ARKANSAS STATE UNIVERSITY

Radiation Safety Manual

Environmental Health and Safety

Introduction

The objectives of the Arkansas State University Radiation Safety Program are to assist in fulfilling the University's commitment to provide a safe and healthy environment for employment and learning and to establish and promote safe practices at all times. Protection of employees, students, the public, and university property and operations are paramount and every attempt will be made to ensure that our facilities are as free as possible from recognized radiation hazards.

The Arkansas Department of Health has issued a Specific Broad Scope License to Arkansas State University. This license authorizes and tightly regulates the responsible use of radionuclides on our campus.

The purpose of Arkansas State University's Radiation Safety Manual is to assist faculty, staff, and students in complying with the regulations of the Arkansas Department of Health and the A-STATE Radiation Safety Committee. This manual is not intended to be an exhaustive or fully comprehensive reference, but rather a guide to enable qualified personnel safe and efficient use of radionuclides and ancillary staff protection from undesirable exposure to the effects of radionuclide use. Further information associated with the use of radioactive materials on this campus can be obtained by contacting the A-STATE Radiation Safety Officer**.**

Radiation Event Medical Management at the U.S. Department of Health & Human Services
http://remm.nlm.gov/

FOR

Emergency Assistance

In case of an emergency or accident situation:

Notify:

Radiation Safety Officer at 972-3644

or

Environmental Health & Safety at 972-2862

Nights, Weekends or Holidays:

Notify

University Police

972-2093

AND

Radiation Safety Officer

864-710-2933

For routine information contact the Radiation Safety Officer

at mdooley@astate.edu.

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Chapter 1 Radiation Safety Committee

1.1 Purpose

The Arkansas Department of Health, Division of Radiation Control and Emergency Management regulations require the establishment of a Radiation Safety Committee (RSC). The purpose of the RSC is to promote the best practice in safe handling and use of radiation sources. The RSC is also established to assure compliance with State regulations and the conditions set forth by the license. Any individual or action, which jeopardizes the license, endangers the permission of all researchers to utilize radioactive materials at Arkansas State University.

1.2 Organization

The Radiation Safety Committee, which meets at least annually and as necessary to conduct the business of the radiation safety program, is comprised of the Radiation Safety Officer, Committee Chair (an appropriate representative appointed by the Office of Research and Academic Affairs), one (1) licensed user, one (1) physicist with knowledge of radiation physics and two (2) faculty members, one of which must be from outside ABI, Agriculture, and the College of Science and Mathematics, trained and experienced in the safe use of radioactive materials.

1.3 Responsibilities

This Committee is responsible for establishing procedures and policies for the authorized procurement, protection, use, and disposal of radioactive materials and for the safety and protection of all personnel, students and visitors, on the Arkansas State University Campus. The Committee shall:

1. Provide technical and administrative guidance and aid in the interpretation of various regulations governing the use of radioactive materials.
2. Review and act upon all new, renewal, and amended applications for possession and use of radioactive materials.
3. Determine the adequacy of training and experience of persons requesting permission to use or supervise the use of radioactive materials.
4. Determine the suitability of space, facilities, or equipment designated for use or storage of radioactive materials.
5. Receive and review periodic reports from the RSO on monitoring, contamination, and personnel exposure.
6. Meet, at the call of the chair of the Radiation Safety Committee or designated representative, to review alleged infractions of safety rules and regulations, incidents, and emergencies concerning any radiation program or project.
7. Provide recommendations to the RSO for items 3-6 above.

Chapter 2 Radiation Safety Officer Duties and Responsibilities

Radiation Safety Officer derives authority from the Division of Finance and Administration with support from the Office of Research and Academic Affairs. The RSO's duties and responsibilities include ensuring radiological safety and compliance with Arkansas Department of Health Division of Radiation Control and Emergency Management and Department Of Transportation regulations and the conditions of the University license. The RSO's duties and responsibilities include the following:

1. Ensure that the radioactive material possessed by Arkansas State University is limited to the types and quantities of material listed on the license.
2. Oversee all activities involving radioactive material, including monitoring and surveys of all areas in which radioactive material is used and stored.
3. Provide necessary information on all aspects of radiation protection to personnel at all levels of responsibility.
4. Oversee proper delivery, receipt, and radiation surveys of all shipments of radioactive material arriving at the University, as well as proper packaging and labeling of all radioactive material being shipped from the University.
5. Maintain an active inventory of all radioisotopes housed at Arkansas State University and records of their disposal.
6. Distribute and process personnel radiation monitoring equipment, determine the need for and evaluate bioassays, monitor personnel radiation exposure and bioassay records for trends and high exposures, notify individuals and their supervisors of radiation exposures approaching the limits, and recommend appropriate remedial action.
7. Coordinate or conduct training programs and otherwise instruct personnel in the proper procedures for handling radioactive material prior to use, at periodic intervals (annual refresher training), and as required by changes in procedures, equipment, regulations, etc. Ensure that all ancillary employees and emergency personnel whose assigned duties may involve exposure to radioactive materials in the course of their employment are trained in Radiation Safety.
8. Supervise and coordinate the radioactive waste disposal program, including effluent monitoring and recordkeeping on waste storage and disposal records.
9. Oversee and manage the storage of radioactive material not in current use, including waste.
10. Perform or arrange for leak tests on all sealed sources and for calibration of radiation survey instruments.
11. Immediately terminate any unsafe condition or activity that is found to be a threat to public health and safety or property.
12. Maintain other records not specifically designated above, including records of receipts, transfers, and surveys as required by Arkansas Department of Health Rules and Regulations.
13. Attend periodic meetings of the Radiation Safety Committee and provide reports to the Committee and Vice Chancellor for Research and Academic Affairs.
14. Ensure that the results of audits, identification of deficiencies, and recommendations for change are documented (and maintained for at least 3 years) and provided to the Radiation Safety Committee and the Vice Chancellor for Research and Academic Affairs for review; ensure that prompt action is taken to correct deficiencies.

15. Ensure that the audit results and corrective actions are made available to all personnel who use licensed material.
16. Ensure that all incidents, accidents, and personnel exposure to radiation as defined by the ASBH Rules and Regulations are investigated and reported to the Arkansas Department of Health and other appropriate authorities, if required, within the required time limits.
17. Maintain understanding of and up-to-date copies of regulations, the license and revised license procedures, and ensure that the license is amended whenever there are changes in licensed activities or responsible individuals.

Chapter 3- Chair of Department of Chemistry and Physics Duties and Responsibilities

The Chair of the Department of Chemistry and Physics functions under the Dean of the College of Sciences and Mathematics. In relation to the Radiation Safety Program, the Chair of the Department of Chemistry and Physics is responsible for performing periodic audits of the radiation safety program to ensure that the RSO and all associated users are complying with all applicable Arkansas Department of Health regulations and the terms and conditions of the license (i.e., leak tests, inventories, use limited to trained approved users, etc.). Internal audits of the Radiation Safety program at Arkansas State University are performed two times per year and a copy of the results of the audit are sent to the Associate Vice Chancellor for Research.

Chapter 4- Licensing and Registration Regulations

4.1 Federal Regulations

There are several areas in which the Federal Government retains regulatory powers in agreement states such as Arkansas.

1. The receipt, possession, use or transfer of by-product, source or special nuclear materials in quantities sufficient to form a critical mass.
2. The construction and operation of any production or utilization facility.
3. The export from or import into the United States of by-product, sources, special nuclear material, or electronic devices.
4. Any agency of the Federal Government.

In all other cases the Arkansas Department of Health, Division of Radiation Control and Emergency Management is given the power to license and regulate the receipt, possession, use and transfer of sources of ionizing radiation.

4.2 State Regulations

Because Arkansas is an agreement state, the Division of Radiation Control and Emergency Management of the Arkansas Health Department is empowered to license or register radiation sources and to enforce

the regulations governing the activities of a licensee or registrant. Arkansas State University has been issued a specific broad scope license.

Within the conditions imposed by the Arkansas Department of Health through the Rules and Regulations, the licensee (A-STATE) is allowed to state what procedures it will follow in the safe use of radioactive materials. Our radioactive materials license therefore contains both state requirements and self-imposed operating procedures that have been approved by the state. When A-STATE is inspected, we are examined for compliance with both the Rules and the conditions of our license.

Copies of the Rules and Regulations for Control of Sources of Ionizing Radiation are at Environmental Health & Safety (117 Administration Building. A copy of these regulations may also be obtained by writing to the Division of Radiation Control and Emergency Management, Arkansas Department of Health, 4815 West Markham Street, Slot 30, Little Rock, Arkansas 72205-3867 or by visiting**:** **http://www.healthy.arkansas.gov/images/uploads/rules/October_1_2017_regulations_FINAL.pdf**

Copies of the current radioactive materials license with all the amendments approved can be found in the Environmental Health & Safety Office.

4.3 Arkansas State University Campus Regulations

No person may use or transfer radioactive materials into or on the campus of Arkansas State University without prior approval by the Radiation Safety Committee.

All statements related to procurement, use and disposal of radioactive materials appearing in this booklet will be considered as the regulations for Arkansas State University, as they reflect the Rules and Regulations, the A-STATE license, and the policy decisions of the A-STATE Radiation Safety Committee. This manual is not intended to be a comprehensive reference. If further information is needed, consult the Arkansas Department of Health, Rules and Regulations for Control for Sources of Ionizing Radiation, the A-STATE license, or the Radiation Safety Officer.

4.4 Posting of Notices

The Arkansas Department of Health (ADH) has adopted regulations with standards to protect you from hazards associated with radioactive materials, which are licensed by the ADH. The ADH requires that Arkansas State University post in a conspicuous place for all employees working in any portion of a restricted area a copy of RH-2824 "Notice to Employees" "Standards for Protection Against Radiation". See Appendix VII.

Chapter 5- Approved Users and Their Responsibilities

5.1 Principal User

Principal Users are those persons who are permitted by the Radiation Safety Committee to purchase, store and use radioactive materials under the Arkansas State University license (See Appendix II for Training and Experience Requirements). The Principal Users are responsible for the safe use of radiation sources by individuals under their control. The principal user is responsible for:

1. Compliance with the A-STATE rules and regulations for radiation safety and the State "Rules and Regulations for the Control of Sources of Ionizing Radiation". http://www.healthy.arkansas.gov/images/uploads/rules/October_1_2017_regulations_FINAL.pdf
2. Obtaining approval of the Radiation Safety Committee prior to obtaining radioactive materials or carrying out a research protocol involving radioactive materials. A "Request to Use/Acquire Radioactive Materials" (Appendix IV) must be completed by the Principal user and must be approved by the RSC prior to beginning research.
3. Ensuring that all authorized users have successfully completed Arkansas Department of Health training disk or another approved training program. All principal users must have completed the course or show documentation of equivalent knowledge or experience.
4. Developing protocols for the research/experiment, to ensure that appropriate safety precautions are taken.
5. Notifying the RSO prior to any personnel changes, including addition or termination of employees/students, or changes in operational procedures, new techniques, or changes of areas where radioactive materials may be used or stored.
6. Directing of personnel under their control to comply with all recommendations to wear pocket dosimeters and finger badges, to survey their hands and clothing, to submit to bioassay, etc. which are designed to control and to reduce their total exposure.
7. Maintenance of required records of receipt, use, storage, and disposal of radioisotopes.
8. Segregation, containment, labeling, and proper disposal of all radioactive waste in accordance with guidelines.
9. Promptly notifying the Radiation Safety Officer of any accidents or incidents.
10. Ensuring that the personnel under their control discharge their individual responsibilities as listed in Section 5.4.

