radioactive materials shall be performed on trays lined with absorbent paper or on surfaces protected with plastic-backed absorbent paper.
- 20) Radioactive materials shall not be used in or on human beings. Any animals administered radioactive materials, or the products of such animals, shall not be used for human consumption.
- 21) Radioactive materials shall not be used in field applications where activity is released without prior approval of the Radiation Safety Committee.
- 22) Chemical hoods in which radioactive materials are used shall have a minimum air face velocity of 100 linear feet per minute.
- 23) Glassware and equipment containing radioactive material shall be properly labeled.
- 24) Trial runs should be made when practicable to determine proper procedures and to evaluate necessary radiation protection.

- 25) Only designated sinks shall be used for washing contaminated glassware or for disposing radioactive materials. Quantities of radioactive materials disposed in the designated sinks to the sanitary sewer may not exceed the limits specified in 25 TAC §289.202(ggg), for the entire University.
- 26) Only designated storage boxes, freezers and refrigerators shall be used for the storage of radioactive materials. **DO NOT** put food in any freezer or refrigerator used for this purpose.
- 27) Radioactive material storage containers shall be labeled in accordance with the 25 TAC §289, with the following information:
 - a. Radioactive material
 - b. Activity and date
 - c. Authorized user
 - d. Caution-Radioactive Materials (with radiation symbol)
- 28) If a suspected or known overexposure occurs to any individual, the Radiation Safety Officer will be notified immediately.
- 29) Records of radiation exposures of University personnel, who are required to wear personnel monitoring devices, shall be maintained by Radiation Safety per 25 TAC §289. Reports of exposures shall be sent to individuals pursuant to 25 TAC §289.
- 30) When specified by the Radiation Safety Committee or the Radiation Safety Officer, protective eyewear shall be worn when working with high energy beta emitters such as P-32.
- 31) Proposed changes in the current authorization shall be submitted in writing to the Radiation Safety Committee (via the Radiation Safety Officer) for approval, and shall be submitted and approved prior to changing the authorized use of radioactive material.
- 32) Approval of the Radiation Safety Officer shall be obtained prior to the transfer of any radioactive material to any other User, institution, or licensee.
- 33) Copies of the "*NOTICE TO EMPLOYEES AND STUDENTS*" signs shall be posted in a sufficient number of places in every establishment where personnel are engaged in activities using radioactive materials so that they can be seen by personnel

entering the area. The information contained in the notice is equivalent to or exceeds that specified in the "*NOTICE TO EMPLOYEES*" of 25 TAC §289.203.

- 34) Each individual using radioactive materials shall be familiar with the appropriate regulations of this document and of 25 TAC §289. Copies of these regulations are available upon request from the Radiation Safety Officer and via the Internet at <http://www.dshs.state.tx.us/radiation/rules.shtm>.
- 35) Individuals involved in or near operations which utilize tritium in any chemical or physical form, other than metallic foil, shall adhere to the bioassay program specified in Section VI. of this document.
- 36) Additions and alterations to the License Commitments may be made by the Radiation Safety Committee when in the estimation of the Committee such additions and alterations are necessary for the protection of the University and its charges, students, or employees. Approval of substantive changes to the License Commitments shall be requested of the Texas Department of State Health Services, Radiation Control.
- 37) For activities involving radioactive materials and animals, Authorized Users shall comply with the procedure titled, "Procedures for Laboratory Animal and Veterinary Medicine Uses," found in Appendix VII. of this document.

C. LABORATORY SURVEYS AND INSPECTIONS

C.1 Surveys by Laboratory Personnel

Each laboratory in which radioactive materials are used shall perform regular surveys. These in-lab surveys are separate and distinct from the surveys (inspections) performed by Radiation Safety. Surveys shall be performed in accordance with Section III.B.5 of this document.

C.1.1 Frequency of Surveys

Frequency of the surveys shall be determined by level of isotope usage. If the laboratory receives a shipment of isotopes in open form, a survey shall be performed at a minimum:

- A. On termination of activities the day radioactive materials are opened and used, or
- B. As specified in the conditions of the Authorization.

If the laboratory uses isotopes in sealed form (Sealed Source), a survey shall be performed to assure that the source is back in its shielded position:

- A. At the close of each day's activities if the source is greater than 1 millicurie, or
- B. As specified in the conditions of the Authorization.

C.1.2 Records of Surveys

Records of all surveys shall be recorded in a Laboratory Logbook or equivalent. The Logbook shall be available for review by Radiation Safety at any time. Information recorded as part of the Survey shall be at a minimum:

- The date of the survey.
- The person performing the survey.
- The reason for the survey.
- Information on the instrument used to perform the survey.
 - The Make, Model, and Serial # of the instrument.
 - The latest Calibration date of the instrument.
- The background reading in the laboratory, taken well away from any known radioactive materials.
- The specific location of the survey.
- The specific location of elevated instrument readings and wipe tests.
- Corrective action taken to remove radioactive contamination if found.

C.2 Inspections by Radiation Safety Staff

The Radiation Safety Officer shall cause a risk-based laboratory inspection program to be performed by qualified personnel who report to the Radiation Safety Officer. The inspections shall be sufficient to detect radiation fields or contamination to ensure that hazards do not exist to personnel apart from expected exposure to radiation workers. The frequency of the surveys shall be determined by the Radiation Safety Officer based on the isotope and quantity in use, the history of the laboratory, and the general level of radiation hazard presented by the laboratory's working environment.

The Radiation Safety Officer or a designated alternate shall make periodic inspections of the isotope usage, storage and disposal records that are maintained in the user's laboratory to determine if the user is in compliance with University procedures and applicable regulations. Laboratories and facilities where radioactive materials are used or stored shall be surveyed periodically in order to detect any changes in radiation levels and to prevent the spread of radioactive contamination. If the inspections detect an unsafe condition, the Radiation Safety Officer shall cause the unsafe condition to be corrected by cleanup, shielding, removal of personnel or equipment, or any other means available to the Radiation Safety Officer.

Records of these surveys shall be maintained by Radiation Safety.

C.2.1 Frequency of Routine Inspections

The purpose of the risk-based radioactive materials laboratory inspection classification program is to develop a quantitative method, based on the risk associated with the laboratory, to determine the inspection frequency. The risk-based approach allows Radiation Safety to determine an appropriate inspection frequency for laboratories using radioactive materials. The main criterion used in the risk-based program is the quantities of radioactive materials used in the laboratory. Laboratories are

reassessed periodically to assure proper inspection classification. For the purpose of classification, multiple laboratories under the control of a single Authorized User shall be grouped as a single laboratory.

Laboratory inspection intervals will be quarterly or annually based on the inspection classification (high-frequency or low-frequency) determined by the criteria outlined below. The overall goal of the risk-based inspection program is to make laboratories and their occupants safer for teaching and research and at the same time ensuring regulatory compliance.

Quantities of Radioactive Materials (Open Form) Used

Laboratories that use more than a predetermined amount of any particular radioactive material in a certain time period (typically 10 mCi in a calendar quarter) will be classified as high-frequency. All other laboratories will be classified as low-frequency. Radioactive materials use is determined by amount of radioactive material received and/or amount of radioactive waste generated in the specified time period.

Additional Factors

A laboratory classified as low-frequency based on the criteria above may be reclassified as high-frequency due to other factors such as failure to mitigate compliance issues identified during inspections, repeat offenses, etc. A laboratory classified as high-frequency based on the criteria above may be reclassified as low-frequency with a consistent history of good compliance with radioactive materials regulations.

Inspections shall be performed at a minimum according to the laboratory's frequency classification. The listing of laboratory frequency classifications shall be maintained by the Radiation Safety Office. High-frequency laboratories shall be inspected quarterly. Low-frequency laboratories shall be inspected annually.

C.2.2 Records of Routine Inspections

The results of all routine inspections shall be documented and maintained for review. Information recorded as part of the inspection shall include, as a minimum, the following:

- The date of the inspection.
- The person performing the inspection.
- The reason for the inspection.
- Information on the instrument(s) used to perform the radiation and/or contamination survey(s).
 - The Make, Model, and Serial # of the instrument.
 - The latest Calibration date of the instrument.
- The background reading in the laboratory, taken well away from any known radioactive materials.
- The building and room number of the inspection.
- The specific location of elevated instrument readings and wipe tests.
- Corrective action taken to remove radioactive contamination if found.

If wipe tests are taken as part of the survey, a record of the wipe test results shall be attached to the record of the survey.

The current inspection form, "Radioactive Material Laboratory Audit Form," is shown in Appendix V. This form may be revised at the discretion of the Radiation Safety Officer.

C.3 Non-routine Inspections

A non-routine inspection may be performed after any of the following events occur:

- Cleanup of a spill.
- Laboratory decommissioning.
- On request.
- Detection of an unsafe condition.

The "Radioactive Material Laboratory Audit Form" or the equivalent may be used to document the results of non-routine inspections.

D. VIOLATIONS OF REGULATIONS

In the event of an alleged violation of the requirements set forth in this document, or those prescribed in the 25 TAC §289, the person noting the alleged violation shall immediately contact the Radiation Safety Officer or a member of the Radiation Safety Committee. The Committee may request the Authorized User to meet and discuss the alleged violation with the Committee. Subsequent action taken by the Committee will depend on the seriousness of the violation and the Authorized User's past record. If the alleged violation is found to be minor, the Radiation Safety Officer shall clarify the policies for using radioactive materials and shall explain the hazards associated with the violation. If the alleged violation is serious, or the alleged violator shows a flagrant disregard for proper operating procedures, the Radiation Safety Committee may revoke the Authorized User's privilege of using radioactive materials.

IV. RADIOACTIVE MATERIAL ACCOUNTABILITY

A. APPLICATION FOR AUTHORIZATION TO USE RADIOACTIVE MATERIALS

Prior to any purchase or use of radioactive materials or change in an existing authorization, the user shall prepare and submit the Application to Use Radioactive Materials to the Radiation Safety Officer. A copy of the application form is shown in Appendix VI and may be revised at the discretion of the Radiation Safety Officer. The Radiation Safety Officer shall review and make an evaluation of the intended user's plans for radiation safety.

