Abilene Christian University
Radiation Safety Manual

November 2022

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1. Organization for Control of Radiation

1.1 The organization for radiation safety at Abilene Christian University (ACU) consists of the Radiation Safety Committee (RSC), a Radiation Safety Officer (RSO) who operates the Radiation Safety Office and assists the RSC in discharging its responsibilities, the University Administration, Department Chairs and Laboratory Directors within whose jurisdictions work with sources of ionizing radiation is conducted, Authorized Users (AUs) who receive their authorizations from the RSC, and Individual Users who work under the supervision of AUs.

1.2 Radioactive materials may only be used by or under the supervision of the RSO or other qualified and trained individuals identified as AUs.

1.3 This Radiation Safety Manual provides a general overview of the requirements for working with or handling items contaminated with radioactive materials. Gloves, lab coats, safety glasses, and other protective equipment will be utilized by staff to protect themselves from contamination as warranted. Employees are expected to adhere to these requirements. However, they require flexibility in determining the appropriate needs for any specific type of work involving radioactive materials.

2. Radiation Safety Committee

2.1 Establishment.

The RSC of ACU is established by the Sr. Vice President of Operations. The purpose of the RSC is to ensure that all sources of ionizing radiation at ACU are used safely and in a manner that complies with applicable regulations of the State of Texas, so that the individual user, the university population and the general public are protected.

The RSC reports through its chair to the Sr. Vice President of Operations and monitors the operations of the university RSO.

2.2 Responsibilities. The RSC shall:

2.2.1 Annually review the ACU Radiation Protection Program and recommend appropriate changes.

2.2.2. Assist the RSO to establish an effective radiation protection program in compliance with applicable regulations and ACU policy.

2.2.3. Assure that each AU is qualified by training and experience, has the facilities to use the material or equipment safely, and proposes a use which is safe for all concerned.

2.2.4. Review instances of alleged infractions of regulations for the safe use of sources of ionizing radiation and recommend remedial action if appropriate (this responsibility extends to on-campus projects conducted by non-university organizations or individuals).

2.2.5. Ensure the maintenance of all records required by law or regulation due to the presence or use of sources of ionizing radiation on the campus.

2.3 Authority.

To meet its responsibilities, the RSC is given the following authority:

2.3.1. To grant or deny authorization to an individual, or to any ACU or non-university organization for the use, on ACU property, of radioactive material or radiation-producing equipment.

2.3.2. To prescribe the conditions for use on ACU property of sources of ionizing radiation, including requirements for bioassay and/or physical examinations of users, special effluent control devices, minimum level of user training and experience, and restrictions on the amount of occupational exposure which an individual may be permitted to receive during his or her ACU association.

2.3.3. To suspend or terminate any project or procedure on ACU property involving the use of sources of ionizing radiation which it finds to be a threat to health or property.

2.4 Membership.

The RSC consists of the Chair and additional members as indicated below. Appointments to the RSC are made by the RSC Chair with the advice of Department Chairs, Deans and the RSO.

2.4.1. Ex-Officio Members.

Chair

Director of Institutional Compliance and Risk Management

Representative from Maintenance and Operations

RSO

2.4.2. Technical Members.

One member, qualified by training and experience in the use of radioactive material or radiation-producing equipment is appointed from each Department/Laboratory which makes extensive use of sources of ionizing radiation.

2.5 Meetings.

The RSC shall meet a minimum of three times per year. More frequent meetings may be scheduled as necessary, such as to evaluate a new proposal for the use of a source of ionizing radiation. An affirmative vote of two-thirds of all members of the RSC is required to approve an application for use of a source of ionizing radiation.

2.6 Records.

The formal record of the RSC is the minutes of its meetings. The minutes shall contain a record of all recommendations and actions of the RSC, together with such additional material as the Chair shall deem appropriate for completeness. The minutes shall be maintained throughout the life of the license by the RSO.

3. RSO Duties and Responsibilities

The RSO is responsible for the following:

3.1 Review and approve designation of use areas and review procedures for the handling and use of radioactive material.

3.2 Review and approve AUs and maintain records documenting compliance with the training and experience requirements established in the license.

3.3 Distribute and receive personnel monitoring devices (dosimeters) for staff monitored for external radiation dose, timely review of results, maintenance of dosimetry records, and issuing reports.

3.4 Provide for the training of all radioactive material users consisting of initial radiation safety training as appropriate for the intended uses and annual refresher training. The RSO will maintain records of radiation safety training to include topics covered, training date(s), and attendees.

