

# **RADIATION SAFETY MANUAL**

FOR THE  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72701  
August 2004

THE UNIVERSITY OF ARKANSAS  
John A. White, Jr., Ph.D., Chancellor

RADIATION SAFETY COMMITTEE  
William D. Brown, Ph.D., Chair

RADIATION SAFETY OFFICER  
Maksudur R. Sarder

# Emergency Assistance

In case of an emergency or accident situation:  
Notify: Office of Environmental Health & Safety  
Radiation Safety  
575-5448

Nights, Weekends or Holidays: Notify Campus Police  
575-2222 or if warranted by the situation, 911

Additional emergency information is available from:  
A. Section 7.0 of this manual  
B. The Chemical Hygiene Plan

For routine contact with the Radiation Safety  
Office of Environmental Health & Safety: 575-5448  
Facilities Management Department

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## **Introduction**

The objective of the University of Arkansas (UA) Radiation Safety Program is to assist all levels of management in fulfilling the UA 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 a license to the UA, which authorizes the use of radionuclides and radiation producing machines or devices. The UA radiation Safety Manual is prepared based on the condition of the license.

The purpose of the UA 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 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, the Radiation Safety Officer or Office of Environmental Health & Safety.

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John A. White, Jr., Ph.D.  
Chancellor

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William D. Brown, Ph.D.  
Chairman, Radiation Safety Committee

## **1.0 RADIATION SAFETY COMMITTEE (RSC)**

## 1.1 THE PURPOSE OF THE RADIATION SAFETY COMMITTEE

The establishment of a Radiation Safety Committee (RSC) is required by Arkansas State Health Department regulations. This was established with the passage of Act 8 of Second Extraordinary Session of 1961, and became effective May 3, 1966 with the approval of and in agreement with the U. S. Atomic Energy Commission (now known as the Nuclear Regulatory Commission, NRC).

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. 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 the UA.

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 Members of the RADIATION SAFETY COMMITTEE are appointed by the Provost and Vice Chancellor for Academic Affairs. Membership of the RSC includes three faculty members experienced in the safe use of radioactive materials, one each from the College of Engineering, Bumpers College of Agricultural, Food and Life Sciences, and Fulbright College of Arts and Sciences; one faculty member experienced in the safe use of sources of non-ionizing radiation from any of the above colleges; the Director of the Southwest Radiation Calibration Center; a representative from the University Health Services; a student; ex officio, the Radiation Safety Officer, the Manager of the Office of Environmental Health & Safety, and the Manager of the Southwest Radiation Calibration Center; and, ex officio and non-voting, the Director of Research and Sponsored Programs.

The Provost and Vice Chancellor for Academic Affairs designates a chairperson from the members and may appoint additional members, as appropriate.

## 1.3 RADIATION SAFETY COMMITTEE RESPONSIBILITIES

The Committee recommends policies and monitors implementation of policies and practices regarding the license, purchase, shipment, use, control, transfer and disposal of radioisotopes and sources of ionizing radiation. It recommends policies and monitors implementation of policies and practices regarding the purchase, shipment, use, control, transfer, and disposal of sources of non-ionizing radiation. Radiation safety is a primary concern of the RSC.

Specifically the RSC must:

- 1) Review and grant permission for, or disapprove, 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 the Arkansas Department of Health Division of Radiation Control and emergency Management of any changes in committee membership.

#### 1.4 RADIATION SAFETY COMMITTEE MEETINGS

Quarterly meetings shall be held each year; more meetings are encouraged as concerns and needs require, 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. 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 Committee's approval 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 its approval, the project shall no longer be carried out within the UA until a new authorization application has been submitted, reviewed and approved.

When the items of non-compliance are found routine Radiation Safety Officer laboratory reviews (See section 2.4), those will be reported to the Radiation Safety Committee.

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 Officer report items of non-compliance found, authorized users response and follow-up results to the Radiation Safety Committee. 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.**

## **2.0 THE RADIATION SAFETY OFFICER (RSO)**

### **2.1 THE AUTHORITY OF THE RSO**

The Radiation Safety Officer (RSO) derives his/her authority from the Chancellor of the University. The RSO is the authorized representative of the Radiation Safety Committee regarding measures to implement radiation protection and control within the University of Arkansas.

