

RADIATION SAFETY MANUAL

FOR
UNIVERSITY OF ARKANSAS AT LITTLE ROCK
LITTLE ROCK, ARKANSAS
Revised August, 2004

THE UNIVERSITY OF ARKANSAS AT LITTLE ROCK
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RADIATION SAFETY OFFICER
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Emergency Assistance

In case of an emergency or accident situation:

Notify: Graduate Institute of Technology
Radiation Safety Office
569-8210 or 569-8003

Nights, Weekends or Holidays: Notify Keith Hudson (316-0502)
or Nawab Ali (221 3990)

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

For routine contact with the Radiation Safety Office: 569-8210
ETAS 329

Introduction

The objective of the University of Arkansas at Little Rock (UALR) Radiation Safety Program is to assist all levels of management in fulfilling the UALR commitment to furnish a place of employment and learning 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. It is vital that faculty, staff, and students have sufficient information available to aid them in the safe conduct of their day-to-day work activities while working with radioactive materials and/or devices.

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

The purpose of the UALR 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 UALR 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 producing equipment should be obtained through consultation with the Radiation Safety Committee or the Radiation Safety Officer.

Joel E. Anderson, Ph.D.
Chancellor

Keith Hudson, Ph.D.
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 is an academic institution license and includes a number of radionuclides and sealed sources. One license is held by the entire University, and any individual or action, which jeopardizes the license, endangers the permission of all researchers to utilize radioactive materials at UALR.

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

1.2 ORGANIZATION OF THE RADIATION SAFETY COMMITTEE

The Radiation Safety Committee is the University level committee of University of Arkansas at Little Rock (UALR). The UALR Radiation Safety Coordinating Committee is composed of the Radiation Safety Officer who also serves as the Chairmen of the committee plus other faculty members of the representative departments who are experienced in the use of radioactive materials. It also includes the directors or their designees of the physical plant and the Office of Research and Sponsored Programs. The RSC will have at least one administration member appointed by the Chancellor.

1.3 RADIATION SAFETY COMMITTEE RESPONSIBILITIES

- 1) To review the use of sources of ionizing radiation used within this institution 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 such as requirements for bioassays, and 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 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 Radioactive Materials Program Leader, Radiation Control, Arkansas 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 Radiation Safety committee shall meet a minimum of one time each semester, upon due notice by the Radiation Safety Officer, 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 Committee or the Radiation Safety Officer (see section 2.3). The Committee may request the Radiation Safety Officer 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 and appropriate action.

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 authorization forthwith, 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 UALR until a new authorization application has been submitted, reviewed and approved.

1.6 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.

*** An exception to this rule is the presence of food and drink in the lab. In the event food and 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, UALR 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 RSO is assisted by an Assistant Radiation Safety Officer and other members of the Graduate Institute of Technology (GIT). The location of Radiation Safety Office is ETAS-329.

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,
- 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 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 and
- 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 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, ETAS-329 (GIT).

3.4 RESPONSIBILITY OF APPROVED USERS

Those persons who are permitted by the Radiation Safety Committee to use radioactive materials under the UALR 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 UALR rules and regulations for radiation safety and the State “Rules and Regulations for the Control of Sources of Ionizing Radiation.”
- 2) 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.
- 3) Adequate planning of an experiment, or procedure, to assure that appropriate safety precautions are taken.
- 4) 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.
- 5) 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.
- 6) Limitation of use of radioisotopes under the permit to those over whom he has supervisory control.
- 7) Maintenance of required current records of receipt, use, storage, and disposal of radioisotopes.
- 8) Preparing a quarterly inventory of radioactive materials on hand and at other times when requested by the RSO.
- 9) Segregation, containment, and labeling of all radioactive waste in accordance with the guidelines of RSO.
- 10) 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.
- 11) 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 UALR 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 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. Ext. 569-8210.
- 11) Conduct decontamination procedures. (See 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 section on 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 Health Department.

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 measurement of radiation, and biological effects of radiation.
- 2) The applicant is to obtain from the Radiation Safety Officer (Ext. 569-8210) UALR 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) The reasonable effort from the applicants is need to be made to answer dissenting questions and/or 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 ETAS-329, and the current UALR radioactive materials license number, ARK-421-BP-RA-11-96. 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 ETAS-329, and the current UALR radioactive materials license number, ARK-421-BP-RA-11-96.

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 swiped, and checked for shipping damage, logged-in, inventory/disposal forms prepared, and stored until delivery to the authorized user. The packages are opened in user’s laboratories.

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 (569-3400).