NOTE: Cleanup of contaminated equipment or areas is the responsibility of the principal user and the persons creating the contamination. It may not be assigned or delegated to staff outside the laboratory, such as custodial or maintenance workers.

5.2 Authorized User

An authorized user is a person who has been added to the Principal User's Authorization and has completed the appropriate training as outlined in Appendix II. The authorized user is responsible to the Principal User for all actions listed below for radioactive material. This user may work with isotopes or

equipment without immediate supervision, and may assume limited responsibilities as defined by the Principal User.

5.3 Individual User

An individual user is a person who works with radioactive material and has completed the required training as designated in Appendix II. The user must be listed on the Principal Users authorization list as an individual user, and is responsible to the Principal User for all actions listed below. The individual must work under direct supervision of the Principal User or an Authorized User designated by the Principal User.

5.4 Responsibilities of Users

One of the basic tenets of safety is that all individuals must take responsibility for their own safety, and ensure that any actions taken do not constitute a hazard to others or to the environment. Each person at Arkansas State University who has any contact with sources of radioactive materials has the following responsibilities:

1. Keep exposure to radiation As Low As Reasonably Achievable (ALARA).
2. Expose liquid or other sources that will disperse in the atmosphere under fume hoods.
3. Wear the recommended radiation monitoring devices for personnel, such as pocket dosimeters and finger badges.
4. Use all recommended protective measures such as protective clothing, remote-handling tools. Mouth pipetting is prohibited.
5. DO NOT smoke, eat, drink, chew gum or tobacco, or apply cosmetics or contact lenses in an area where radioactive materials are used or stored. DO NOT store or prepare food or drink in any area that has been used for radioactive materials, e.g., refrigerators, cabinets, glassware. If food or empty food packaging is found in the normal trash, this is interpreted as "evidence of consumption" by regulators.
6. Maintain good housekeeping and clean working habits. Work surfaces must be covered with a plastic backed absorbent paper. Where practical, an impervious tray or pan should be used under the paper in order to ensure containment of spills. Working areas must be clearly delimited.
7. Survey work areas at least weekly when less than 200 uCi are used; otherwise survey daily at the end of each laboratory or work period.
8. Label radiation equipment and segregate radioactive waste and equipment to avoid cross contamination.
9. Report immediately to the Principal User and RSO the details of a spill or other accidents involving radioactivity.
10. Maintain a log of all meter and wipe surveys conducted by the user. (See Appendix V for Logbook Guidelines).
11. Carry out decontamination procedures when necessary and take the necessary steps to prevent the spread of contamination to other areas.
12. Clean hands when leaving the laboratory.

When using radioisotopes other than low energy beta emitters, the following extra precautions are required:

13. Place all sources behind suitable shielding.
14. Survey hands, feet, clothing and personal materials at the end of each laboratory or work period.
15. Monitor radiation with a survey meter when radioisotopes are being used.
16. Annual retraining

Chapter 6- Procurement, Receipt and Inventory of Radioactive Materials

6.1 Purchases

The Principal User must submit to the Radiation Safety Officer a "Request for Acquisition of Radioactive Material form (Appendix IV) detailing the description of the radioactive material, sources or equipment to be ordered, intended use and planned disposal. The description shall indicate the radioisotope, its chemical and physical form, and the total activity in Becquerels, millicuries or microcuries. Before committee discussions, the RSO checks to insure that all requested radioisotopes are authorized by A-STATE's license and do not exceed the authorized possession limits.

The Radiation Safety Committee will then check each request for proper use of radioisotopes. The deliberations will include:

1. Whether the training and experience of the proposed user(s) are adequate for the proposed purposes and for possible emergency procedures.
2. Ensure the available facilities and equipment (or those to be obtained) do not compromise safety and are adequate for the stated needs.
3. Review proposed use to ensure all federal, state, and local safety requirements will be met.
4. Review the operating, handling, and emergency procedures to ensure they are adequate for this material.

After approval by the RSC, ordering information is provided to the University purchasing agent, including instructions to have the material sent directly to the Central Receiving, c/o Radiation Safety Officer, Arkansas State University, 2713 Pawnee Dr. State University, Arkansas 72467. Arrangements must be made for delivery to occur during normal working hours.

6.2 Receipt of Radioactive Materials

Within 3 hours of arrival of the radioisotope (this includes radioisotopes brought to campus personally by a Principal User) the Radiation Safety Officer will be contacted immediately by Central Receiving to handle the package, wearing gloves, check the package for contamination and enter the radioisotope into the inventory (in accordance with RH-1307). Shipping and receiving personnel are instructed to immediately contact the RSO if there is any obvious damage to the packaging. Only after checking for contamination and confirming the lack thereof will the RSO notify the Principal User of satisfactory receipt and availability of material.

Upon receipt of a sealed source, a survey of the packing material and surface of the instrument will be performed in a secure area to verify integrity of contents. If damage and contamination has resulted

from shipment or receipt, the Arkansas Department of Health and the manufacturer will be immediately notified, without delay.

Survey criteria for external surveys are as follows:

LABEL CRITERIA FOR RADIOACTIVE MATERIAL PACKAGES

	DOSE RATE LIMITS	
LABEL	AT ANY POINT ON ACCESSIBLE SURFACE OF PACKAGE	AT THREE FEET FROM EXTERNAL SURFACE OF PACKAGE
RADIOACTIVE- WHITE I	0.5 mR/hr	0.0 mR/hr
RADIOACTIVE- YELLOW II	50 mR/hr	1.0 mR/hr
*RADIOACTIVE- YELLOW III	200 mR/hr	10 mR/hr

The area designated for receipt and inspection of newly delivered radioisotopes is LSE 102E. Within three hours of receipt, the package is surveyed, swipe tested, unpacked and checked for shipping damage. Contents are verified to match with packing slip and box labeling. The integrity of the final source container will be inspected to look for breakage of vials or seals, leakage or discoloration of packing material. A Radioactive Receipt Form is completed and the material is logged in and stored until delivery to the authorized user (attached). Records will be maintained for at least 3 years beyond the usage of that radioisotope. The shipping box will be disposed of once all identifying labels are removed or defaced. Packing material which is contaminated will be treated as radioactive waste. The carrier and the Arkansas Department of Health, Radiation Safety Department, will be notified on the event that surface contamination exceeds the limits of 10 CFR 71.87(1), or when external radiation levels exceed the limits of 10 CFR 71.47.

The Assistant Radiation Safety Officer is on call to receive packages when the Radiation Safety Officer is unavailable.

6.3 Transfer of Possession

Outside Agencies - All radioactive material must enter and exit the campus through the Radiation Safety Officer. Before material may be released to anyone not directly associated with Arkansas State University, the RSO will be notified of the desired transfer. The RSO will ensure that all federal and state regulations are followed, in accordance with RH-501 of the ADH Rules and Regulations. The following information must be provided prior to the transfer taking place:

1. Name of institution receiving radioactive material and a written certification from that institution identifying authorization to receive the type, form and quantity of radioactive material to be transferred. The certification must also include the current license number, expiration date and issuing agency name.
2. Name of Radiation Safety Officer at receiving institution.
3. Isotope, chemical compound, and amount of activity.

This is necessary for compliance with Arkansas State University license and to avoid potential legal prosecution. A documented record of all such transactions will be maintained by the RSO in accordance with RH-3200 of the ADH Rules and Regulations set forth by the Department of Transportation, 49 CFR Parts 170 through 189. The Radiation Safety Officer will prepare the package for shipping.

Interdepartmental - Internal transfer of radioactive material will be approved by the RSO. These transfers must be between committee-approved principal users. The recipient will have a current authorization for the same radioactive material. Receipts of such transfers will be maintained by the parties involved and by the RSO.

6.4 Shipping of Radioactive Materials

Radioactive materials may only be shipped by the Radiation Safety Officer (who maintains up to date training for Department of Transportation Hazardous Materials Shipping). Shipping by any other university personnel (aside from the transportation described in section 6.6) is prohibited.

6.5 Security and Storage of Radioactive Materials

6.5.1 Security

The Arkansas Department of Health rules and regulations require that security of radioactive materials must be in place at all times. Violations of this regulation are frequently cited at institutions utilizing radioactive materials, and place the license to use such materials in jeopardy. Section RH-1308, of the state Rules and Regulations reads:

"The Licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage."

This means that in all locations where radioactive materials are present the trained user must be in constant attendance. Otherwise the lab must be locked or secured to prevent unauthorized removal or access. If the laboratory is unoccupied access to the lab MUST BE LOCKED.

6.5.2 Storage

Radioactive materials shall be stored in sealed containers in such a way as to prevent accidental spillage or breakage, and to prevent release into the air. If the material requires shielding, it shall be stored in shielded containers in order to prevent doses to personnel accessing the storage areas.

If the radioactive material has been stored in a freezer or ultra freezer, it is recommended that the material be thawed, opened and handled in a certified fume hood or biological safety cabinet. Aerosols from stored radioactive materials may cause contamination of adjacent areas and doses to personnel if not handled in the proper way after storage. All radioactive materials, whether in storage, waste or use, must be labeled with the radioactive warning symbol and the words "Caution, Radioactive Materials".

6.6 Transport of Portable Gauges

Appropriate regulations and labeling as required by the U.S. Department of Transportation will be followed when radioactive material is transported between locations. Transportation of portable gauges (e.g., CPN 503DR Hydroprobe) will be in compliance with Appendix M of the Portable Gauge Licensing Guide (Appendix X). The Principal or Authorized user will be responsible for ensuring that the gauges are properly labeled, packaged, secured and documented. Markings are to include the following: shipping name, RQ, identification number, and package type. DOT warning labels must be present on both sides of the carrying case as appropriate for the radiation levels at the surface and at 1 m. A bill of lading is required to be maintained within the travel vehicle for transport to assure compliance of Appendix M. Included within the bill of lading is an emergency response telephone number. Prior to each transport a visual inspection is to be made to ensure there is no damage. If defects are identified the RSO must be notified, who will coordinate the repair or discontinuance of the gauge. The portable gauge is to be physically secured at all times to prevent shifting during transport. Any person that transports the portable gauge must complete Department of Transportation Hazardous Materials Shipping training specific to the transport of the gauge and must keep the training current according to DOT regulations. Courses that meet the university training requirements are contained in the Hazardous Materials Shipping Program.

Chapter 7- Rules for the Safe Handling for Radioactive Materials

7.1 Classification of Areas

All rooms or areas in which licensed quantities of radioactive materials are used or stored must be posted with a "Caution Radioactive Material" sign and a "Notice to Employees".

7.2.1 Unrestricted Areas

An unrestricted area is any area to which access is not controlled by the licensee or principal user for the purposes of protection of individuals from exposure to radiation and radioactive materials. An area is unrestricted and does not require control measures:

1. If an individual continually present in the area cannot receive more than 0.0002rem (0.02 mSv) in any one hour or 0.05 rem (0.5 mSv) in a calendar year; and
2. If, when allowance is made for expected occupancy and time variations in dose-rate, no individual is likely to receive more than 500 mrem (5 mSv) in a calendar year.