When the Radiation Safety Officer completes the review, the application shall be submitted to the Radiation Safety Committee for review and approval. If any issue is raised by a Committee member, the issue shall be resolved prior to issuance of the Authorization.

New users and amended Authorizations shall be approved by a majority of the Committee in attendance at a Committee meeting in which a quorum has been established. The approval of applications for authorization to use radioactive materials shall be maintained by the RSO and shall be noted in the minutes of Committee meetings.

If approval of an application cannot wait until a meeting of the Committee, the RSO may request approval by a majority of the Committee members via phone, email, or other appropriate form of communication. Committee members shall submit their approvals to the Radiation Safety Officer either in writing or by electronic means. Upon completion of the required radiation safety training by the applicant and the Committee's approval, the Authorization is finalized and signed by the applicant, the Radiation Safety Officer, and the Committee Chair or Vice-Chair.

A copy of the Authorization with all signatures will be provided to the Authorized User.

An Authorized User may submit to the Radiation Safety Officer a written request to amend his/her authorization to reduce possession limits, remove places of use, and/or discontinue previously authorized activities. Such requests do not require approval of the Committee but shall be reviewed and processed by the Radiation Safety Officer. The amended Authorization shall be finalized and signed by the applicant, the Radiation Safety Officer, and the Committee Chair or Vice-Chair.

Visiting researchers may only use radioactive materials under the authorization and control of a currently approved Authorized User. No provision exists for granting a temporary authorization.

B. PURCHASING

It is the responsibility of each person to comply with the following requirements regarding the purchase of radioactive materials at the University. In no event is any person authorized to purchase, receive or transfer radioactive materials or irradiation services without approval of the Radiation Safety Officer or his/her designee. In the event of an emergency, the employee may submit the request to the Chair of the Radiation Safety Committee for approval.

After obtaining an Authorization to Use Radioactive Materials, the following procedures shall be observed in purchasing radioactive materials:

1. A departmental requisition shall be prepared through the University's secure purchasing system and indicate the radioactive materials to be purchased, the activity of each radioactive material required, and the name or unique authorization number of the Authorized User purchasing the radioactive material. The purchasing system queries the radioactive material inventory tracking system for the Authorized User's authorized radioactive materials, activity limits, and current inventory. The system automatically limits the purchase of each radioactive material such that the summation of the proposed purchase and the current inventory does not exceed the authorization limit for the Authorized User.
2. The requisition is electronically forwarded to the Purchasing Office for processing and creation of a purchase order.
3. The Purchasing Office electronically forwards the purchase order to Radiation Safety for approval electronically.
4. No person shall circumvent the approval process, whether the approval is automatic, electronic, or on paper.

Repetitive or standing purchase orders with vendors to automatically replenish radioactive material inventories will not be authorized.

C. SHIPPING

Shipments of radioactive materials from or by the University shall comply with the requirements of the appropriate regulatory agencies. A Radioactive Material Shipment Form or equivalent shall be completed for each shipment. All shipments shall be approved by Radiation Safety and/or other University personnel possessing the appropriate US Department of Transportation training.

D. RECEIVING

D.1 General

Incoming shipments of radioactive material shall be delivered to the designated radioactive material receiving location on the main campus unless prior arrangements have been made with Radiation Safety.

Radiation Safety shall be notified as soon as possible of incoming packages of radioactive material. Radiation Safety personnel will retrieve the package, survey the package as required by 25 TAC §289.202(ee), and deliver the package to the Authorized User's laboratory. Packing materials will be surveyed for contamination prior to disposal in the general waste. All labels and markings should be removed or defaced prior to disposal of the packaging in the trash.

A Radioactive Material Disposition Form or equivalent will be completed and delivered with the radioactive material to the User. Disposition of the radioactive materials received in the shipment shall be recorded on the form (or equivalent document) for each shipment.

D.2 Receipt and Inspection Procedure

When packages are received and readied for inspection, the person conducting the inspection shall wear appropriate protective equipment (such as gloves) and:

- monitor the external surfaces of a labeled package, labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in DOT regulations Title 49, CFR, §§172.403 and 172.436-440, for radioactive contamination unless the package contains only radioactive material in the form of gas or in special form as defined in §289.201(b) of this title;
- monitor the external surfaces of a labeled package, labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in DOT regulations 49 CFR §§172.403 and 172.436-440, for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity, as defined in §289.201(b) of this title and specified in §289.257(ff) of this title; and
- monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged.

Personnel shall perform the monitoring specified above as soon as practicable after receipt of the package, but not later than three hours after the package is received at our facility if it is received during normal working hours. If a package is received after working hours, the package shall be monitored no later than three hours from the beginning of the next working day. If we discover there is evidence of degradation of package integrity, such as a package that is crushed, wet, or damaged, the package shall be surveyed immediately. Precautions shall be taken to prevent the spread of radioactive contamination.

Radiation safety personnel shall immediately notify the final delivery carrier when removable radioactive surface contamination or external radiation levels exceed the limits specified in the below Sections D.3 and D.4. The Radiation Safety Officer or his/her designee shall notify the Texas Department of State Health Services by telephone or facsimile.

D.3 Limits for removable radioactive surface contamination

The level of removable radioactive contamination may be determined by wiping an area of 300 square centimeters (cm²) of the surface concerned with an absorbent material, using moderate pressure, and measuring the activity on the wiping material. Sufficient measurements must be taken in the most appropriate locations to yield a representative assessment of the removable contamination levels. The amount of radioactivity measured on any single wiping material, when averaged over the surface wiped, must not exceed the limits given in Table 1 below.

Table 1. Radioactive Material Package Contamination Limits		
Contaminant	Maximum permitted on swipe	
	μCi/cm²	dpm/cm²
Beta-gamma emitting radionuclides; all radionuclides with half-lives less than 10 days; natural uranium; natural thorium, uranium-235; uranium-238; thorium-232; thorium-228; and thorium-230 when contained in ores or physical concentrates.	10⁻⁵	22
All other alpha emitters	10⁻⁶	2.2

D.4 Limits for external radiation levels

External radiation levels around the package may not exceed 200 millirems per hour (mrem/hr) (2 millisieverts per hour (mSv/hr)) at any point on the external surface of the package. The transport index shall not exceed 10.

E. STORING AND POSTING

If radioactive materials are stored in a cabinet or refrigerator, there must be sufficient shielding around the radioactive materials such that the radiation level at the surface of the cabinet or refrigerator is less than 2 mrem/hr (0.02 mSv/hr). Posting of signs, storage, and security requirements must be in compliance with 25 TAC §289.

Any questions concerning the regulations involving purchase, shipping, receiving, or storing and posting of warnings should be referred to Radiation Safety for information or clarification.

F. INVENTORIES

The Quarterly Inventory of each radioactive material performed per Section VI.E. of this document shall be checked by the Authorized User or the User's delegate to verify accuracy. Any shortages or overages of radioactive materials shall be reported to Radiation Safety. The Authorized User or delegate shall affirm to Radiation Safety that the inventory is correct. Failure to complete an inventory may be cause for suspension of purchasing radioactive materials by the User, and may result in termination of the User's Authorization.

Procedures for completing sealed source inventories are outlined in Appendix VIII. A listing of the inventory of sealed sources is shown in Appendix VIII. This listing may be revised at the discretion of the Radiation Safety Officer and may require prior agency approval.

V. INSTRUMENTATION

A. GENERAL

Radiation detection instruments are used to provide information on radiation levels and surface contamination. Various types of radiation detection instruments and equipment are possessed and used by Radiation Safety, Authorized Users, and radiation workers. The principal use is for routine monitoring and to provide additional monitoring in the event of a radiation emergency. Radiation Safety maintains calibration facilities suitable for calibrating most types of instruments.

B. INSTRUMENTS AND DETECTORS

An Authorized User is required to purchase and use an instrument(s) specific for the laboratory's needs, and must use a detector appropriate for the type of radiation to be detected. Radiation Safety assists Users in identifying appropriate types of detection equipment and may recommend equipment manufacturers.

C. INSTRUMENT CALIBRATION METHODS

Radiation survey instruments at the University shall be calibrated to read within $\pm 20\%$ of the actual reading at least annually, and after each instrument repair. Calibrations shall be made by personnel designated by the RSO or RSC, or by individuals who are authorized by the Texas Department of State Health Services, another Agreement State, or the U.S. Nuclear Regulatory Commission. Calibration shall be made using an appropriate radiation source depending on the type of radiation the instrument is designed to detect. At least two radiation exposure values shall be checked for each meter scale on instruments used for measuring radiation fields. Instruments utilized for surface contamination measurements are typically calibrated with a pulser and checked with appropriate calibrated sources to determine efficiency. Both the pulser and calibration sources are traceable to the National Institute of Standards and Technology (NIST).

Records shall be established and maintained for each calibration at the main offices of Radiation Safety and at any remote site for a minimum of three years. Each instrument shall be marked with a calibration sticker showing the date of calibration, the date the next calibration is due, and the name of the person performing the calibration. Further specific instructions for calibrating instruments are found in Appendix III of this document.

D. INSTRUMENT TYPE FOR USE

The instrument used to survey for radiation shall be the correct type to detect the radiation in question. For most purposes, a G-M "pancake" detector is preferred. Phosphorous-32 and -33, Sulfur-35, and Carbon-14 may be detected with a "pancake" probe or a thin end-window. Carbon-14 emits a relatively weak beta; therefore, a survey should proceed carefully and slowly to allow detector response. Tritium must be detected using a liquid scintillation counter or special detector approved by Radiation Safety. Isotopes which emit gamma radiation or a combination of beta and gamma, such as Iodine-131, Cesium-137, and Cobalt-60, may be detected with a Geiger-Muller tube. Any isotope or combination of isotopes which emits alpha radiation or neutron radiation must

be detected with a detector approved by Radiation Safety. If any question arises regarding the type of detector to be used to perform a survey, contact Radiation Safety for advice and assistance.

Below is the current (May 2009) list of instruments in use.