## 2.2 ORGANIZATION

The RSO is assisted by the other professional staff members of the Office of Environmental Health and Safety (EH&S) as appropriate.

## 2.3 RESPONSIBILITIES OF THE RADIATION SAFETY OFFICER

The responsibilities of the RSO include:

- 1) Provide consulting services regarding all aspects of radiation protection.
- 2) Develop and maintain a procedure for personnel and area monitoring, and maintain the records attending these actions.
- 3) 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.
- 4) Establish and maintain procedures for the safe disposal of radioactive materials.
- 5) Supervise periodic leak testing of sealed radioactive sources.
- 6) Inspect all facilities and equipment for appropriate radiation safety procedures and features.
- 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.

## 2.4 SITE REVIEW

The RSO is required to conduct a minimum of one annual on site review of the laboratory facilities and activities of authorized users of radioactive materials. The actual number of audits an authorized user receives in a year can vary according to the volume and use of radioactive materials. The RSO may ask the assistance of Radiation Safety Committee members for these reviews.

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 the 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. Maintains radioactive waste according to procedures outlined in the Radiation Safety Manual.
10. Ensures all personnel comply with the recommendations to wear radiation dosimeters provided.

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 noted, the authorized user must submit a **written** response outlining the new procedures to ensure future compliance. This response must be received by the RSO within **30 calendar days** of the audit result notification. 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 RSO submits documentation of the follow-up audit results to the Radiation Safety Committee. 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.**

## **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, the Division of Radiation Control and Emergency Management of the Arkansas State Health Department 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 has been issued a license by this agency covering a broad spectrum of uses. The regulations adapted for Arkansas cover by-product, source, and special nuclear material as well as natural and accelerator products, and machines designed to emit ionizing radiation such as X-ray machines.

Copies of the pertinent state regulations will be kept in each laboratory and can be obtained a full copy of the state regulations from the Radiation Safety Officer.

### 3.3 UNIVERSITY OF ARKANSAS CAMPUS REGULATIONS

No person may use or transfer into the University of Arkansas any radioactive materials without prior written approval by the Radiation Safety Committee. Under the University's current specific license, all transfers must also be approved by the Arkansas Health Department.

All statements related to procurement, use and disposal of radioactive materials appearing in this booklet will be considered as the University of Arkansas 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 Office of Environmental Health and Safety (EH&S) at the Physical Plant on Razorback Road.

### 3.4 RESPONSIBILITY OF AUTHORIZED USERS

Those persons who are permitted by the Radiation Safety Committee to use radioactive materials under the UA 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 rules and regulations for radiation safety and the Arkansas State Board of Health *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. Any condition changes from original application (*e.g.* changes in operational procedures, new techniques, or changes of areas where radioactive materials may be used or stored) require approval by the RSC prior to those changes, and also, under the University's current specific license, approval from the Department of Health.
- 5) Direction of personnel under their control to comply with all recommendations to wear personal dosimeters (Film badges or TLDs), 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 the University.
- 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 RSO of any accidents or incidents. Any major accident (See Section 7.0) should be reported to the RSO and UAPD within one hour. UAPD will secure the area until the arrival of the RSO.

### 3.5 RESPONSIBILITY OF THE INDIVIDUAL USER OF RADIOACTIVE MATERIALS

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 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.
- 2) Wear the recommended radiation detectors for personnel, such as TLDs (thermo luminescence dosimeters).
- 3) Survey hands, shoes, body and clothing for radioactivity and remove all loose contamination **before** leaving the laboratory. The RSO must be notified immediately and personnel must remain in laboratory for decontamination if contamination is not "loose".
- 4) Use all recommended protective measures such as protective clothing, respiratory protection, remote pipetting devices, ventilated and shielded glove boxes and hoods. Gloves will be worn when handling radioactive materials.
- 5) Will not smoke, eat, or drink in radioisotope laboratories. Likewise cosmetics will not be applied in radioisotope laboratories. Smoking materials, food, drinks, nor cosmetic items will be stored in laboratories. If food, drinks, smoking materials, or cosmetics are found during lab audit it will result in an immediate one-week suspension of all radioactive material use.
- 6) Maintain clean working habits. Work surfaces must be covered with plastic backed absorbent paper, plastic side down. 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. 575-5448.
- 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 section on Security of Radioactive Materials, Section 5.6).
- 14) Workers are responsible for providing quarterly inventories and must also maintain current accurate inventories which must include all radioactive materials on hand, those materials that being used in experiments and/or stored as radioactive waste.