Radioisotopes may be transported through an unrestricted area, but may not be used in an unrestricted area.

7.1.2 Controlled Area

A controlled area is outside of a restricted area, but inside the site boundary. A controlled area in which radioisotopes are used and access is limited, but the potential exposure rates fall well below the limits that define a Restricted Area.

7.1.3 Restricted Areas

All areas within the University in which dose levels do not conform to the standard for unrestricted areas shall be restricted and under the control of the Radiation Safety Officer for radiation safety purposes are restricted areas. The approved user responsible for work with radioisotopes in that area shall be responsible for controlling access to the area. Both Federal and State regulations define restricted areas containing radiation requiring special control measures as follows:

1. Radiation Area - An area accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in any one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. A sign bearing the radiation symbol and the words "Caution Radiation Area - No Entrance to Unauthorized Personnel" is to be posted at the entrance.
2. High Radiation Area - An area accessible to individuals in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in one (1) hour at thirty (30 centimeters from the radiation source or thirty (30) centimeters from any surface that the radiation penetrates. A sign bearing the radiation symbol and the works "Caution High Radiation Area - No Entrance to Unauthorized Personnel" is to be posted at the entrance.
3. Very High Radiation Area - any area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads * (5 gray) in one hour at one meter from the radiation source or from the surface that the radiation penetrates.

***NOTE -** At Very High doses received at high dose rates, units of absorbed dose (e.g., rads and grays) are appropriate, rather than units of dose equivalent (e.g., rems and sieverts).

Within the restricted area, strict surveillance should be maintained to assure that significant exposure levels are not present, whether in the form of contamination, airborne levels of radiation or external exposure levels.

7.2 Radiation Dose Limits

7.2.1 ALARA

ALARA is an acronym meaning As Low As Reasonably Achievable. It is a requirement in the law for all facilities possessing radioactive materials licenses to have a formal ALARA program. The radiation protection standards set forth in this manual are used to control radiation exposure to all personnel occupationally exposed to radiation. It is the policy of Arkansas State University to keep this exposure as low as reasonably achievable (ALARA).

7.2.2 Occupational Dose Limits

Occupational dose limits to individual adults shall be in accordance with RH-200 of the Arkansas Department of Health, Rules and Regulations. No individual may receive in one calendar year, except for planned special exposures, a total occupational exposure in excess of the following:

Total Effective Dose	5 rems (0.05 Sv), or
Sum of deep-dose equivalent and committed dose equivalent to any individual organ or tissue other than the lens of the eye	50 rems (0.5 Sv)
Lens of the eye (lens dose)	15 rems (0.15Sv) and
Skin & extremities	Shallow dose equiv. of 50 rems (0.50Sv)

DE – Dose Equivalent is the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

CDE – Committed Dose Equivalent ($H_{T,50}$) is the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

EDE – Effective Dose Equivalent (H_E)is the sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (w_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \sum w_T H_T$).

CEDE – Committed Effective Dose Equivalent ($H_{E,50}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E,50} = \sum w_T H_{T,50}$).

DDE – Deep Dose Equivalent (H_d), (which applies to external whole-body exposure) is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).

TEDE – Total Effective Dose Equivalent is the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

SDE – Shallow-dose Equivalent (H_s), (which applies to the external exposure of the skin or an extremity) is the dose equivalent at a tissue depth of 0.007 centimeter (7mg/cm^2), averaged over an area of one (1) square centimeter.

LDE – Lens of Eye Dose Equivalent. Applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm^2).

7.2.3 Minors Working with Radioactive Materials

The annual occupational dose limits to minors, (individuals under the age of 18) must be limited to ten percent (10%) of the annual dose limits specified for adult workers. For these workers/students, safety training must be completed prior to work with radioactive materials as with other occupational workers and students.

7.2.4 Exposure Limits for the General Public

Any person who is not regularly employed or authorized in using radioactive materials must not receive a radiation dose in excess of either:

- 0.1 rem (1 mSv) in any one year.
- 0.002 rem (0.02 mSv) in any one hour.

7.2.5 Exposure Limits to an Embryo/Fetus

Arkansas State University incorporates radiation dose guidelines, in accordance to RH-1207 of the ADH Rules and Regulations, for ensuring safe radiation limits for the embryo/fetus of occupationally exposed employees. Pregnant radiation workers who wish to declare their pregnancy should notify the Radiation Safety Officer in writing as soon as possible after learning of their pregnancy.

The regulatory dose limit to the embryo/fetus of a declared pregnant woman is 0.5 rem (5 mSv) for the entire pregnancy period.

The dose equivalent to the embryo/fetus is the sum of the deep-dose equivalent to the declared pregnant woman and the dose equivalent to the embryo/fetus resulting from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

7.3 Personnel Monitoring

Personnel monitoring of exposure to radiation and radioactive materials shall be performed to demonstrate compliance with the occupational dose limits. As a minimum, individual monitoring devices will be required where:

1. An individual receives or is likely to receive in one year from sources external to the body, a dose in excess of ten (10) percent of the applicable limits (Section 7.2.2).
2. An individual enters a high or very high radiation area.
3. A minor is likely to receive, in one year, from sources external to the body, a dose in excess of ten (10) percent of the applicable annual limit RH1206 or RH1207, Arkansas Rules and Regulations; and
4. A declared pregnant woman is likely to receive during the entire pregnancy from radiation sources external to the body, a deep dose equivalent in excess of 0.5 rem (5 mSv).

(All of the Occupational Doses in Section 7.2.2 continues to be applicable to the declared pregnant worker as long as the embryo/fetus dose limit is not exceeded.)

5. Specific radioisotopes include the following: P-32 in aqueous form and moisture density gauges (Cs-137 and Am-241).
6. Monitoring of these isotopes will continue as long as there is measurable activity. TLDs will be exchanged quarterly through the manufacturer.

7.3.1 Dosimeters

The principal user is responsible for seeing that each person under his/her control is issued a radiation dosimeter when his/her activities may result in exposures greater than the annual dose limits outlined in Section 7.2.

Finger rings and chest thermoluminescent dosimeters (TLDs) will be worn by individuals working with radioisotopes or during their entry of ABI 356 and LSE 102E (unless entry to the room is cleared by the RSO in the absence of ongoing radiation work. Users working with gauges, which are sources of gamma and neutron radiation, must wear chest and ring TLDs. TLDs must never be shared with another individual and be used only for occupational (or class) exposure monitoring. The University will supply TLDs obtained from an accredited dosimetry service approved by the Arkansas Department of Health. TLDs will be exchanged and monitored on a quarterly basis.

7.3.2 Bioassays

The Radiation Safety Officer will request a bioassay if an individual's dose, determined by area contamination or pocket dosimeter, warrants a further medical check, or if a bio-contamination type accident occurs. If the quantity of H-3 or other biohazardous radioisotopes used is large enough (more than 0.1 mCi) to suggest a possible hazard, a bioassay procedure will be instituted (See Appendix IX "Guidelines for Bioassays").

IF YOU SUSPECT THAT YOU HAVE RECEIVED A SIGNIFICANT EXPOSURE, CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY.

7.4 Posting of Laboratories and Areas

All lab areas that contain radioactive material will be indicated by the posting of the standard trefoil warning sign at the entrance to the laboratory. Address and telephone numbers of the principal user involved with the lab will be clearly indicated thereon. Signs are required by regulation to denote areas or containers with levels of radiation or radioactivity specified in the following sections:

Radiation Areas: Each radiation area shall be conspicuously posted with a sign or sign bearing the radiation symbol and the words **"CAUTION RADIATION AREA"** in areas accessible to personnel in which the total effective dose received in any one hour exceeds 0.002 rem (0.02 mSv) and 0.05 rem (0.5 mSv) in a year.

High Radiation Areas: Each high radiation area shall be posted with a sign or signs bearing the radiation symbol and words **"CAUTION HIGH RADIATION AREA".** In addition, one or more of the following features must be utilized at the entrance or access point to the high radiation area:

1. A control device that upon entry causes the level of radiation to be reduced below the level at which an individual might receive a deep-dose equivalent of 0.1 rem (1mSv) in one (1) hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
2. A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; or
3. Entryways that are locked, except during periods when access to the area is required, with control over each individual entry.

Very High Radiation Areas: Each area in which there may exist radiation levels in excess of 500 rads (5 grays) in one (1) hour at one (1) meter from a radiation source or any surface through which the radiation penetrates must be posted with a sign or signs bearing the radiation symbol and "**GRAVE DANGER, VERY HIGH RADIATION AREA".** Each entrance or access point must be equipped with entry control devices which function automatically to prevent any individual from inadvertently entering the area when very high radiation levels exist.

Radioactive Materials: Each laboratory or area where radioactive materials are used or stored must be posted at the entrance with a "CAUTION RADIOACTIVE MATERIALS" sign. Entry and area warning signs are to be posted and removed only after notifying the RSO.

Refrigerators, freezers, and other "in lab" storage areas, and containers in which materials are stored or transported must have a visible label with the radiation caution symbol and the words "Caution Radioactive Materials". The label should also state the kind and approximate quantity (e.g. "< 250 Ci) of radioactive material in the container.

AIRBORNE RADIOACTIVITY AREAS: The Radiation Safety Officer must give approval prior to any research utilizing airborne radioactive materials. Any room, area or enclosure in which airborne radioactive materials exist in concentration excess of the amounts specified in RH 2200, Appendix A, Table 1, Column 1 of the ADH Rules and Regulations.

7.5 Posting of Equipment

All vessels containing radioactive materials will be clearly marked with radiation warning tape and/or labels stating:

1) Radioisotope
2) Chemical Form of the Radioisotope
3) Total Activity at date of purchase
4) Date of Purchase

All glassware used in experiments involving radioisotopes will be labeled with radiation warning tape, with the particular radionuclide(s) inscribed thereon, until the vessel has been decontaminated and checked for radiation.

7.6 Vacating Laboratory Spaces

The Radiation Safety Officer must be informed of all changes in authorized laboratory spaces. Upon notification, the Radiation Safety Officer will conduct a clearance survey. Radiation Warning Signs can only be removed by the Radiation Safety Officer.

Chapter 8 Surveys

The Radiation Safety Officer will make annual independent surveys (audits) of all active radioisotope laboratories. Surveys of laboratory work surfaces and floors will be performed regularly when the laboratory is in use. Labs may be audited on a more frequent schedule depending on the amount of radioactivity in use. Such things as inventory assessment, contamination control, and waste disposal practices will be addressed during these audits.

Survey (audit) results will be forwarded to the authorized user, and a recheck may be conducted in the event problems have been detected that need corrective action.

8.1 Operating Procedures to Be Utilized by RSO

The following areas will be swipe tested and surveyed at the intervals indicated:

1. Areas in which radioactive wastes are stored at least monthly
2. Areas in which sealed sources are stored or used: every 6 months
3. Areas authorized for use with radioactive materials in which no radioactive materials have been used or stored during the previous month will not be swipe tested or surveyed until actual use has resumed.

Areas in which less than 1 mCi of radioisotopes of low energy (<0.3 MeV) have been used will not require survey with a hand held survey meter.

Swipes will each cover a 100 cm² area. Each swipe will be counted by liquid scintillation counting or other instrument in a low background area.