3.5 Supervise and coordinate radioactive waste disposal, including the maintenance of waste in storage (including decay-in-storage) and disposal records.

3.6 Maintain records of radioactive materials inventory, receipt and transfer of licensed material, radiation surveys and audits, instrument calibration reports, and personnel dosimetry reports.

3.7 Provide supervision and assistance for the management of emergency, accident, spill, or exposure situations.

3.8 Ensure that the terms and conditions of the radioactive materials license are met and that the license is amended for changes in the use of radioactive material, responsible individuals, or commitments provided in the licensing process.

3.9 Ensure that licensed materials are properly secured against unauthorized removal at all times when not in use.

3.10 Ensure that the radiation safety program is reviewed at intervals not exceeding 12 months.

4. Responsibilities and Requirements of Authorized Users

AUs are individuals working under the terms and conditions of the radioactive materials license that meet the criteria established herein. AUs have the authority to (a) work unsupervised with licensed radioactive materials and (b) supervise other radioactive material users. The RSO is responsible for evaluating applications for AU status and maintaining records establishing that AUs meet or exceed the criteria established by the RSC. At a minimum, AUs will have one year experience working with radioactive materials similar to those used under this license.

5. Responsibilities and Requirements of Individual Users

5.1 Prior to beginning work with licensed radioactive material, individuals must complete the following requirements:

5.1.1 Receive authorization from the RSO.

5.1.2 Administrative processing and receipt of a personnel monitoring device (if required for the work to be performed or the work area).

5.1.3 Complete initial radiation safety training (as provided for by the RSO).

5.1.4 Complete project-specific/hands-on training to be provided by an AU covering activities approved under the AU's authorization.

5.2 Individual User Responsibilities.

Each individual who works with radioactive materials must adhere to the following procedures:

5.2.1 Keep exposures to ionizing radiation to levels as low as reasonably achievable (ALARA).

5.2.2 Participate in radiation safety training as requested by the RSO.

5.2.3 Wear the prescribed personnel radiation dosimeters such as whole body badges and extremity (ring) badges, when required for the radioactive materials used.

5.2.4 Survey hands, shoes, and body for radioactive contamination before leaving the area when working with unsealed sources of radioactive material.

5.2.5 Use all appropriate protective measures as dictated by the protocol or procedure, such as:

- Wear protective clothing, typically consisting of gloves, lab coats, and safety glasses.
- Use protective barriers and other shields whenever possible.

- Use mechanical devices whenever their aid will assist in reducing doses.

5.2.6 Do not smoke, eat, drink, apply cosmetics, or store/use personal effects in posted radioactive material areas where unsealed sources are used or stored. Refrigerators shall not be used jointly for foods and radioactive materials.

5.2.7 Maintain good personal hygiene.

- Keep fingernails short to avoid cutting latex/vinyl gloves.
- Do not work with radioactive materials if there is a break in the skin below the wrist, or use double gloves.
- Wash hands and arms thoroughly after handling radioactive material to limit intake through the mouth, nose, or eyes.

5.2.8 Immediately report accidental inhalation, ingestion, or injury involving radioactive materials to the AU and the RSO, and carry out their instructions regarding bioassays and recommended corrective action.

6. General Policies and Procedures for Radioactive Materials Use

6.1 Designation of Radioactive Materials Use Areas and Posted Areas.

The RSO's office phone number and an off-duty phone number will be posted along with the other postings as required (including this written program).

6.1.1 Radioactive Materials are to be used only in rooms or areas as authorized by the RSO.

6.1.2 The RSO will be responsible for the designation of posted areas.

6.1.3 Areas where more than exempt quantities of radioactive materials are used or stored will be posted with the signs as required in 6.2.

6.1.4 The RSO will arrange for a free release inspection survey for areas in which radioactive material use has been discontinued and no longer requires designation as a posted area.

6.2 Signs and Labels for Laboratories, Areas and Equipment.

6.2.1 A "CAUTION RADIOACTIVE MATERIALS" sign must be conspicuously posted on the door(s) to areas where licensed radioactive materials are being used or stored.

6.2.2 All equipment contaminated or potentially contaminated with radioactive material shall be marked "CAUTION RADIOACTIVE MATERIALS" with tape, decals, or by other conspicuous means.