Type	# of Units
Portable alpha scintillation survey instrument	2
Portable beta scintillation survey instrument	1
Portable beta-gamma scintillation survey instrument	2
Portable windowless gas flow proportional counter	2
Bench-top gamma spectrometer	1
Bench-top gas flow proportional counter	1
Portable GM dose rate survey instrument	5
Portable GM end window survey instrument	12
Portable GM pancake survey instrument	110
Portable GM thin wall survey instrument	1
Portable ion chamber survey instrument	2
Bench-top liquid scintillation counter	2
Portable μ R scintillation survey instrument	2
Portable NaI 1x1 survey instrument	1
Portable NaI low-energy gamma survey instrument	8
Portable neutron survey instrument	1
Portable isotope identifier	2

VI. TESTS AND RECORDS

A. GENERAL

The Texas Department of State Health Services requires that certain tests be made and records maintained of the results of these test. The requirements for radiation surveys and records of these surveys are covered under 25 TAC §289. This same regulation specifies the requirements for personnel monitoring with indirect and/or direct reading dosimeters, area posting, source storage, and waste disposal. Radioactive Material License No. L00485 (The University of Texas at Austin) defines the requirements for leak testing of sealed sources. Each person at the University who is authorized to use radioactive materials shall become familiar with these regulations and shall see that they are followed by others who work for them. In addition, all individuals must have adequate training and testing prior to working with radioactive materials.

B. LEAK TESTS

The Radiation Safety Officer is responsible for the sealed radiation source leak testing program at the University. Leak tests shall be made by personnel designated by the RSO or RSC, or by individuals who are authorized by the Texas Department of State Health Services, another Agreement State, or the U.S. Nuclear Regulatory Commission. Approved University personnel will be trained on proper leak test procedures. When leak tests are due, arrangements shall be made with the Authorized User for the test to be performed.

The following procedures shall be followed in leak testing sealed sources:

- 1) Wipe the surface of the source with an appropriate piece of paper or fabric. Wetting the paper or fabric may be considered as moisture allows contamination to stick better.
- 2) If the source is located inside an apparatus and cannot be removed from the unit, wipe around the irradiation port and source placement tube or other accessible part of the unit where contamination might collect.
- 3) Wear a dosimeter during leak testing operation if appropriate or required. Use long-handled tongs or suitable method to limit exposure to hands and body.
- 4) The wipe test shall be evaluated by counting in an appropriately calibrated laboratory instrument capable of detecting 0.005 microcuries of removable activity. The results shall be recorded and maintained as appropriate.
- 5) If analysis reveals greater than 0.005 microcuries, take the source out of service. Notify the Radiation Safety Officer or his/her designee immediately.

C. INTERNAL INSPECTIONS

Inspections of areas in which radioactive materials are used or stored shall be performed as specified in Section III.C.2. Records shall also be maintained as specified in that Section.

D. RADIOACTIVE WASTE DISPOSAL

Records of all disposals shall be maintained by the Radiation Safety staff and should include the following information:

1. Radioactive isotope.
2. Activity in millicuries.
3. Method of disposal.
4. Date of disposal.

Further requirements for records are detailed in Section VII.L.

E. INVENTORIES

A computerized Quarterly Inventory of each radioactive material, by Purchase Order Number (or other appropriate ID number), shall be sent to each Authorized User. It is the responsibility of the Authorized User or designee to check the accuracy of the inventory, make corrections as necessary, and promptly return it to Radiation Safety. An inventory of Sealed Sources shall be conducted semi-annually, which will include the radionuclide and activity in each sealed source, the location of the sealed source, the name of the individual conducting the inventory, and the date of the inventory. The Sealed Source inventory may be conducted concurrently with the Quarterly Inventory or with the semi-annual leak test. Records of the Sealed Source inventory shall be maintained for a minimum of five years.

F. DOSIMETRY AND REPORTS

A centralized dosimetry service is available to authorized users of radioactive materials at the University. Arrangements have been made with a National Voluntary Laboratory Accreditation Program accredited company to furnish dosimetry service for the University. Requests for additions and deletions of dosimeters shall be made through Radiation Safety. All reports on dosimetry provided by the service will go to the Radiation Safety Office.

To initiate the dosimetry service, staff will complete and submit the Dosimetry Service Request form. Individuals issued dosimeters will be instructed to wear them when handling radioactive materials or sealed sources. Whole-body dosimeters will be worn at the chest or waist level. When not worn, dosimeters will be stored in a low-background area. The control dosimeters will also be stored in a low-background area.

Indirect and/or direct reading whole-body and/or extremity dosimeters as appropriate are to be worn by University personnel who may be working in areas where the following conditions exist:

- Any person likely to receive 10% of the annual allowable limit.
- Any person working within a high radiation area.
- Other situations as determined by the Radiation Safety Officer.

G. BIOASSAY PROGRAM ¹²⁵I and ¹³¹I

Since radioiodinated solutions and compounds undergo decomposition which may result in the volatilization of radioiodine, individuals working with these materials have a potential for accidental uptake of radioactive iodine. Once inside the body, the iodine concentrates in the thyroid, contributing to the radiation dose received by that organ. This bioassay program will enable the Radiation Safety staff to determine an individual's radioiodine thyroid burden, so that a thyroid organ-dose can be determined for those who have had an uptake. In addition, the program will monitor the effectiveness of isotope handling procedures.

TABLE 2
ACTIVITY LEVELS ABOVE WHICH BIOASSAY FOR
¹²⁵I OR ¹³¹I IS REQUIRED

<u>TYPE OF OPERATION</u>	<u>ACTIVITY HANDLED IN UNSEALED FORM</u>	
	Volatile or Dispersible	Bound to Non-Volatile Agent
Process in open room or bench with possible escape of iodine from process vessels	0.1 mCi	1.0 mCi
Process with possible escape of iodine carried out within a fume hood of adequate design, face velocity and performance reliability	1.0 mCi	10 mCi
Processes carried out with gloveboxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage	10 mCi	100 mCi

PROGRAM REQUIREMENTS

1. PROGRAM PARTICIPATION:

- a. Individuals who handle unsealed quantities of ^{125}I and ^{131}I in excess of the quantities listed in Table 2, and those individuals who work close enough to such handling that uptake is possible (within a few meters) should participate in this bioassay program. The quantities in Table 2 apply to that amount handled either in a single usage or the total amount handled over a period of three consecutive months.
- b. It shall be the responsibility of individual authorized users to notify the Radiation Safety Office of the names of those individuals working under his/her authorization who require bioassay for radioiodine.

2. FREQUENCY OF BIOASSAY:

- a. Prior to beginning work with ^{125}I or ^{131}I in quantities which require participation in the bioassay program, individuals shall be given a "baseline" or "preoperational" bioassay.
- b. A "routine" bioassay shall be performed within 72 hours (but not less than six hours) on individuals following commencement of work with quantities of radioiodine necessitating participation in this program. Bioassays shall continue on a biweekly schedule as long as conditions exist which necessitate an individual's participation in the program. When work with radioiodine is less frequent than every two weeks, a bioassay shall be performed within 10 days of the end of radioiodine operations. Individuals who work under conditions which present a high potential for uptake may be required to submit to bioassay more frequently than biweekly.
- c. After three months of routine biweekly bioassays the frequency of bioassay may be reduced to quarterly, at the discretion of the Radiation Safety Officer.
- d. An "emergency" bioassay shall be performed on any individual as soon as possible following an incident in which that individual may have received an uptake in excess of 2.5 μCi of I-125 and 2.0 μCi of I-131.
- e. Individuals who are required to participate in this program shall undergo a "postoperational" bioassay within two weeks (but not less than six hours) after discontinuing operations with radioiodine. This bioassay shall be performed prior to an individual's termination of employment with, or withdrawal from the University.

3. ACTION LEVELS AND CORRESPONDING ACTIONS:

- a. When the thyroid burden at the time of measurement exceeds 0.75 μCi of I-125 and 0.63 μCi of I-131 or a corresponding appropriate amount of a mixture of these two isotopes, the following actions shall be taken:
 - (1) An investigation of isotope handling procedures shall be conducted. If this investigation indicates that a continuation of current operations would cause further uptake of radioiodine in excess of the above limits, operations using radioiodine in that lab shall be discontinued until corrective actions can be implemented that will lower the potential for uptake.
 - (2) Restrict the affected individual from further work with radioiodine until the thyroid burden is less than the above limits.
 - (3) Perform "diagnostic" bioassays on the affected individual at biweekly intervals until the thyroid burden is less than the above limits.
 - (4) Calculate the committed thyroid dose based on biological half-life determined from follow-up bioassays.
 - (5) Make exposure record entries and notify state or federal agencies as appropriate.

- b. In addition to the actions in 3.a, when the thyroid burden exceeds 2.5 μCi of I-125 or 2.0 μCi of I-131 or a corresponding appropriate amount of a mixture of these two isotopes, the following actions shall be taken.
 - (1) Refer the case to appropriate medical consultation.
 - (2) Perform diagnostic bioassays at weekly intervals until the thyroid burden is less than the values stated in 3.a.

- c. If the affected individual and others working in the same area were on a quarterly bioassay schedule at the time the limits of 3.a were exceeded, reinstate biweekly bioassay schedule until it has been demonstrated that further exposures will not cause the limits of 3.a to be exceeded.

4. BIOASSAY PROCEDURES:

Bioassay procedures are contained in Appendix IV to this Manual.

H. PROGRAM AUDITS

The Radiation Protection/Safety Program will be audited at annual intervals per 25 TAC §289. The program areas to be audited will include, but are not limited to, the following:

- Radioactive material Receipt and Delivery
- Laboratory Inspections
- Instrument Calibrations
- Sealed Source Leak Tests
- Sealed Source Inventory
- Dosimetry and exposures (Non-Confidential Documents Only)
- Environmental surveillance
- Application for Authorization to Use Radioactive Materials
- Excess Materials Pickup, Processing, and Waste Shipments
- Shipping of Radioactive Materials
- Training Records
- Radioactive material Inventory

An Audit shall consist of a review of records of each of the above areas which show that the actions specified for execution of each area have occurred.

I. RADIATION WORKER TRAINING

Individuals who do not have formal training in radiation safety must attend the University's radiation worker training course. The course is approximately eight hours in length. Alternatively, the course may be conducted via computer or over the Internet, or by using video instruction. If these methods of training are used the course will include the same topics as those included in a live course. The Radiation Safety Officer may waive the course if the individual can provide evidence of equivalent training and/or experience. If the Radiation Safety Officer waives the course, the individual must take the radiation worker refresher course.