8.2 User Guidelines for Conducting Surveys

1. Surveys will be conducted each day that loose or uncontained radioactive material is used. Use areas will be swipe tested and surveyed with a survey meter (if appropriate for the radioisotope) after use for the purpose of detecting contamination. Areas in which only small quantities of radioactive material (less than 200 uCi) are used will be surveyed weekly, rather than daily. Swipe tests will be done after a known or suspected spill of radioactive material. Areas where the contamination level exceeds 200 dpm/ 100 cm^2 or is found to be twice background will be decontaminated and retested.
2. Swipes will each cover a 100 cm² area. Each swipe will be counted by liquid scintillation counting or other instrument in a low background area.
3. Prior to disposing of radioactive material, a survey will be performed of all material that will be disposed to ensure that radiation levels are at or below background. Measurement will be performed with an appropriate instrument. All records of disposal will be kept until the ADH terminates the license.
4. Records of all surveys must be maintained for a minimum of 3 years after the record is made, for review in accordance with RH-1500 of the ADH Rules and Regulations. The minimum information will include:
    a. Location, date and identification of equipment used, including the serial number, calibration date and pertinent counting efficiencies.
    b. Name of person conducting the survey.
    c. Drawing of area surveyed, identifying relevant features such as active storage areas, active waste areas, etc.
    d. Measured exposure rates, keyed to location on the drawing (point out rates that require corrective action).
    e. Detected contamination levels, keyed to locations on drawing.
    f. Corrective action taken in the case of contamination (as defined above) or excessive exposure rates (exposures likely to exceed 10% of the exposure limits defined in RH-1200 of the ADH Rules and Regulations); reduced contamination levels or exposure rates after corrective action and any appropriate comments.

8.3 Contamination Levels

Removable surface contamination levels shall be controlled such that a level of 200 dpm per 100 cm^2 is not exceeded. When removable radioactivity is found above the set limit, the area must be decontaminated and then re-surveyed and documented. Nonremovable contamination should be labeled and shielded whenever possible in order to maintain ALARA limits.

It is understood, that certain areas may be routinely contaminated, such as internal parts of equipment and inside areas of glassware, and that it may not be practical to decontaminate these surfaces after each use. The equipment should be monitored routinely and cleaned periodically. Signs must be posted and protective clothing and gloves should be used when in contact with these areas.

Radioactive contamination levels of air and water in restricted areas must be controlled such that the

levels specified in RH 2200 Appendix A, Table I, of the ADH Rules and Regulations are not exceeded. In unrestricted areas, contamination levels of air and water shall not exceed those specified in RH 2200, Appendix A, Table II.

8.4 Leak Tests

A sealed source is radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling (RH-200.av).

Each sealed source containing radioactive material shall be tested for leakage and/or contamination in accordance with the requirements of RH-1212 of the ASBH Rules and Regulations for Control of Sources of Ionizing Radiation at intervals not to exceed six months. In the absence of a certificate from a transferor, indicating that a test has been made within six months prior to the transfer, the sealed source shall not be put into use until tested. Leak tests will be performed on sealed sources if they appear to be damaged.

If the test reveals the presence of 0.005 microcuries or more of removable contamination, the licensee shall immediately withdraw the sealed source from use and and shall cause it to be decontaminated and repaired or to be disposed of in accordance with Department regulations. A report shall be filed within 5 days of the test with the Radiation Controls Section Arkansas Department of Health, Radiation Control, 4815 West Markham, Slot 30, Little Rock, AR 72205, describing the equipment involved, the test results, and the corrective action taken.

Tests for leakage and/or contamination shall be performed by the Radiation Safety Officer or Assistant Radiation Safety Officer, analysis of the leak test shall be performed by persons specifically authorized by the Department, the U.S. Nuclear Regulatory Commission, or an Agreement State to perform such services. All leak tests will adhere to manufacturer instructions for that specific unit. Kits for and the testing of sealed sources at A-STATE are from National Leak Testing Center, Troxler Electronic Laboratories, Inc. and Integrated Environmental Management, Inc.

The periodic leak test required by this condition does not apply to sealed sources that are stored and not being used. The sources excepted from this test shall be tested for leakage prior to use or transfer to another person unless they have been leak tested within six months prior to the date of use or transfer.

8.4 Survey Instruments and Calibration

To facilitate safe practice in the University, the Radiation Safety Committee requires that an appropriate calibrated survey meter be available to users. The calibration procedures will be conducted by the RSO in accordance to the Arkansas State University license.

Instruments must be calibrated at least annually and after servicing. Calibrations will be performed by Ludlum Measurements, Inc., or another approved reference laboratory utilizing radionuclide sources. Calibration will be performed at two points on each scale used for radiation protection purposes. The two points will be approximately 1/3 and 2/3 of full scale. A survey instrument may be considered

properly calibrated when the instrument readings are within ± 10 percent of the calculated or known values for each point checked. Readings within ± 20 percent are considered acceptable if a calibration chart, graph or response factor is prepared, attached to the instrument and used to interpret readings to within ± 10 percent. Also, when higher scales are not checked or calibrated, an appropriate precautionary note will be posted on the instrument. Survey instruments will be calibrated by the manufacturer. The Radiation Safety Officer must be informed prior to the purchase of a new instrument or repair and factory calibration of an existing instrument.

Upon receipt of the calibrated survey meter, the RSO will verify detection limits by the use of a check source (Dosimeter Model 3060 Dosimeter Calibrator; Cs-137). A reference check will be performed by the RSO for each survey meter on a quarterly basis.

Calibration of the Beckman Coulter Scintillation Counter (Model LS6500 in ABI 356) will be conducted annually by a service representative of Beckman Coulter, in accordance with manufacturer instructions.

If the instrument contains an internal radioactive standard, the Radiation Safety Officer must be notified prior to disposal of the instrument, so that proper inventory and disposition can be assured.

Chapter 9 Radioactive Waste

All radioactive waste must be disposed of in accordance with State Rules and Regulations. Ultimate disposal of wastes must be carried out by the Radiation Safety Officer. Sealed sources will be returned to the manufacturer for disposal. Complete records of all waste disposals must be maintained. Detailed regulations for waste disposal are found in sections RH-1400 through RH-1407 of the ADH Rules and Regulations.

9.1 Decay in Storage

Waste containing radioisotopes with short half-lives (e.g., P-32) may be stored in an approved area until the radioactivity has decayed to background levels for sewer discharge. Any waste that will decay in storage will be stored in LSE 102E until six half-lives of the radioactive isotope has passed. All wastes must be clearly labeled as radioactive with the radioisotope indicated and the date that it is placed in storage. After the amount of residual radioactivity has been determined to be at background levels (confirmed by scintillation) and this information recorded, the radiation safety officer may dispose of the material.

9.2 Disposal of Liquid Waste

The ADH Rules and Regulations for disposal of liquid wastes are such that this is the least expensive and most preferred method of radioactive waste disposal. The regulation that limits release of radioactive materials into uncontrolled areas is RH-1402; actual limits for disposal of radioactive wastes to the sewer system are found in RH-1402. In calculating whether disposal of radioactivity in this manner is permitted, please note that the volume of water leaving the A-State campus in a month is approximately 38,000,000 liters. The radioactivity in liquid wastes must be readily soluble (or readily dispersible biological material) in water. Radioactive material can only be disposed into the sanitary sewer system by the Radiation Safety Officer. Radioactivity contained in scintillation vials can be disposed via the sewer system by the RSO as long as it does not contain ingredients that cause disposal to be in violation

of EPA or other agency regulations for the control of hazardous chemicals. The committee recommends the use of so-called biodegradable scintillation fluid for this reason. Scintillation vials that cannot be disposed in this manner must be accumulated as solid waste and transferred to a licensed radioactive waste hauler for transport and disposal.

9.3 Disposal of Solid Waste

Radioactive material that cannot be dissolved in water or decayed in storage must be treated as solid waste. This generally entails transfer of control to a low-level waste processor for disposal. Disposal in this manner is expensive, and details of the process are found in RH-1402 in the Rules and Regulations. At the present time, storage of such waste is minimal; due to periodic changes in approved waste handler, at the time as disposal is warranted an approved waste handler with an Arkansas vendor license will be identified and contacted for disposal.

9.4 Animal Waste

Arkansas State University is not currently considering conducting research involving radioisotopes with animals. No protocols will be approved for such research. Regardless of the radioactivity involved, the user is responsible for complying with all applicable federal, state, and local regulations relating to disposal of hazardous or toxic materials.

9.5 Records of Disposal

For all radioactive waste that is generated, records shall be maintained where required. The records shall include the date of disposal and the amount disposed.

Chapter 10 Emergency Procedures

In any radiation emergency, personnel protection and emergency medical care have priority over radioactive decontamination of the building and equipment. For all cases, contact the Radiation Safety Officer 870-972-3644 , after hours 864-710-2933 who must be notified as soon as possible.

Arkansas State University must notify the Arkansas Department of Health as soon as possible but not later than four (4) hours after the discovery of an event that may allow unnecessary exposure to or release of radiation or licensed radioactive material in excess of regulatory limits. Events may include fires, natural disasters, explosions or toxic gas releases, etc.

10.1 Accident Procedures

In emergency or accident situations involving radioactive material, the following steps should be taken.

1. Restrict Access: Persons in the immediate area should be asked to leave the area. Establish a restricted area boundary, limiting access to the area to authorized personnel only.
2. Maintain Surveillance: The restricted area must be kept under constant, direct observation.
3. Portable Gauges: Portable gauge emergency procedures will comply with Appendix X.

4. Notify:
    a. The local authorities by dialing 911
    b. The Radiation Safety Officer 972-3644 (W) or 864-710-2933 (H) or the Assistant Radiation Safety Officer 870-972-3086, after hours 870-897-6439. If the incident falls under the requirements of Paragraphs RH-1501 and/or RH-1502 of the Arkansas Rules and Regulations for Control of Sources of Ionizing Radiation, the Arkansas Department of Health must also be notified 1-501-661-2136.
    c. In the event of any transportation accident involving radioactive material, both the Arkansas Department of Health and the Arkansas State Police must be notified.

IMPORTANT: DO NOT HANDLE UNATTACHED OR UNSHIELDED SOURCES OF RADIOACTIVE MATERIAL. Decontamination and recovery operations should only be attempted by properly trained individuals, under the direct supervision of the Radiation Safety Officer and using proper handling tools.

Chapter 11 Administrative Procedures

The Committee, the Radiation Safety Officer, or the University Safety Officer can initiate investigations of safety violations. The Committee may request the Radiation Safety Officer to make special investigations of any facilities where radiation sources are used.

11.1 Violation Procedures

Upon investigation, should the Radiation Safety Officer find any violations, the following guidelines will be utilized:

1. All emergencies that create a situation that is immediately dangerous to the life and health (IDLH) of any person must be corrected immediately or shutdown of the space will occur.
2. Verbal warning to user, outlining deficiencies found and how these deficiencies should be corrected.
3. Follow-up investigation to be conducted within 30 days of verbal warning. Failure to correct prior violations will result in a written warning, requiring the Principal User to provide a written response as to how the deficiencies have been corrected. A copy of this investigation will be sent to the Associate Vice Chancellor of Research as well as the department head and/or dean to whom the person in violation of the rules reports.
4. A follow-up investigation will be conducted within 30 days of the second audit. Failure to meet conditions one and two which are previously listed will result in loss of user privileges.