6.3 Shielding of Sources.

Radioactive sources will be shielded in such a manner that the dose rates in unrestricted areas will not exceed 2 millirem in any one hour and will not cause a member of the public to receive 100 mrem in one year.

6.4 Protection of Work Surfaces from Contamination.

When using unsealed radioactive materials, all work surfaces (bench tops, storage areas, and areas adjacent to permanent set-ups and sinks, etc.) will be covered with stainless steel or plastic trays, or other impervious materials. For many purposes a plastic-backed absorbent paper will be satisfactory.

6.5 Periodic Surveys of Radioactive Material Use Areas.

6.5.1 Restricted areas where unsealed sources are used (described in Section 9 of this manual) will be subject to contamination surveys to ensure that contamination levels are maintained in accordance with the survey frequencies and contamination levels shown below.

6.5.2 **Daily Survey -** The immediate areas (e.g., bench tops) in which unsealed radioactive materials are being used will be monitored for contamination at least once daily following the use of the radioactive materials by the users in that area. The daily check is required to be performed only on the days that unsealed radioactive materials are used. These daily checks will consist of direct monitoring using portable radiation detection instruments appropriate for the radionuclides being used. If materials with ^{3}H or ^{63}Ni are being used, collection and analysis of wipe tests for contamination is required.

6.5.3 **Monthly Survey -** Each posted lab or area in which unsealed radioactive materials are used during a given month will be surveyed by the RSO or his designate. This survey will include, as necessary: direct monitoring using portable radiation detection instruments for contamination, measuring exposure rates, performing wipe tests for removable contamination and checking compliance with standard radiation safety practices. A survey report form will be completed documenting all survey activities and results.

6.5.3 Copies of the monthly survey records will be maintained by the AU and/or RSO.

6.6 Radiation Detectors.

6.6.1 Each posted area shall have available for use at least one portable survey meter to be used by radiation workers during and following work with licensed materials. The meter(s) present must be appropriate for the radionuclide(s) in use.

6.6.2 Each survey meter or radiation detector will have a dedicated check source. The standard check source will be 1 μCi Tl-204 for beta/gamma GM detectors, or 0.05 μCi I-129 for NaI gamma detectors, and will be mounted on the side of the survey meter. Other sources may be used as appropriate.

6.6.3 Survey meters used for making required measurements will be calibrated at intervals not exceeding 12 months. Survey meters that exceed the 12 month interval may only be used for classroom demonstrations.

6.6.4 Survey meters retained for instructional purposes only are not required to be calibrated.

7. Radioactive Spill Procedures and Emergencies

7.1 Radioactive Contamination of Areas.

7.1.1 In general, no radioactive contamination can be tolerated. Exceptions to this includes certain lab surfaces, dry boxes, stainless steel trays, absorbent paper covered surfaces, or other equipment which is used frequently for radioactive material work and which will be clearly marked with the standard radiation caution tape or labels. Any contamination that is not confined to controlled surfaces shall be cleaned immediately.

7.1.2 Surface contamination action guidelines for all areas will be as follows:

	Beta-gamma; U	Th, I	Alpha
Removable	1,000 dpm/100 cm^2	200 dpm/100 cm^2	20 dpm/100 cm^2
Fixed	5,000 dpm/100 cm^2	1,000 dpm/100 cm^2	100 dpm/100 cm^2

7.1.3 The amount of removable radioactive material per 100 cm^2 of surface area will be determined by wiping the surface with a dry filter or soft absorbent paper, applying moderate pressure and assessing the amount of radioactive material on the wipe area with an appropriate instrument of known efficiency (e.g. liquid scintillation or gamma counter).

7.1.4 The amount of fixed contamination will be determined from direct monitoring of the surface or item in question with an appropriate survey meter and correcting for measurements above background, to obtain the net count-rate, for the instrument efficiency, and for the measurement geometry.

7.2 Decontamination of Areas Contaminated with Radioactivity.

7.2.1 Preparations for decontamination should begin promptly when warranted. Determine the extent and hazard presented by the contamination. The RSO will be available to assist in this evaluation when needed. The individual responsible for the contamination will be expected to do most of the clean-up under the supervision of the AU or RSO.

7.3 Decontamination of Personnel Contaminated with Radioactivity.

7.3.1 Notify other personnel in the area and the AU immediately after a contaminating accident.

7.3.2 Wash affected body area involved thoroughly for 2 or 3 minutes, repeatedly "soaping" and rinsing. Consideration may be given to the chemistry of the contaminant and an attempt made to find a suitable agent for dissolving it. Cleansing agents may be used, but soaps are preferred to synthetic detergents. Avoid the use of organic solvents as they may make the skin more permeable to radioactive contaminants.