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

5.3 MATERIAL TRANSFERRED TO THE UALR BY AN INDIVIDUAL

Purchases made under an individual license or another institutional license and transferred to the UALR 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 UNIVERSITY OF ARKANSAS AT 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 (RSO). 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
- 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 UNIVERSITY OF ARKANSAS AT 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 As Low As Reasonably Achievable. It is a requirement in the law for all facilities possessing radioactive materials licenses to have a formal ALARA program. The radiation protection standards set forth in this manual are used to control radiation exposure to all personnel occupationally exposed to radiation. It is the policy of the University of Arkansas 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:

<u>Part of Body</u>	<u>Adult / Yearly</u>
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.

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 UALR 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 P³² 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 569-8210 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

Research Staff:

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” In areas accessible to personnel in which a major portion of the body could receive in any one hour a dose of 5 mrem. A sign is NOT required on a room containing a sealed source if the radiation level 12 inches from the surface of the source container or housing does not exceed 5 mrem/hour.

6.4.2 “CAUTION RADIOACTIVE MATERIAL” Each laboratory or area where radioactive materials are used or stored must be posted at the entrance with a “CAUTION RADIOACTIVE MATERIALS” sign. Entry and area warning signs are to be posted and removed only 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 and quantity of radioactive material and the date of measurement of material in the container.

6.4.3 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 may 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, and waste disposal practices will be addressed during these surveys.

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

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 radiation surveys weekly, monthly, or at time of use, depending on the types and quantities of radioactive materials in use in the laboratory. Removable contamination can be detected and measured through a wipe test of the surface, which is counted in an appropriate counting instrument. One of the following instruments may be used, as necessary, for surveys.

1. Beckman LS6500 Beta Scintillation Counter
2. Rate meter Ludlum, model 18/17735
3. Rate meter Ludlum, model 3/19342
4. Rate meter, Ludlum, model 19/18433
5. Rate meter Ludlum, model 2/86399

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 recording the results and date.

Removable Contamination Surveys- Frequency

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.

The wipe test procedure should be sufficiently sensitive to detect the presence of 200 DPM/100 cm² of removable contamination. A radioactive source with a known amount of activity must be used to convert sample measurements (usually in counts per minute or CPM) to disintegrations per minute or DPM.

Wipe tests are performed by wiping the areas of interest with a filter paper disk or cotton tipped applicator and then determining the activity in a counter calibrated for the suspected radionuclide. Wipe tests are more sensitive than instrument surveys.

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

- 1) 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.
- 2) 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.
- 3) Containers must be properly labeled and area signs posted where necessary.
- 4) 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 UALR 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-429A by appointment only. Call RSO at 569-8210 to make an appointment. Waste should be in radioactivity disposable yellow bags (available in RSO office) 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.
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 (569-8210) 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, liquid scintillation vials, 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 LIQUID SCINTILLATION VIALS

It is important that all bags of liquid scintillation vials be tagged to indicate the generating user, isotope, and total activity in the bag. The trade name of the cocktails that were used should be indicated. All scintillation cocktail must be classified as biodegradable and environmentally safe. Additional disposal charges will be incurred for chemically hazardous cocktail. Please consult the material safety data sheets for chemical properties of scintillation cocktail. It is advantageous to include the approximate number of liquid scintillation vials and the approximate volume in the vials on the tag. Liquid scintillation vials should be double bagged before transport to prevent leakage.

Liquid scintillation vials with short half-life isotopes (≤ 65 days) are stored in ETAS-429A (Radioactive Waste Holding 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.

Liquid scintillation vials containing C-14, H-3, or I-125 at concentrations below 0.05 μCi per gram of cocktail (0.00005 mCi/gm) are disposed as deregulated radioactive waste. Liquid scintillation vials containing C-14, H-3 or I-125 in concentrations greater than 0.05 $\mu\text{Ci/gm}$ are temporarily stored and shipped out of UALR by a commercial disposal service. The responsible generator will then be billed for the cost of this service.

Liquid scintillation vials containing isotopes with half-lives greater than 65 days (other than C-14 and H-3) are temporarily stored and shipped out of UALR 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.

6.9.3 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 (≤ 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-429A) for processing and disposal. Call 560 8210 to make an appointment before bringing the waste. Lids with a short half-life (≤ 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 (>65 days) will be temporarily stored and shipped out of UALR 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

All individuals must complete UALR radiation safety training and pass the test at 80%. UALR has established a radiation safety-training program for workers using radioactive materials. It is mandatory that all radioactivity workers attend a 2-hour radiation safety training provided at UALR. Arrangements can also be made to obtain this training at UAMS. This covers lab safety when radioactive material is in use and the specific requirements of the UALR Radiation Safety Program. The authorized user shall notify the Radiation Safety Officer when a new laboratory personnel joins the laboratory. Please contact the Radiation Safety Office for the training schedule.