The Radiation Safety Committee or the Radiation Safety Officer reserve the right to revoke the user's authorization, at any time, if in the Committee's opinion or the Radiation Safety Officers opinion, the health or safety of persons or property are placed in immediate danger. If any violation of university safety rules leads to and radiation exposure, radiation level or concentration of radioactive materials that exceeds the limits mandated by the Arkansas Department of Health, the event will be reported to the state in accordance with RH-1504. All decisions regarding the cessation of radioactive materials use by university personnel are communicated to the Associate Vice Chancellor of Research. Any violation that directly affects other radiation users will be communicated to them via email; if a violation affects a

space used by multiple users, access to the space will be controlled by the radiation safety officer until such time as the violation is corrected.

11.2 Recordkeeping

All records regarding radiation safety are kept by the radiation safety officer in binders corresponding to the year in which the records are created. The only exception to this is the personnel dosimetry records. Since there is sensitive information on these records, the personnel dosimetry records are kept in a locked cabinet under the control of the radiation safety officer.

Appendix I Radiation Safety Committee Membership

Dr. Bruce Johnson, Ph.D., Chair, Radiation Safety Committee, (Professor of Physics) (bjohnson44@gmail.com)

Melissa Dooley, M.S., EHS Director (mdooley@astate.edu)

Ben Rougeau, DVM, Assistant RSO, Chemistry & Physics (brougeau@astate.edu)

David Gilmore, Ph.D., Biological Sciences (dgilmore@astate.edu)

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Ronald Johnson, Ph.D. Biological Sciences (rlj@astate.edu)

Appendix II Acceptable Training and Experience Requirements for Users of Radiation Sources

II.1 Principal User

This individual is expected to be faculty wishing to utilize radioisotopes in teaching or research. To be approved as a principal user, an individual must demonstrate previous experience, successfully complete the Arkansas Department of Health (ADH) training disc or complete another approved course.

Demonstration of previous experience can consist of a training certificate from another institution, first authorship on a paper in which radioisotopic use was a major component of the research methods, or a passing score on the exam at the end of the ADH training disc. Individuals without previous experience must successfully complete the ADH training disc or an approved alternative course. Training will include the following subject areas:

1. Radiation terminology
2. Basic radiation physics
3. Biological effects of radiation
4. Radiation instruments
5. Radiation in everyday life
6. Regulations and responsibilities
7. Standard safety procedures
8. Emergency procedures

Annual refresher training is also required. Annual refresher training may be postponed if no radioactive materials have been used in the previous year until the next use of radioactive materials.

II.2 Authorized User

This individual is expected to be a student or staff member working with radioisotopes under the authority of a Principal user. To become an Authorized user, an individual must successfully complete the ADH training disc or an alternative approved course, and be approved by the Radiation Safety Committee. An Authorized user may work with radioactive material without direct supervision and may be designated to supervise an individual user.

Annual refresher training is also required. Annual refresher training may be postponed if no radioactive materials have been used in the previous year until the next use of radioactive materials.

II.3 Individual User

This individual is expected to be a student working with radioactivity under the direct supervision of a Principal or designated Authorized user. Direct supervision means that a supervisor is present and attentive to the activities of the individual user. Allowing an Individual user to work unsupervised is a violation of the license and could result in the termination of the project. An Individual user must receive adequate training from the RSO, the USO, or the principal user, and this training will be documented by an exam given by the RSO covering most of the same topics listed above but in lesser depth. Informal instruction by the Principal user and completion of the ADH training disk or an alternative approved course prior to handling radioisotopes will also be considered for approval by the Radiation Safety Committee.

II.4 Ancillary Personnel

These are individuals with access to controlled areas (faculty, students, and staff such as housekeeping) that do not work with radioactive materials. All individuals with such access will receive simple, documented training on the basics of radiation safety from the RSO. Any individuals who do not agree to be trained or violate regulations will have their access to these areas revoked. This training occurs on an annual basis.

Appendix III Inventory and Disposal Log for Radioactive Material

Sample Inventory								
Date received or used	Isotope	Form	Amount before use	Amount after use	User	PO	Activity before use	Activity after use
10/23/2006	C-14	Butyric Acid	2.5 mL	2.5 mL	John Doe	DO2314	250 uCi	250 uCi
12/25/2006	C-14	Butyric Acid	2.5 mL	2.25 mL	Joe Smith		250 uCi	225 uCi
01/12/2007	C-14	Butyric Acid	2.25 mL	1.85 mL	Dawn Brown		225 uCi	185 uCi
For Items not used monthly, an amount must be entered into the balance column for the month.								
Disposal Log								
Date	Isotope	Form	Amount added	Total amount	User	Activity added	Total activity	
12/30/2006	C-14	Butyric Acid	0.25 mL	0.25 mL	Joe Smith	25 uCi	25 uCi	
01/25/2007	C-14	Butyric Acid	0.40 mL	0.65 mL	Dawn Brown	40 uCi	65 uCi	
Use separate container for Separate isotopes								

Appendix IV Request for Approval to Use and Acquire Radioactive Material

REQUEST FOR APPROVAL TO USE and ACQUIRE RADIOACTIVE MATERIAL

Date:_____ Principal User:_____

Department:_____ Campus Phone: _____Email:_____

Radioisotope (type, maximum amount and chemical form)

_____

1. On an attached sheet, describe how and where the radioisotope will be used. Include an outline of the research protocol in sufficient detail for the Committee to review. Include the equipment which may be used, handling procedures, the types of waste that will be generated, and how the waste will be disposed in accordance with state and federal regulations and A-STATE policy. Include a list of expected authorized and individual users whom you expect to be working on this project.
2. Your signature below indicates that you have read, understood, and agreed to the following:

   - □ I will comply with all policies, rules, and regulations as outlined in the A-STATE Radiation Safety Manual, the A-STATE Radioactive Materials License, and the "Rules and Regulations for Control of Sources of Ionizing Radiation" of the state of Arkansas.
   - □ I assume all the responsibilities of Principal user as outlined in the A-State Radiation Safety Manual.
   - □ I will maintain all necessary records to document use and disposal of radioactive materials.
   - □ All radioactive materials sent or brought to campus must be shipped directly to the RSO and not to Central Receiving to check for contamination and for addition to the inventory.
   - □ The RSO will inspect and swipe test my facility monthly.
   - □ I and my project are responsible for the cost of all cleanup/disposal/testing required/recommended by the RSO or by state or federal authorities.

_____ _____ _____

Signature Date

Transmit original and 6 copies to A-STATE Radiation Safety Committee, c/o Melissa Dooley, RSO, P.O. Box 1530, Environmental Health and Safety (ext. 2862).

RSC use only: Approved Tabled for clarification Rejected

Conditionally approved if: _____

_____ _____

RSO Signature Date

REQUEST FOR ACQUISITION OF RADIOACTIVE MATERIAL

Date:_____ Principal User: _____

Department:_____ Campus Phone: _____Email:_____
Radioisotope (type, max. amount, and chemical form): _____

Vendor/Catalog # of radioisotope _____

Expected Period of Use: _____

Who are the expected authorized and individual users whom you expect to be working with this reagent? _____

Your signature below indicates that you have read, understood, and agreed to the following:

- □ I will comply with all policies, rules, and regulations as outlined in the A-STATE Radiation Safety Manual, the A-STATE Radioactive Materials License, and the "Rules and Regulations for Control of Sources of Ionizing Radiation" of the state of Arkansas.
- □ I assume all the responsibilities of Principal user as outlined in the A-STATE Radiation Safety Manual.
- □ I will maintain all necessary records to document use, and disposal of radioactive materials.
- □ All radioactive materials sent or brought to campus must be shipped directly to the RSO and not to Central Receiving to check for contamination and for addition to the inventory.
- □ The RSO will inspect and swipe test my facility monthly.
- □ I and my project are responsible for the cost of all cleanup/disposal/testing required/recommended by the RSO or by state or federal authorities.

_____ _ _____

Principle User Signature Date

_____ _____

RSO Signature Date

BILLING INFORMATION:

Please bill this radioisotope order to the following:

GRANT #	COST ALLOCATION (%)	GRANT PI(s)

FORWARD INVOICE FOR PAYMENT OF BILL TO:

Appendix V Logbook for Radioactive Material

Each Principal user must maintain a logbook in the laboratory that contains records of radioisotope use, and disposal. The log book must be separate of other lab notebooks and readily accessible to the RSO or other inspectors.

Contents:

1) Log of Radioactive Materials on Hand: Every time radioactive material is received, the following information must be entered into the log: Isotope, chemical form, amount (Ci or mCi), volume, and date of arrival. Each entry must be on a separate page with ample room after the entry to record changes in amounts during usage. Every time radioactive material is used, the following information must be entered into the log: date of use, the volume (or mass) of material used, the volume (or mass) disposed, and the volume (or mass) remaining. At least once a week, the remaining balance of radioactivity must be entered; decay of short half-life radioisotopes must be taken into account.

2) Log of Swipe Tests: Swipe tests must be performed at least weekly when using 200uCi or less. Workers using in excess of 200 uCi in a day must perform swipe tests daily at the conclusion of the experiment. The logbook should contain a map of the laboratory with radioactive use areas clearly indicated.

   Numbered swipe tests should be keyed to the map and the areas briefly described. It is highly recommended that the same core swipe areas be numbered the same from week to week. Core areas should include the work area, around the work area, any sink for radioactive disposal, and high traffic areas that may have been contaminated (floor near door, doorknobs, telephone). Additional locations should include any place a spill may have occurred (bench, floor) or places that have been handled (lid of microcentrifuge, controls for gel dryer). Background (paper disk in scintillation fluor) should be determined each time; you may use the same background vial over and over. Vials that register background levels can be utilized for repeated swipe tests.

   Swipe tests twice background must be redone following decontamination of the affected area. Swipe test data must be dated and legibly entered into the log. Scintillation counter printouts may be saved as additional documentation.

Sample Log

S-35

Date	Task	Volume Used/DIsposed	Balance Volume	Balance Activity
4/26/17	Receipt of S-35 Methionine	0.5 mL	0.5 mL	0.5 mCi
4/28/17	Used to label cultures	0.1 mL (all sink)	0.4 mL	0.4 mCi
4/30/17	Used to label cultures	0.1 mL (all sink)	0.3 mL	0.3 mCi
5/3/17	Inventory	0	0.3 mL	0.28 mCi
5/10/17	Inventory	0	0.3 mL	0.27 mCi

Appendix VI ADH Form Y

OCCUPATIONAL EXPOSURE RECORD FOR A MONITORING PERIOD								Form Y
1. Name: Last, First, Middle Initial				2. Identification Name	3. ID Type	4. Sex – M or F	5. Date of Birth	
6. Monitoring Period	7. Licensee or Registrant Name			8. Licensee or Registration Number			9B. Record or Estimate	9B. Routine or PSE
INTAKES				DOSES (in rem)				
10A. Radionuclide	10B. Class	10C. Mode	10D. Intake in µCi	Deep Dose Equivalent (DDE)			11.	
				Eye Dose Equivalent to the lens of the eye (LDE)			12.	
				Shallow Dose Equivalent, Whole Body (SDE, WB)			13.	
				Shallow Dose Equivalent, Max Extremity (SDE, ME)			14.	
				Committed Effective Dose Equivalent (CEDE)			15.	
				Committed Dose Equivalent, Maximally Exposed Organ (CDE)			16.	
				TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE) (Blocks 11 & 15)			17.	
				TOTAL ORGAN DOSE EQUIVALENT, MAX ORGAN (TODE) (Blocks 11 & 16)			18.	
				19. Comments				
20. Signature of Licensee or Registrant							21. Date Prepared	

Arkansas Department of Health
Revised 10/01/12

Appendix K to Section 3

Appendix VII Notice to Employees

NOTICE TO EMPLOYEES

Arkansas Department of Health
STANDARDS FOR PROTECTION AGAINST RADIATION

The Arkansas Department of Health (ADH) has adopted regulations with standards to protect you from hazards associated with radioactive materials and radiation emitting machines which are licensed or registered by ADH. In particular, the following information is available for your review:

Section 3: Standards for Protection Against Radiation
Part N: Notice, Instructions, and Reports to Workers; Inspections
Any other documents your employer must provide.

