RADIATION SAFETY MANUAL

FOR
UNIVERSITY OF ARKANSAS AT LITTLE ROCK
LITTLE ROCK, ARKANSAS

THE UNIVERSITY OF ARKANSAS AT LITTLE ROCK
Christina Drale, Ph.D., Chancellor

RADIATION SAFETY OFFICER
Vince Rodgers, CRSO

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Emergency Assistance

In case of an emergency or accident situation:
Notify: Campus Police 501-916-3400
Radiation Safety Office
501-916-6354 or 501-916-6351
Facilities Management Operations Center
501-916-3390

Nights, Weekends or Holidays:
Campus Police (501-916-3400)

Additional emergency information is available from:
Section 7.0 of this manual

For routine contact with the Radiation Safety Office: 501-916-6354
Facilities Management Rm 217

Introduction

The objective of the University of Arkansas at Little Rock (UA Little Rock) Radiation Safety Program is to assist faculty, staff, and students in furthering the UA Little Rock commitment to safety. This is accomplished by furnishing an environment which is as free as possible from recognized radiation hazards that cause, or are likely to cause, harm or death to personnel and/or the surrounding community. We strive towards this goal by providing sufficient information to aid in the safe conduct of day-to-day work activities while working with radioactive materials and/or devices.

The Arkansas Department of Health issues an academic institution license to UA Little Rock, which authorizes the use of radionuclides. An essential component of that license is this Radiation Safety Manual.

The purpose of the UA Little Rock Radiation Safety Manual is to assist both personnel and management in complying with the objectives of the Arkansas Department of Health, Bureau of Radiation Control regulations, and the UA Little Rock Radiation Safety Committee. This Manual is not intended to be an exhaustive or fully comprehensive reference, but rather a guide for authorized users, or other technically qualified individuals. Further information or advice concerning hazards associated with radioactive materials or ionizing radiation producing equipment should be obtained through consultation with the Radiation Safety Committee or the Radiation Safety Officer.

Christina Drale, Ph.D., Chancellor

Vince Rodgers, CRSO, Radiation Safety Officer

1.0 RADIATION SAFETY COMMITTEE (RSC)

1.1 THE PURPOSE OF THE RADIATION SAFETY COMMITTEE

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. The license held by the University of Arkansas at Little Rock (UA Little Rock) is an academic institution license and includes a number of radionuclides and sealed sources. One license is held by the entire University. Any individual, or action, which jeopardizes the license, endangers the permission of all researchers who utilize radioactive materials at UA Little Rock.

This RSC's services are available to all users, Department Heads, and Administrative Officials of the University.

1.2 ORGANIZATION OF THE RADIATION SAFETY COMMITTEE

The RSC is the University level committee of the University of Arkansas at Little Rock. The UA Little Rock Radiation Safety Committee is composed of the Radiation Safety Officer (RSO) plus other faculty members of representative departments who are experienced in the use of radioactive materials. It also includes the Director of Environmental Health and Safety, who serves as the Chairman of the committee. The RSC will have at least one member of the university administration who is appointed by the Chancellor.

1.3 RADIATION SAFETY COMMITTEE RESPONSIBILITIES

1) Review the use of ionizing radiation sources used within the University. Look from the standpoint of radiological health and safety of working personnel and other factors, which the Committee may wish to establish.
2) Prescribe special conditions that will be required during a proposed use of by-product material. Examples of such are requirements for bioassays, physical examinations of users, minimum level of training, and experience of users.
3) Receive and review records and reports from the Radiation Safety Officer or other individuals who are delegated responsible for radiation safety practices in this institution.
4) Recommend remedial action to correct safety infractions.
5) Formulate and review the institutional training programs for the safe use of radioisotopes.
6) Maintain written record of actions taken by the Committee.
7) Inform RSO, Radiation Control, and Arkansas Department of Health of any changes in committee membership.
8) Monitoring the institutional program to maintain occupational doses as low as reasonably achievable (ALARA).

1.4 RADIATION SAFETY COMMITTEE MEETINGS

The RSC shall meet a minimum of one time each year, upon due notice by the Director of Environmental Health and Safety, who shall advise the committee members of the time and place of the meetings. The proceedings of each meeting shall be recorded, published, and circulated to committee members and may be made available to interested persons upon request.

1.5 SAFETY VIOLATIONS

Investigation of safety violations can be initiated by the RSC or the RSO (see section 2.3). The RSC may request the RSO to make special investigations of any facilities where radiation sources are used. Promptly, upon completion, a report of the investigation shall be submitted to the RSC for review.

After consideration of the violation report, the Committee may:

A. Make a recommendation for mandatory remedial action. Failure to comply with Committee remedial action, may result in withdrawal of the user's radioactive material authorization, or

B. Revoke the user's authorization forthwith. This action can be taken if, in the Committee's opinion, the violation endangers the health or safety of persons or property. In the event the RSC withdraws approval, the project shall no longer be carried out within UA Little Rock until a new authorization application has been submitted, reviewed, and approved.

1.6 ENFORCEMENT POLICY

The Radiation Safety Office is required to conduct, at minimum, an annual review of the laboratory activities performed by authorized users of radioactive material. The actual number of audits an authorized user receives in a year can vary according to the volume and use of radioactive materials.

During the audit, items listed in the radiation safety manual are evaluated to determine the user's compliance with the regulations. The following items are evaluated:

1) Performs and documents contamination surveys as required by use.

2) Maintains a current inventory of all radioactive materials in the possession of the authorized user.

3) Records use and disposal of all radioactive materials.

4) Provides proper storage and labeling of radioactive materials.

5) Ensures adequate security (Locks laboratory doors when lab is not occupied).

6) Maintains acceptable radiation and contamination levels in the laboratory.

7) Ensures proper posting of signs and notices in the laboratory.

8) Prohibits smoking and the use of food or drink in the laboratory.

9) Radioactive waste is maintained according to procedures outlined in the Radiation Safety Manual.

10) Ensures all personnel comply with the recommendations to wear film badges or other forms of radiation dosimeters (if deemed necessary by the RSC).

At the completion of the laboratory audit, a letter is sent to the authorized user stating the results. If infractions or items of non-compliance are noted during the audit, each item is outlined for the authorized user with recommendations for compliance.

When items of non-compliance are present, the authorized user must submit a **written** response outlining the new procedures to ensure future compliance. This response must be received by the Radiation Safety Office within **30 calendar days** of the audit. Failure to comply with the 30 day time period, will result in the **loss of user privileges,** i.e., no radioactive material can be purchased, used, or received until compliance with all rules and regulations is documented.

Follow-up audits will be used to evaluate efforts to correct any items of noncompliance. If items of noncompliance are not corrected and are noted on follow-up audits, **user privileges will be revoked until the authorized user addresses each infraction.** The Radiation Safety Committee will evaluate the efforts and results of the authorized user in correcting items of noncompliance.

*** An exception to this rule is the presence of food and drink in the lab. In the event that food and/or drink is found in the lab, it will result in an immediate one-week suspension of all radioactive material use.**

SUMMARY OF ACTIONS:

1) Audit with infractions - letter to authorized user with copy to chairman of the department.

2) 30 days to submit written documentation outlining methods to ensure future compliance.

3) Follow-up audit to assess correction of infractions.

4) Failure to comply with the rules and regulations set forth by the Arkansas Department of Health, UA Little Rock Radiation Safety Committee, Radiation Safety Office and the Radiation Safety Manual will result in the loss of user privileges.

2.0 THE RADIATION SAFETY OFFICER (RSO)

2.1 THE AUTHORITY OF THE RSO

The Radiation Safety Officer derives authority from the Chancellor of the University of Arkansas at Little Rock. The RSO is the authorized representative of the Radiation Safety Committee regarding measures to implement radiation protection and control within the University of Arkansas at Little Rock.

2.2 ORGANIZATION

The Environmental Health & Safety Office oversees the Radiation Safety Program. The Radiation Safety Office and Radiation Safety Officer are located in room 217 in the Facilities Management building.

2.3 RESPONSIBILITIES OF THE RADIATION SAFETY OFFICER

The responsibilities of the Radiation Safety Officer include:

1) Provide consulting services on all aspects of radiation protection and safety.

2) Maintain radiation doses, releases, contamination, and other risks, as low as reasonably achievable (ALARA).

3) Develop and maintain a procedure for personnel and area monitoring, and maintain the records attending these actions.

4) Conduct educational training programs for the purpose of instructing employees and students in the proper procedures and the equipment necessary for the safe use of radiation sources.

5) Establish and maintain procedures for the safe disposal of radioactive materials.

6) Supervise periodic leak testing of sealed radioactive sources.

7) Furnish all authorized users of radioactive materials a copy of the Radiation Safety Manual and inform them of relevant sections of the State regulations as well as periodic changes of same.

3.0 LICENSING AND REGISTRATION REGULATIONS

3.1 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, source, special nuclear material, or electronic devices.
4) Any agency of the Federal Government.

In all other cases the delegated authority within the agreement state is given the power to license and regulate the receipt, possession, use and transfer of sources of ionizing radiation.

3.2 STATE REGULATIONS

- As an Agreement State, Radiation Control, Arkansas Department of Health, is empowered to license radiation sources and to enforce the regulations governing the activities or register of a license or registrant. The University of Arkansas at Little Rock has been issued a license by this agency that cover specific uses for academic institutions.

A current copy of the ASBH Rules and Regulations for Control of Sources of Ionizing Radiation can be reviewed in the Radiation Safety Office. Copies of these regulations may be obtained by writing to Radiation Control, Arkansas Department of Health, 4815 West Markham Street, Slot 30, Little Rock, Arkansas 72205-3867 for a fee of $30.00 or can be viewed on the ADH website.

3.3 UNIVERSITY OF ARKANSAS AT LITTLE ROCK CAMPUS REGULATIONS

No person may use or transfer into the University of Arkansas at Little Rock any radioactive materials without prior written approval by the Radiation Safety Committee or RSO. Exceptions may be made for the short-term use of low level or sealed sources for special purposes, e.g., instructional demonstrations, after prior consultation with the Radiation Safety Officer.

All statements related to procurement, use, and disposal of radioactive materials appearing in this booklet would be considered as the University of Arkansas at Little Rock regulations as well as specific directives given in individual permits relating to these or other sources of radiation.

A copy of the radioactive material license and inspection reports can be found in the RSO Office.

3.4 RESPONSIBILITY OF APPROVED USERS

Those persons who are permitted by the Radiation Safety Committee to use radioactive materials under the UA Little Rock license are responsible for the safe use of radiation sources by individuals under their control. The authorized user is responsible for:

1) Compliance with the UA Little Rock rules and regulations for radiation safety and the State “Rules and Regulations for the Control of Sources of Ionizing Radiation”. Instruction of employees under their control in the use of safety devices and procedures. Ensuring all radiation workers complete a radiation safety orientation prior to working with radioisotopes.

2) Adequate planning of an experiment, or procedure, to assure that appropriate safety precautions are taken.

3) Notify the RSO of any personnel changes, including addition or termination of employees, or changes in operational procedures, new techniques, or changes of areas where radioactive materials may be used or stored.

4) Direction of personnel under their control to comply with all recommendations to wear film badges, if applicable, to survey their hands and clothing, to submit to bioassay, etc. which are designed to control and to reduce their total exposure.

5) Limitation of use of radioisotopes under the permit to those over whom has supervisory control.

6) Maintenance of required current records of receipt, use, storage, and disposal of radioisotopes.

7) Preparing a quarterly inventory of radioactive materials on hand and at other times when requested by the RSO.

8) Segregation, containment, and labeling of all radioactive waste in accordance with the guidelines of RSO.

9) Cleanup of contaminated equipment or areas is the responsibility of the authorized user and the persons creating the contamination. It may not be assigned or delegated to staff outside the laboratory, such as housekeeping or maintenance workers.

10) Promptly notifying the Radiation Safety Office of any accidents or incidents.

3.5 RESPONSIBILITY OF THE INDIVIDUAL USER OF RADIOISOTOPES

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 UA Little Rock who has any contact with sources of ionizing radiation has a responsibility to:

1) Keep his exposure to radiation at the lowest practical value and specifically below the maximum permissible exposure as stated in Section 6.2.

2) If appropriate, wear the recommended radiation detectors for personnel, such as film badges and thermoluminescent dosimeters.

3) Survey his/her hands, shoes, body, and clothing for radioactivity and remove all loose contamination before leaving the laboratory.

4) Use all recommended protective measures such as protective clothing, respiratory protection, remote pipetting devices, ventilated, and shielded glove boxes and hoods.

5) No smoking, eating, drinking, chewing gum or application of make-up is permitted in radioisotope laboratories. If evidence of food or drink is found, it will result in an immediate one-week suspension of all radioactive material use. No food item shall be stored in a radioactive material use or storage area.