The radiation worker refresher course is approximately one hour in length and addresses topics specific to the University such as dosimetry, waste disposal, purchasing, emergency procedures, operating procedures, record keeping, as well as a basic review of radiation safety techniques. Alternatively this course may be conducted via computer or over the Internet, or by using video instruction. If these methods of training are used the course will include the same topics as those included in a live course.

Upon successful completion of either course, credit is posted to the individual's electronic training history in the campus-wide training database. If requested, the successful graduate is issued a certificate of completion.

Radiation safety courses are taught by senior staff of the Radiation Safety Office. At the Nuclear Engineering Teaching Laboratory (NETL), comparable, site-specific radiation worker training is taught by the reactor health physicist. If necessary or desired, outside training specialists may be utilized to present the courses. Subjects covered in the radiation worker training include, but are not limited to the following:

- Atomic Structure and Radioactivity,
- Interactions of Radiation with Matter,
- Quantities and Units of Radiation,
- Basic Principles of Radiation Protection,
- Safe Handling of Radioactive Materials and Sources,
- Radiation Detection Instruments and Surveys,
- Dosimetry,
- Waste Disposal,
- Purchasing and Receiving Radioactive Materials,
- Sections of 25 TAC §289 and this document,
- Emergency Procedures, and
- Record Keeping.

The Radiation Safety Officer may also require radiation workers to be trained in other areas, such as general hazard communication (Texas Hazard Communication Act) and laboratory safety.

The Radiation Safety Office shall maintain records of course attendance and course credit.

J. BIOASSAY PROGRAM (³H) TRITIUM

This program applies to individuals working with or around tritium gas or tritiated compounds excluding metallic foil. Tritium does not present an external exposure hazard because the low energy beta particle emitted cannot penetrate the outer dead layer of skin. The hazard to personnel is through internal contamination. The critical organ for tritium uptake is the whole body. Three to four hours after intake, tritiated water is uniformly distributed in all body water. This bioassay program will enable the Radiation Safety staff to determine an individual's tritium burden, so that a dose can be determined for those who have had an uptake. In addition, the program will monitor the effectiveness of isotope handling procedures.

TABLE 3

Activity levels above which bioassay for tritium is required

Types of Operation	HTO and tritiated organics including DNA precursors	Tritium gas in sealed process vessels	HTO mixed with more than 10 kg of inert H ₂ O or other material
Processes in <i>open room or bench</i>	100 mCi	100 Ci	10 mCi/kg
Processes in a <i>fume hood</i> with adequate face velocity and performance reliability	1 Ci	1 kCi	100 mCi/kg
Processes in <i>glove boxes</i>	10 Ci	10 kCi	1 Ci/kg

Reference: HPS N13.14-1994

HTO - A water molecule in which one of the hydrogen atom positions is occupied by a tritium atom. (tritiated water)

PROGRAM REQUIREMENTS

1. Program Participation

- a. Individuals who handle quantities of ^3H in excess of the quantities listed in Table 3, and those individuals who work close enough to such handling that uptake is possible (within a few meters) should participate in this bioassay program. The quantities shown apply to both the quantity handled at any one time or total amount of activity handled by an individual over any two week period.
- b. It shall be the responsibility of individual authorized users to notify the Radiation Safety Office of the names of those individuals working under his/her authorization who require bioassay for tritium.

2. Types of Bioassay That Should be Performed

- a. Baseline (preemployment or preoperational) - prior to beginning work with tritium. This is performed in order to correctly assign any tritium intake that may be subsequently detected.
- b. Routine - on a biweekly schedule for those individuals that regularly work in an environment in which the amount of tritium exceeds the activity levels defined in the previous table.
- c. Special - on a case by case basis for individuals working in an off-normal condition or for individuals not participating in a routine bioassay program and performing isolated tasks with amounts of tritium that exceed activity levels defined in the previous table.
- d. Emergency - a bioassay should be performed on all affected individuals within one day of and at least more than two hours after a possible exposure that could exceed the action limits.
- e. Post-operational - a bioassay should be performed within ten days of the last possible exposure to tritium when operations are being discontinued or when the individual is terminating activities with potential exposure to this radionuclide.
- f. Diagnostic - a series of measurements performed at a relatively high frequency in order to more accurately assess the dose resulting from a known tritium intake.

3. Frequency of Bioassay

- a. Prior to beginning work with ^3H in quantities that require participation in the bioassay program, individuals shall be given a "baseline" bioassay. Urinalysis shall be used to determine tritium in the body.

- b. A "routine" bioassay shall be performed two weeks following the commencement of work with quantities of tritium necessitating participation in this program. Bioassays shall continue on a biweekly schedule as long as conditions exist which necessitate an individual's participation in the program. When work with tritium is less frequent than every two weeks, a bioassay shall be performed within 10 days of the end of the tritium operations. Individuals who work under conditions which present a high potential for uptake may be required to submit to bioassay more frequently than biweekly.
- c. After three months of routine biweekly bioassays the frequency of bioassay may be reduced at the discretion of the Radiation Safety Officer.
- d. An "emergency" bioassay shall be performed on any individual as soon as possible following an incident in which that individual may have received an intake in excess of 4 μCi of tritium (5% of Annual Limits on Intake for tritium: $8\text{E}+4 \mu\text{Ci}$).
- e. Individuals who are required to participate in this program shall undergo a "post-operational" bioassay within two weeks (but not less than two hours) after discontinuing operations with tritium. This bioassay shall be performed prior to an individual's termination of employment with, or withdrawal from the University.

4. Action Points and Corresponding Actions

Routine Monitoring Program

Monitoring Interval (days)	Administrative Limits and Corresponding Actions		
	Estimate Internal Dose [Committed Effective Dose Equivalent] (See Appendix A)	Investigation, corrective actions, and additional measurements (See Appendix B -Section 1)	Notify DSHS (See Appendix B -Section 2)
7	8 nCi/ml	15 nCi/ml	1520 nCi/ml
14	5 nCi/ml	10 nCi/ml	987 nCi/ml
30	2 nCi/ml	3 nCi/ml	307 nCi/ml

Special Monitoring Program

Monitoring Interval (days)	Administrative Limits and Corresponding Actions		
	Estimate Internal Dose [Committed Effective Dose Equivalent] (See Appendix A)	Investigation, corrective actions, and additional measurements (See Appendix B -Section 1)	Notify DSHS (See Appendix B -Section 2)
1	11 nCi/ml	22 nCi/ml	2200 nCi/ml
2	11 nCi/ml	21 nCi/ml	2149 nCi/ml
3	10 nCi/ml	20 nCi/ml	2006 nCi/ml
4	9 nCi/ml	19 nCi/ml	1869 nCi/ml
5	9 nCi/ml	17 nCi/ml	1743 nCi/ml
6	8 nCi/ml	16 nCi/ml	1629 nCi/ml
7	8 nCi/ml	15 nCi/ml	1520 nCi/ml

- 5. Bioassay Procedures are contained in Appendix IV to this Manual.

Appendix A

Whenever the tritium concentration in the urine exceeds the **recording level** (value in the first column of the action points table), calculate the internal dose (mrem) as committed effective dose equivalent. The committed effective dose equivalent will then be added to the external effective dose equivalent obtained with dosimeters to determine the total effective dose equivalent.

Calculate the dose by using HPS N13.14 -1994, Internal Dosimetry Programs for Tritium Exposure -Minimum Requirements, NUREG/CR-4884, Interpretation of Bioassay Measurements, and other appropriate standards and guides. To calculate the dose the following information must be obtained:

- Calculated concentration of tritium in urine at time zero
- Measured concentration of tritium in urine at time t (monitoring period or time after intake)
- Monitoring period (days) or time after intake

Appendix B

SECTION 1

Whenever the tritium concentration in the urine exceeds the **derived investigation level** (value in the second column of the actions points table), the following actions should be taken:

1. Calculate the internal dose using the methods described in Appendix A.
2. An investigation of the operations involved should be carried out to determine the cause of exposure and to evaluate the potential for further exposures.
3. If the investigation indicates that further work in the area might result in exposure of a worker to concentrations that are excessive, the Radiation Safety Office will restrict the worker from further exposure until the source of exposure is discovered and corrected.
4. Corrective actions that will eliminate or lower the potential for further exposures should be implemented.
5. A repeat bioassay should be taken within a week of the previous measurement and should be evaluated within 24 hours after measurement in order to confirm the presence of tritium and to obtain an estimate of its effective half-life for use in estimating the committed dose equivalent.

SECTION 2

If the tritium concentration in the urine at any time exceeds the notification level (value in the third column of the actions points table), the following actions should be taken:

1. Carry out all steps described in the above section.
2. As soon as possible, refer the case to appropriate medical consultation for recommendations regarding the removal of tritium from the body.
3. In accordance with 25 TAC §289.202, notify the Texas Department of State Health Services.
4. Carry out repeated measurements at approximately one week intervals at least until the tritium concentration is less than 3 nCi/ml. If there is a possibility of longer term retention of tritium, continue measurements, as long as necessary to ensure that appreciable exposures do not go undetected.

VII. DISPOSAL OF RADIOACTIVE WASTE

A. GENERAL

Each Authorized User who generates waste materials contaminated with radioactive materials or possesses excess materials which are candidates for disposal as radioactive waste shall determine the category of the waste and document the actions taken regarding proper disposal. The most common types of radioactive waste and excess materials are Liquids, Dry Solids, Sharps, Sealed Sources, and Animal Waste.

A.1 Liquids

Liquid radioactive waste and excess materials generally fall into two categories: Aqueous and non-aqueous. The two types are handled in a different manner. Liquid radioactive waste and excess materials to be picked up by Radiation Safety shall be placed in non-breakable containers. If a breakable inner container is used, the non-breakable outer container shall have a sufficient amount of absorbent to absorb all of the liquid in the event of an inner container failure.

Liquid radioactive wastes consisting of other hazardous materials, such as solvents (toluene, xylene, etc.) used for scintillation counting, shall not be disposed via the sanitary sewer. These liquids must be collected by Radiation Safety for analysis and proper disposal.

A.1.1 Aqueous Liquids

Aqueous biodegradable solutions which are considered excess materials and which contain radioactive materials may be disposed by laboratory personnel or Radiation Safety staff via the sanitary sewer system in accordance with §289.202(gg), if the radioactive material is readily soluble, or is readily dispersible biological material, in water.