These may be found at the following location:

YOUR EMPLOYER'S RESPONSIBILITY
Your employer is required to:

1. Comply with all applicable regulations and the conditions of the license or registration.
2. Post or otherwise make available to you a copy of the regulations, licenses, and operating procedures which apply to work in which you are engaged, and explain the provisions to you.

YOUR RESPONSIBILITY AS A WORKER
You should:

1. Know the provisions of the ADH regulations, the precautions, the operating procedures, and the emergency procedures which apply to your work.
2. Observe the provisions of your own protection and for the protection of your co-workers.
3. Report unsafe working conditions or violations of the license or registration conditions or regulations to ADH.

REPORTS OF YOUR RADIATION EXPOSURE HISTORY

1. The ADH regulations specify the occupational limits for radiation exposure including concentrations of radioactive material in air and water. These regulations require your employer to give you a written report if you receive exposure in excess of any applicable limit. The limits on your exposure are contained in RH-1200, RH-1206, and RH-1207. While these are the maximum allowable limits, your employer should keep your radiation exposure below those limits as is reasonably achievable.
2. If you work where personnel monitoring is required and request information on your radiation exposures,
   a. your employer must advise you annually of your exposure to radiation, and
   b. upon termination of employment, your employer must give you a written report of you radiation exposures.
   c. A report of any exposure in excess of a limit must be reported to you.

INSPECTIONS: All licensed or registered activities are subject to inspection by the ADH.

INQUIRIES

Direct all inquiries on matters outlined above to: ADH, Radiation Control Section, 4815 West Markham Street, Mail Slot 30, Little Rock, Arkansas 72205-3867 or to (501) 661-2301. For emergencies, call (800) 633-1735.
POSTING REQUIREMENT: In accordance with RH-2802, copies of this notice must be posted in every establishment where employees are engaged in activities licensed or registered by the ADH. Posting must permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

Appendix I to Section 3 — Revised 10/01/12
Form X

Appendix VIII Materials Licensed for Use at Arkansas State University

Radioactive Material (Element and Mass Number)	Chemical and/or Physical form	Maximum Radioactivity and/or quantity of material which licensee may possess at any one time.	Purpose
A. Radioactive Material from Atomic Numbers 3-83	Any	Not to exceed 50 millicuries per radionuclide,excluding items below.	To be used for teaching purposes, calibration, or research and development as defined in Paragraph RH-2000(p) in the ASBH Rules and Regulations for Control of Sources of Ionizing Radiation.
B. Hydrogen-3	Any	50 millicuries total	
C. Phosphorous-32	Liquid	1 millicurie total	
D. Uranium	Natural	20 kilograms total	
E. Uranium-232	Any	5 millicuries total	
F. Uranium-233	Any	2 grams total	
G. Americium-241	Sealed Source, (Isotope Products AF-241)	0.1 microcuries, No single source to exceed 0.1 uCi	To be used for survey instruments and student experiments on exposure levels.
H. Americium-241	CPN Model CPN-131	50 millicuries total, No single source to exceed 50 mCi	CPN International Model 503 Moisture Gauge
I. Nickel-63	Sealed source and/or Foil (U.S. Radium LAB 508-3 New England Nuclear NER-004 or Amersham NBC) in a Varion Model 3800 GC.	15 millicuries total, No single source to exceed 15 millicuries	Electron Capture Devices for use in Gas Chromatographs (models described in second column).
J. Nickel-63	Sealed source and/or Foil Eckert and Ziegler Isotope Products Inc. Model NER-004 or Model NBC; QSA Global Inc. Model NBC) in a Bruker Chemical Analysis Model 450-GC.	30 millicuries totalNo single source to exceed 15 mCi	
K. Nickel-63	Sealed source and/or Foil Dupont Merck Model NER-002; NRD Model N- 1001; or Amersham Model NBC-7020) in a Perkin Elmer Model 330-0119 GC.	15 millicuries total, no single source to exceed 15 mCi	
L. Nickel-63	Plated foil IPL NER-004 or NRD N-1001 in Shimadzu ECD Detector in a Shimadzu GC-2014	10 millicuries total. No single source to exceed 10 millicuries.	
M. Radium-226	Sealed Sources	1 millicurie total	Materials solely under the control of the radiation safety officer.
N. Thorium-228	Any	5 millicuries total	
O. Thorium-232	Any	20 kilograms total	
P. Uranium-depleted	Any	5 kilograms total	

Appendix IX Guidelines for Bioassays

IX.1 Conditions under Which Bioassays May Be Necessary for the Use of I-125 and I-131

1. When an individual handles in open form unsealed quantities of radioactive iodine that exceed those shown in Table 1 below. The quantities shown in Table 1 apply to both the quantity handled at any one time or integrated as the total amount of activity introduced into a process by an employee over any 3-month period.
2. When quantities handled in unsealed form are greater than 10% of Table 1 values, routine bioassay may still be necessary under certain circumstances. A written justification for not performing such

measurements should be prepared and recorded whenever bioassay is not performed and the quantities handled exceed 10% of the levels in Table 1.

3. Bioassay is generally not required when process quantities handled by a worker are less than 10% of those in Table 1.

Types of bioassays that should be performed are:

1. Baseline: Prior to beginning work with radioactive iodine in sufficient quantity that bioassay is specified in Item 1 above.
2. Routine: At the frequency specified.
3. Emergency: As soon as possible after any incident that might cause thyroid uptakes to exceed burdens given below, so that recommended actions can be most effective.

Show in the application that the need for bioassays has been thoroughly considered and that the proposed bioassay program is appropriate for the intended use of radioactive material.

Submit procedures for bioassays that address at least the following:

1. Frequency of testing.
2. Methods used for testing (e.g., thyroid scan, urinalysis), including a description of the procedures involved.
3. Determination of baseline values on individuals involved.
4. Instrumentation used.
5. Provisions for monitoring excretion of radioactive material in any individual who shows radionuclide uptake.
6. Action levels for the tests and the corrective action to be taken when these levels are exceeded. Recommended action levels for thyroid burden at the time of measurement is 0.12 microcurie of I-125 and 0.04 microcurie of I-131.

NOTE: Guidance on bioassay program for I-125 and I-131 is provided in NRC Regulatory Guide 8.20. If bioassays are not considered appropriate for the proposed program, specify the reasons for this conclusion.

TABLE 1

ACTIVITY LEVELS ABOVE WHICH BIOASSAY FOR I-125 OR I-131 IS NECESSARY

ACTIVITY HANDLED IN UNSEALED FORM

MAKING BIOASSAY NECESSARY

TYPES OF OPERATION	VOLATILE OR DISPERSIBLE	BOUND TO NONVOLATILE AGENT
Processes in open room or bench, with possible escape of iodine from process vessels.	1 mCi	10 mCi
Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability	10 mCi	100 mCi
Processes carried out within glove boxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage.	100 mCi	1000 mCi

IX.2 Additional Information for Use of Tritium (H-3)

IX.2.1 Special Surveys

IX.2.1.1 Airborne Tritium

If Tritium is requested in sufficient quantity and form as to be airborne, air monitoring for Tritium may be necessary. Describe the procedures and equipment used to perform this monitoring, including appropriate action levels. Specific regulatory requirements for airborne radioactive material concentrations in restricted areas are contained in Paragraph RH-1201 of the Arkansas Board of Health's Rules and Regulations for Control of Sources of Ionizing Radiation.

IX.2.1.2 Contamination Surveys

Since Tritium tends to be a persistent and pervasive contamination problem, a rigorous program for conducting wipe surveys (smears) of Tritium use and storage areas should be implemented. Wipes should be taken of any surface that may have been contaminated on at least a weekly basis. Action levels for these surveys should be no higher than 200 dpm/100 cm. Describe the procedures and

equipment involved in performing wipe surveys of Tritium use and storage area, including frequency, action levels, materials involved and the person responsible for conducting surveys.

IX.2.2 Handling of Contaminated Material

Some materials, which may become contaminated by Tritium during routine operations, include soil, building materials and transformer and lubricating oils in particle accelerators with Tritium targets. Describe the procedures used to decontaminate and/or dispose of material that has been contaminated. Also, describe the control procedures that will be implemented to reduce the possibility of Tritium contamination.

IX.2.3 Bioassay Methods

Bioassays may be required for persons working with millicuries (or higher) quantities of Tritium. Submit procedures for Tritium bioassay, which address at least the following:

1. Frequency of testing.
2. Method of testing (e.g., urinalysis) including a description of the specific procedures involved.
3. Determination of baseline values on individuals involved.
4. Instrumentation used.
5. Action levels for bioassays.
6. Corrective actions to be taken when action levels are exceeded, including provisions for monitoring excretion of Tritium or for retesting of individuals which show uptake.
7. A bioassay should be performed within one month of the last possible exposure to Tritium, when operations are being discontinued, or when the worker is terminating activities with potential exposure.

Routine bioassay is necessary when quantities processed by an individual at any one time or the total amount processed per month exceed those for the forms of Tritium shown in Table 2. Under certain circumstances, routine bioassay may still be necessary when quantities are less than the levels in Table 2 but more than 10% of those levels. A written justification for not performing bioassays should be presented in these cases.

Special bioassay measurements may be needed to verify the effectiveness of respiratory protective devices or protective clothing used to prevent inhalation or absorption of Tritium. These special bioassays should be performed to determine the actual Tritium intake of an individual wearing a respiratory protective device or protective clothing if the concentration of Tritium (in any form) in the air is such that exposure for 40 hours per week for 12 weeks to the uniform concentration of Tritium in air specified in Table 1, Column 1, of Paragraph RH-2200, Appendix A. Special bioassay procedures should also be conducted for personnel wearing respirators if, for any reason, the average Tritium concentration in air and the duration of exposure are unknown or can not be conservatively estimated by calculation.