7.3.3 If decontamination efforts are not completely effective, notify the RSO. Such decontaminating agents as "Versene" or "Radiacwash" etc., may be used under the direction of the RSO.

7.4 Major Spills (greater than 10 μCi total, more than 1 m^2 contaminated area, or including unrestricted areas).

7.4.1 CLEAR THE ROOM: Notify all persons not involved in the spill to vacate the room, but to not leave the area until they have been surveyed for contamination.

7.4.2 PREVENT THE SPREAD: Cover the spill with absorbent paper or material, but do not attempt to clean it up. Confine the movement of all personnel to prevent the spread of contamination.

7.4.3 CLOSE THE ROOM: Turn off ventilation systems. Leave the room and lock the door(s) to prevent entry.

7.4.4 CALL FOR HELP: Notify the RSO immediately.

7.4.5 SURVEY PERSONNEL AND DECONTAMINATE IF NECESSARY: Contaminated clothing should be removed and stored for further evaluation by the RSO. If the spill is on the skin, flush thoroughly and then wash with mild soap and warm water.

7.4.6 PLAN FURTHER ACTION: The RSO will supervise the decontamination effort and provide guidance for the decontamination methods and the potential need for follow-up bioassay.

7.5 Minor Spills (less than 10 μCi total and less than 1 m^2 area in restricted areas).

7.5.1 NOTIFY: Notify persons in the area that a spill has occurred and call the RSO.

7.5.2 PROTECT PERSONNEL: Perform any personnel decontamination before proceeding with spill clean-up.

7.5.3 CONTROL: Restrict access to the contaminated area. Do not allow anyone or anything to leave the contaminated area without being monitored for radioactivity before starting clean-up work.

7.5.4 SURVEY: Use a GM pancake detector for most alpha and beta/gamma emitters, wipes and liquid scintillation counting for ^{3}H and ^{14}C, Ni-63, or < 1 μCi ^{125}I. Check the area around the spill, hands, and clothing for contamination. Mark off the contaminated area with "CRAM" tape.

7.5.5 CLEAN-UP: Gather decontamination supplies. Wear protective clothing (lab coat and disposable gloves at a minimum). Wear assigned dosimetry. Clean up the spill using dry paper towels first. Use decontamination agents after dry techniques have been used. Work from the outside edge of the spill in towards the center. Use only 1 "pass" of the paper towel then place in radioactive waste.

7.5.6 SURVEY AGAIN: Use appropriate survey meter for direct measurements and take wipes and analyze for "removable" contamination.

7.5.7 REPORT: Report the results of the decontamination effort to the RSO.

7.6 Emergencies

Contact the AU and RSO if any unexpected emergencies arise during decontamination and decommissioning activities. When necessary, appropriate notification will be made to the TDSHS to inform them of the nature of the emergency.

8. Radiation Dosimetry for Personnel

Radiation doses to users of radioactive material under this license are not expected to exceed 10% of the allowable limits established by the State of Texas from either external or internal sources. However, to demonstrate compliance with the requirement the following program will be implemented:

8.1 External Radiation Monitoring

8.1.1 External monitoring will not be required for ^{3}H, ^{14}C, ^{35}S, ^{33}P, ^{63}Ni, and alpha-emitting isotopes.

8.1.2 Users of more than 0.5 mCi of gamma or high energy beta emitting radioisotopes will have whole body doses measured with film, TLD's or other equivalent technology, obtained from a commercial vendor (with successful participation in the National Voluntary Laboratory Accreditation Program for personnel dosimetry). The quantities apply to both the quantity handled at any one time or the integrated amount of activity introduced in 1 month. The RSO reserves the right to provide an external monitoring badge to any radiation worker.

8.1.3 Dosimeters for personnel monitoring will be exchanged quarterly.

8.1.4 Doses to the extremities will be evaluated with TLD ring badges for users of high energy beta/gamma emitters who perform procedures requiring them to handle more than 1 mCi in 1 month.

8.2 Internal Radiation Monitoring

8.2.1 Bioassay monitoring is not a part of the routine radiation safety program as it is not warranted. It is not likely that any worker will receive an intake approaching ten percent of an annual limit on intake (ALI). Bioassay monitoring will only be implemented following an incident (spill, fire,

etc.). In the event that the RSO determines a need for internal dose monitoring, it is likely that it would be accomplished via urinalysis.