6) Maintain clean working habits. Plastic backed absorbent papers with plastic side down shall be used on work surfaces while performing experiments. This minimizes work surface contamination. Where practical, an impervious tray or pan should be used under the paper in order to ensure containment of spills.

7) Check working areas for contamination periodically or after each radioisotope procedure in conformity with Section 6.5.

8) Maintain good housekeeping practices in the laboratories.

9) Label radiation equipment and segregate radiation waste and equipment to avoid cross contamination.

10) Report immediately to the RSO the details of a spill or other accidents involving radioactivity.

11) Conduct decontamination procedures. (See Section 7.0, Emergency Procedures)

12) Workers must practice ALARA (As Low As Reasonably Achievable) in their work, and minimize the potential for exposures, contamination, or release of radioactive materials.

13) Workers are responsible for maintaining security of radioactive materials. (See Security of Radioactive Materials, Section 5.6).

4.0 PROCEDURE FOR OBTAINING APPROVAL TO USE RADIOISOTOPES

The Radiation Safety Committee has obtained, in the name of the University of Arkansas at Little Rock, an academic institution license from the Arkansas Department of Health for the use of radioactive materials. The Radiation Safety Committee or RSO approves internal permits for responsible and qualified individuals to use radioactive materials within the University of Arkansas at Little Rock, after the permission has been approved by the Department of Health.

The permits are approved for the purchase, transfer, use, and disposal of specific amounts of a particular nuclide within the educational and research facilities of the University of Arkansas at Little Rock.

The Committee or RSO requires the completion and approval of the following application forms before permission can be granted. An application is included in Appendix IV.

4.1 APPLICATION FOR RADIOISOTOPE APPROVAL

Each individual planning to use radiation sources must demonstrate to the Committee or RSO adequate training in, and facility for, the safe use of these materials. The following requirements have been adopted in the issuance of permits for non-human use (biological, chemical, or physical):

1) The applicant must have a minimum of 20 hours training and a working knowledge of basic radioisotope handling techniques. Topics of training should include: Principles and practices of radiation safety, radiation measurement, monitoring techniques and instruments, mathematics and calculations basic to use and measure radiation, and biological effects of radiation.

2) The applicant is to obtain from the Radiation Safety Officer, UA Little Rock application forms (see Appendix IV).

3) The applicant is to send to the RSO, completed typed copies of these forms. Hand written forms will not be accepted.

4) After initial review by the Radiation Safety Officer, and/or the Radiation Safety Committee, the application will be sent to the Arkansas Department of Health for approval or disapproval and amendment of the license.

5) A reasonable effort from the applicants may be necessary to answer dissenting questions and/or provide clarifications.

6) Upon approval, the RSO will provide the applicant with a letter of approval. This letter may contain special conditions and/or restrictions relative to the planned activities.

7) The RSO will periodically review the status of a user, use, or work in progress for the purpose of updating the "users list" so that it provides an accurate summary of the work being conducted. Applications are to be submitted at any time there is a change affecting possession limits, disposal methods or amounts, or any change which might result in changes in radiation dose to personnel, patients, or general public. Normally, only the information affected by the change is required in these renewals.

8) The review of radioactive material use applications will include an evaluation of the adequacy of the proposed facilities. Areas considered in the evaluation may include:

   a. Availability of radiation detection instruments.

   b. Adequacy of ventilation and fume hoods.

   c. Appropriate work surfaces and floors (non-porous).

   d. Provisions for shielding and secure storage of sources.

5.0 PROCUREMENT OF RADIOACTIVE MATERIALS

5.1 PURCHASES

Purchase orders for radioactive materials must have the approval of RSO before the Purchasing Department can process them. The purchase order shall indicate the radioisotope, chemical form, total activity in Becquerels, milliCuries or microCuries, the name of the approved user authorizing the order, delivery address of Facilities Management 217, and the current UA Little Rock radioactive materials license number, ARK-0421-03620. When the order is a confirmation order (blanket order), the RSO shall be notified so the shipment can be logged and dispatched to the proper person upon arrival.

Orders may be processed through the on-line ordering system of Purchasing. All orders must be routed to RSO for approval before going to Purchasing. Each order must contain the isotope, chemical form, total activity, name of authorized user, delivery address of Facilities Management 217, and the current UA Little Rock radioactive materials license number, ARK-0421-03620.

5.2 RECEIPT AND STORAGE

During "normal" working hours, the delivery vendor (Federal Express, Airborne Express) delivers all radioactive materials to the RSO office. Here they are checked for shipping damage and sent back if obvious damage is seen, logged-in, inventory/disposal forms prepared, surveyed by the RSO for radiation emission, and if no problems are found, stored until delivery to the authorized user. The packages are opened in user's laboratories (or the radiation storage facility if applicable) and are wipe tested as needed at that time.

Deliveries are not accepted after "normal" working hours, on weekends, or holidays. However, the Public Safety Officer on duty is to be notified for any emergencies after working hours (501-916- 3400).

The RSO must be contacted when special attention or special arrangements are required.

5.3 MATERIAL TRANSFERRED TO THE UA LITTLE ROCK CAMPUS BY AN INDIVIDUAL

Purchases made under an individual license or another institutional license and transferred to the UA Little Rock shall have prior approval by the RSO. The person who is to receive this material must have the RSO approval for the specific isotope and his/her receipt of it must not result in exceeding his/her or the University of Arkansas at Little Rock possession limit.

5.4 TRANSFER OF MATERIALS FROM ONE USER TO ANOTHER WITHIN THE UA LITTLE ROCK CAMPUS

Transfer of radioactive material between investigators of different projects must be reported prior to the transfer by telephoning the RSO office. These transfers must be between committee approved principal investigators, and within the limits of the approved quantities. The transfer should not take place until the authorization to do so has been given by the RSO. Any authorized radioisotope user leaving the jurisdiction of the University of Arkansas at Little Rock must make arrangements with the RSO to dispose of or transfer the radioactive materials to another authorized user. Transportation of radioactive materials within the confines of the university will comply with both the Arkansas Department of Health, Radiation Control and Department of Transportation (DOT) regulations. Transportation of radioactive materials across buildings or rooms within the campus will be by walking following proper procedures. Any transfers of radioactive materials between principal investigators must be pre-authorized by the campus Radiation Safety Officer. Whenever radioactive materials are transported from one building to another, Radiation Safety Officer must be notified of the following information:

- When the material will need to be moved
- The names of the person sending and receiving the material, and the sending and receiving locations
- The radioisotopes being moved
- The chemical form of the isotope
- The total activity in mCi
- The number of containers
- Phone numbers and responsible persons
- Any special conditions

Prepare package using guidelines established as follows:

1) The package must have a radioactive warning label with the isotope, activity, and date clearly marked. Clearly identify the principle investigator and one other contact in the event of an accident or loss of this package.
2) The package must be wipe tested for removable contamination before it leaves its place of origin and after it reaches its destination. Contact RSO, if any removable contamination is detected.
3) Radioactive material must be moved in such a manner that material cannot readily be released from the package under normal conditions.
4) A liquid, gas or dispersible solid must be transported in a suitable vessel with an outer container wall of leak-resistant, non-shatterable material.
5) A liquid must be packaged with sufficient absorbent material to completely absorb twice the volume of liquid.
6) The inner container must be clearly marked with a "Radioactive Materials" label listing the amount and identify of the radioisotope.
7) Adequate shielding must be provided when appropriate.

8) The inner container must be placed within a closed, strong outer package known to be free of contamination.
9) The outer package must bear a notice that the Office of Radiation Safety (provide a phone number) should be notified if the package is found.

Only authorized users with adequate training or RSO may transport any radioactive material.

5.5 TRANSFER OF MATERIALS FROM AUTHORIZED USERS TO INDIVIDUALS OUTSIDE THE UA LITTLE ROCK CAMPUS

All radioactive material must enter and exit the campus through the Radiation Safety Office. Any investigator who wishes to transfer radioactive material to an off-site investigator must contact the Radiation Safety Office before the transfer is to take place. The Radiation Safety Office must ensure that all federal and state regulations are followed. The following information must be provided before the transfer is to take place:

1) Name of institution receiving radioactive material.
2) Name of Radiation Safety Officer at receiving institution.
3) Name of investigator receiving radioactive material.
4) Isotope, chemical compounds, and amount of activity.
5) Confirmation must be given to the RSO that the facility is licensed to receive radioactive material. A copy of the institution's radioactive material license is required.

The Radiation Safety Officer will prepare the package for shipping.

5.6 SECURITY AND STORAGE OF RADIOISOTOPES

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 tampering. If the laboratory is unoccupied: **LOCK THE DOORS**.

STORAGE:

Storage of radioactive materials shall be in secured or locked cabinets, refrigerators, freezers or waste areas, unless attended by the licensee. 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 nuclide 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, the words “Caution, Radioactive Materials”.

6.0 RULES FOR THE SAFE HANDLING OF RADIOACTIVE MATERIALS

6.1 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”. Signs can be obtained from the RSO office.

6.1.1 UNRESTRICTED AREAS

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

1) If an individual continually present in the area cannot receive more than two mrem (0.02 mSv) in any one hour or

2) If, when allowance is made for expected occupancy and time variations in dose-rate, no individual is likely to receive more than 100 mrem (1 mSv) in a calendar year (prior approval must be obtained from the Arkansas Department of Health).

6.1.2 RESTRICTED AREAS

All areas within the University of Arkansas at Little Rock 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. 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 - Any area accessible to individuals in which there exists ionizing radiation at such levels that a major portion of the body of such individuals could receive an absorbed dose greater than 5 mrem (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 - Any area accessible to individuals in whom there exists ionizing radiation at such levels that a major portion of the body could receive in any one hour an absorbed dose greater than 100 mrem (1 mSv). A sign bearing the radiation symbol and the words “Caution High Radiation Area - No Entrance to Unauthorized Personnel” is to be posted at the entrance.

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. In accordance with the ALARA principle, unrestricted area

limits for contamination; exposures and/or releases are to be adhered to at all time, rather than restricted area limits.

6.2 RADIATION DOSE LIMITS

6.2.1 ALARA

ALARA is an acronym meaning **A**s **L**ow **A**s **R**easonably **A**chievable. 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 U of A at Little Rock to keep this exposure as low as reasonably achievable (ALARA).

It is not a violation of the law to exceed an ALARA guideline; however, these occurrences alert radiation safety staff and radioactive materials users to situations, which need to be reviewed to determine whether the practices may be modified to better reflect ALARA management practices.

6.2.2 OCCUPATIONAL DOSE LIMITS

No individual may receive, in one calendar year, a total occupational exposure in excess of the following:

Part of Body	Adult/Yearly
Whole body- head and trunk; gonads; arms above elbow, legs above the knee; active blood forming organs (TEDE)	5,000 mrem or 50 mSv
Extremities- hands and forearms; feet and ankles, leg below the knee (SDE)	50,000 mrem or 500 mSv
Lens of eyes (LDE)	15,000 mrem or 150 mSv
Single organ dose (TODE)	50,000 mrem or 500 mSv
Skin of whole body (SDE)	50,000 mrem or 500 mSv

DE- Dose Equivalent. 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 Seivert.

CDE- Committed Dose Equivalent. Means the dose equivalent to organs or tissues of reference that will be received from an intake of radioactive materials by an individual during the 50-year period following the intake.

EDE- Effective Dose Equivalent. It is the sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.

CEDE- Committed Effective Dose Equivalent. It 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.

DDE- Deep Dose Equivalent. Applies to external whole-body exposure. It is the dose equivalent at a tissue depth of 1 centimeter (1000 mg/cm^2)

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

SDE- Shallow Dose Equivalent. Applies to the external exposure of the skin or an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeter, averaged over an area of 1 square centimeter.

LDE- Lens of Eye Dose Equivalent. Applies to the external exposure of the lens and is taken as the dose equivalent at tissue depth of 0.3 centimeter.

TODE- Total Organ Dose Equivalent. The sum of the CDE and DDE for the maximally exposed organ.

Additional information about radiation units and conversion factors can be found at this link to the U.S. Department of Health & Human Services.

6.2.3 EXPOSURE LIMITS FOR THE GENERAL PUBLIC

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

A. 100 mrem (1 mSv) in any one year.
B. Two mrem (0.02 mSv) in any one hour.

6.2.4 PREGNANT RADIATION WORKERS

The UA Little Rock requires that “Pregnant Employees working with Ionizing Radiation,” must follow radiation dose guidelines for ensuring safe radiation limits for the embryo/fetus of occupationally exposed employees. Pregnant radiation workers should notify the Radiation Safety Office 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 500 mrem (5 mSv) per gestation period. It is further recommended that the monthly exposure should not exceed 50 millirem.