Bioassays should be performed when air monitoring indicates exposures may exceed 25% of the quarterly limit on intake (inhalation plus absorption) in Paragraph RH-1201 (a)(1). This 25% value should be taken to be 1.6 millicuries. *

Multiplying the concentration given in RH-2200, $5x10^{-6}$ μCi/ml, by $6.3x10^{8}$ ml gives the corresponding quarterly intake of Tritium by inhalation. In the case of inhaled HTO, which mixes instantly with other water molecules after entering body fluids, the intake may be assumed equal to the uptake. The uptake of Tritium (as HTO) by absorption through the skin is assumed equal to the uptake by inhalation unless the form of Tritium in the air can be demonstrated to have lower uptakes. The total uptake, including skin absorption, would be assumed to be about 6.3 mCi, which delivers a dose commitment of about 1.25 rems to standard man (using Q = 1.7). A 40-hour occupational exposure at a concentration of $5x10^{-6}$ μCi/ml would thus result in an intake of 6.3/13=0.48 mCi and a dose commitment of about 0.1 rem. An acute intake (in less than one day) of 0.48 mCi would result in an initial body water concentration of about 11 μCi/liter.

IX.2.4 Bioassay Frequency Guidelines

IX.2.4.1 Initial Routine

A bioassay sample of at least 100 ml of urine should be taken within 72 hours following entry of an individual into an area where operations require bioassay according to the criteria in this guide and then every two weeks or more frequently thereafter as long as the individual is working with Tritium. When work with Tritium is on an infrequent basis (less frequently than every two weeks), bioassay should be performed within 10 days of the end of the work period during which Tritium was handled.

IX.2.4.2 After Three Months

A sampling frequency selected in accordance with the above paragraph may be changed to quarterly if, after three months, the following three conditions are met:

1. The average urinary Tritium concentration from specimens obtained during the 3-month period does not exceed 3 μCi/L,
2. If measurements of the concentration of Tritium in air are required as a condition of the license, the quarterly average concentration (μCi/ml) to which the workers are exposed multiplied by the factor 6.3×10^{8} ml does not exceed 0.8 mCi and
3. The working conditions during the 3 month period, with respect to the potential for Tritium exposure, are representative of working conditions during the period in which a quarterly urinalysis frequency is employed, and there is no reasonable expectation that the criteria given in items a and b above will be exceeded.

IX.2.4.3 After Use of Respiratory Protective Devices or Protective Suits

A bioassay sample should be taken within 72 hours after respiratory protective devices; suits, hoods or gloves are used to limit exposure as stated in this guide.

IX.2.5 Bioassay Action Level and Corresponding Action Guidelines

IX.2.5.1 Biweekly or More Frequent Sampling

Whenever the intake of Tritium within any 40-hour work period exceeds the amount that would be taken into the body from uniform exposure for 40 hours at the air concentration (5×10^{-6} μCi/ml) specified in Table 1, Column 1 of Appendix A, paragraph RH-2200, the licensee is required to make evaluations, take necessary corrective actions and maintain records by Paragraph RH-1201 (b) (2).

If urinary excretion rates exceed 5 μCi/L but are less than 50 μCi/L, the following course of action should be taken:

1. A survey of the operations involved, including air and surface contamination monitoring, should be carried out to determine the causes of the exposure and evaluate the potential for further larger exposures or for the possible involvement of other employees.
2. Any reasonable corrective actions that the survey indicates may lower the potential for further exposures should be implemented.
3. A repeat urine sample should be taken within one week of the previous sample and should be evaluated within a week after collection. Internal dose commitments should be estimated using at least these two urine sample evaluations and other survey data, including the probable times of the intake of Tritium.
4. Any evidence indicating that further work in the area might result in an employee receiving a dose commitment in excess of the limits established in RH-1200 should serve as cause to remove the employee from work in the operation until the source of exposure is discovered and corrected.
5. Reports or notification must be provided as required by RH-1504 and RH-2804, or as required by conditions of the license pursuant to RH-1205.

If urinary excretion rates exceed 50 μCi/L, the following course of action should be taken:

1. Carry out all steps in Item above.
2. If the projected dose commitment exceeds levels for whole body as provided in RH-1502, provide appropriate notification to the Department.
3. Refer the case to appropriate medical/health physics consultations for recommendations regarding immediate therapeutic procedures that may be carried out to accelerate removal of Tritium from the body and reduce the dose to as low as is reasonably achievable.
4. Carry out repeated sampling (urine collections of at least 100 ml each) at approximately one-week intervals at least until samples show an exception rate less than 5 μCi/L. If there is a possibility of long-term organic compartments of Tritium that require evaluation, continue sampling as long as necessary to ensure that appreciable exposures to these other compartments do not go undetected and to provide estimates of total dose commitments.

IX.2.5.2 Quarterly Sampling

Carry out the actions called for when any of the levels indicated in the above paragraphs are exceeded. In addition, reinstitute biweekly (or more frequent) sampling for at least the next 6-month period, even when urinary excretion falls below 5 μCi/L.

Appendix X Operating, Transport, Security and Emergency Guidelines for Portable Gauges

X.1 Operating Procedures

The following Operating Procedures will be used by all Authorized Users to remove, transport, use and return the gauge to storage. Any deviations from these Operating Procedures must be approved by the Radiation Safety Officer. Only individuals that have been taken the training provided by Troxler on the use of the portable gauge may use the gauge. The certificate must be provided to the RSO prior to the gauge being used.

X.1.1 Preparation for Work

1. In regards to personnel monitoring:
    a. Always wear your assigned badge when using the gauge.
    b. Never wear another person's badge.
    c. Never store your badge near the gauge.
2. Before removing the gauge from its place of storage, ensure that, where applicable, each gauge source is in the fully shielded position and that in gauges with a movable rod containing a sealed source, the source rod is locked (e.g., keyed lock, padlock, mechanical control) in the shielded position. Place the gauge in the transport case and lock the case.
3. Sign out the gauge in a Utilization Log book (that remains at the storage location) including the date(s) of use, name(s) of the authorized users who will be responsible for the gauge, and the temporary jobsite(s) where the gauge will be used.
4. Block and brace the gauge to prevent movement during transport and lock the gauge in or to the vehicle. Follow all applicable Department of Transportation (DOT) requirements when transporting the gauge.

X.1.2 Using the Gauge

1. Use the gauge according to the manufacturer's instructions and recommendations and the Operating Procedures and Emergency Procedures. The gauge will also be used in a manner that will keep radiation doses As Low As is Reasonably Achievable (ALARA) by:
    a. Minimize the TIME spent in close proximity to the gauge (the shorter the time, the lower the dose);
    b. Maximize the DISTANCE from the gauge (doubling the distance reduces radiation intensity); and
    c. Make use of available SHIELDING to block out radiation.
2. Establish and maintain constant surveillance of the restricted area and always keep unauthorized persons away from the gauge.
3. Do not touch the unshielded source rod with your fingers, hands, or any part of your body.
4. Do not place hands, fingers, feet, or other body parts in the radiation field from an unshielded source.
5. Unless absolutely necessary, do not look under the gauge when the source rod is being lowered into the ground. If you must look under the gauge to align the source rod with the hole, follow the manufacturer's procedures to minimize radiation exposure.
6. After completing each measurement in which the source is unshielded, immediately return the source to the shielded position.

7. Always maintain constant surveillance and immediate control of the gauge when it is not in storage. At job sites, do not walk away from the gauge when it is left on the ground. Take actions necessary to protect the gauge and yourself from danger of moving heavy equipment.
8. Always keep unauthorized persons away from the gauge.
9. Perform routine cleaning and maintenance according to the manufacturer's instructions and recommendations.
10. When the gauge is not in use at a temporary jobsite, place the gauge in a secured storage location (e.g., locked in the trunk of a car or locked in a storage shed).
11. Do not smoke, eat, drink, or store any of these types of products in the use or storage area of the gauges containing radioactive material.

X.1.3 Completing the Work

1. Prior to transporting the gauge, ensure that, where applicable, each gauge source is in the fully shielded position. Ensure that in gauges with a movable source rod, the source rod is locked in the shielded position (e.g., keyed lock, padlock, mechanical control). Place the gauge in the transport case and lock the case. Block and brace the case to prevent movement during transportation. Lock the case in or to the vehicle.
2. Return the gauge to its proper locked storage location at the end of the work shift.
3. Log the gauge into the Utilization Log when it is returned to storage.
4. After making changes affecting the gauge storage area (e.g., changing the location of gauges within the storage area, removing shielding, adding gauges, changing the occupancy of adjacent areas, moving the storage area to a new location), reevaluate compliance with public dose limits and ensure proper security of gauges.

X.1.4 Maintaining the Gauge

1. Personnel monitoring badges will always be worn when performing non-routine maintenance on the gauge.
2. Routine cleaning and maintenance of the gauge will be performed in accordance with the manufacturer’s instructions and recommendations.
3. No maintenance will be performed on the gauge that includes removing the radioactive source from the gauge. Any maintenance that is not included in the manufacturer’s instructions and recommendations will be performed by the manufacturer or by another person who is specifically licensed to perform the maintenance.
4. A Quarterly Inventory of all gauges will be performed by the Radiation Safety Officer or their designee. Records of the inventory shall be maintained on file for inspection purposes and shall be retained for at least 3 years following the date the record was created. 5. Leak testing of the radioactive sources will be performed and documented every six months in accordance with the Radioactive Material License. Gauges that do not have a current leak test will not be used.

X.2 Transportation of Portable Gauges

U.S. DOT requirements for highway shipments via common carrier are similar to requirements for transporting a gauge to a temporary job site. Operators are responsible for ensuring that their gauges

are properly packaged, marked, labeled, secured, blocked and braced, and that proper documentation accompanies the devices.

The following discussion serves as basic guidance only. The U.S. DOT regulations should be consulted prior to packaging and transporting radioactive material.

X.2.1 Marking

Markings and labels on gauge transport containers must be durable, legible, in English, and printed on or affixed to the package surface (e.g., a label, tag or sign).

Required markings include:

1. Shipping name (ex.: radioactive material, special form, n.o.s., Class 7)
2. RQ (for gauges with an Am-241:Be source > 10 mCi); add to shipping name)
3. Identification number (ex.: UN 3332)
4. Package type (ex.: TYPE A)

X.2.2 Labeling

Required labels include:

1. "Cargo Aircraft Only" label (required for shipments by air)
2. Two DOT warning labels (gauges typically require RADIOACTIVE YELLOW II labels; see table) applied to opposite sides of the package, listing the package contents and activity in SI and customary units, and the package's Transport Index (TI), the dimensionless number indicating the package's radiation level at 1 meter (manufacturers provide the TI for their gauges).

	Packaging Labeling Criteria	
Warning Label	**Max. Rad. Level at Package Surface (mR/hr)**	**Max. Rad. Level at 1 m (TI)**
Radioactive White I	0.5	None
Radioactive Yellow II	50	1
Radioactive Yellow III	200	10

X.2.3 Shipping Papers

The information required on shipping papers depends on the type of shipment being made. Transporting gauges to and from temporary job sites in company vehicles (without any transfers) can be exclusive use shipments, which require minimal information on the shipping paper (commonly known as a "bill of lading"). Gauges shipped by common carrier to the manufacturer or another recipient require additional information. Gauges shipped by air or internationally require still more information.