Radiation Safety shall be responsible for collecting sanitary sewer release data to determine compliance with the monthly concentration limits (§289.202(ggg)(2)(F), Table III) and the sum of fractions requirement specified in §289.202(gg)(2)(D). Notwithstanding §289.202(gg)(1)(D), the total radioactivity released into the sanitary sewer under the University's Radioactive Material License cannot exceed 5 curies per year of hydrogen-3, one curie per year of carbon-14, and one curie per year of all other radioactive materials combined. Radiation Safety shall generate and retain records to demonstrate compliance with these requirements.

A.1.2 Non-Aqueous Liquids

All non-aqueous liquids considered radioactive waste or excess materials shall be collected in dedicated, marked containers for pickup by Radiation Safety. The contents of the containers shall be documented and reported to Radiation Safety prior to pickup. Radiation Safety shall make a determination of the suitability of the liquids for further use, and shall recycle or dispose of the non-aqueous liquids per requirements of the 25 TAC §289. Non-Aqueous liquids may be disposed as

regulated or exempt waste. If disposed as exempt waste per 25 TAC §289.202(fff), all procedures per Part F. of this Section will be followed.

B. DRY SOLIDS

Dry solid radioactive waste generated in University activities, which includes liquids in absorbed, adsorbed, or sequestered form, may be transferred to Radiation Safety for processing and recycling or disposal. Each Authorized User shall collect the excess materials in a dedicated, marked container. The contents of the container shall be documented on the Radioactive Materials Pickup form or equivalent and reported to Radiation Safety prior to pickup. Radiation Safety shall make a determination of the suitability of the materials for further use, and shall recycle, transfer, or dispose of the materials per requirements of the 25 TAC §289 per the instructions provided in Section F.3 of this document.

The following instructions shall be observed when packaging excess dry solid materials for pickup by Radiation Safety:

- Solids shall be placed in approved radioactive materials containers with plastic bag liners.
- No sharps capable of penetrating the plastic liners or liquids shall be in the dry solids.
- All containers shall be marked “Caution-Radioactive Materials, unless specifically exempted from such markings by regulation.

C. LIQUID SCINTILLATION VIALS

Used liquid scintillation vials which do not meet the specific disposal criteria may be emptied of liquids and replaced into the original vial cartons and secured. The Radioactive Materials Pickup form shall note that vials are to be picked up.

D. SHARPS

A “sharp” is generally defined as an item which will penetrate the plastic liners placed in a dry solid container with minimal effort. Examples of sharps are broken glass, syringes, and pipette tips.

Sharps must be packaged in specially designed containers and must be free of any hazardous materials, chemicals, or infectious materials prior to pickup.

Sharps contaminated with radioactive materials must be packaged for pickup by Radiation Safety, who will make determination of the classification of the sharps, and will recycle or dispose as waste.

E. SEALED SOURCES

All sealed sources which are considered radioactive waste shall be held separate from other radioactive wastes for removal by Radiation Safety. A determination will be made by Radiation Safety as to the disposition of the source. Under no circumstances shall a sealed source be disposed with other radioactive waste by any Authorized User.

F. SPECIFIC EXCESS MATERIALS AND SEPARATION AND DISPOSAL

F.1 Specifically Exempt Materials

25 TAC §289.202(fff)(1) provides for the disposal of certain excess materials without regard to its radioactivity.

- 1) 0.05 microcuries or less of H-3, C-14, or I-125 per gram of medium used for liquid scintillation counting or in vitro clinical or laboratory testing;
- 2) 0.05 microcuries or less of H-3, C-14, or I-125 per gram of animal tissue, averaged over the weight of the entire animal.

All excess materials containing radioactive materials shall be picked up by Radiation Safety and a determination shall be made by Radiation Safety personnel as to the qualification of the materials with regard to 25 TAC §289.202(fff) per the procedure in paragraph F.3 of this Section. Documentation shall be generated and maintained to verify qualification of this waste as exempt waste.

F.2 Short-Lived Isotopes ($T_{1/2} < 300$ days)

Solid materials containing radionuclides with half-lives less than or equal to 300 days (e.g. ^{32}P , ^{33}P , ^{45}Ca , ^{35}S , ^{125}I , etc.) may be disposed as specifically exempt waste provided concentration and annual curie limits as described in the 25 TAC §289.202(fff)(4) and the University's Radioactive Materials License are not exceeded. The solid radioactive excess materials which contain only radioactive materials with half-lives less than or equal to 300 days and no other hazardous materials will be separated and placed into containers for disposal. All markings denoting the material as Radioactive Materials shall be defaced or removed from items placed into the waste. All pertinent data for routine disposal of these materials shall be recorded on the Radioactive Materials Pickup form. Upon classification of these materials as waste, disposal of this waste shall be by Radiation Safety in accordance with 25 TAC §289.202(fff)(4) and the procedure described in paragraph F.3 of this Section. Short-lived radioactive materials of ≤ 120 days which exceed concentrations or amounts for disposal as non-radioactive materials may be held for Decay-In-Storage per paragraph F.3.5 of this Section.

The Radiation Safety Office must be contacted prior to the generation of wastes containing radioactive materials and other hazardous materials.

F.3 Separation and Disposal of Waste

All excess radioactive materials which are declared to be waste shall be separated by Radiation Safety for disposal per the following procedure:

F.3.1 Preparation of Waste

- A. **Initial Waste Survey** - All excess materials which are classified as waste will be processed by Radiation Safety at the waste preparation facility. The Radioactive Materials Pickup form will be used to initially separate the waste types into half-lives greater than 300 days and half-lives \leq 300 days. The waste will then be further separated into candidates for disposal per 25 TAC §289.202(fff) and (gg) and candidates for disposal as radioactive materials. Appropriate survey instruments may be used to survey the waste for separation into isotope types. If materials with half-lives greater than 300 days are mixed with materials with half-lives \leq 300 days, the package will be disposed as determined by analysis of the various disposal requirements.
- B. **Specifically Exempt Waste** - The excess materials classified as waste per the description of 25 TAC §289.202(fff) and (gg), will be separated from other radioactive waste by Radiation Safety at the waste preparation facility. All signs, labels, or other markings which would indicate that the materials were radioactive shall be permanently and completely defaced or removed. No package will be sent for disposal until it is ascertained that all conditions of 25 TAC §289 are satisfied. If the waste is a non-aqueous liquid as defined in Part A.1.2, it will be transferred in containers with no radiation markings to University EHS Hazardous Materials Section for disposal.

F.3.2 Disposal into a Type I Landfill

All materials disposed in a Type I landfill shall meet the requirements of 25 TAC §289.202(fff)(4), and shall not exceed the concentration and curie limitations of the University's License. The Type I landfill shall be a Type I Municipal solid waste site as defined in the Municipal Solid Waste Management Regulations of the Texas Commission on Environmental Quality (TCEQ), unless the waste contains a hazardous waste as defined in the Solid Waste Disposal Act. Hazardous waste will be disposed at a facility authorized to manage hazardous waste by the TCEQ, US Environmental Protection Agency or other appropriate regulatory agency.

F.3.3 Delivery Procedure to a Type I Landfill

Delivery of waste to the Type I landfill shall comply with the following procedure:

1. No liquid wastes are allowed,
2. Solid waste shall be containerized in cardboard, wooden or metal containers and free of radioactive material labels,

3. Only appropriately trained staff may transport waste,
4. University owned or leased vehicle shall be used for transport,
5. Waste holding area of vehicle shall be secured to prevent unauthorized access to the waste following loading and during transport.
6. Waste containers shall be secured in holding area to prevent movement normal to transport.
7. Radiation Safety staff shall have a radiation survey meter, such as a Ludlum Model 3 with a Model 44-9 G-M pancake probe, in the vehicle to perform contamination surveys.
8. Upon return from the landfill, perform and document a direct survey of the vehicle's waste holding area.
9. Remove any contamination resulting from the transport of the waste, and
10. File the survey results with the copy of the waste manifest.

F.3.4 Disposal via a Licensed Low-Level Radioactive Waste Facility

Any radioactive materials classed as waste which do not meet the criteria specified in 25 TAC §289.202(fff) or (gg) shall be disposed at a facility licensed to accept radioactive materials for disposal. The materials shall be packaged according to USDOT, waste processor, and disposal site requirements as applicable, and shall be identified by isotope, quantity, chemical form, and any other requirements which are levied for the proper manifesting, processing, and disposal of these items. Radiation Safety may compact the materials for disposal. Transportation shall be via a carrier licensed to accept and deliver radioactive materials. The University currently uses the services of a licensed waste broker for the off-site treatment and/or disposal of radioactive waste.

Infrequent transfers of solid and liquid radioactive waste may be received from the Nuclear Engineering Teaching Laboratory, USNRC License No. R-129, located at the University's J.J. Pickle Research Campus. The radioactive waste is generated by research and educational activities and limited primarily to activated components and compactable materials, such as laboratory protective clothing and paper, and contaminated liquid wastes. Prior to any transfer of solid or liquid radioactive waste from NETL, the waste shall be characterized to determine for each radioactive material the quantity in micro or millicuries, physical and chemical form, as well as volume and/or weight. The RSO shall review the characterization for adequacy and determine whether the radioactive material is within the material authorizations of License No. L00485. Upon written approval from the RSO, the transfer may then occur. Immediately upon receipt, the radioactive material inventory records shall be increased based on the waste characterization. The waste shall be disposed in the same manner as described in the previous paragraph.

F.3.5 Decay-in-Storage (DIS)

Radioactive materials with half-lives ≤ 120 days (e.g. ^{32}P , ^{33}P , ^{35}S , ^{125}I , etc.) may be held for decay by storing in a secure area. If more than one isotope is included in the materials held for DIS, the materials shall either be segregated or the longest half-life isotope shall be used to compute the amount of time required before disposal may occur. After storing the waste

for a sufficiently long time so the radioactive material has significantly decayed, the waste shall be surveyed in a low background area with an appropriate survey instrument to ensure that readings are indistinguishable from background. Defacing or removing radiation labels is not required if the labels are otherwise obscured in containers which are not designed to be opened (e.g. sharps or medical waste containers). Records shall be maintained to document proper disposal of the material and shall include the following information:

- The date of disposal,
- Manufacturer's name, model number, and serial number of the survey instrument used,
- Background radiation level,
- Radiation level measured at the surface of the waste container,
- Name of the individual performing the survey.