8.2.2 Emergency bioassays will be performed in case of a spill involving more than 1 mCi of licensed material or for other possible intakes in excess of 10% of an ALI.

8.3 ALARA

Exposures to radiation will be maintained at levels as low as reasonably achievable (ALARA). The following ALARA goals are in place.

Annual ALARA Goals	
Occupationally Exposed Adults	0.5 rem whole body (TEDE) 5 rem organ or tissue 1.5 rem lens of eye (LDE) 5 rem skin (SDE)
Declared Pregnant Woman	0.1 rem to embryo/fetus

The RSO will investigate any personnel dose which exceeds one of the tabulated ALARA goals.

9. Area Survey Procedures

9.1 **Daily Survey** (After Use of Unsealed Radioactive Material in Posted Areas). Survey with an appropriate survey meter for the isotope(s) used, unless wipe samples are required (see Section 5).

9.1.1. Check battery condition, replace if necessary.

9.1.2. Check meter response using “check source.”

9.1.3. Take a background reading in a nearby area that does not include licensed radioactive sources.

9.1.4. Perform the surveys required. Use good technique (probe within 1 – 2 cm from the surface, audio “on”, moving detector <5 cm per s).

9.2 **Monthly Survey**.

9.2.1 All posted areas authorized for use of unsealed radioactive material will be surveyed monthly by the RSO or his/her designate. If only ^{3}H or ^{63}Ni is used, wipe tests will be performed in place of survey meter monitoring.

9.2.2 The monthly survey will consist of:

Measurement of radiation levels in restricted and unrestricted areas with a survey meter sufficiently sensitive to detect 0.1 mR/h and surface

contamination levels at or less than 2,000 dpm/100 cm^2. Exposure rate readings will only be taken if unusual or high radiation readings are found during contamination surveys.

The action limits for external radiation levels for Radiation Surveys of Unrestricted Areas will be as follows: Any radiation levels above normal background will be investigated to insure compliance with the dose limits to the public of 2 mrem in any 1 hour and less than 100 mrem in 1 year.

A series of wipe tests (area of 100 cm^2) to assess surface contamination levels. The method for performing wipe tests will be sufficiently sensitive to detect 200 dpm per 100 cm^2 for the isotopes used.

10. Disposal of Radioactive Materials

The procedure described herein applies to work with unsealed sources of radioactive materials leading to the generation of radioactive wastes.

10.1 Radioactive waste must be disposed of according to special procedures.

10.2 All radioactive waste must be presented for pick up from the facility in a condition suitable to be handled manually. It is the user's responsibility to ensure this. The user must also be able to provide accurate descriptions of the waste including radionuclide and the estimated activity of each radionuclide placed in each waste container.

10.3 Plans for proper handling of pathogenic waste, mixed chemical and radioactive waste or other unusual waste must be made prior to the generation of the waste in consultation with the RSO.

10.4 All waste containers must be conspicuously marked "Caution Radioactive Material" and located away from other non-radioactive waste containers. No liquid waste is permitted in the solid radioactive waste and no solids (such as leak test swabs) are to be placed into a liquid waste container.

10.5 Radioactive waste handling in posted areas.

10.5.1 Dry/Solid Radioactive Waste.

- All dry/solid radioactive waste must be placed in the step cans (or equivalent) provided. Additional waste containers can be requested as needed. They must be kept fitted with a disposable polyethylene liner.
- Broken glassware must not be placed directly in the dry/solid radioactive waste container but into a "sharps" container that is labeled with "Caution Radioactive Material."
- Sharps, pipettes, sharp plastic and glass are to be placed into cardboard boxes or equivalent designed for this waste.

10.5.2 Liquid radioactive waste.

- Liquid waste will be placed into decay-in-storage or held for transfer to a licensed radioactive waste broker for off-site disposal.
- No liquid radioactive wastes will be disposed into the sanitary sewer.
- Original source vials containing high activities in low volumes should be handled separately from low activity concentration liquid waste. Consult the RSO for guidance. Lead shielding that may be supplied by the manufacturer for shielding source vials will not be collected unless it is still needed to shield the source vial for disposal. Remove or obliterate the radioactive markings, survey for contamination, and dispose of the shielding as lead (not in the regular trash).