6.3 PERSONNEL MONITORING

Personnel monitoring is required where:

1) An individual receives or is likely to receive in one year from sources external to the body, a dose of 10 percent of the applicable limits (Section 6.2).

2) An individual enters a high or very high radiation area.

3) An individual is likely to receive, in one year, an intake in excess of 10 percent of the applicable annual limit on intake (ALI) found in Table 1, Columns 1 and 2 of Appendix G to RH-1000 through RH-2110, Arkansas Rules and Regulations.

4) A minor or declared pregnant woman is likely to receive, in one year, a committed effective dose equivalent in excess of 0.05 rem (0.5 mSv).

6.3.1 WHOLE BODY AND TLD DOSIMETERS

Radiation detection dosimeters (badges) must be worn routinely by personnel when exposure to penetrating radiation is possible. Where the hand dose may exceed 10 percent of the relevant limit (6.2), ring or wrist film badges (TLD- thermoluminescent dosimeters) must be worn. Individual workers handling 1 mCi or greater of P^{32} must wear extremity badges. Where the nature of the radiation or the unusual level of the possible exposure dictates their choice, personnel dosimeters of the ionization type should be worn and readings recorded daily. A guide concerning the advisability of wearing radiation dosimeters is included as Appendix III.

Lost or damaged dosimeters should be reported to the radiation safety office immediately. Replacement dosimeters will be issued. Please contact RSO (501-371-7607) for new dosimeters.

An administrative dose may be determined for an individual when a dosimeter issued by the RSO is lost, damaged, not returned for processing, or records of previous exposures cannot be obtained upon application for dosimetry. The exposure will be evaluated by any of the following methods:

1) Obtaining the individual's work history for the period in question and evaluating an exposure taking into consideration the work performed and past exposure history.

2) Averaging the recorded doses for the three wearing periods prior to and after the period in question whenever possible.

3) Assigning 1.25 rem for each quarter based on an averaging of 5 rem over 12 months for whole body dose equivalents.

6.3.2 BIOASSAYS

When the Radiation Safety Officer considers that significant fractions of the maximum permissible body burden of a given nuclide may be accumulated, the RSO may institute bioassay-assay procedures such as urinalysis or thyroid counting. Individuals who propose the use millicurie amounts of Iodine-125 must have a baseline thyroid uptake before iodination begins. Individuals using millicurie amounts of radioiodine should submit to a thyroid uptake within 24-48 hours post iodination. It is the responsibility of the individual user to call and schedule an appointment with RSO.

6.4 POSTING OF LABORATORIES, AREAS, AND EQUIPMENT

Signs are required by regulation to denote areas or containers with levels of radiation or radioactivity specified in the following sections.

6.4.1 "CAUTION RADIATION AREA"

Each laboratory or area where ionizing radiation is produced by an instrument (i.e. x-ray, gamma ray) must, have a "Caution Radiation Area" sign posted on the door. Warning signs are to be posted and removed only by Radiation Safety personnel.

6.4.2 "CAUTION RADIOACTIVE MATERIAL"

Each laboratory or area where radioactive materials are used or stored, must have a "Caution Radiation Area" sign posted on the door. Warning signs are to be posted and removed only by Radiation Safety personnel.

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 of radioactive materials, quantity, and the date of measurement of materials in the container.

Other signs are required for HIGH RADIATION AREAS (dose rate greater than 100 mrem in an hour) with the above exceptions, and in AIRBORNE RADIOACTIVITY AREAS. The Radiation Safety Officer must be consulted regarding control measures in these areas.

6.5 SURVEYS

The RSO will make independent surveys of all active radioisotope laboratories. Many labs will be audited on a more frequent schedule depending on the amount of radioactivity in use. Such things as inventory assessment, contamination control, exposure control, and waste disposal practices will be addressed during these surveys.

Survey results will be forwarded to the authorized user. A recheck may be conducted in the event that problems have been detected that need corrective action. Section 1.6 of this manual (Enforcement Policy) outlines the procedures to be followed in the event of said safety infractions.

Internal surveys are to be conducted by the authorized user or his/her designee in conjunction with the RSO surveys. Each lab actively using isotopes, must conduct periodic radiation surveys, depending on the types and quantities of radioactive materials in use in the laboratory. The frequency will be decided by the RSO. Removable contamination can be detected and measured through a wipe test of the surface, which is then counted by an appropriate counting instrument. The following instruments may be used, as necessary, for surveys:

1. Proportional Detector Ludlum, 44-110-4/M2000 Scaler(low-level beta wipe tests)
2. Rate meter Ludlum, model 18/17735
3. Rate meter Ludlum, model 3/19342
4. Pancake Probe Ludlum, model 44-9/PR197712
5. NaI Tube Probe Ludlum, model 44-6/PR3354
6. Alpha Probe Ludlum, model 43-5/PR3353

Records of these surveys must be maintained for review. Each survey record should include the following:

- a diagram of the area surveyed
- a list of items and equipment surveyed
- specific locations on the survey diagram where wipe test was taken

- ambient radiation levels with appropriate units
- contamination levels with appropriate units
- make and model number of instruments used
- background levels
- name of the person making the evaluation, and date evaluation was made

Good practice dictates that the authorized user use the survey instrumentation once each time an isotope is used in a laboratory, or at least once daily. For any isotope, background testing is done prior to experiments using radiation being conducted. For example, Tritium should be tested weekly and C-14 isotope tested monthly, both via **wipe testing.** However, if radiation is NOT in use in a particular area, and it was surveyed after such use stopped, we discontinue surveys and wipe tests until that isotope use starts again.

Removable Contamination Surveys-

Research Laboratory areas where only small quantities of radioactive material are processed (less than 200 microcuries at a time), survey for removable contamination shall be performed daily after each use.

Wipe tests are performed by swiping the areas of interest with a filter paper disk or cotton tipped applicator and then determining the activity in a scaler calibrated for the suspected radionuclide. Wipe tests are more sensitive than instrument surveys. The instrument that we use to conduct wipe testing is called the Ludlum 44-110-4 with a M2000 scaler.

The Ludlum 44-110-4 detector is a windowless gas flow proportional detector. It is able to detect low-energy alpha and beta radiation, as well as measure tritium. This detector is made of an aluminum housing with four platinum wires mounted in the sample chamber above where the sample is placed. The chamber is filled with P10 gas (P10 gas is 90% Argon and 10% Methane). The gas is restricted as it leaves the tank and runs into the detector chamber at a rate of 0.1 L/min. Any ionizing particle that passes from the sample through the chamber, will ionize surrounding gaseous atoms. The resulting ions and electrons are accelerated by the electric field across the chamber, causing a localized cascade of ionization known as a Townsend avalanche. This collects on the nearest wire and results in a charge that is proportional to the ionization effect of the detected particle. By computing pulses from all of the wires, the amount of radiation from the sample can be measured.
To be measured, the detector must be connected to a scaler/counter. Our scaler/counter is the Ludlum M 2000. It is connected to the 44-110-4 by a Ludlum type C cable. The M 2000 is a general purpose scaler/counter that is typically used for counting samples. It can be run by both AC power and batteries. It has fine adjustment controls for setting both the high-voltage and threshold settings. When connected to the 44-110-4, it receives the pulses created by the sample or background, and turns them into measurable data. This data will be measured in counts per minute (cpm). To get the correct value (in cpm) of a sample, first a background reading must be taken. This is accomplished by running the instrument with nothing in the sample tray. You will get a value (in cpm) for the background. The sample is then measured. The sample value (in cpm) includes the value of the background. To get the true value (in cpm) of the sample, the value of the background run must be subtracted from the value of the sample. This leaves you with the true value (in cpm) of the sample. This value can then be used to see what amount of radiation, if any, is present on the sample.

The wipe test procedure should be sufficiently sensitive to detect the presence of 2x background readings, as determined by the Ludlum 44-110-4 / 2000 Scaler. Refer to the standard operating

procedure for this device and follow instructions accordingly to determine the presence of contamination by wipe test. A radioactive check source with a known amount of activity, must be used to run a positive control sample. A blank filter paper must also be run to find the background value.

In keeping with the ALARA concept, any detectable contamination should be cleaned immediately.

6.5.1 CONTAMINATION LEVELS

Removable surface contamination levels for beta or for beta-gamma emitters shall be controlled such that a level of **200 DPM per 100 sq. cm**. is not exceeded. When removable radioactivity is found, the area must be decontaminated and then re-surveyed and documented. Detectable levels of removable contamination should be removed, and non-removable 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. In some cases, such as P-32 contaminated equipment, shielding is required.

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 Arkansas 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.

6.6 HANDLING OF RADIOACTIVE MATERIALS

1) Before any work is undertaken with quantities of radioisotopes, which may produce significant external or internal exposure, attention shall be given by the user to precautionary measures including the use of hoods, remote handling equipment, and air monitoring. The Radiation Safety Officer shall be consulted for recommendation on initial or unusual operations.
2) Work, which may result in contamination of work areas, shall be done over stainless steel trays or trays lined with heavy absorbent paper.
3) Personnel working in areas containing radioactive materials shall wash their hands thoroughly, using plenty of soap, before eating, smoking or leaving work. Those working with unsealed sources should monitor hands and shoes upon completing operations.
4) Eating, storing, or preparation of food is forbidden in a laboratory or rooms where work with radioactive sources is taking place or where contamination may exist. **If empty food or food containers are found in the normal trash, this is interpreted as "evidence of consumption" by regulators. There will be an immediate one-week suspension of all radioactive material work.**
5) Smoking, application of cosmetics, chewing tobacco and gum are not permitted in areas where work with radioactive sources is in progress or where contamination may exist. Under no circumstances should cigarettes, cigars or pipes be laid on tables or benches where radioactive work has been or is in progress.
6) Pipetting by mouth is not permitted.
7) Impervious gloves shall be worn whenever handling radioactive materials. Impervious gloves shall always be worn when handling open vessels containing alpha emitters or Sr-

90, or when handling equipment possibly contaminated with these materials. Gloves should be cleaned, if practicable, before removal or disposal. They should be handled and stored to prevent contamination of the inside surface.

8) All individuals handling radioactivity shall wear laboratory coats. In cases where millicurie amounts of activity are being handled and there is a likelihood of spillage and personal contamination, the laboratory coat should be removed before leaving the isotope laboratory and kept in the laboratory. Where contamination is noted during a laboratory survey, or there has been a spill of radioactive material, which may have produced contamination of a person or clothing, both the person and the clothing shall be monitored.

Personal contamination should be removed as soon as possible. Clothing that shows contamination, surface count-rates on a thin end-window Geiger-Mueller survey meter of less than 200 DPM may be allowed for laundry. Clothing showing higher count-rates shall be stored until the count-rate is less than 200 DPM, laundered by an approved decontamination laundry, or disposed of through a commercial disposal company, at the discretion of the Radiation Safety Officer.

6.7 STORAGE

Radioisotopes requiring a “Radioactive Materials” label must be stored in areas under the control of the user, which may be locked or otherwise secured against unauthorized removal of the material. The radioisotopes shall be stored in a container, shielded if necessary, such that the radiation at a distance of one foot from the container does not exceed 100 mrem/hour, i.e., the area may be classified as no more than a Radiation Area. Containers must be properly labeled and area signs posted where necessary. Suitable precautions shall be taken so that the probability of an explosion in the storage area, which would cause the dispersion of the radioactivity, is very small.

6.8 TRANSPORTATION ON UA LITTLE ROCK PREMISES

When transporting radionuclides between rooms or buildings, precautions must be taken to minimize the risk of accidents and the risk of exposing the public to radiation. Examples of precautions would be secondary containers to avoid breakage of primary container and absorbent material to retain the isotope in case of breakage. The container must also be labeled radioactive, indicating isotope and activity and, of course, should provide adequate shielding.

6.9 RADIOACTIVE WASTE DISPOSAL

All radioactive waste should be transported by the generating department to the Radiation Safety storage facility in closed or sealed containers. All waste should be transported on carts to minimize potential spills and accidents. Waste will be accepted at ETAS-577 by appointment only. Call RSO to make an appointment. Waste should be in radioactivity disposable yellow bags and be appropriately labeled with a completed radioactive waste tag. All waste should be properly packaged and tagged before transportation to RSO. Consult the appropriate section below or RSO for packaging and handling of specific waste types. RSO will make arrangements with a commercial disposal service for final disposal of the radioactive waste.

WASTE TAGS

Waste tags should be as complete as possible. The following information is necessary:

1) Authorized user's name.
2) Isotope - Isotopes should not be mixed. Isotopes with a half-life greater than 65 days should never be mixed with those having a half-life of 65 days or less.