G. ANIMAL TISSUE AND CARCASSES

All animal tissues, carcasses, excrement, and bedding which have been contaminated with radioactive materials must be disposed through Radiation Safety. These items must be double bagged to prevent leaks and tears. All description requirements of the Radioactive Waste Pickup form must be met for pick-up. Radiation Safety will pick up the items and determine the proper type of disposal based on the isotopes and concentration. Animal disposal will follow the procedures in Part F.3 of this document, except animals which meet the requirements of 25 TAC §289.202(fff)(1) or (gg) may be macerated for disposal via the sanitary sewer. Additional requirements are found in Appendix VII of this Manual.

H. RELEASE INTO THE ATMOSPHERE

Release of radioactive materials into the atmosphere shall only be incidental to working with radioactive materials in solid or liquid form, unless specific permission is given to use radioactive gases by the Radiation Safety Committee. Although limitations on the atmospheric effluent are given in 25 TAC §289.202, Radiation Safety shall be contacted prior to using any radioactive materials in a situation where release to the atmosphere may occur. Any actions which might result in release of radioactive materials into the atmosphere shall be conducted in an area with a forced ventilation system such as a fume hood, ventilated greenhouse, or other area where characteristics of the airflow are known. Releases to the atmosphere shall comply with requirements of 25 TAC §289.202(o)(2)(B)(i).

I. RECORDS

All excess radioactive materials shall be documented prior to pick-up by Radiation Safety on the Radioactive Materials Pickup form (or equivalent). Radiation Safety will document the isotope and quantity, chemical form, volume, physical form, date received, Purchase Order Number (if available), the type of disposition, date of disposal, the concentration in $\mu\text{Ci/gm}$ if 25 TAC §289.202(fff)(1) is used for disposal, the concentration in Ci/m^3 and Ci/yr if 25 TAC §289.202(fff)(4) is used for disposal, and will retain copies of these records. Information for the instrument used to survey the materials for separation and disposition will be recorded, including

the name of the surveyor, the date of survey, the instrument type, model number, serial number, and the date of calibration.

VIII. EMERGENCY PROCEDURES

A. GENERAL

A.1 Available Resources

In the event of an emergency involving radioactive materials, the following materials can be obtained by contacting the Radiation Safety Office: coveralls, disposable gloves and shoe covers, respirators, decontamination wash materials, pocket dosimeters, high-and-low-range survey instruments, radiation signs, tags, labels, aprons, handling tongs, plastic bags, high volume air samplers, filters and vacuum cleaning equipment.

A.2 Radiation Incident

A radiation incident shall be defined as an accident or unusual occurrence that causes unplanned, exposure to personnel or results in a spill of material. In the event of a radiation incident, the procedures outlined in subsequent parts of this Section shall be followed immediately. A current list of Emergency Phone Numbers for Radiation Safety shall be available in each area where radioactive materials are used.

B. SPILLS OF RADIOACTIVE MATERIALS

B.1 Minor Spill (<100 microcuries)

A minor spill is defined as a spill of less than 100 microcuries. The laboratory shall initiate and complete cleanup operations, and document the spill and cleanup. The following procedures should be followed in the event of a minor spill. Personnel are expected to use sound judgment in initiating clean-up efforts.

- Notify persons in the area that a spill has occurred.
- Prevent the spread of contamination by covering the spill with absorbent paper.
- Clean up the spill, wearing disposable gloves and using absorbent paper.
- Carefully fold the absorbent paper with the clean side out and place in a plastic bag for transfer to a radioactive waste container. Put contaminated gloves and any other contaminated disposable material in the bag.
- Survey the area with an appropriate low-range radiation detector survey meter or other appropriate technique. Check the area around the spill for contamination. Also check hands, clothing, and shoes for contamination.
- Allow no one to return to work in the area until the incident is resolved.
- Report the incident to the RSO promptly if complications are encountered.
 - Cooperate as needed with the RSO and/or Radiation Safety staff (e.g., investigation of root cause, provision of requested bioassay samples).
 - Follow any instructions of the RSO and/or Radiation Safety staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

Reminders to RSO for Minor Spills

- Follow up on the decontamination activities and document the results.
- As appropriate, determine cause and corrective actions needed; consider bioassays, if there is a potential for internal contamination.
- If necessary, notify the TDSHS.

B.2 Major Spills (>100 microcuries)

A major spill is defined as a spill of greater than 100 microcuries. The laboratory shall notify the Radiation Safety Officer and not initiate cleanup operations without authorization from the Radiation Safety Office. The following procedures should be followed in the event of a major spill. Personnel are expected to use sound judgment in initiating clean-up efforts.

- Clear the area. If appropriate, survey all persons not involved in the spill and vacate the room.
- Prevent the spread of contamination by covering the spill with absorbent paper (paper should be dampened, if solids are spilled), but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.
- Shield the source only if it can be done without further contamination or significant increase in radiation exposure.
- Close the room and lock or otherwise secure the area to prevent entry. Post the room with a sign to warn anyone trying to enter that a spill of radioactive material has occurred.
- Notify the RSO immediately.
- Survey all personnel who could possibly have been contaminated. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with a mild soap.
- Allow no one to return to work in the area unless approved by the RSO.
- Cooperate with the RSO and/or Radiation Safety staff (e.g., investigation of root cause, provision of requested bioassay samples).
- Follow the instructions of the RSO and/or Radiation Safety staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

Reminders to RSO

- Confirm decontamination of personnel. If decontamination of personnel was not fully successful, consider inducing perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.
- Supervise decontamination activities and document the results. Documentation should include location of surveys and decontamination results.
- Determine cause and needed corrective actions; consider need for bioassays if licensed material is suspected to have been ingested, inhaled, or absorbed through or injected under the skin.
- If necessary, notify the TDSHS.

B.3 Injuries Involving Radioactive Materials

If a person is both injured and contaminated, the following listed action will vary with different accident conditions. Contact Radiation Safety for assistance if needed.

1. For serious injuries, immediately call 911. Treatment of the serious injury should take precedence over almost all concern for contamination control and radiation exposure.
2. Notify Radiation Safety. (After normal working hours use emergency phone list).
3. No transport restrictions should be imposed that would seriously compromise the patient's medical care.
4. When transporting a contaminated patient to a hospital emergency room or the designated emergency receiving point, the following procedures should be followed:
 - a. Contaminated clothing should be removed if, possible.
 - b. If skin decontamination is necessary, wash the patient thoroughly with soap or detergent and water.
 - c. Wrap patient in a clean sheet or blanket.
 - d. A representative from Radiation Safety should accompany the patient, but do not delay transport if Radiation Safety personnel are not present.
5. External contamination is not immediately harmful to the patient unless the skin is badly punctured or wet.
6. Minor injuries can usually be treated at the scene and can usually wait until after an initial radiation survey has been completed.
7. Cuts which penetrate the skin offer a point of easy access to the body for radioactive materials. Radioactive materials should not be allowed to come in contact with a cut anywhere on the body. If a person is cut by a contaminated article, this should receive immediate treatment. It should first be cleansed very thoroughly. The wound should be checked for contamination if a high energy beta or gamma emitter is known to be involved. Soft beta and gamma cannot be easily detected in a cut, particularly in the presence of water. Cuts involving possible contamination should be reported to Radiation Safety so that necessary steps can be taken immediately to evaluate the contamination.

C. EMERGENCY NOTIFICATION

The Texas Department of State Health Services has established a 24-HOUR RADIOLOGICAL EMERGENCY ASSISTANCE telephone number:

(512) 458-7460

This number shall be used for emergency assistance reporting only. For routine business matters call (512) 834-6688. Additional assistance may be obtained if necessary by contacting Radiation Safety, University Police or **911**.

The Radiation Safety Officer shall notify the Radiation Safety Committee immediately of the occurrence of any radiation incident that may affect the health or well-being of any individual.

D. EMERGENCY PHONE NUMBERS

**RADIATION SAFETY
EMERGENCY PHONE NUMBERS**

Environmental Health and Safety 24-hour Immediate Response Pager and Phone

Pager: 512-875-0911

Phone: 512-658-2411

Radiation Safety Personnel

<u>Name</u>	<u>Position</u>	<u>Office</u>	<u>Alternate</u>
Scott Pennington	Radiation Safety Officer	512-471-2042	512-935-9015
Chris Walter	Radiation Safety Manager	512-471-1496	512-935-9044
DeWayne Holcomb	Radiation Safety Specialist	512-471-2038	512-935-9023
Ryan Green	Radiation Safety Specialist	512-471-2029	512-935-9047
Tracy Tipping	Reactor Health Physicist	512-232-4174	512-826-2671

University Emergency Phone Number **911**

The Radiation Safety Officer may revise this page as needed.

APPENDIX I – Radiation Safety Committee Membership Roster
(As of April 2016)

Chair

Dr. Kevin N. Dalby Professor
Division of Chemical Biology and Medicinal Chemistry

Vice-Chair

Dr. Daniel T. Jaffe Vice President for Research
Office of the Vice President for Research

Members

Dr. Rick Russell Associate Director, Professor
Department of Molecular Biosciences

Dr. Jack L. Ritchie Department Chair, Professor
Department of Physics

Mr. Tracy N. Tipping Health Physicist and Laboratory Manager
Nuclear Engineering Teaching Laboratory

Dr. J. Steven Swinnea TMI X-Ray Facility Manager
Department of Chemical Engineering

Mr. John M. Salsman Director
Environmental Health and Safety

Dr. Karen M. Vasquez Professor
Division of Pharmacology and Toxicology

Dr. Christopher S Sullivan Associate Professor
Department of Molecular Biosciences

Ex-Officio Member

Mr. W. Scott Pennington Assistant Director, MS, MSM, CHP, CLSO
Radiation Safety Officer
Environmental Health and Safety

Drs. Dalby, Vasquez, Russell, and Sullivan are active Authorized Users.