10.5.3 Liquid scintillation vials (LSV).

- All LSV should be tightly capped and returned to the original shipping trays. The estimated activity for each radionuclide in the tray must be marked on the outside of the tray and the tray labeled "Caution Radioactive Material."
- LSV must be segregated by radionuclide. This provides the greatest flexibility for disposal.

10.6 Preparing radioactive wastes for disposal.

10.6.1 The user must be able to estimate the contents of each radioactive waste container. The following information will be included on a tag attached to each item or in another waste log book or record.

- User's Name
- Date
- Activity (⌠Ci or mCi)
- Isotope
- Waste Type

10.6.2 Only clear or translucent plastic bags will be used for packaging dry/solid radioactive waste in the lab. These bags should be sealed at the top and properly labeled. If there is danger that the bag may be torn or damaged by its contents, multiple bags will be used.

10.7 Radioactive waste may be disposed of by transfer to an authorized recipient.

Each procedure that uses radioactive materials will be examined and the fraction of the total activity in each waste stream estimated. This calculation will be changed as necessary for each change in procedures.

Records will be maintained of radioactive waste as it is generated, stored and shipped for off-site disposal.

10.8 Short half-life Radioactive Waste. Short half-life radioactive waste (≤ 120 day half-life) may be held for decay-in-storage. The short half-life radioactive waste will be stored, surveyed along the container surfaces at the end of the decay period and, if no radiation readings above background are found, disposed of as non-radioactive waste, as described in the following procedure:

All radioactivity labels must be defaced or removed from containers and packages prior to disposal in ordinary (non-radioactive) waste.

Non-radioactive waste should not be mixed with radioactive waste being held for decay-in-storage.

Metal stepcans or drums or fiberboard containers will be used to decay radioactive waste. Each radioactive waste container will be lined with a plastic bag. No waste will be placed in an unlined container.

Plastic bags will be used for packaging dry/solid radioactive waste. These bags should be sealed at the top and properly labeled. If there is danger that the bag may be torn or damaged by its contents, multiple bags will be used.

The outer surface of each stepcan or fiberboard container containing radioactive wastes will be labeled with "Caution, Radioactive Materials" labels or tape.

Fill out a Radioactive Waste Decay-In-Storage Form (located in this manual) for each waste container. A form will be started upon the initial placement of a radioactive waste container into the decay-in-storage area and will be completed when the waste is found suitable for disposal. The RSO will retain the records of decay-in-storage disposal for at least 3 years.

The procedure is as follows. Place any potentially contaminated waste material in a plastic bag. Typical waste stream components consist of paper towels, latex gloves, disposable laboratory diapers and/or absorbent paper.

Seal each bag of waste with tape. Complete a Radioactive Waste Decay-In-Storage form; attach it to the waste container in a plastic sheet holder. Be sure this form is securely attached to its respective container.

Following a minimum of ten half-lives since the container was placed in storage, monitor along the container surface for radioactivity as follows:

- Perform quality control measurements with calibrated pancake GM and/or NaI detectors, as appropriate.
- Survey the waste container in a background area.

- Monitor all surfaces of the container with no shielding between the waste container and detector.
- Discard the contents as ordinary trash only if the survey indicates no residual radioactivity, i.e., surface readings are indistinguishable from background.
- If the surveys indicate residual radioactivity, replace the container into the storage area.

Check to be sure there are no radioactive labels present on any piece of trash. Remove or obliterate any found.

Radioactive Waste Decay-in-Storage Program
Report of Release of Waste as Non-Radioactive

Date of Survey	
Surveyor's Name	
Meter Information	**Serial #:**
	Meter Type/Manufacturer:
	Calibration Date :
	Background Radiation Level (cpm or mR/hr):
Waste Container Identification	

Waste Information

Waste Description	Radionuclide(s) in Waste	Date waste generated	Radiation Level at Surface of Waste (cpm / mR/hr) circle one

Date of Survey

Waste Description	Radionuclide(s) in Waste	Date waste generated	Radiation Level at Surface of Waste (cpm / mR/hr) circle one

10.9 Dry/Solid Radioactive Waste. Dry/Solid radioactive waste which is not eligible for decay-in-storage will be packaged according to the instructions from the disposal broker for shipment/transfer to an authorized recipient for final disposal. If there is no access available for final disposal, the long half-life radioactive waste will be placed in interim storage until final disposal is available.

10.10 Disposal of Liquid Scintillation Vials (LSV). LSV containing radioactive material will be packaged according to the instructions from the disposal broker for shipment/transfer to an authorized recipient.