Annual refresher training is also required. Training can be obtained by annual refresher training course offered by GIT, UAMS or CD-ROM computer based training. All training will be documented. Ancillary personnel will be also given basic awareness about radioactive material in the laboratories.

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 uncalibrated 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 should be informed of the purchase of a new instrument or repair and factory calibration of an existing instrument.

Fixed radiation detection instrumentation, such as, liquid scintillation counters and gamma well counters should be maintained and serviced as suggested by the manufacturer or vendor. The counting efficiency for isotopes in use must be periodically determined and used when converting contamination survey results from counts per minute to disintegrations per minute.

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 (501-569-8210 or after hours, 501-316-0502) 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 10 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 (569-8210) during working hours or the Public Safety (501-569-3400) 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 exists.
- b) Notify RSO Office (569-8210) of the nature of the emergency, number of persons involved, and the location.
- c) **AWAIT THE EMERGENCY RESPONDERS** who will assist and provide direction, as well as contact any other necessary responders.

7.3 Annual Audit

The RSO will make annual audits 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, and waste disposal practices will be addressed during these audits. (See the audit checklist used by the RSO in Appendix V).

7.4 EMERGENCY CONTACTS

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

Keith Hudson, RSO

Office: 569-8211

Home: 316-0502

Pager: 954-3845

Nawab Ali, Assistant RSO

Office: 569-8003

Home: 221 3990

Pager: 954-3840

Radiation Safety Office: Phone: 569-8210

After hours or on weekends: Please call UALR Public Safety 569-3400 and they will contact Radiation Safety Officer.

APPENDIX I

RADIATION SAFETY COMMITTEE MEMBERSHIP

Keith Hudson, PhD	Professor, Director of GIT, and RSO
Gary Thompson, PhD	Professor, Applied Science
John Bush, PhD	Associate Professor, Biology
Ali Shaikh, PhD	Professor, Chemistry
Alois Adams, PhD	Associate Professor, Physics
Jerry G. Stevenson	Associate Vice Chancellor
Nathan D. Lester	Physical Plant designee
Sharon Kaufman	ORSP designee

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 UALR community and the general public.

B. BASIC TRAINING

All authorized users 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 UALR Radiation Safety program.
- 6) Experience in the uses for which application is made.

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 UALR 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 UALR 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-months 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 569-8210

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 569-8210. 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:
TITLE:

DEPT.:
PHONE:

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

NAME:
TITLE:

DEPT.:
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. μ Ci/experiment:

d. Waste Disposal ⁽²⁾:

	mCi/month and volume (gals. or lbs.)			
Nuclide	Dry Waste	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.):

<u>Hours</u>	<u>Subject</u>
_____	Principles of radiation safety
_____	Radiation measurement, monitoring techniques and instruments
_____	Mathematics & calculations basic to use and measurement of radiation
_____	Biological effects of radiation
_____	<u>Other (specify)</u>
_____	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).

<u>Date(s)</u>	<u>Monitoring type</u>	<u>Bioassay type</u>	<u>Facility and address</u>
_____	_____	_____	_____

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
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, 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 UALR 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 (569-3400)?	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 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, UALR Radiation Safety Committee, Radiation Safety Office and the Radiation Safety Manual will result in the loss of user privileges.

APPENDIX VII

Radioisotope Inventory and Disposal Log Sheet

Radiation Safety Office

UNIVERSITY OF ARKANSAS AT LITTLE ROCK

RADIOISOTOPE INVENTORY AND DISPOSAL LOG

USER: _____
 NUCLIDE: _____

ROOM NO.: _____

CHEMICAL FORM: _____

VENDOR: _____
 P.O. NO: _____
 CATALOG NUMBER: _____

DELIVERY DATE: ____/____/____
 ACTIVITY DELIVERED: _____.____ mCi
 LOT NUMBER: _____
 ASSAY DATE: ____/____/____

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.	SOLID	LIQUID	TRANSFER TO:	
	mCi USED	DRAIN	L.S.V.	ANIMALS	SOLID	LIQUID	TRANSFER TO:
TOTALS							

TOTAL UNUSED: _____

Return this form to RSO Office (ETAS 329) 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. Drain- The amount of activity that is disposed of by pouring it down the drain or sanitary sewer.
4. Vials- The amount of activity disposed of in liquid scintillation vials to be disposed of by RSO.
5. Solid- The amount of activity in dry solid form, placed in yellow bag waste containers.
6. Liquid- The amount of activity found in collected liquid waste. The container should be appropriate for the liquid or chemical found in the waste.
7. 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.