## **4.0 PROCEDURE FOR OBTAINING APPROVAL TO USE RADIOACTIVE MATERIALS**

The Radiation Safety Committee has obtained in the name of the University of Arkansas a license from the Arkansas State Board of Health for the use of radioactive materials. The Radiation Safety Committee is empowered to recommend permits for responsible and qualified individuals to use radioactive materials within the University of Arkansas to the Health Department, Division of Radiation Control and Emergency Management. Final approval for all use resides at 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.

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

### **4.1 APPLICATION FOR RADIOACTIVE MATERIALS APPROVAL**

Each individual planning to use radiation sources must demonstrate to the Committee adequate training in, and facilities for, the safe use of these materials. The following requirements have been adopted for the issuance of permits for non-human use (biological, chemical, or physical) of radioactive materials (sealed source, unsealed source, ionizing radiation producing devices).

- 1) The applicant must have a minimum of 20 hours training and a working knowledge of basic radioisotope handling techniques. All authorized users are expected to have working knowledge of the following areas.
  - a. Principles, practices, and policies of radiation protection.
  - b. Methods of measurement, standardization, and monitoring of radiation sources and the associated instrumentation.
  - c. Basic mathematics and calculations fundamental to the use and measurement of radiation and radioactivity.
  - d. Biological effects of radiation.
  - e. Familiarity with the UA Radiation Safety program.
  - f. Experience in the uses for which application is made.
  - g. Authorized users must be knowledgeable about the pertinent state and federal regulations concerning the proper use of radioactive materials as well as the

requirements of the current University license provided by the Arkansas Department of Health

- 2) The applicant is to obtain from the RSO (575-5448) UA application forms (see Appendix III).
- 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 Committee Chairman and Radiation Safety Officer, copies of the application will be sent to each Committee member for review.
- 5) At the next Radiation Safety Committee meeting, the application will be discussed. The applicants shall attend the meeting to answer any questions regarding to the request and/or clarifications. The applicants may request taking a poll by mail, if next scheduled meeting does not meet their experimental schedules. In this case, copies of the application, along with a ballot, will be sent to each Committee member for his/her independent consideration and approval or disapproval. The RSO collects the ballots and notifies the Committee members and the applicants of the results. In either case, the applicants are granted approval to be recommended to the Arkansas Department of Health by a two-thirds vote by the Committee membership. Reasonable effort is to be made to answer dissenting questions and/or clarifications.
- 6) Upon approval of the application by the Arkansas Department of Health and issuance of an amended license, the RSO will provide the applicant with a copy of the letter of approval.
- 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 any time there is a change affecting possession limits, disposal methods or amounts, or any change in circumstances that could result in changes in radiation dose to personnel or general public. All such changes require prior approval. Normally, only the information relevant to the change is required in these renewals.

#### 4.2 APPLICATION FOR RADIOISOTOPE APPROVAL FOR HUMAN USE

The University **shall not administer radioactive materials to humans.**

## **5.0 PROCUREMENT OF RADIOACTIVE MATERIALS**

### **5.1 PURCHASES**

Once authorized by the RSC to use radioactive materials, approved users or radiation workers working for them who have completed University of Arkansas new RAM user training may order radionuclides. All purchase requisitions (for regular, standing, or blanket purchase orders) must be approved by the RSO. Purchasing will not accept the order without RSO approval. The following information is required on the purchase requisition:

**Approved user, vendor, radionuclide, activity, and shipping address.**

All Radionuclides must be shipped to the attention of the:

**Radiation Safety Officer  
Environmental Health & Safety  
Physical Plant  
521 South Razorback Road  
Fayetteville, Arkansas 72701.**

Purchase requisitions and approval are obtained electronically through the purchasing department or it may be obtained by contacting the RSO (e-mail, phone).