APPENDIX II – Procedure for Remote Site Use of Radioactive Materials

1. PURPOSE

The purpose of this procedure is to provide control for the use of radioactive materials by The University of Texas at Austin at sites in the State of Texas other than the specific locations listed on State of Texas Department of State Health Services, License L00485.

2. LICENSE REFERENCES

The University of Texas at Austin is licensed to use radioactive materials at temporary sites throughout Texas per the Radioactive Materials License: Open form amounts of radioactive materials, specifically Carbon-14 (C-14) and Tritium (H-3) labeled reagents, 6.0 millicuries total.

3. DISCUSSION

3.1 Marine Research with Open Form Materials

Field research is performed by The University of Texas Marine Science Institute aboard a seagoing vessel, R/V (Research Vessel) *Katy*, while at sea. During the research protocols, small marine life and water samples are taken, brought aboard ship, tagged with radioactive materials, processed in experimental conditions, and then stored for proper disposal on return to shore. This research may be performed in international waters, in which case a Form NRC-241 is submitted to the United States Nuclear Regulatory Commission requesting reciprocity.

3.2 Procedures for Control

The procedures detailed here are designed to assist the researcher in achieving proper safety and in complying with relevant regulations. No procedures can fully replace cognizance and awareness of safety, therefore the procedures are designed to reinforce training and heighten attention to the requirements of using radioactive materials.

4. PROCEDURE - OPEN FORM RADIOACTIVE MATERIALS

1. Confirm the presence of the following items on the vessel:
 - A. Copy of The University of Texas at Austin Radioactive Materials License, including the License Commitments.
 - B. Storage containers for radioactive waste.
 - C. Labels and signs to denote containers with radioactive materials and cabins which have radioactive materials, and postings required by the 25 TAC §289, specifically including the *Notice to Employees and Students*.

- D. Protective wear, including gloves, coats, glasses, and any other garments or wear to prevent contamination of an individual using radioactive materials.
 - E. Tools used to properly handle radioactive materials during the experimental protocol.
 - F. Adequate space dedicated to radioactive materials use, storage, and handling.
 - G. Detection equipment suitable for detecting the radioactive materials used in the experiment.
 - H. Cleanup equipment to clean spills.
2. Confirm all protocols and procedures are approved by the Authorized User.
 3. Confirm all individuals who will be performing the protocol have proper training in the use of radioactive materials.
 4. Move the radioactive materials to the vessel, post the cabin in which the materials are located, and ensure proper marking of equipment to be used during the protocol.
 5. Perform the experiment per requirements of the protocol. During the experiment, ensure containment of all radioactive materials.
 6. After completion of the experiment or of the day's work, perform surveys of work areas and equipment to determine levels of contamination, if any.
 7. During decontamination, clean all equipment, and place all cleaning solutions, materials, and equipment which are contaminated into marked containers for disposal/cleanup onshore.
 8. Check all personnel involved in the experiment for contamination on hands, feet, and other areas, and decontaminate if required.
 9. At termination of cruise, perform complete survey of equipment and work areas. If surveys indicate contamination levels of 1000 dpm/100 cm² of surface area, clean the area until the contamination is reduced significantly below this level. NOTE: Copies of all survey data shall be maintained at Marine Science Institute.
 10. On return to shore, remove all radioactive materials (including radioactive waste) from the vessel and transfer the materials to appropriate storage locations. Document the radioactive waste for pickup by Radiation Safety. Document the surveys in the radiation log book. Perform final survey of the vessel, and record survey readings. Remove cabin postings and markings from cleaned containers.

APPENDIX III –Procedure for Calibration of Radiation Survey Meters

1. The RSO will supervise the instrument calibration program. The Radiation Safety Officer and RSC may delegate meter calibration activities to approved employees. Those individuals, approved by the RSO or RSC to perform meter calibrations, will be trained on proper meter calibration procedures.
2. A list of instruments to be calibrated is maintained.
3. Calibration shall be performed with a radiation source and/or pulser traceable to the National Institute of Standards and Technology.
4. We intend to use a Model 28-6A calibrator containing up to 606 mCi of Cs-137. This source will be an approximate point source. The strength of the source shall be sufficient to calibrate the instrument on all ranges, or at least up to 1 R/hr on the higher ranges. Attenuators may be used to reduce the exposure rate to acceptable rates for calibration.
5. Each scale of the instrument will be calibrated at least at two points located approximately 20% and 80% of full scale. For logarithmic rate-changing instruments, a calibration will be made near the mid-range of each decade and two points will be calibrated on at least one of the decades.
6. The true exposure rate at any distance from the source shall be calculated based on known characteristics of the source and the inverse square law on the date of the calibration of the source.
7. The exposure rate (or count rate) measured by the instrument under calibration shall not differ from the true rate by more than 20% at any point of measurement.
8. Instrument calibration records shall be maintained by the Radiation Safety Office for a minimum of three years. The records shall include at a minimum the make/model/serial number of the instrument, the detector type, the date of calibration, the individual performing the calibration, and measurements taken on each scale.
9. The date of calibration of the instrument, the initials or other designator of the calibrating individual, and the date the next calibration is due shall be affixed to the instrument on completion.
10. If repairs are made to an instrument, the instrument shall be recalibrated, records shall be generated, and the instrument may or may not be taken out of its regular calibration cycle. At no time shall the calibration of an instrument exceed annual interval.

APPENDIX IV – Bioassay Program Procedures

³H (TRITIUM) BIOASSAY PROCEDURES

- A. Prior to commencement of operations using quantities of ³H in excess of those listed in Table 3 of Section VI., authorized users shall notify the Radiation Safety Office of such and provide the names and contact information of those individuals who meet the criteria of J.1.a. of Section VI. Authorized users shall not permit any individual who meets the criteria of J.1.a. to work with or near tritium until they have undergone a baseline bioassay.
- B. The Radiation Safety Office shall contact these individuals and schedule a time and place convenient to both parties for the collect of a baseline urine sample. The Radiation Safety staff shall provide participants with plastic containers with screw-tight lids for urine collections.
- C. The Radiation Safety Office shall analyze urine samples using a liquid scintillation counter and NIST traceable standards. The volume and counting time shall be sufficient to have a minimum detectable activity of at least 0.1 nCi/L.
- D. Individuals participating in this program shall notify the Radiation Safety Office following their initial work with or near tritium to schedule the first routine bioassay. Upon completion of this first bioassay, a bioassay schedule shall be established for the individual in accordance with J.3.b. of Section VI.
- E. Excluding baseline samples, participants should collect the entire 24-hour urinary output. The Radiation Safety Office suggests that participants start the 24-hour sampling period with the first urinary elimination in the morning and continue until the next morning. On the container, the participant should record the start and stop days and times for the collection.
- F. Any individual involved in a tritium incident who may have exceeded the limit of J.3.d. of Section VI. shall notify the Radiation Safety Office immediately. The Radiation Safety Officer may request sampling within 2 to 48 hours after a suspected or known intake.
- G. Any individual who is participating in this program shall notify the Radiation Safety Office upon discontinuing work with tritium or prior to terminating employment with or otherwise leaving the University. A final urine sample should be provided for a post-operational bioassay within ten days of the last possible exposure.
- H. In the event an administrative limit is exceeded in Section VI.4., the applicable actions specified in the appendices of Section VI. shall be followed.

¹²⁵I and ¹³¹I BIOASSAY PROCEDURES:

- A. Prior to commencement of operations using quantities of ¹²⁵I or ¹³¹I in excess of those listed in Table 2 of Section VI., authorized users shall notify the Radiation Safety Office of such and provide the names of those individuals who meet the criteria of G.1 of Section VI. Authorized users shall not permit any individual who meets the criteria of G.1. to work with or near radioiodines until they have undergone a baseline bioassay.
- B. The Radiation Safety Office shall contact these individuals and schedule baseline bioassays at a time and place convenient to both parties.
- C. Individuals participating in this program shall notify the Radiation Safety Office following their initial contact with radioiodine to schedule the first routine bioassay (to be performed within 6-72 hours). Upon completion of this first bioassay, a bioassay schedule shall be established for the individual in accordance with G.2.b. and G.2.c. of Section VI.
- D. Any individual involved in a radiological incident who may have exceeded the limits of G.3.b. of Section VI. shall notify the Radiation Safety Office immediately.
- E. Any individual who is participating in this program shall notify the Radiation Safety Office prior to terminating employment with or otherwise leaving the University.
- F. Bioassay shall be performed by individuals designated by the Radiation Safety Officer and shall be conducted in accordance with the detailed bioassay test instructions as modified to the specific test area.
- G. A background shall be taken of the room environment; a reading shall be taken of the individual's thigh, and a reading of the individual's thyroid for each bioassay.

APPENDIX V – Radioactive Material Laboratory Audit Form

THE UNIVERSITY OF TEXAS AT AUSTIN
ENVIRONMENTAL HEALTH AND SAFETY
 Radiation Safety
 (Revised: May 2009)

Radioactive Material Laboratory Audit Form

In order to ensure that operations are carried out safely and in compliance with The Texas Department of State Health Services regulations, as well as UT policies and procedures, Radiation Safety staff conducts periodic audits of laboratories. During the course of each audit both external radiation levels and surface contamination levels may be monitored. Also reviewed are the lab's radionuclide inventory, survey records, and training records. Any discrepancies encountered during the audit will be discussed with the authorized user or designee.

Building(s): _____

Room(s): _____

Authorized User: _____

Isotope(s): _____

YES: Satisfactory Compliance NO: Unsatisfactory Compliance N/A: Not Applicable or Observed

	Yes	No	N/A		Yes	No	N/A		
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Lab Signs and Postings	8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Training Records
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Radiation Safety Manual	9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Dosimeters Properly Worn
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Copy of Authorization	10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RAM Security
4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RAM Inventory Records	11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Proper Shielding
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RAM Waste Records	12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Use Areas Demarcated
6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Receipt/Use/Waste, Records match	13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RAM Container Labels
7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	User Surveys	14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Survey Instruments

Comments:

See continuation sheet as necessary for further detail

Report Attachments: _____ **Inspection Date:** _____

Audited by: _____ **Signature:** _____ **Date:** _____

Reviewed by: _____ **Signature:** _____ **Date:** _____

THE UNIVERSITY OF TEXAS AT AUSTIN
ENVIRONMENTAL HEALTH AND SAFETY
Radiation Safety
(Revised: May 2009)

Radioactive Material Laboratory Audit Form
Continuation Sheet

Authorized User: _____

Date of Audit _____

APPENDIX VI – Application to Use Radioactive Material

APPLICATION TO USE RADIOACTIVE MATERIAL

(Revised: May 2009)

THE UNIVERSITY OF TEXAS AT AUSTIN
ENVIRONMENTAL HEALTH AND SAFETY
RADIATION SAFETY OFFICE
SER 221, Mail Code C2600
512-471-3511, FAX: 512-475-6383

This form shall be completed and returned to the Radiation Safety Officer (RSO). (It is suggested that an electronic draft be submitted to the RSO for review and comment prior to obtaining the required signatures.) Only upon notification of approval shall use of radioactive material be permitted. Please type or electronically submit this form. Hand-written forms will not be accepted.