3) Activity - This should be an upper estimate of how much activity is in each container. The unit of activity should be specified.
4) Date - date waste is taken to RSO.
5) Does the waste contain any toxic materials? This is very important to insure proper disposal and for the protection of the personnel that must handle the waste.
6) Type of Waste - This should indicate what type of waste is inside the bag (including both radioactive and non-radioactive chemicals if it is a mixture).
   Each type of waste should be placed in a separate bag or bottle.

Lead or lead lined containers should not be included in the yellow bags. These may be brought down separately. Manufacturer vials containing unused activity should not be placed in the bag. Because of the higher specific activity in the unused isotope, these are processed separately. Call RSO if there are any questions about proper packaging or handling of waste.

6.9.1 STORAGE OF WASTES

1) Each laboratory must maintain a waste can, preferably with a foot-operated lid, which must display a radioactive materials label in a prominent position. The use of a yellow disposable liner bag (available in RSO office) is required in order to maintain the waste can free of contamination.
2) Waste should be separated by type (i.e. dry solids, wet material, bulk liquids, and small liquid vials)
3) Waste should also be separated by half-life. Isotopes with half-lives greater than 65 days should not be mixed with isotopes having a half-life shorter than 65 days. Where possible, it is advantageous to separate waste by individual isotopes.
4) Radioactive wastes must be stored only in restricted areas where they can be secured against unauthorized removal by housekeeping personnel. Waste should be clearly labeled as radioactive to prevent accidental removal.
5) Liquid wastes should be stored in sealed containers (no open beakers), preferably in polyethylene bottles or typical 4-liter glass reagent jugs. Plastic milk jugs or other containers, which formerly held food or beverage items, are not permitted. There must be no possibility of a chemical reaction during storage that might cause an explosion or cause the release of radioactive gases or vapors.

6.9.2 WASTE FROM WIPE TESTS

It is important that all bags of filter paper, cotton swabs, and aluminum planchettes from wipe tests be tagged to indicate the generating user, isotope, and total activity in the bag.

6.9.3 LIQUID WASTE

All liquid waste will be disposed of by the RSO. Bulk liquid waste should be brought to RSO for disposal. Liquids should be labeled as organic or aqueous solutions. A waste tag should be completed and attached to EACH liquid container. The exterior of the container should be free of contamination before it is transported from the laboratory.

Bulk liquids should be designated as either aqueous or organic solutions. Liquids with a short half-life (less than or equal to 65 days) will be stored for decay through ten half-lives. Upon decay they are surveyed to verify that the waste is at background levels and then disposed of appropriately, aqueous solutions to the drain, organic solutions according to the Hazardous Materials. If the organic waste requires a commercial disposal service the responsible generator will be billed for the cost of this service. Small vials containing liquid should **not** be placed in a dry solids bag.

A permit for the use of isotopes may contain limitations on disposal of liquid wastes by sanitary sewer. Instructions for record keeping may also be given. Such limitations will be designed to insure conformity with Federal and State regulations. Dispose of radioactive waste into a designated sink may be allowed if the following conditions are met:

1) Only one sink in each laboratory may be designated for radioactive waste disposal, and it must be marked appropriately with the radiation symbol and the words "radioactive materials" in such a way that both laboratory personnel and plumbers are made aware of this fact. The pipes beneath the sink should be marked with "Radioactive Materials" tape.
2) A record is kept giving the date and upper estimate of the amount of activity discharged for the day. This is accomplished by maintaining and returning the inventory/disposal forms.
3) The material is readily soluble or dispersible in water.
4) The quantity of material discharged per day into the sink does not exceed the concentration listed in Table 3 of Appendix G to RH-1000 through RH-2101 of the Arkansas Rules and Regulations.

6.9.4 SOLID WASTES

As for liquid waste, all solid radioactive waste will be disposed of by the RSO. Radioactive waste in the form of dry solids and damp material should be brought to the radiation storage area (ETAS-577) for processing and disposal. Call the RSO to make an appointment before bringing the waste. Lids with a short half-life (less than or equal to 65 days) will be stored in the radioactive waste storage area for decay through ten half-lives. Upon decay they are surveyed to verify that the waste is at background levels and then disposed of as non-radioactive waste.

Solids with a long half-life (greater than 65 days) will be temporarily stored and shipped out of UA Little Rock by a commercial disposal service. The responsible generator will then be billed for the cost of this service. Small vials containing liquid should not be placed in a dry solids bag.

6.10 TRAINING OF PERSONNEL

Anyone likely to receive more than 100 millirem in one year, including authorized users, staff members, and students, will be required to successfully complete radiation safety training before using radioactive material.

UA Little Rock will utilize the personnel training program as described in the UA Little Rock radiation safety manual. Based on our limited radiation usage, our training procedures, as outlined in the manual, are adequate. Authorized User (AU) training includes watching the “Radiation Basics Made Simple” 8 section video series from the Center for Disease Control (CDC), followed by taking the associated quizzes. Each quiz requires an 80% or better score to pass. All courses are overseen by the RSO. The Authorized User training is accessible online at https://ehs.host.ualr.edu/EHSTrain/EHSTrainWebISAPI.dll/. All training courses are documented through the EHSA Training software. Furthermore, an AU must meet the requirements of Appendix II.

In addition, authorized users are required to provide a brief training to students or staff members on the specific radioisotopes that they use. This must include:

a. Nature of the radiation that the particular radioisotope emits, including general radiation protection principles and characteristics of ionizing radiation.
b. Level of exposure, which would result from working with the source, including units of radiation dose and quantities.
c. Proper radiation detection instruments to be used.
d. Biological hazards of exposure and proper handling procedures to ensure exposure are well within guidelines.
e. What to do in case of an emergency.

Ancillary Training: Ancillary personnel hazard awareness training will be given by the RSO at least annually. Ancillary personnel are people who may need to enter radiation areas, but are not radiation workers (office personnel, janitorial, skilled tradesmen, non-radiation workers, etc.) The training is documented by a sign-in sheet or through the training software database, depending on delivery.

6.11 SURVEY INSTRUMENTS AND CALIBRATION

To facilitate safe practice in the University, the Radiation Safety Committee requires that an appropriate calibrated survey meter be available in each authorized laboratory area. Any un-calibrated meter will be seized by the RSO and sent for calibration. "Appropriate" in most cases means a thin window Geiger-Mueller type meter (end window or pancake type) that will detect nanocurie quantities of the particular radioisotopes utilized in the laboratory. A "laboratory area" may be one laboratory or a series of laboratory spaces. Labs located on different floors or in different buildings each need their own meters. Authorized "tritium-only" users will not be required to meet this requirement, since these meters will not detect the low energy beta emissions of tritium.

Instruments must be calibrated annually. Calibrations can be performed by a registered vendor, certified lab or returned to the manufacturer. A certificate of calibration is required for each instrument. This certificate must be on file in the laboratory for review during regulatory inspections. The Radiation Safety Office must be authorize the purchase of a new instrument or repair and factory calibration of an existing instrument. All instrumentation and equipment shall be used according to manufacturer recommendations.

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

6.12 REMOVAL OR TRANSFER OF LABORATORY EQUIPMENT

Any equipment in the laboratory, which could have been contaminated with radioactive material, must be surveyed before removal to another laboratory, transfer to a repair shop, or transfer to Surplus Property. Before the equipment is transferred and following satisfactory survey, the Radiation Safety Office will remove all warning signs and stickers. Transfers to Surplus Property must be cleared by the Radiation Safety Office.

6.13 VACATING LABORATORY SPACES

The Radiation Safety Office must be informed of all changes in authorized laboratory spaces, including transfers or departures from the University and laboratory relocations. The Authorized User must notify the Radiation Safety Office **two (2) weeks** before departure from the University Campus. The Authorized User is responsible for surveying all spaces and equipment and proper removal of all radioactive waste and radioactive sources prior to the changes. Upon notification,

the Radiation Safety Office will complete a final clearance survey of the authorized spaces. Radiation Warning signs may be removed only by the Radiation Safety Office.

All unused radioactive materials must be accounted for and turned over to the Radiation Safety Office for storage or disposal. Materials may be transferred to another authorized user following RSO approval.

6.14 NEW LABORATORY SETUP

New laboratories will be posted and set-up by the Radiation Safety Office. The Authorized User should contact the Radiation Safety Office to schedule the set-up. The Radiation Safety personnel will review policies and procedures and answer any other questions regarding radiation safety matters.

7.0 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, the Radiation Safety Office (916-6354 or after hours, 916-3400) must be notified as soon as possible.

7.1 SEALED SOURCE RUPTURE

If the rupture of a sealed source occurs, or if potentially hazardous quantities of radioactive dusts, mists, fumes, organic vapors or gases are introduced into the air, the following emergency measures should be taken immediately:

1) No immediate attempt should be made to clean up the spill.
2) All windows should be closed, fans and air conditioners should be shut off, and everyone should leave the room.
3) All doors should be closed and locked.
4) If powdered or gaseous sources are involved, the door and all other openings leading into the room should be sealed with wide masking tape and heavy wrapping paper.
5) The spread of radioactive contamination can be diminished by restricting the movements of potentially contaminated persons to a local zone just outside the spill area until the extent of shoe and clothing contamination is ascertained.
6) Every person who might have been contaminated should be monitored for radioactivity, and, if contaminated, should remove his clothes and be decontaminated. If no means are available for monitoring, it should be assumed that the person is contaminated.
7) The Radiation Safety Officer should be called immediately. If necessary, outside consultants experienced in radiation hazards will be called in and their advice followed.

7.2 RADIOACTIVE LIQUID SPILLS

All spills of radioactive material must be cleaned up promptly. The responsibility for cleaning or for calling for experienced help rests on the individuals working in the area involved and responsible for the spill. A major spill is defined as an uncontrolled and inadvertent release of radioactive material, which exceeds 100 microCuries and does not involve airborne contamination. Under no circumstances should any untrained person attempt to examine or clean up a major spill of radioactive material. (The clean-up technique should be planned with the same care as is used in quantitative chemical analyses or in bacteriological handling of virulent organisms.) Fans or ventilating apparatus should not be turned on in an attempt to blow the isotope or its decay products away. Such a maneuver will only disseminate the radioactive

material through-out the area. If the isotope is blown out of a building, air currents may carry the finely divided material into nearby or air-intake ducts. Proper precautions taken immediately will protect human life and reduce financial losses. In the case of some isotopes with long half- lives, expensive equipment or entire buildings have been rendered useless . When decontamination is possible it can run into millions of dollars, depending on the extent and nature of the contamination. Precautions taken in the first few minutes after an accidental release of radioactive material can mean the difference between inconvenience and disaster. The Radiation Safety Officer shall be notified immediately of all accidents involving possible body contamination or ingestion of radioactivity by personnel, over-exposure to radiation, contamination of equipment, spread of contamination or difficulty in cleaning up a contaminated area. The RSO must be notified immediately in the event of loss of radioisotopes.

A *minor incident* with radioactive materials is an abnormal occurrence involving low amounts (generally less than 100 microCuries) of radioactive materials, where the worker handling the spill knows how to clean it up, has the decontamination materials on hand, and can respond without incurring risk of exposures or spreading within a reasonably short time.

A *major incident* is an abnormal occurrence involving larger amounts (generally greater than 100 microCuries) of radioactive materials, high risk nuclides, large areas contaminated, contamination of the skin, airborne radioactivity, or any situation where contamination may have been spread outside the authorized area. Major spills must be reported to the Radiation Safety Officer or his/her designee immediately, as required by state and federal law. Call the RSO (916-6354) during working hours or the Public Safety (916-3400) during non-working hours.

In the event of a MINOR incident, these procedures should be followed:

a) Notify the authorized user and persons in the room at once.
b) Permit only the minimum number of persons in the area necessary to deal with the spill.
c) Confine the spill immediately.
d) Use protective gloves and drop absorbent paper on a liquid spill.
e) Decontaminate, using a monitor to check the progress of the work.
f) Monitor all persons involved in the spill and the cleaning.

In the event of a MAJOR incident, the following procedure should be instituted:

a) Notify all persons in the area that a major spill or incident has occurred and evacuate unnecessary personnel. Notify the authorized user and the Radiation Safety Officer.
b) If hands are protected from contamination (i.e., gloves), right the container of the spilled liquid. If possible, shield the source, but only if it can be done without significantly increasing your radiation exposure.
c) If the spill is on clothing, discard outer clothing at once.
d) Vacate the room and lock the doors in order to prevent entry.
e) If skin contamination has occurred, measure levels of contamination with a survey meter, record, and begin decontamination by gentle washing with warm water and soap, washing downwards towards extremities, not upwards.