1. Exclusive use shipments (shipments to and from job sites) require a bill of lading with the information listed below. The shipping paper must be immediately accessible to the driver during transport.
    a. Description of shipment [proper shipping name, RQ (if applicable), identification number, hazard class, type of package, name and activity of each nuclide, category of labeling and Transport Index)
    b. Emergency response telephone number (24-hour monitored number of a person knowledgeable about the hazards associated with portable gauges)
2. Common carrier shipments (shipments offered to third parties for transport) require a bill of lading with the information listed below, if the shipment is made by highway. If shipped by air, the carrier will provide a "Dangerous Goods Airbill" that will describe the required information:
    a. Name and address of shipper [can be the consignee (company offering the package for shipment) or the consignor (company shipping the package)]
    b. Description of shipment (same as for exclusive use shipments)
    c. Emergency response telephone number (24-hour monitored number of a person knowledgeable about the hazards associated with portable gauges)
    d. Shipper's certification (statement certifying that the package has been properly classified, described, packaged, marked and labeled, and is in proper condition for transportation)
    e. Signature of shipper (commits the signor to certification of the shipment)
3. Emergency response information (ERI) will be provided with the bill of lading and will be immediately accessible to the driver during shipment.
4. Accessibility: Shipping papers and ERI will be immediately accessible to the driver during transport of gauges.

X.2.4 Inspection

Prior to shipment, inspect transport containers to ensure proper packaging and unimpaired physical condition of the container and its closure devices. Promptly report any defects to the RSO prior to shipment or use. The RSO will label and remove from use any gauge or package found to be defective and ensure their repair or replacement.

X.2.5 Blocking and Bracing

Block and brace gauge transport containers to prevent shifting during normal transportation conditions. Gauges cannot be transported in a vehicle's passenger compartment.

X.2.5 Expected Instruments/Articles

Portable devices classified as excepted instruments/articles (e.g., XRF analyzers) are exempt from marking, labeling and shipping paper requirements, but must have a notice included with the package that lists the company's name and provides the following statement: "This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package--instruments or articles, UN2910."

X.3 Security of Portable Gauges

X.3.1 Storage and Control of Licensed Radioactive Materials

The Rules and Regulations for Control of Sources of Ionizing Radiation, Paragraph RH-1306, "Storage of Sources of Radiation" requires licensees to secure sources of radiation from unauthorized removal or access. Further, Paragraph RH-1308, "Control of Material Not in Storage" states that the licensee shall control and maintain constant surveillance of radioactive material that is in a controlled or unrestricted area and that is not in storage.

Despite these requirements, thefts of portable gauges do occur which can pose a potential risk to public health and safety.

X.3.2 Security Requirements

The Department is providing licensing guidance to applicants to assist them in improving their gauge security program**.** Improved security programs for portable gauges that comply with the provisions of this Appendix will be required in order to obtain or renew an Arkansas Radioactive Material License. This Appendix requires individuals using portable gauges under specific licenses to use a minimum of two independent physical controls that form tangible barriers to secure portable gauges from unauthorized removal, whenever portable gauges are not under the control and constant surveillance of the licensee. The proposed physical controls may also reduce accidental losses such as gauges falling out of a vehicle while in transit.

This Appendix applies to a licensee with a portable gauge regardless of the location, situation, and activities involving the portable gauge. At all times, the licensee would be required to either maintain control and constant surveillance of the portable gauge or use a minimum of two independent physical controls to secure the portable gauge. The Department expects that the physical controls would be designed and constructed of material suitable for securing the gauges from unauthorized removal and that the physical controls could not be easily defeated by the use of small hand tools. In addition, the Department expects that both of the controls must be defeated for the portable gauge to be removed to deter a theft by requiring a more determined effort to remove the gauge.

X.3.3 Securing a Portable Gauge at a Licensed Facility

Long term storage of portable gauges is usually at a permanent facility listed in the license or license application. When a portable gauge is stored at a licensed facility, the licensee is required to use a minimum of two independent physical controls to secure the gauge. Examples of two independent physical controls to secure a portable gauge when stored at a licensed facility are as follows:

1. The portable gauge or transportation case containing the portable gauge is stored inside a locked storage shed within a secured outdoor area, such as a fenced parking area with a locked gate.

2. The portable gauge or transportation case containing the portable gauge is stored in a room with a locked door within a secured building for which the licensee controls access by lock and key or by a security guard.
3. The portable gauge or transportation case containing the portable gauge is stored inside a locked, non-portable cabinet inside a room with a locked door if the building is not secured.
4. The portable gauge or transportation case containing the portable gauge is stored in a separate secured area inside a secured mini-warehouse or storage facility.
5. The portable gauge or transportation case containing the portable gauge is physically secured to the inside structure of a secured mini-warehouse or storage facility.

X.3.4 Securing the Portable Gauge in a Vehicle

Licensees commonly use a chain and a padlock to secure a portable gauge in its transportation case to the open bed of a pickup truck while using the vehicle for storage. Because the transportation case is portable, a theft could occur if the chain is cut and the transportation case with the portable gauge in it is taken. If the licensee simply loops the chain through the handles of the transportation case, a thief could open the transportation case and take the portable gauge without removing the chain or the case. Because the transportation case is also portable, it must be protected by two independent physical controls if the portable gauge is inside. A lock on the transportation case or a lock on the portable gauge source rod handle would not be sufficient because the case and the gauge are portable.

A vehicle should be used for storage only for a short period of time when a gauge is in transit. Portable gauges should only be kept in a vehicle overnight if it is not practicable to provide temporary storage in a permanent structure. When a portable gauge is being stored in a vehicle, the licensee would be specifically required to use a minimum of two independent physical controls to secure the gauge. Examples of two such independent physical controls to secure portable gauges in these situations are:

1. The locked transportation case containing the portable gauge is physically secured to a vehicle with brackets, and a chain or steel cable (attached to the vehicle) is wrapped around the transportation case such that the case cannot be opened unless the chain or cable is removed. In this example, the transportation case would count as one control since the brackets would prevent easy removal of the case. The chain or cable looped only through the transportation case-handle is not acceptable.
2. The portable gauge or transportation case containing the portable gauge is stored in a box physically attached to a vehicle, and the box is secured with (1) two independent locks, or (2) two separate chains or steel cables attached independently to the vehicle in such a manner that the box cannot be opened without the removal of the chains or cables, or (3) one lock and one chain or steel cable is attached to the vehicle in such a manner that the box cannot be opened without the removal of the chain or cable.
3. The portable gauge or transportation case containing the portable gauge is stored in a locked trunk, camper shell, van, or other similar enclosure and is physically secured to the vehicle by a chain or steel cable in such a manner that one would not be able to open the case or remove the portable gauge without removal of the chain or cable. In this example, the transportation case would not count as one control because it could be easily removed.

X.3.5 Securing a Portable Gauge at a Temporary Job Site or at Locations other than a Licensed Facility

When a job requires storage of a portable gauge at temporary job sites or at locations other than a licensed facility, the licensee must use a permanent structure for storage if practicable to do so. Storage of radioactive material in a private residence or motel/hotel room overnight on a temporary basis is not authorized or approved. When a portable gauge is stored at a temporary job site or at locations other than an authorized facility, the licensee is required to use a minimum of two independent physical controls to secure the gauge. Examples of two independent physical controls to secure portable gauges at such locations are:

1. At a temporary job site, the portable gauge or transportation case containing the portable gauge is stored in a locked non-portable structure (e.g., construction trailer, sea container, etc.), and is physically secured by a chain or steel cable to the structure in such a manner that an individual would not be able to open the transportation case or remove the portable gauge without removing the chain or cable. A lock on the transportation case or a lock on the portable gauge source rod handle would not be sufficient because the case and the gauge are portable.
2. The portable gauge or transportation case containing the portable gauge is stored inside a locked room within a temporary facility, and is physically secured by a chain or steel cable to a permanent or non-portable structure (e.g., large metal drain pipe, support column, etc.) such that an individual would not be able to open the transportation case or remove the portable gauge without removing the chain or cable.
3. The portable gauge or transportation case containing the portable gauge is stored in a locked garage, and is within a locked vehicle or is physically secured by a chain or steel cable to the vehicle in such a manner that an individual would not be able to open the transportation case or remove the portable gauge without removing the chain or cable.
4. The portable gauge or transportation case containing the portable gauge is stored in a locked garage, and is within a locked enclosure or is physically secured by a chain or steel cable to a permanent or non-portable structure in such a manner that an individual would not be able to open the transportation case or remove the portable gauge without removing the chain or cable.

X.3.6 Controlling and Maintaining Constant Surveillance of a Portable Gauge

When a portable gauge is not secured with a minimum of two independent physical controls, the licensee is required to control and maintain constant surveillance of the gauge. This is consistent with Paragraph RH-1308, which states that the licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage. Control and constant surveillance is required when the gauge is not in storage, e.g., is in use or undergoing maintenance. The Department interprets “control and maintain constant surveillance” of portable gauges to mean being immediately present or remaining in close proximity to the portable gauge so as to be able to prevent unauthorized removal of the gauge.

X.4 Emergency Procedures for Portable Gauges

If the source fails to return to the shielded position (e.g., as a result of being damaged, source becomes stuck below the surface) or if any other emergency or unusual situation arises (e.g., the gauge is struck by a moving vehicle, is dropped, or is in a transport vehicle involved in an accident) specific response actions must be taken.

X.4.1 Individual at the Scene

The individual at the Scene must do the following:

1. RESTRICT ACCESS: Immediately secure the area and establish a restricted area boundary. Keep individuals at least 15 feet away from the gauge until the situation is assessed and radiation levels are known. However, perform first aid for any injured individuals and remove them from the area only when medically safe to do so.
2. MAINTAIN SURVEILLANCE: Maintain constant, direct surveillance of the restricted area by an Authorized User.
3. DETAIN INDIVIDUALS: If any heavy equipment is involved, detain the equipment and operator until it is determined there is no contamination present.
4. REMAIN AT THE SCENE: Gauge users and other potentially contaminated individuals should not leave the scene except for immediate medical attention.
5. NOTIFY: Notify the persons in the order listed below of the situation:

NAME	WORK PHONE NUMBER	HOME PHONE NUMBER
Melissa Dooley, RSO	870-972-3644	870-761-0377
Ben Rougeau	870-972-3086	870-897-6439

6. FOLLOW DIRECTIONS: Follow the directions provided by the person contacted above.

NOTE: DO NOT HANDLE UNSHIELDED SOURCES OF RADIOACTIVE MATERIAL

X.4.2 RSO and License Management

The RSO and License Management must do the following:

1. Arrange for a radiation survey to be conducted as soon as possible by a knowledgeable person using appropriate radiation detection instrumentation. This person could be a licensee employee using a survey meter located at the job site or a consultant. To accurately assess the radiation danger, it is essential that the person performing the survey be competent in the use of the survey meter.

2. If gauges are used for measurements with the unshielded source extended more than 3 feet below the surface, contact persons listed on the emergency procedures need to know the steps to be followed to retrieve a stuck source and to convey those steps to the staff on site.

3. Make necessary notifications to local authorities as well as the Arkansas Department of Health, 1-800-633-1735 or 1-501-661-2136 (staffed 24 hours a day) Immediate Department notification is required when gauges containing radioactive material are lost or stolen, when gauges are damaged or involved in incidents, and when it becomes apparent that attempts to recover a source stuck below the surface will not be successful.

4. Reports to the Department must be made within the reporting timeframes specified by the regulations.

5. Reporting requirements are found in Paragraphs RH-1501 and RH-1502.

6. Recovery operations and decontamination must only be attempted by properly trained and licensed individuals.

Note: In the event of a transportation accident involving radioactive material, the Arkansas Department of Health, the Arkansas State Police and the U.S. Department of Transportation must be notified.