11. Shipping Radioactive Materials

11.1 Radioactive materials, including radioactive waste items generated during routine and decontamination and decommissioning activities, will be prepared for transport in accordance with US Department of Transportation (DOT) regulations.

11.2 All staff involved in preparing packages of radioactive material for transportation will complete appropriate hazardous materials training on shipping radioactive materials.

11.3 Packages containing Class 7 materials will be provided to licensed/permitted haulers.

11.4 All Class 7 transfers/shipments must be packaged and labeled in accordance with DOT regulations. Licensed material shall not be transferred or shipped from one licensee to another without the approval of the RSO.

12. Procedures for Procurement, Receipt, and Inventory

12.1 Procurement Procedures.

12.1.1 The AU will notify the RSO of any intended acquisition of licensed radioactive materials.

12.1.2 The AU will complete a purchase requisition/order (PO) and forward it to the RSO, when necessary.

12.1.3 The RSO will insure that the requested material, quantities, and form are authorized by the license and that the possession limits are not exceeded prior to the order being placed with a vendor.

12.2 Receipt of Radioactive Materials Packages

Instructions to Shipping and Receiving Personnel

12.2.1 Upon arrival, receiving personnel will immediately contact the RSO. The RSO or designee will monitor and wipe test packages as required by 12.3 below.

12.2.2 During off-duty hours (from 5 PM to 8 AM), licensee personnel should accept delivery of radioactive packages in accordance with the following procedure:

12.2.2.1 Any package containing radioactive material that arrives during off duty hours shall be signed for by designated trained personnel on duty and taken immediately to the designated receiving area and placed in locked secure storage.

12.2.2.2 If the package appears to be damaged, immediately contact the RSO. Ask the carrier to remain at the facility until it can be determined that neither the carrier nor the vehicle is contaminated.

12.3 Procedure for Opening Packages Containing Radioactive Material

Authorized individuals shall implement procedures for opening each package, as follows:

12.3.1 Wear gloves to prevent hand contamination.

12.3.2 Visually inspect the package for any sign of damage (e.g. crushed or puncture). If damage is noted, stop and notify the RSO.

12.3.3 Check DOT White I, Yellow II, or Yellow III label or packing slip for activity of contents, so shipment does not exceed possession limits.

12.3.4 Monitor the external surfaces of a labeled package according to specifications in the following table.

Package	Contents	Survey Type	Survey Time
Labeled White I Yellow II Yellow III	Not Gas or Special Form Less than Type A Quantity	Contamination	As soon as practicable but not more than 3 hours after receipt of package if received during normal work hours
Not Labeled	Licensed Material	None	None
Damaged	Licensed Material	Contamination Radiation Level	As soon as practicable; not more than 3 hrs after package receipt if received during normal work hours

12.3.5 Open the outer package (following supplier's directions if provided) and remove packing slip. Open inner package to verify contents (compare requisition, packing slip and label on the bottle or other

container). Check integrity of the final source container (e.g. inspection for breakage of seals or vials, or loss of liquid, discoloration of packaging material, high count rate on smear). Again check that the shipment does not exceed license possession limits. Notify the RSO of any problems or discrepancies.

12.3.6 Survey the packing material and packages for contamination before discarding. If contamination is found, treat as radioactive waste. If no contamination is found, obliterate the radiation labels prior to discarding in the regular trash.

12.3.7 Document package survey on Radioactive Package Inspection Form (attached) and maintain records.

12.3.8 Notify the final carrier and the TDSHS by telephone or facsimile when removable radioactive surface contamination or external radiation levels exceed acceptable limits.

12.4 Inventory Procedures.

12.4.1 The RSO will record the receipt of radioactive sources in a spreadsheet used to provide real-time tracking of the inventory of licensed materials.

12.4.2 The RSO or designee will conduct a semi-annual inventory of sealed sources maintained at ACU. The inventory form will identify each source by serial number, radionuclide, activity, and location. A copy of the inventory record shall be maintained in the radiation safety files.

12.4.3 The RSO shall date each line item confirming the materials were on-site and keep a copy of the report for at least three years.