In the event of an EMERGENCY in which radioactive materials are involved, the following procedure should be instituted:

a) Notify all persons in the area that an EMERGENCY has occurred and evacuate the area if a risk to persons present exits.
b) Notify Campus Police immediately (916-3400) of the nature of the emergency, number of persons involved, and the location. Notify the RSO Office (916-6354).
c) AWAIT THE EMERGENCY RESPONDERS who will assist and provide direction, as well as contact any other necessary responders.

7.3 ANNUAL AUDIT

An audit is conducted, in part, to fulfill the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 10 CFR 20.1101 for an annual review of the content and implementation of the licensee's radiation protection program. Audits should be performance-based and include observations of licensed activities, interviews with personnel, and inspection of facilities and equipment. Audits should also identify program weaknesses and allow licensees to take early corrective actions [before a U.S. Nuclear Regulatory Commission (NRC) inspection]. During an audit, the auditor needs to keep in mind not only the requirements of the NRC's regulations but also the licensee's commitments in its applications and other correspondence with the NRC. The auditor also should evaluate whether the licensee is maintaining exposures to workers and the general public as low as is reasonably achievable (ALARA) and, if not, make suggestions for improvement. The audit document is located in Appendix V.

The RSO will also make annual audits of all active radioisotope laboratories. Some labs will 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. (See the audit checklist used by the RSO in Appendix VI).

7.4 EMERGENCY CONTACTS

If there are any questions of contamination, techniques for handling contamination, or personnel exposure, the following individuals should be contacted.

Vince Rodgers, EHS Director RSO:
Office: 501-916-6351
Cell: 501-529-2841

Radiation Safety Office: 501-916-6354

After hours or on weekends: Please call UA Little Rock Public Safety 501-916-3400 and they will contact Radiation Safety Officer.

APPENDIX I

RADIATION SAFETY COMMITTEE MEMBERSHIP-June 2021*

Vince Rodgers, CRSO	EHS Director, Chair, Interim RSO
Keith Hudson, PhD	Professor, Chemistry
Nawab Ali, PhD	Associate Professor, Biology
John Bush, PhD	Associate Professor, Biology
Tony Hall, PhD	Associate Professor, Physics
Mariya Khodakovskaya, PhD	Associate Professor, Biology

APPENDIX II

ACCEPTABLE TRAINING AND EXPERIENCE FOR AUTHORIZED USERS OF RADIATION SOURCES.

A. General

There are four categories of use for the purposes of training and experience evaluation. They are in vitro applications. An applicant is required to describe the intended project sufficiently for the Radiation Safety Committee or RSO to make a sound judgment regarding his/her level of ability. The Committee's primary concern is for the safety of the applicant, coworkers, the UA Little Rock community and the general public.

B. Basic Training

All authorized users (AU) regardless of the category of intended use, are expected to have working knowledge of the following areas. A minimum of 20 hours of formal training is required.

1) Principles, practices, and policies of radiation protection.
2) Methods of measurement, standardization, and monitoring of radiation sources and the associated instrumentation.
3) Basic mathematics and calculations fundamental to the use and measurement of radiation and radioactivity.
4) Biological effects of radiation.
5) Familiarity with the UA Little Rock Radiation Safety program.
6) Experience in the uses for which application is made.

In addition, an AU should have (i) a college degree at the bachelor's level or equivalent training and experience in physical, chemical, biological sciences, or engineering; and (ii) training and experience commensurate with the scope of proposed activities, i.e specific material training of any nuclides to be used. Training also includes use of monitoring devices, exposure surveys, and contamination testing. Each Principle Investigator will be required to submit a Standard Operating Procedure (SOP) outlining safety measures and protocols to achieve ALARA levels. The SOP shall be reviewed and accepted by the RSO prior to radioactive material usage.

APPENDIX III

PROCEDURES FOR REQUISITION AND USE OF PERSONNEL DOSIMETERS

Federal and State laws specify the wearing of personnel dosimeters for individuals entering controlled areas in which they will receive, or are likely to receive, 10% of the annual occupational limit, (see section 6.2). Declared pregnant employees are subject to more restrictive radiation exposure limits. These employees should contact the Radiation Safety Officer for consultation about ways of minimizing their radiation exposure during the pregnancy and other information related to the UA Little Rock policy for pregnant employees.

Ring thermoluminescent dosimeters (TLDs) are recommended for personnel working with millicurie quantities of P-32 or I-125.

PERSONNEL DOSIMETER REQUISITION:

The radioisotope user, supervisor, or department head, is responsible for seeing that each person under his control is issued a radiation dosimeter by the Radiation Safety Officer, when his /her activities may result in exposures greater than 10% of the annual dose limits (see section 6.2).

Dosimeters will be issued when the following information can be supplied: the prospective wearers' name, social security number, date of birth, room number or department, and the name, address, and dates of any previous occupational radiation exposure. If the individual has previous occupational radiation exposure, State regulations require UA Little Rock to request their exposure history from their previous employers. Forms will be provided.

If there is any doubt about the advisability of a person wearing a radiation dosimeter, a dosimeter can be issued for a six-month trial period to determine the routine exposure levels.

USE:

There are three primary reasons for wearing a dosimeter.

1) To assure that the radiation exposure of the individual is within the established "safe" limits as set up by National and International Radiation Protection Commissions and to comply with state and federal regulations.
2) To alert the RSO and the individual wearer of changes in procedures or work habits which result in increased radiation exposure.

3) To fulfill the legal and moral responsibility to maintain records of radiation exposure and keeping exposures ALARA.

As with most sensitive instruments, there are precautions, which must be observed in order that the measurements derived are accurate and reliable.

1) The dosimeter should never be exposed to liquids, excessive heat or mechanical stress. Do not wash and/or dry the radiation dosimeters in the laundry.

2) The dosimeter should never be stored in such a way that it will be exposed to more radiation than the person to whom the badge is assigned.

3) The dosimeter should never be worn during personal medical radiation treatments or x-rays. (The radiation dose of interest is only occupational.)

4) The dosimeter should always be worn when conducting procedures using radioactivity.

5) The dosimeter should be worn on the side of the body nearest the radiation source. The badge should be worn at the collar or waist.

6) Ring TLDs should be worn beneath protective gloves to prevent contamination of the ring or accidental disposal when the gloves are removed.

7) Ring TLDs may be rinsed in tap water, but excessive soap should not be used.

8) Lost, damaged or contaminated dosimeters should be reported immediately to the Radiation Safety Office.

9) Radiation dosimeters are exchanged monthly. The dosimeter and the ring TLD should be returned promptly at the first of each month after replacement dosimeters are received. If you do not receive replacement dosimeters, please notify the Radiation Safety Office.

EXCHANGE OF RADIATION DOSIMETERS:
Each authorized user, supervisor, or department head, will assign one person to collect and distribute dosimeters. The new replacement dosimeters will be sent to the designated person at the first of each month. All exchanges should be made as soon as possible. Old previously worn dosimeters must be returned to the Radiation Safety Office by the eight (8th) of each month. Radiation dosimeters not returned within 60 days of the issue date may not provide an accurate dose assessment. It is imperative that dosimeters damaged, contaminated or lost be reported to the RSO immediately.

The designated person should not collect the previous month's dosimeters until replacement dosimeters are received. If replacement dosimeters are not received by the second of the month, the designated person should contact the Radiation Safety Office immediately at 916-6354

POSTING OF EXPOSURE REPORTS
Exposure reports will be sent to authorized users around the end of the month. These reports are to be posted where all monitored personnel can review their exposure readings. If employees have questions concerning their occupational radiation exposure, they may contact the Radiation Safety Officer at 916-6354. Whole body, deep dose exposures exceeding 100 mrem per month will be investigated by the Radiation Safety Office.

CHARGES:
Each authorized user utilizing personal dosimeters will be billed for expenses. The cost per dosimeter will include a set up charge for new participants and the unit cost of the dosimeter. Lost or damaged holders and/or rings will be assessed a fee based on current costs for the dosimetry services.

APPENDIX IV

APPLICATION FORMS FOR RADIOACTIVE MATERIAL USE:

Form 1- Application for Radionuclide Use

Form 2- Training and Experience Supplement

University of Arkansas at Little Rock

FORM 1 - APPLICATION FOR RADIONUCLIDE USE

APPLICATION CLASS: [ ] New [ ] Renewal [ ] Amendment Date:

1. TITLE OF PROJECT:

2. INVESTIGATOR NAME: **DEPT.:**
TITLE: **PHONE**:

a. Name & title of others who will work on this project (complete supplemental training sheet for each):
NAME: **DEPT.:**
TITLE: **PHONE**:

3. Radioactive materials to be used:

Nuclide	Physical / Chemical forms	Maximum amount in possession (mCi)

4. RADIONUCLIDE USAGE AND DISPOSAL:

a. Location(s) of use:
b. Location(s) of storage:
c. Duration of Usage:
d. Type of usage: (e.g. in vitro) _____(Animal or human use is not permitted)
e. **Ci/experiment**
f. Waste Disposal (2):

Nuclide	Dry Waste	mCi/month and volume (gals. or lbs.) Liquid Scint.	Aqueous Liquid	Non-aqueous liquid

Note: Review rules for radioactive waste disposal.

DATE RECEIVED:_____ DATE APPROVED:_____

University of Arkansas at Little Rock - APPLICATION FOR RADIONUCLIDE USE (Form 1, continued)

5. DESCRIPTION OF HOW RADIONUCLIDES WILL BE USED (Give special attention to procedures that have potential of contamination - centrifugation, evolution of gases, vapors, etc.):

University of Arkansas at Little Rock - APPLICATION FOR RADIONUCLIDE USE (Form 1, continued)

6. RADIATION SAFETY PROCEDURES TO BE FOLLOWED, FACILITIES & EQUIPMENT, ETC.
(Attach separate pages as necessary).

a. Procedures to ensure radionuclides are not lost or stolen.

b. Posting and labeling practices.

c. Contamination control measures (trays, gloves, adsorbent paper, etc.).

d. Fume hood availability.

e. Radiation survey meter availability.

f. Shielding devices. _____none required.

g. Personnel Dosimetry.

_____ Film badges _____ Ring badge _____ Bioassay

h. Other.

University of Arkansas at Little Rock - APPLICATION FOR RADIONUCLIDE USE
FORM 2 - TRAINING AND EXPERIENCE SUPPLEMENT (Attach to Form 1)

---

1. NAME: **TITLE:** **DEPT.:**
SOCIAL SECURITY NO: **BIRTHDATE:** **SEX:**

2. FORMAL TRAINING:

a. List Dates and Institution(s):

b. List number of clock hours for each of the following subjects covered (20 hours total required for P.I.):

Hours **Subject**
Principles of radiation safety
Radiation measurement, monitoring techniques and instruments
Mathematics & calculations basic to sue and measurement of radiation
Biological effects of radiation
Other (specify)
Total hours

c. Is a copy of certification of training attached to application? _____ yes_____no

3. EXPERIENCE WITH RADIATION SOURCES:

a. Dates and Institution(s):

b. Nuclide Maximum amount (mCi) Type of use

4. RADIATION EXPOSURE HISTORY: Give address(es) of facilities where you have been issued personnel monitoring (film badges, ring badges) or where bioassays (thyroid uptake, urinalysis) have been performed. (Include dates).

Date(s) Monitoring type Bioassay type Facility and address

5. CERTIFICATION: I certify that the above information is correct to the best of my knowledge and I authorize release of my previous radiation exposure history as described above.

SIGNATURE:_____ DATE:_____

APPENDIX V

UA Little Rock Audit Program

The form in this appendix is used to document the annual audit of the radiation safety program. Guidance on completing each section of the form is listed below. In the "remarks" portions of the form, note any deficiencies identified, and the corrective actions taken (or to be taken).

Section 1–Audit History. Enter the date of the last audit, whether any deficiencies were identified, and whether actions were taken to correct the deficiencies.

Section 2–Organization and Scope of Program. Give a brief description of the organizational structure, noting any changes in personnel or procedures, and amendments to the license. Describe the scope of licensed activities at the audited location. Check if the radiation safety officer (RSO) is the person identified on the license and fulfills the duties specified in the license.

Section 3–Training, Retraining, and Instructions to Workers. Ensure that workers have received the training required by 10 CFR 19.12 Be sure that the user has received training and has a copy of the licensee's safe use and emergency procedures before being permitted to use byproduct material. Note whether refresher training is conducted in accordance with licensee commitments. **Ensure that each worker has a copy of the licensee's procedures and, by interview or observation of selected workers, that he or she can implement them.**

Section 4–Audits. Verify that audits fulfill the requirements of 10 CFR 20.1101, are conducted in accordance with licensee commitments, and are properly documented.

Section 5–Facilities. Verify that the licensee's facilities are as described in its license documents.