- 1) Name, department, campus address, phone number, and email of person responsible for possession, use, and disposal of radioactive material:

- 2) Address of Laboratory or place of use and storage, if different from 1):

- 3) Name, UTEID and title of individual(s) who will use or supervise the use of radioactive material:

- 4) Applicant's previous permits, authorizations or equivalent obtained under a NRC or Agreement State license or registration:

- 5) Radioactive material for which authorization is desired. (Be specific. List each radioactive material with the maximum quantity and chemical/physical form of each to be used in each procedure and to be possessed at any one time):
- 6) Describe, in detail, proposed uses for radionuclide(s) identified in item 5) and period of time radioactive material use is requested (use additional sheets if necessary):
- 7) Describe procedures which will assure radiation doses to faculty, staff and students are **As Low As Reasonably Achievable** (ALARA) :
- 8) Describe the types of radioactive waste to be generated and radioactive waste collection and handling procedures (e.g., chemical and physical form of the waste, radioactive materials in each waste stream, other hazardous or potentially infectious materials present, total activity or concentration of radioactive material, and type of liquid scintillation cocktail used, if applicable).

9) Describe personnel training and experience. Include, at a minimum, individual(s) identified in item 3):

10) Type and number of radiation detection instruments available for surface contamination and area surveys:

11) Proposed personnel monitoring devices (>1 mCi of P-32 manipulated at one time, requires whole body and ring dosimeters):

12) Clearly identify location(s) of use and describe facilities to be used (include fume hoods, sinks, refrigerator/freezer, etc.). Include a detailed sketch of the location(s) with this application:

13) Describe radiation survey procedures, methods of locating and remediating radioactive contamination, and record keeping of survey results:

14) If animals are to be used, describe procedures (handling, disposal, etc.):

15) In the event of an accident, describe emergency procedures:

Applicant's Signature

Date

Dean or Department Chairperson's Signature

Date

Reviewed, Radiation Safety Officer's Signature

Date

APPENDIX VII - Procedures for Laboratory Animal and Veterinary Medicine Uses

This procedure provides additional information on the use of byproduct materials in laboratory animals, in animals used for research in the environment, and by veterinarians.

Training

Before allowing an individual to care for animals used in studies with or treated with licensed material, the RSO and AU shall ensure that the user has sufficient training and experience to maintain doses ALARA, control contamination, handle waste appropriately, etc.

Classroom training (which may be live or via video, computer, etc.) will cover the following areas:

- Principles and practices of radiation protection.
- Radioactivity measurements, monitoring techniques, and using instruments.
- Mathematics and calculations basic to using and measuring radioactivity.
- Biological effects of radiation.

Appropriate on-the-job-training will consist of:

- Observing authorized personnel using survey equipment, using proper contamination control techniques, and proper disposal of radioactive material.
- Using survey equipment, proper contamination control techniques, and proper disposal of radioactive material procedures under the supervision of, and in the physical presence of, an individual authorized to handle animals treated with licensed material or otherwise containing licensed material.
- Procedures for ensuring animal rooms are locked or otherwise secured unless attended by the Authorized User or appropriately trained users of the radioactive material.

Laboratory Animals

Contamination Control and Waste Handling

In order to minimize the spread of contamination, animals used in studies with or treated with licensed material should be housed in cages or stalls separate from other animals. The cages or stalls shall be secured to prevent unauthorized access to the animals. Individuals caring for these animals should reduce the chance of personal contamination by wearing gloves, lab coat, and eye protection, as appropriate.

Special care should be observed when cleaning the cage or stall. The cage or stall, the bedding, and waste from the animal may contain radioactive material. Any radioactive material should be properly disposed of as described in the section waste processing procedures for animal materials.

Disposal of laboratory animals that contain radioactive material require special procedures. Animal carcasses that contain less than 1.85 kBq/gram (0.05 microcuries/gram) of carbon-14,

hydrogen-3, or iodine-125 may be disposed of by the same method as non-radioactive animal carcasses. Animal carcasses that contain byproduct material with a half-life of less than or equal to 120 days may be allowed to decay-in-storage in a freezer dedicated for radioactive material. Animal carcasses must be held for a sufficiently long time so the radioactive material has significantly decayed based on the longest lived isotope present. After storage, the animal carcasses may be disposed as non-radioactive, if radiation surveys (performed in a low background area and without any interposed shielding) of the carcasses at the end of the holding period indicate that radiation levels are indistinguishable from background.

Veterinary Use

Training

All veterinary personnel that come in contact with animals that have been treated with radioactive materials will have taken the Radiation Worker training specified in Section VI. of this document.

Animal Materials

- I.** No animal waste will be picked up for disposal prior to suitable deactivation of infectious agents. Four types of radioactive waste are generated from animal experiments; bedding, dry, blood/urine, and carcasses. Each type is to be segregated and prepared for disposal.
- II.** Bedding
 1. This consists of bedding material only. Bedding is to be double bagged in plastic bags.
 2. Separate the bedding material by the half-life of the isotope that was used on the animal (Greater than or less than 300 day half-life).
- III.** Solid or dry waste also follows the Waste Processing Procedures located in Section VII.
- IV.** Blood/Urine
 1. Collect blood/urine separately in plastic container.
 2. Follow the bulk liquid waste procedures located in Section VII.
- V.** Carcasses
 1. Separate carcasses with a half-life less than or equal to 120 days and double bag in plastic bags.
 2. Separate carcasses with a half-life greater than 300 days and those that are less than 0.05 $\mu\text{Ci}/\text{gram}$ for H-3, C-14, and I-125. These carcasses should be double-bagged in plastic bags with as much of the air removed as possible.
 3. For those that have content greater than 0.05 $\mu\text{Ci}/\text{gram}$ for H-3, C-14, and I-125 label high concentration and separate from the other carcasses.
 4. All carcasses should be kept frozen until Radiation Safety picks them up.

APPENDIX VIII - Sealed Source Inventory
(As of May 2009)

Authorized User Responsibilities

A quarterly inventory form will be generated for the Authorized Users. The AUs will perform a quarterly inventory of their sealed sources using the computerized inventory form. The AU will verify the accuracy of the information, complete the inventory form (see sample form and inventory below), and promptly return the completed form to the Radiation Safety Office.

Radiation Safety Staff Responsibilities

The Radiation Safety staff shall ensure that all of the distributed forms have been returned. They will identify any discrepancies between the records and the items noted on the inventory forms. Any discrepancies will be investigated and resolved.

Follow-up/Enforcement Procedures for Compliance

In the event the AU fails to return the completed inventory form, Radiation Safety staff will send a written reminder to return the completed form. Failure of the AU to respond within the allotted time period will result in a formal, non-compliance letter sent to the Department Head with a copy sent to the AU. The Radiation Safety staff will perform a physical inventory of the sealed sources in the authorized place of use.

Any Authorized User who twice, in one year, fails to return a completed Quarterly Inventory form in a timely manner resulting in Radiation Safety staff having to physically inventory the sources shall have a formal letter of non-compliance addressed to the appropriate Dean and copied to the Radiation Safety Committee. Further action may be taken by the RSC or Radiation Safety Officer resulting in confiscation of the sealed sources by Radiation Safety and revocation of the AU's authorization.

Exceptions to the Policy:

Any exceptions to established policy are at the discretion of the RSC or RSO.

Return to: Safety Office
 Service 202
 M/C C2600

The University of Texas at Austin
 Office of Environmental Health and Safety
 Radioactive Material Quarterly Inventory
 For 1st QU 2009 (DUE May '02)

Lic Nbr.: 301
 Name: HOFFMANN, GERALD

Dept: PHYSICS / C1600 Bldg: RLM Location: 10.306 Prepared by: _____ Date: _____

Isotope	P.O. Number	Compound	Quantity Received*	Date Received	Current Activity*	Date			
						JANUARY	FEBRUARY	MARCH	
						Date	Quantity**	Date	Quantity**
PM147	00002711	S/N PHC419 (PHY-27)	1.0000	04/05/76	0.0051				
PU239	M195	S/N M195 (CNS-8)	930.0000	08/22/61	928.7420				
PU239	00M56411T	S/N M564 (CNS-9)	10000.0000	09/23/70	9989.0540				
SR90	06A33779010	S/N OF526	10.0000	06/19/06	9.3267				
SR90	2-304010	S/N 422-304	0.0103	03/01/93	0.0069				
SR90	21461711	S/N S-672 (PHY-43)	5.0000	03/01/92	3.2600				
SR90	21912911T	S/N T-370 (PHY44)	5.0000	05/27/92	3.2795				

* All Activity is Measured in Millicuries
 ** For Sewer Disposal Only (Use Reverse Side if Necessary). Use Form US0-1-4 to record all other disposals.

Sealed Source Inventory
(This page was intentionally left blank)

APPENDIX IX - Periodic Intervals

It is recognized that periodic inspection, calibration, testing, etc. is required to maintain a successful radiation safety program. The intervals as listed below are to provide operational flexibility and not to reduce frequency of the required task. The listed intervals were chosen to be consistent with those authorized in licenses issued to the University by the USNRC. Established frequencies shall be maintained over the long term. Allowable intervals shall not exceed the following:

- Annual – not to exceed 15 months
- Semiannual – not to exceed 7.5 months
- Quarterly – not to exceed 4 months
- Monthly – not to exceed 6 weeks
- Weekly – not to exceed 10 days