12.4.4 Accountability and Leak Testing for Sealed Sources

12.4.4.1 The RSO will maintain a list of all sealed sources containing licensed material.

12.4.4.2 Each sealed source containing radioactive material other than H-3, with a half-life greater than 30 days and in any form other than a gas, will be tested for leakage and/or contamination at intervals not to exceed six months or as specified in the sealed source device registration certificate for the source or device. In the absence of a certificate from the transferor indicating that a test has been made within six months prior to the transfer, the sealed source will not be put into use until tested. If there is a reason to suspect that a sealed source may have been damaged, or may be leaking, it will be tested for leakage before further use.

12.4.4.3 Records of leak tests will be kept in units of microcuries and maintained by the RSO.

12.4.4.4 If the test reveals the presence of 0.005 microcuries or more of removable contamination, the RSO will immediately withdraw the sealed source from use and order it to be decontaminated and repaired or to be disposed of as radioactive waste.

12.4.4.5 Any licensed sealed source is exempt from leak tests when the source contains 100 microcuries or less of beta and/or gamma emitting material or 10 microcuries or less of alpha emitting material.

12.4.4.6 All leak test samples will be analyzed by an Agreement State or NRC licensed vendor in accordance with their approved procedures.

Radioactive Package Inspection Form

Step	Action/Information
1	Date of Inspection _____ Order PO Number _____
2	Package Condition (circle one): Good, no apparent damage Damage noted (e.g. crushed, wet, or leaking)
3	If Package is damaged, perform wipe test and check radiation level at the surface and at one meter. Check all surfaces with meter and wipe test. Record maximum readings. Wipe test must cover at least 300 cm^2. Wipe test results: _____ dpm Radiation level results: _____ mRem/hr at the surface mRem/hr at one meter
4	Package Labels (circle one):
	No Labels
	White I 
	Yellow II 
	Yellow III 
5	If labeled (White I, Yellow II, or Yellow III) package is damaged, perform inspection as stated above in Step 3. If labeled (White I, Yellow II, or Yellow III) package is not damaged, perform wipe test only and record results. Wipe test must cover at least 300 cm^2. Wipe test results: _____ dpm If package is not labeled and not damaged, the inspection is completed.

13. Security of Licensed Materials

13.1 Access Control.

Access into work areas will be controlled to keep unauthorized personnel from entering areas where licensed materials are used or stored. When possible, physical barriers, such as locked doors, will be used along with adequate signage to warn individuals of the hazards posed by the presence of radioactive materials. Administrative controls, such as the use of guards or sentries, may be used when warranted and physical barriers are unavailable.

13.2 Physical Security of the Radioactive Material Use Areas.

13.2.1 The access to the posted areas will be restricted via locked doors or will have another suitable means to prevent entry by unauthorized personnel. The main entrance, or access, will be attended when not closed and locked.

13.2.2 Visitors will be escorted when in posted areas. Personnel have the right to challenge unfamiliar persons as to their identity and reasons for being in posted areas or laboratories.

13.2.3 Radioactive sources shall be stored in a locked room, closet, or storage cabinet when not in use.

14. Radiation Safety Training

14.1 Initial Training. Each user must receive a minimum of a basic radiation safety training class. The training can be any combination of traditional classroom training, review of written materials, 1-on-1 training, computer-based training, or viewing videos. The following topics comprise the initial radiation safety training content:

- Radioactivity Fundamentals
- Biological Effects of Radiation (NRC Reg Guide 8.29 and 8.13)
- Review of the ACU Radiation Safety Program
- Inventory and Security of Radioactive Materials
- Reporting Violations
- Review of Rules and Regulations
- Use of Dosimeters and Bioassays; ALARA
- Instrumentation and Radiation Surveys
- Contamination Control and Emergency Response
- Radioactive Waste

Training at another facility can be used to meet this requirement if a review of this Radiation Safety Program is provided. When prior training is cited, the user will provide proof of training to the RSO, who will maintain all relevant training records. In addition, the RSO or his/her designate will review the

user's technique for handling isotopes and procedures and offer critique and instruction as necessary in a "1-on-1 session."

14.2 Annual Refresher Training. The RSO will provide for annual refresher radiation safety training to ACU radiation workers on any of the above listed topics. The training can be any combination of reading, 1-on-1 training, computer-based training, viewing videos, or classroom instruction. Lectures and written materials/examinations which are read and completed by radiation workers may also be used to complete annual refresher training.

14.3 Instructions to Ancillary Personnel.

If deemed beneficial by the RSO, personnel frequenting any portion of a restricted area (e.g. housekeeping, security) who do not otherwise work with radioactive material will receive instructions concerning the appropriate performance of their work in areas where radioactive materials may be used or stored.