Section 6–Materials. Verify that the license authorizes the quantities and types of byproduct material that the licensee possesses.

Section 7–Leak Tests. Verify that all sealed and plated foil sources are tested for leakage at the prescribed frequency and in accordance with licensee commitments. Records of results should be maintained.

Section 8–Inventories. Verify that inventories are conducted at least once every 3 months to account for all sources; inventory records shall be maintained for at least 3 years and available for inspection.

Section 9–Radiation Surveys. Verify that the licensee has appropriate, operable, and calibrated survey instruments available, that the instruments are calibrated (at the required frequency) in accordance with license conditions and in accordance with 10 CFR 20.2103. Calibration records must be retained for 3 years after the record is made. Verify compliance with 10 CFR 20.1301. Check that radiation levels in areas adjacent to use are within regulatory limits and records are in accordance with 10 CFR 20.2103. Records of surveys must be retained for 3 years after the record is made.

Section 10–Receipt and Transfer of Radioactive Material (Includes Waste Disposal). Verify that packages containing byproduct material, received from others, are received, opened, and surveyed in accordance with 10 CFR 20.1906, "Procedures for receiving and opening packages." Ensure that transfers are performed in accordance with 10 CFR 30.41, 10 CFR 40.51, and 10 CFR 70.42, as appropriate. Records of surveys, receipt, and transfer must be maintained in accordance with 10 CFR 20.2103 and 10 CFR 30.51, 10 CFR 40.61, and 10 CFR 70.51, as appropriate.

Section 11–Transportation. Determine compliance with U.S. Department of Transportation (DOT) requirements, if applicable.

Section 12–Personnel Radiation Protection. Evaluate the licensee's determination that unmonitored personnel are not likely to receive more than 10 percent of the allowable limits. Alternately, if personnel dosimetry is provided and required, verify that it complies with 10 CFR 20.1501(c) and licensee commitments. Review personnel monitoring records; compare exposures of individuals doing similar work; and determine reasons for significant differences in exposures. If any worker declared her pregnancy in writing, evaluate the licensee's compliance with 10 CFR 20.1208. Check whether records are maintained as required by 10 CFR 20.2101, 2102, 2103, 2104, and 2106.

Section 13–Auditor's Independent Measurements (If Made). The auditor should make independent survey measurements and compare the results with those that the licensee made or used.

Section 14–Notification and Reports. Check on the licensee's compliance with the notification and reporting requirements in 10 CFR Parts 19, 20, 30, 40, and 70. Ensure that the licensee is aware of the telephone number for NRC's Emergency Operations Center (301-816-5100).

Section 15–Posting and Labeling. Check for compliance with the posting and labeling requirements of 10 CFR 19.11, 20.1902, 20.1904, and 21.6.

Section 16–Recordkeeping for Decommissioning. Check to determine compliance with 10 CFR 20.1501(b) and 10 CFR 30.35(g), 10 CFR 40.36(f), and 10 CFR 70.25(g) and 10 CFR 70.51(b)(3), as appropriate.

Section 17–Bulletins and Information Notices. Check to determine if all NRC correspondence (e.g., regulatory issue summaries (RISs), bulletins, information notices, and Office of Nuclear Material Safety and Safeguards (NMSS) newsletters) issued since the previous audit and applicable to academic, research and development, and other licenses of limited scope have been reviewed. Check whether the licensee took appropriate action (e.g., training, updating procedures, etc.) in response to this NRC correspondence.

Section 18–Special License Conditions or Issues. Verify compliance with any special conditions on the licensee's license. If the licensee has any unusual aspect of its work, review and evaluate compliance with regulatory requirements.

Section 19–Continuation of Report Items. This section is self-explanatory.

Section 20–Problems or Deficiencies Noted; Recommendations. This section is self-explanatory.

Section 21–Evaluation of Other Factors. Evaluate licensee management's involvement with the radiation safety program, whether the RSO has sufficient time to perform his or her duties, and whether the licensee has sufficient staff to handle the workload and maintain compliance with regulatory requirements.

Note: All areas indicated in audit notes may not be applicable to every license and may not need to be addressed during each audit.

UA Little Rock Audit Checklist

Audit Report No._____ License No. _____

Licensee's name and mailing address:

_____

_____

_____

_____

Audit of activities at (address):

_____

_____

_____

_____

Contact at Audit Location_____ Telephone No. _____

Date of this Audit _____

Summary of Findings and Action:

[ ] No deficiencies

[ ] Deficiencies

[ ] Action on previous deficiencies

Recommendations:

Auditor:_____ Date:

(Signature)

1. AUDIT HISTORY [ ] N/A (N/A means "Not applicable"–Initial Audit)

   A. Last audit of this location conducted

   B. Problems or deficiencies identified during last two audits or 2 years, whichever is longer [ ] Y [ ] N

C. Open problems or deficiencies from previous audits:

Status Requirement	Prob./Def.	Corrective Action Taken (Y/N)	Open/Closed

D. Any previous problem or deficiency not corrected or repeated [ ] Y [ ] N [ ] N/A
Explain:

2. ORGANIZATION AND SCOPE OF PROGRAM

A. Briefly describe organizational structure

1. Structure is as described in license documents [ ] Y [ ] N

2. Multiple authorized locations of use [ ] Y [ ] N

3. Briefly describe scope of activities involving byproduct material, frequency of use, staff size, etc. [ ] Y [ ] N

4. Amendments and program changes [ ] Y [ ] N

B. Radiation safety officer [ ] Y [ ] N

1. Authorized on license [ ] Y [ ] N

2. Fulfills duties as RSO [ ] Y [ ] N

C. Use only by authorized individuals [ ] Y [ ] N

Remarks:

3. TRAINING, RETRAINING, AND INSTRUCTIONS TO WORKERS

A. Instructions to workers per 10 CFR 19.12 [ ] Y [ ] N

B. Training program required [ ] Y [ ] N

C. Training records maintained [ ] Y [ ] N

D. Evaluation of individuals' understanding of procedures and regulations based on interviews, observation of selected workers [ ] Y [ ] N

1. Each has an up-to-date copy of the licensee's safe use and emergency procedures [ ] Y [ ] N

2. Adequate understanding of:
   Current safe use procedures
   Emergency procedures [ ] Y [ ] N

E. 10 CFR Part 20

Workers cognizant of requirements for:

1. Radiation Safety Program (10 CFR 20.1101) [ ] Y [ ] N

2. Annual dose limits (10 CFR 20.1301, 20.1302) [ ] Y [ ] N

3. New NRC Forms 4 and 5 [ ] Y [ ] N

4. 10 percent monitoring threshold (10 CFR 20.1502) [ ] Y [ ] N

5. Dose limits to minors (10 CFR 20.1207) [ ] Y [ ] N

6. Dose limits to embryo or fetus and declared pregnant women (10 CFR 20.1208) [ ] Y [ ] N

7. Procedures for opening packages (10 CFR 20.1906) [ ] Y [ ] N

Remarks:

4. INTERNAL AUDITS, REVIEWS, OR INSPECTIONS

A. Audits are conducted [ ] Y [ ] N

1. Audits conducted by _____

2. Frequency _____

B. Content and implementation of the radiation protection program reviewed annually [10 CFR 20.1101(c)] [ ] Y [ ] N

C. Records maintained (10 CFR 20.2102) [ ] Y [ ] N

5. FACILITIES

A. Facilities as described in license application

B. Commensurate security procedures implemented (20.1801, 20.1802; Part 37 if applicable) [ ] Y [ ] N

Remarks:

6. MATERIALS

Isotopes, quantities, and use as authorized on license [ ] Y [ ] N

Remarks:

7. LEAK TESTS

A. Leak test performed as described in correspondence with the NRC (consultant, leak test kit, licensee performed) [ ] Y [ ] N

B. Frequency: every 6 months or other interval, as approved by NRC or Agreement State [ ] Y [ ] N

C. Records with appropriate information maintained [ ] Y [ ] N

Remarks:

8. INVENTORIES

A. Conducted at 3-month intervals [ ] Y [ ] N

B. Records with appropriate information maintained [ ] Y [ ] N

Remarks:

9. RADIATION SURVEYS

A. Instruments and Equipment: [ ] Y [ ] N

1. Appropriate operable survey instrumentation possessed or readily available [ ] Y [ ] N

2. Calibrated as required (10 CFR 20.1501) [ ] Y [ ] N

3. Calibration records maintained [10 CFR 20.2103(a)] [ ] Y [ ] N

B. Briefly describe survey requirements [10 CFR 20.1501(a)]

1. Airborne radioactive material – effluents released and/or worker personal area monitoring

2. Waterborne radioactive material – effluents released to unrestricted areas and/or sewer releases

3. External exposure of public and/or workers – contamination and/or ambient radiation and/or bioassay

4. Facilities and equipment – restricted and unrestricted areas

5. Decommissioning – release of equipment for unrestricted use and/or release of facilities for unrestricted use

C. Performed as required [10 CFR 20.1501(a)] [ ] Y [ ] N

1. Radiation levels within regulatory limits [ ] Y [ ] N

2. Corrective action taken and documented [ ] Y [ ] N

D. Records maintained (10 CFR 20.2103) [ ] Y [ ] N

E. Protection of members of the public

1. Adequate surveys made to demonstrate either (a) that the total dose equivalent (TEDE) to the individual likely to receive the highest dose does not exceed 100 millirem (mrem) in a year, or (b) that if an individual were continuously present in an unrestricted area, the external dose would not exceed 2 mrem in any hour and 50 mrem in a year [10 CFR 20.1301(a)(1), 20.1302(b)] [ ] Y [ ] N

2. Unrestricted area radiation levels do not exceed 2 mrem in any one hour [10 CFR 20.1301(a)(2)] [ ] Y [ ] N

3. Records maintained (10 CFR 20.2103, 20.2107) [ ] Y [ ] N

Remarks:

10. RECEIPT AND TRANSFER OF RADIOACTIVE MATERIAL (INCLUDES WASTE DISPOSAL)

A. Procedures describe how packages are received and by whom [ ] Y [ ] N

B. Written package opening procedures established and followed [10 CFR 20.1906(e)] [ ] Y [ ] N

C. If package shows evidence of degradation, monitor for contamination and radiation levels [ ] Y [ ] N [ ] N/A

D. Monitoring of degraded packages performed within time specified [10 CFR 20.1906(c)] [ ] Y [ ] N [ ] N/A

E. Transfer(s) between licensees (including “disposal”) performed per (10 CFR 30.41, 40.51, 70.42) [ ] Y [ ] N [ ] N/A

F. Records of receipt or transfer maintained (10 CFR 20.2103(a), 30.51, 40.61, 70.51) [ ] Y [ ] N

G. Transfers within licensee’s authorized users or locations performed as required [license condition (L/C)] [ ] Y [ ] N [ ] N/A

H. Package receipt or distribution activities evaluated for compliance with (10 CFR 20.1301, 20.1302) [ ] Y [ ] N [ ] N/A

Remarks:

11. TRANSPORTATION [10 CFR 71.5(a) and 49 CFR 170-180] [ ] N/A

A. Licensee shipments are

1. Delivered to common carriers [ ] Y [ ] N [ ] N/A

2. Transported in licensee's own private vehicle [ ] Y [ ] N [ ] N/A

3. No shipments since last audit [ ] Y [ ] N [ ] N/A

B. Hazmat Training

1. Applicability and responsibility for training and testing (49 CFR 172.702) [ ] Y [ ] N [ ] N/A

C. Packages [ ] N/A

1. Authorized packages used [49 CFR 173.415, 173.416(b)] [ ] Y [ ] N [ ] N/A

2. Closed and sealed during transport [49 CFR 173.475(f)] [ ] Y [ ] N

D. Shipping Papers [ ] N/A

1. Prepared and used [49 CFR 172.200(a)] [ ] Y [ ] N

2. Proper shipping name, hazard class, United Nations (UN) number, quantity, package type, nuclide, reportable quantities, radioactive material, physical and chemical form, activity, category of label, Transportation Index (TI), shipper's name, certification, and signature, Emergency response phone number, "Cargo Aircraft Only" (if applicable) (49 CFR 172.200–204) [ ] Y [ ] N

3. Readily accessible during transport [49 CFR 177.817(e)] [ ] Y [ ] N

E. Vehicles [ ] Y [ ] N

1. Cargo blocked and braced [49 CFR 177.842(d)] [ ] Y [ ] N

2. Placarded, if needed (49 CFR 172.504) [ ] Y [ ] N

3. Proper overpacks, if used (shipping name, UN Number, labeled, statement indicating that inner package complies with specification package) (49 CFR 173.25) [ ] Y [ ] N

F. Any incidents reported to DOT (49 CFR 171.15, 171.16) [ ] Y [ ] N

Remarks:

12. PERSONNEL RADIATION PROTECTION

A. ALARA considerations are incorporated into the Radiation Protection Program [10 CFR 20.1101(b)] [ ] Y [ ] N

B. Prospective evaluation performed showing that unmonitored occupationally exposed individuals are not likely to receive >10 percent of allowable limit [10 CFR 20.1502(a)] [ ] Y [ ] N [ ] N/A

OR

C. External dosimetry provided and required [ ] Y [ ] N [ ] N/A

1. Supplier_____Frequency _____

2. Supplier is National Voluntary Laboratory Accreditation Program-approved [10 CFR 20.1501(c)] [ ] Y [ ] N

3. Dosimeters exchanged at required frequency (L/C) [ ] Y [ ] N

D. Occupational intake monitored and assessed [10 CFR 20.1502(b)] [ ] Y [ ] N [ ] N/A

E. Reports [ ] N/A

1. Reviewed by_____Frequency _____

2. Auditor reviewed personnel monitoring records for period _____ to _____

3. Prior dose determined for individuals likely to receive doses (10 CFR 20.2104) [ ] Y [ ] N

4. Maximum exposures TEDE_____Other _____

5. NRC Forms or equivalent [10 CFR 20.2104(d), 20.2106(c)]

a. NRC Form 4 “Cumulative Occupational Exposure History” [ ] Y [ ] N

Complete: [ ] Y [ ] N

b. NRC Form 5, “Occupational Exposure Record for a Monitoring Period” [ ] Y [ ] N

Complete: [ ] Y [ ] N

6. Worker declared her pregnancy in writing during inspection period (review records) [ ] Y [ ] N [ ] N/A

   If yes, determine compliance with (10 CFR 20.1208) [ ] Y [ ] N
   Check for records per [10 CFR 20.2106(e)] [ ] Y [ ] N

F. Records of exposures, surveys, monitoring, and evaluations maintained (10 CFR 20.2102, 20.2103, 20.2106, L/C) [ ] Y [ ] N

Remarks:

13. AUDITOR'S INDEPENDENT MEASUREMENTS (IF MADE)

A. Survey instrument Serial No. Last calibration

B. Auditor's measurements compared to licensee's [ ] Y [ ] N

C. Describe the type, location, and results of measurements:

14. NOTIFICATION AND REPORTS [ ] N/A

A. Licensee in compliance with (10 CFR 19.13) (reports to individuals, public and occupational, monitored to show compliance with Part 20) [ ] Y [ ] N [ ] N/A

B. Licensee in compliance with (10 CFR 20.2201) (theft or loss) [ ] Y [ ] N [ ] None

C. Licensee in compliance with (10 CFR 20.2202, 30.50, 40.60, 70.50) (incidents) [ ] Y [ ] N [ ] None

D. Licensee in compliance with (10 CFR 20.2203, 30.50, 40.60, 70.50) (overexposures and high radiation levels) [ ] Y [ ] N [ ] None

E. Licensee aware of telephone number for NRC Emergency Operations Center (301-816-5100) [ ] Y [ ] N

F. Licensee in compliance with 10 CFR 20.2207, if applicable (reports of transactions involving nationally tracked sources) [ ] Y [ ] N [ ] N/A

15. POSTING AND LABELING

A. NRC Form 3 "Notice to Workers" is posted (10 CFR 19.11) [ ] Y [ ] N

B. 10 CFR Parts 19, 20, 21, Section 206 of Energy Reorganization Act, procedures adopted pursuant to Part 21, and license documents are posted, or a notice indicating where documents can be examined is posted (10 CFR 19.11, 21.6) [ ] Y [ ] N

C. Other posting and labeling per (10 CFR 20.1902, 1904) and the license is not exempted by (10 CFR 20.1903, 1905) [ ] Y [ ] N

Remarks:

16. RECORDKEEPING FOR DECOMMISSIONING (if needed) [ ] N/A

A. Records of information important to the safe and effective decommissioning of the facility maintained in an independent and identifiable location until license termination [ ] Y [ ] N

B. Records include all information outlined in [10 CFR 30.35(g), 40.36(f), 70.25(g) and 70.51(b)(3)] [ ] Y [ ] N

Remarks:

17. BULLETINS AND INFORMATION NOTICES

A. NRC Correspondence (e.g., RISs, Bulletins, Information Notices, NMSS newsletters) issued since last audit have been reviewed [ ] Y [ ] N

B. Appropriate actions taken in response to RISs, bulletins, information notices [ ] Y [ ] N

Remarks:

18. SPECIAL LICENSE CONDITIONS OR ISSUES [ ] N/A

A. Review special license conditions or other issues, and describe findings:

B. Problems or deficiencies identified at licensee facilities other than at audit location:

C. Evaluation of compliance:

19. CONTINUATION OF REPORT ITEMS [ ] N/A
(If more space is needed, use separate sheets and attach to report.)

20. PROBLEMS OR DEFICIENCIES NOTED; RECOMMENDATIONS [ ] N/A

***Note**:* Briefly state (i) the requirement and (ii) how and when violated. Provide recommendations for improvement.

21. EVALUATION OF OTHER FACTORS

A. Senior licensee management is appropriately involved with the radiation safety program or RSO oversight [ ] Y [ ] N

B. RSO has sufficient time to perform his or her radiation safety duties and is not too busy with other assignments [ ] Y [ ] N

C. Licensee has sufficient staff [ ] Y [ ] N

Remarks and recommendations:

APPENDIX VI

UNIVERSITY OF ARKANSAS AT LITTLE ROCK RADIOACTIVE MATERIAL ENFORCEMENT POLICY

The Radiation Safety Office is required to conduct a minimum of an annual review of the laboratory activities performed by authorized users of radioactive material. The actual number of audits an authorized user receives in a year can vary according to the volume and use of radioactive materials.

During the audit, items listed in the radiation safety manual are evaluated to determine the user's compliance with the regulations. The following items are evaluated:

1) Performs and documents contamination surveys as required by use.

2) Maintains a current inventory of all radioactive materials in the possession of the authorized user.

3) Records use and disposal of all radioactive materials.

4) Provides proper storage and labeling of radioactive material.

5) Ensures adequate security (Locks laboratory doors when lab is not occupied).

6) Maintains acceptable radiation and contamination levels in the laboratory.

7) Ensures proper posting of signs and notices in the laboratory.

8) Prohibits smoking and the use of food or drink in the laboratory.

9) Radioactive waste is maintained according to procedures outlined in the Radiation Safety Manual.

10) Ensures all personnel comply with the recommendations to wear film badges or other forms of radiation dosimeters.

At the completion of the laboratory audit, a letter is sent to the authorized user stating the results. If infractions or items of non-compliance are noted during the audit, each item is outlined for the authorized user with recommendations for compliance.

When items of non-compliance are present, the authorized user must submit a **written** response outlining the new procedures to ensure future compliance. This response must be received by the Radiation Safety Office within **30 calendar days** of the audit.

Failure to comply with the 30 day time period will result in the **loss of user privileges,** i.e., no radioactive material can be purchased, used, or received until compliance with all rules and regulations is documented.

Follow-up audits will be used to evaluate efforts to correct any items of noncompliance. If items of noncompliance are not corrected and are noted on follow-up audits, **user privileges will be revoked until the authorized user addresses each infraction.** The Radiation Safety Committee will evaluate the efforts and results of the authorized user in correcting items of noncompliance.

SUMMARY OF ACTIONS:

1) Audit with infractions - letter to authorized user with copy to chairman of the department.

2) 30 days to submit written documentation outlining methods to ensure future compliance.

3) Follow-up audit to assess correction of infractions.

4) Failure to comply with the rules and regulations set forth by the Arkansas Department of Health, UA Little Rock Radiation Safety Committee, Radiation Safety Office and the Radiation Safety Manual will result in the loss of user privileges.

UNIVERSITY OF ARKANSAS AT LITTLE ROCK
Radiation Safety Office
AUDIT CHECKLIST

Primary Investigator: _____ Assistant: _____

Laboratory: _____ Department: _____ Date: _____

Slot: _____ Phone: _____ Inspected by: _____

PHYSICAL FACILITY

1. Are biological safety cabinets certified annually?	YES	NO	N/A
2. Are sinks operational?	YES	NO	N/A
3. Are emergency showers and eyewashes accessible and unobstructed?	YES	NO	N/A
4. Are appropriate warning signs and notices posted (radiation, chemicals, biohazard, in-case-of-emergency-contact)?	YES	NO	N/A

WORK PRACTICES

5. Is eating, drinking, smoking, and cosmetic application prohibited?	YES	NO	N/A
6. Are foods and beverages not stored in the laboratory?	YES	NO	N/A
7. Is personal apparel appropriate?	YES	NO	N/A
8. Are appropriate protective devices (gloves, aprons, gowns, goggles, etc.) provided and properly used in all work areas in which chemicals, blood and body fluids are handled?	YES	NO	N/A
9. Is personal housekeeping adequate?	YES	NO	N/A

PROCUREMENT, DISTRIBUTION, AND STORAGE

10. Are hazardous substances properly segregated in a well identified area with adequate ventilation?	YES	NO	N/A
11. Are all containers properly labeled?	YES	NO	N/A
12. Is the integrity of chemical containers maintained (i.e. No leakage, cracked cap, etc)?	YES	NO	N/A
13. Are flammable and combustible storage limits adhered to?	YES	NO	N/A
14. Are flammable and combustible liquids not stored in conventional refrigerators?	YES	NO	N/A

15. Is each lab refrigerator labeled to indicate whether or not it is acceptable for liquid flammable storage? YES NO N/A

16. Are cylinders of all gases having Health Hazard Ratings of 3 or 4 and cylinders of gases having a Health Hazard Rating of 2 with no physiological warning properties kept in a continuously mechanically ventilated hood or other continuously ventilated enclosure? YES NO N/A

17. Are all gas cylinders secured in place to prevent falling? YES NO N/A

INFORMATION AND TRAINING

18. Is a UA Little Rock Safety Manual available? YES NO N/A

19. Is an MSDS readily available for each chemical/radioactive substance? YES NO N/A

20. Do employees have ready access to MSDS Notebook? YES NO N/A

21. Have Employees received appropriate information and training on the OSHA Hazard Communication Standard, Lab Safety Standard, Radiation Safety and Biohazard Safety? YES NO N/A

22. Is required training documented for all employees? YES NO N/A

FIRE SAFETY

23. Are ABC fire extinguishers available? YES NO N/A

24. Are extinguishers properly mounted on wall or located near the exit door? YES NO N/A

25. Are fire extinguishers inspected monthly? YES NO N/A

26. Are fire extinguishers in good condition, fully charged and unobstructed? YES NO N/A

27. Is each phone posted with the fire reporting number (916-3400)? YES NO N/A

28. Are electrical cords, plugs, and receptacles in good condition? YES NO N/A

29. Are all extension cords in use appropriate? YES NO N/A

30. Are power strips used properly? YES NO N/A

31. Are items stored at least three feet from electrical panels? YES NO N/A

32. Is combustible storage: Orderly? YES NO N/A
33. from sprinkler? YES NO N/A

34. Separated from heat source? YES NO N/A

35. Are rated floor, ceiling and wall penetrations sealed? YES NO N/A

WASTE DISPOSAL

36. Are infectious such as biohazard waste and bacteriologic wastes safely disposed of in containers or red bags? YES NO N/A

37. Are all hazardous wastes which are ignitable, corrosive, reactive, toxic, or acutely hazardous disposed of safely in labeled containers? YES NO N/A

38. Are all waste sharps discarded in puncture-resistant containers that have been properly labeled to warn handlers of the potential hazard? YES NO N/A

39. Are correct disposal methods used when disposing of chemicals in the sanitary sewer? YES NO N/A

RADIATION SAFETY

40. Are radioactive materials used in this lab? YES NO N/A

41. Are appropriate radiation warning signs and notices posted:

Doors	YES	NO	N/A
Refrigerators	YES	NO	N/A
Work benches	YES	NO	N/A
Hood	YES	NO	N/A
Sink/P-trap	YES	NO	N/A
Storage/Waste Containers	YES	NO	N/A

42. Are spill trays or absorbent pads used in areas where radioactive materials are manipulated? YES NO N/A

43. Are laboratory survey records up to date (at least monthly)? YES NO N/A

44. Do inventory/disposal records reflect use? YES NO N/A

45. Are waste disposal procedures appropriate? YES NO N/A

46. Are appropriate personnel monitoring in use? YES NO N/A

47. Is copy of current Radiation Safety Manual available? YES NO N/A

48. Is survey meter available and functioning? YES NO N/A

Date of last calibration: _____

49. Are radiation use areas secured when unattended? YES NO N/A

50. Are use areas designated on laboratory diagram? YES NO N/A

Comments: _____

_____

APPENDIX VII

Radioisotope Inventory and Disposal Log Sheet

Radiation Safety Office UNIVERSITY OF ARKANSAS AT LITTLE ROCK

RADIOISOTOPE INVENTORY AND DISPOSAL LOG

USER: _____ **ROOM NO:** _____

NUCLIDE: _____ **CHEMICAL FORM:** _____

VENDOR: _____ **DELIVERY DATE:** _____

P.O. NO: _____ **ACTIVITY DELIVERED:** _____

CATALOG NUMBER: _____ **LOT NUMBER:** _____

ASSAY DATE: _____

APPENDIX VII (cont.)