In addition to purchases, the RSO must be notified of and approve of all shipments of radionuclides (such as transfers, gifts, samples, or replacements) prior to their receipt. Radioactive material requiring any special attention (e.g., should not be refrigerated, should be frozen) need to be noted at this time. Materials with no special instruction will be kept in EH&S refrigerator until delivery.

### **5.2 RECEIPT AND STORAGE**

The RSO will maintain a comprehensive log of all incoming radioactive materials. A complete survey will be performed on all packages containing radioactive materials. The packages will be monitored for internal and external contamination, as well as checked for damage. The RSO will proceed to open the outer and inner package to verify the contents and check the integrity of the final source container, (i.e., inspect for evidence of breakage, loss of liquid, discoloration of packaging, etc.). The package and packaging are monitored for contamination. Form ORS-29 (See Appendix VI for a copy) is then completed. When cleaned of any contamination, the isotopes are delivered to the respective users along with a copy of form ORS-29. All labels are obliterated before discarding uncontaminated packages and packing material into the regular trash.

During “normal” working hours, the delivery vendor (Federal Express, Airborne Express) delivers all radioactive materials to the EH&S office. Here the RSO will swipe the packages, beta count or use a survey meter as appropriate, open the packages and check for shipping damage, log-in the packages, prepare inventory/disposal forms, and store them until delivery to the authorized user.

All deliveries must be arranged to arrive between 8:00 am and 4:00 pm during regular working days (Monday through Friday). The RSO must be contacted when special attention or special arrangements are required.

### 5.3 MATERIAL TRANSFERRED TO THE UA BY AN INDIVIDUAL

Purchases made under an individual license or another institutional license and transferred to the UA must receive approval by the RSO, the RSC, and the Health Department **prior to that transfer**. The person who is to receive this material must all ready be included in the University’ specific license for that specific isotope and his/her receipt of it must not result in exceeding his or the University of Arkansas’ possession limit.

### 5.4 TRANSFER OF MATERIALS FROM ONE USER TO ANOTHER WITHIN THE UNIVERSITY OF ARKANSAS CAMPUS

Transfer of radioactive material between investigators of different projects must be reported prior to the transfer by telephoning the RSO. These transfers must be between committee and Department of Health 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 University of Arkansas or terminate the use of radioactive material on the premises must make arrangements with the RSO to dispose of or transfer the radioactive material to another authorized user. The same is true for equipment that produces ionizing radiation.

### 5.5 TRANSFER OF MATERIALS FROM AUTHORIZED USERS TO INDIVIDUALS OUTSIDE THE UNIVERSITY OF ARKANSAS CAMPUS

All radioactive material must enter and exit the campus through the RSO. Any investigator who wishes to transfer radioactive material to an off-site investigator **must**

contact the RSO before the transfer is to take place. The RSO must ensure that all federal and state regulations are followed, and that the transfer is approved by the RSC and the Department of Health. 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.

The RSO will prepare the package for shipping.

## 5.6 SECURITY AND STORAGE OF RADIOISOTOPES

### SECURITY:

The Arkansas State Board of Health *Rules and Regulations for Control of Sources of Ionizing Radiation* 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:

- (a) 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. In unrestricted areas this means the cabinet, refrigerator, etc. must be locked. In restricted areas such as a laboratory where radioactive materials are used, the area must be locked if unattended. (Restricted and unrestricted areas will be defined in the next section.) 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 cold 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 as required by the Arkansas State Board of Health *Rules and Regulations for Control of Sources of Ionizing Radiation*.

## **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 EH&S office.

### 6.1.1 UNRESTRICTED AREAS

An unrestricted area is 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 100 mrem (1 mSv) in any seven consecutive days to any portion of the body; or
- 2) If, when allowance is made for expected occupancy and time variations in dose-rate, no individual is likely to receive more than 500 mrem (5 mSv) in a calendar year.

### 6.1.2 RESTRICTED AREAS

All areas where radioactive areas are stored or used will be considered as restricted areas. All areas within the University of Arkansas in which dose levels do not conform to the standard for unrestricted areas shall be restricted and under the control of the RSO 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 a dose equivalent greater than 5 mrem (0.05 mSv) in any hour, or 100 mrem (1 mSv) in any five consecutive days. A sign bearing the radiation symbol and the words “Caution Radiation Area - No Entrance to Unauthorized Personnel” is to be posted at the entrance. The definition of Radiation Area will be as defined in the Arkansas State Board of Health *Rules and Regulations for Control of Sources of Ionizing Radiation*.
- 2) High Radiation Area - Any area accessible to individuals in which there exists ionizing radiation at such levels that a major portion of the body could receive in any hour a dose equivalent 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.
- 3) Very High Radiation Area - Any area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads \* (5 gray) in one hour at one meter from the radiation source or from any surface that the radiation penetrates.