PACKAGE SURVEY AND WIPE TEST RESULTS

[ ] This package is exempt from survey requirements [RH-1307 (c) (1) and has NO evidence of shipping damage.

[ ] Radiation survey required. Results are: mR/hr @ surface
mR/hr @ 3 feet

[ ] Contamination survey required. Interior wipe: net DPM
Exterior wipe: net DPM

Package Comments:

RECORD ALL USAGE IN MILLICURIE UNITS(mCi).

Date	mCI Used	Drain	L.S.V.	Animals	Solid	Liquid	Transfer To:
Totals							
Total Unused:							

Return this form to RSO Office promptly upon completion.

APPENDIX VII (cont.)

Radioisotope Inventory and Disposal Log Sheet
(Instructions for completing record)

All use and disposal of radioisotopes should be recorded on the appropriate radioisotope inventory and disposal log sheet. Each use of radioisotopes should be documented by entering the date, amount used, and the amount disposed of by each of the listed disposal methods.

All usage should be recorded in **milliCurie** (mCi) units. Using units of volume, such as microliters, is ineffective because the specific activity of each shipment is not known and the conversion to units of activity can not be done.

Radioisotope decay can be ignored for the purposes of recording usage and disposal on the log sheet.
The following list gives the use of the different columns found on the log sheet.

1. Date- The date the material was used. Each use of the radioisotope should be recorded on the log sheet immediately.
2. mCi- The total amount of activity removed from the container during a particular usage.
3. Vials- The amount of activity disposed of in liquid scintillation vials to be disposed of by RSO.
4. Solid- The amount of activity in dry solid form, placed in yellow bag waste containers.
5. Liquid- The amount of activity found in collected liquid waste. The container should be appropriate for the liquid or chemical found in the waste.
6. Transferred- The amount of activity transferred to another approved or authorized user of radioactive material. The RSO should approve all transfers before the transfer occurs.

All columns should be totaled at the end of isotope use. All activity should be accounted for on the disposal log. The log sheet or a photocopy should be returned to RSO when use of the radioisotope is complete. Each radioisotope shipment remains in your possession until the completed log sheet is returned to RSO.

LOW BETA RADIATION WIPE TESTING
Standard Operating Procedure

INTRODUCTION-

Levels of beta radiation of certain radionuclides are too low to be detected with routine radiation survey instruments (GM counter, etc). In this case, wipes are taken with filter paper then measured with a proportional gas counter. To measure low beta, the following devices are used:

- Ludlum Model 44-110-4 Windowless Sample Counter-Detector
- Ludlum M2000 Scaler
- P-10 Gas (90% Argon; 10% Methane)

The Ludlum 44-110-4 detector is a windowless gas flow proportional detector. It is able to detect low-energy alpha and beta radiation, as well as measure tritium. It is composed of an aluminum housing with four platinum wires mounted in the sample chamber above where the sample (in this case, filter paper) is placed. The chamber is filled with P-10 gas. The gas is regulated at a rate of 0.1 L/min. Any ionizing particle that passes from the sample through the chamber, will ionize surrounding gaseous atoms. The resulting ions and electrons are accelerated by the electric field across the chamber, causing a localized cascade of ionization known as a Townsend avalanche. This collects on the nearest wire and results in a charge that is proportional to the ionization effect of the detected particle. By computing pulses from all of the wires, the amount of radiation from the sample can be measured.

The detector must be connected to the Ludlum M 2000 scaler/counter using a type C cable. The M 2000 is a general purpose scaler/counter that is typically used for counting samples. Either AC power or batteries power it. It has fine adjustment controls for setting both the high-voltage and threshold settings. When connected to the 44-110-4, it receives the pulses created by the sample or background, and turns them into measurable data. This data will be measured in counts per minute (cpm). To get the net value (in cpm) of a sample, first a background reading must be taken. This is accomplished by running the instruments with nothing in the sample tray. You will get a value (in cpm) for the background. The sample is then measured. The sample value (in cpm) includes the value of the background. To get the net value (in cpm) of the sample, the value of the background run must be subtracted from the value of the sample. This leaves you with the net value (in cpm) of the sample. This value is then converted to disintegrations per minute (dpm) to see what amount of radiation, if any, is present on the sample. Dpm can be calculated from cpm as long as you know your efficiency for the isotope that you are measuring.

2.0 RESPONSIBILITIES-

Wipe testing may only be done by trained, authorized users and their trained staff, or the Radiation Safety Officer (RSO). The RSO will conduct training for this procedure and will keep all training and wipe test records in the radiation safety database and in the radiation safety office (FM 217).

3.0 DEFINITIONS-

- PPE- Personal protective equipment. These items are worn to protect you from spills, splashes, ingestion, inhalation, etc. Lab coats, safety glasses, and gloves all fall into this category.
- ALARA- an effort, approach, or policy that aims to maintain the level of exposure to radiation “As low as reasonably achievable.”
- Wipe test- A wipe test is carried out when filter paper is wiped on a possible source of low level beta radiation. It is then measured by running it in a scintillation counter or gas proportional detector/counter.
- P10 Counting Gas- P10 counting gas is a gas comprised of 90% argon mixed with 10% methane.
- Cpm- Counts per minute when used in detecting radiation.
- Dpm- Disintegrations per minute when used in describing how radioactive particles behave.
- Efficiency- The efficiency of a specific isotope changes with different detection methods. Efficiency = CPM/DPM
- Low level beta radiation- Radioactive beta particles that have a low enough energy level or are in a few enough count, that they cannot be detected by routinely used survey equipment. They must be wiped and tested

4.0 HEALTH AND SAFETY WARNINGS-

-Personal Protection Equipment needed for wipe testing is as follows:

- Lab coat, safety glasses, and gloves to conduct the wipe part of the test.
- Once the sample is placed inside of the instrument, gloves need to come off in order to not contaminate the counter. While counting and recording data, safety glasses and lab coat are optional.
- When removing sample from the instrument tray, gloves need to be donned again to protect the hands.

- The P10 gas is stored in a cylinder. It must always be secured to keep the cylinder from falling over and causing harm. The gas is under pressure and therefore poses a hazard if it is damaged or punctured.
- Wipe tests are performed to look for radioactive particles. Great care should be taken to keep radioactive particles away from your body. (ALARA)
- Waste planchettes and filter papers must be disposed of in radioactive waste bags. These bags are yellow and labelled as radioactive waste. This waste does not enter the normal waste stream. It will be stored and picked up by a vendor of choice.

5.0 MATERIALS-

- Ludlum model 44-110-4 proportional gas detector
- Ludlum model M 2000 counter/scaler with power cord or D batteries
- Type C cable to connect the two
- P10 counting gas (90%argon, 10% methane)

- Gas cylinder regulator with built in gas restrictor
- Flowmeter and inline restrictor
- Plastic tubing to carry P10 gas between regulator and in-line restrictor to flowmeter, and then from the flowmeter to the Ludlum 44-110-4
- Filter paper wipes suitable for wipe testing
- Aluminum planchettes purchased from Ludlum (disposable disks that filter paper is placed on to keep radiation from contaminating the detector)
- Proper PPE (gloves, safety glasses, lab coat)
- Radioactive materials waste bags
- Paper and pen/pencil to write down counts per minute of background, sample, check source
- Calculator to do conversions from cpm to dpm
- Check source correlating with the type of radiation being tested for

6.0 PROCEDURES –

- Conduct wipe test on appropriate surfaces where contamination might be found, e.g. counter tops, ECD's, packaging, etc. Swipe the filter paper over the area that you would like to test for low beta radiation. If testing counter tops, swipe multiple locations covering at least 100 cm^2 per wipe. For an ECD, swipe where tubing/columns enter or exit the detector. Be sure to wear proper PPE while conducting the test.
- Once wipe/wipes are taken, seal in a proper container and transport them to the RSO workroom in ETAS 577. Access is restricted, so coordination may be necessary.
- Once inside, handle the materials to insure no cross contamination; change gloves as needed.
- Enable flow of P10 gas by turning the valve counterclockwise. Be sure the regulator is in the #5 position.
- Next, follow the tubing down to be sure it is on securely at all fittings.
- Be sure flowmeter is at a rate of 100 cc/mL.
- Plug in M 2000 into power strip behind the cart.
- Set switch on M 2000 to **line.** (the other two options are off and for battery usage)
- Be sure the top switch is set to X1. That will measure minutes. The reading 001 equals one minute. When in the X0.1 position, it will measure 001 in 6 seconds ($1/10^{th}$ of a minute).
- Be sure the bottom switch is to HV.
- The word "**count"** should be lit up.
- On the 44-110-4, be sure the silver switch on top is pushed toward the back of the instrument, towards the black cable, and the back wall. That is the closed position that lets no counting gas into the sample chamber drawer.
- There is a black knob on the right side of the 44-110-4. It is in the locked position when pushed toward the back wall. This is the position it has to be in, in order to allow gas through and to count the wipe.
- To open the drawer in the 44-110-4, pull the black knob towards yourself. That will unlock the sample chamber drawer. Next, place both thumbs on the top layer of metal on the front while placing your fingers on the back part of the drawer slide. Push the drawer with your fingers while bracing with your thumbs. It will be tight.
- Once the drawer is out as much as it can be, you will see a round tray-like holder in the middle. This is where you will place an aluminum planchette, containing the blank filter

paper that you are using as your background and later the filter paper used for the wipe test.

- Push the drawer back into the instrument. Push the black knob towards the back wall to lock the drawer into place.
- Pull the silver switch on top of the instrument towards you. This allows the gas to flow through the sample chamber drawer. Wait about a minute to let the gas to fill the drawer.
- Be sure the timer shows 001, then press the count button. You will see a red light appear above the word count. That light will stay on the entire minute that the counter is counting. You will see red numbers counting up from zero while this happens.
- Once the count light goes off, the counter is finished making its measurement.
- Notate this count. Run the same sample two more times by just pushing the count button each time. Notate these counts. Average all three, this will give you the background count value.
- Run the same process for each sample you have, counting each three times to get an average count for each sample.
- Ensure gas is turned off at the cylinder when done, and throw all waste into the RAD waste.
- Follow instructions in 7.0, reporting and documentation, for your data.

7.0 REPORTING AND DOCUMENTATION –

When testing for low level beta radiation, calculations must be performed in order to get usable data. The results that appear in the "count" box on the M2000 are registered in counts per minute (CPM). Convert CPM to DPM (Disintegrations Per Minute). To get the value (cpm) of a wipe sample, first a background reading must be taken. This is accomplished by running clean filter paper in the detector. The value returned provides the background radiation value. This is done three times to come up with an average background value. The wipe sample is then measured. This is also done three times and averaged to get the average sample value. The sample value returned includes the background cpm. The net value (cpm) of the sample is determined by subtracting the average background from the average wipe test total count. Once the net cpm has been calculated, you divide that value by the efficiency of the radioactive material you are looking for (calculated to that specific meter and isotope) to convert the cpm into dpm. If the net value is 2x background or more, steps shall be made to decontaminate the affected area(s).

Example 1: Background Avg = 100cpm
Sample Avg = 150cpm (no contamination or leak)

Example 2: Background Avg = 100cpm
Sample Avg = 300cpm (suspected contamination or leak)

Prior to wipe testing, a radioactive check source with a known amount of activity shall be used to run a positive control and verify the device is operating properly.

In keeping with the ALARA concept, any detectable contamination shall be cleaned immediately. Users must be trained prior to operating the system. Contact the RSO with any questions.

8.0 REFERENCES - Reference can be made to both our radiation safety manual and our

radioactive material's license. Also see calibration sheets from Ludlum, showing efficiencies for each radioactive material that is calibrated for our instrument.

9.0 ATTACHMENTS, FORMS, CHECKLISTS – Attached are copies of the product manual for both the Ludlum 44-110-4 and the Ludlum M2000. Follow manufacturer recommendations at all times. A copy of the P10 counting gas SDS is also attached.

10.0 REVIEWS AND REVISIONS – This SOP shall be reviewed at least annually by the RSO.

Process:_____ Date: _____