\* The exposure rates for Very High Radiation Areas are in rads, rather than rems, because potentially life-threatening exposures could result in areas with these fluxes of radiation.

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.

The University has established an “Investigational level” for any individual who receives a quarterly exposure of 300 mrem or greater. The RSO will work with the individual seeking information on duties and task performed. The RSO will evaluate the procedures and duties following completion of the investigations.

### 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<sup>2</sup>)

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 MINORS WORKING WITH RADIOACTIVE MATERIALS

The maximum whole body exposure to minors (individuals under the age of 18) must be limited to 10% of the permissible limits for adults. For these workers, safety training must be completed prior to work with radioactive materials as with other occupational workers. This section is necessary because of the active undergraduate research program at the University and the increasing number of students who enter college under the age of 18.

### 6.2.4 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. 2 mrem (0.02 mSv) in any one hour.

### 6.2.5 PREGNANT RADIATION WORKERS

There is a regulatory dose limit to the embryo/fetus of a declared pregnant woman of 500 mrem (5 mSv). UA operates with an action limit of 400 mrem for the entire gestation period, not to exceed 40 mrem per month. This limit will be applied to the declared pregnant workers.

Pregnant radiation workers have right to choose to declare or not to declare their pregnancy (or intention of becoming pregnant). Workers wish to declare their pregnancy or intended pregnancy should notify the RSO in writing as soon as possible after learning of their pregnancy. A form attached in Appendix V may be used. After receiving notification, the RSO will visit and determine whether extra precautions or monitoring are required to ensure the exposure to the fetus does not exceed the limit. Unless this written notification is received, the reduced exposure limit and other consideration for pregnant worker will not be applied. The RSO is responsible for consulting or providing information to radiation workers to help them understand all the potential risks associated with the radioactive materials they will be handling. The proposed UA policy, "Pregnant Employees Working With Ionizing Radiation," incorporates safety information and radiation dose guidelines for ensuring safe radiation limits for the embryo/fetus of occupationally exposed employees. A copy of the policy is in Appendix V.

### 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).
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). See Table 1, Columns, 1 and 2 of Appendix G to RH-1000 through RH-2110, of the Arkansas State Board of Health *Rules and Regulations for Control of Sources of Ionizing Radiation*. This document is available at EH&S.
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). The University is required to document **that the minor student has not** received in excess of 10% of the annual limits set forth in RH-1200, and that the fetal/embryo dose during the entire pregnancy did not exceed 0.4 rem

### 6.3.1 PERSONAL 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 (6.2.2), ring type dosimeter 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 personal dosimeters is included as Appendix II. Dosimeters should not be worn outside the areas where radiation is present. Dosimeters should be stored secured from radiation when not in use.

Lost or damaged dosimeters will result in the assignment of an administrative dose. An administrative dose will be determined for an individual when a film badge or TLD (thermo luminescence 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.

### 6.3.2 BIOASSAYS

When the RSO 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 routinely handling 1 mCi of tritium, or 10 mCi of C-14, or involved in a spill of this magnitude, shall submit bioassay-assay samples.

Individuals who propose the use of I-125 or I-131 in iodination procedures must have a baseline thyroid uptake before iodination begin. Individuals using one (1) millicurie ( $3.7 \times 10^7$  Bq) or greater of radioiodine in unsealed form should submit to a thyroid uptake within 24-48 hours post iodination. Any investigator contemplating such a procedure should contact the RSO as arrangements with medical facility must be completed to allow measurement of baseline thyroid radioactive iodine and radioactive iodine after the iodination procedure. **This determination is not required if the iodine is part of a kit, i.e. the iodine is in a nonvolatile chemical form unless the radioactivity is 10 mCi or more.** Bioassays are required for persons who handle 10 mCi of I-125 or I-131 bound to a nonvolatile agent in an open room or bench.

**If you suspect that you have received a significant exposure, contact the RSO immediately.**

## 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 individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in one (1) hour at 30 cm from the radiation source or from any surface that the radiation penetrates. The only exceptions to posting requirements are contained in RH-1304 of the Arkansas State Board of Health *Rules and Regulations for Control of Sources of Ionizing Radiation*.

### 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

Other signs (*e.g.* HIGH RADIATION AREAS, AIRBORNE RADIOACTIVITY AREAS) may be required. The RSO must be consulted regarding control measures in these areas.

## 6.5 SURVEYS

The RSO will make annual independent surveys (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 IV).

Surveys must be able to evaluate under the circumstances present:

- A. The extent of radiation levels,
- B. Concentrations or quantities of radioactive material, and
- C. The potential radiological hazards that could be present.

Survey (audit) results will be forwarded to the authorized user, and a recheck may be conducted in the event problems have been detected that need corrective action. Section 1.5 and 2.4 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. Each lab actively using isotopes must conduct radiation surveys weekly, monthly, or at time of use, depending on the quantities of radioactive materials present in the laboratory. The criteria of survey frequency are found in Table 1. Records of these surveys must be maintained for review. Records must include the following:

1. Location, date and identification of equipment used, including the serial number and pertinent counting efficiencies.
2. Name of person conducting the survey.
3. Drawing of area surveyed, identifying relevant features such as active storage areas, active waste areas, etc.
4. Measured exposure rates, keyed to location on the drawing (point out rates that require corrective action).
5. Detected contamination levels, keyed to locations on drawing.
6. Corrective action taken in the case of contamination or excessive exposure rates, reduced contamination levels or exposure rates after corrective action, and any appropriate comments.
7. Maps/diagrams of all areas where contamination is found will be permanently maintained on file by the RSO for the duration of the license.

Surveys of use areas of unsealed radioactive materials will include not only the original container of the material, but also the area in which the material is stored.

For unsealed sources, which are in extended storage, the containers of these materials and their storage areas must be surveyed monthly.

Sealed sources will be leak tested every 6 months (Every three years for Ni-63 housed in gas chromatograph ECDs with documentations authorized 3-year leak test). The exposure rates of storage areas (except GCs) are surveyed monthly by survey meters.

**Table1. Survey Documentation Requirement**

	Areas	Condition	Frequency
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Unsealed source	Use area	Use 200 $\mu$ Ci/operation or more	After each operation
		Use <200 $\mu$ Ci/operation	Weekly
		No use	No survey required *1
	Storage area (source, waste)	Any use	In conjunction with use area survey
0		Monthly *2	
Sealed source		Leak test	Every 6 months *3
		Storage survey	Monthly *3

\*1: Need to document "no use" period

\*2: Consult with the RSO when no one is available to perform the monthly survey (e.g., summer)

\*3: The RSO will conduct these surveys. Users should assist the RSO.

Ni-63 in Gas chromatograph (GC) are not checked by survey meters.

### 6.5.1 CONTAMINATION LEVELS

Removable surface contamination levels for beta or for beta-gamma emitters shall be controlled such that a level of **two-times background** is not exceeded. The action limit of two times background will be based on cpm (counts per minute) determined with the same survey instrument at the same time as the background was determined. When using scintillation counters with known efficiency for the counting condition, action levels in Table 2 may be used.

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 fixed contamination should be labeled and shielded whenever possible.

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 labeled and 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 and unrestricted areas must be controlled such that the levels specified in the Arkansas State Board of Health *Rules and Regulations for Control of Sources of Ionizing Radiation* and Environmental Protection Agency are not exceeded. Table 3 summarizes limits for common used isotopes.

**Table 2. Surface contamination level not requiring any action \***

Nuclides	Limit (dpm/100cm <sup>2</sup> )
Natural Uranium, U-235, U-238 and associated decay products except nuclides listed below	1,000
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-129	20
Natural Thorium, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-125, I-126, I-131, I-133	200
Nuclides with decay modes other than alpha emission or spontaneous fission, except nuclides listed above.	1,000

\* Prepared by referring the requirement of Arkansas State Board of Health *Rules and Regulations for Control of Ionizing Radiation RH-1213*

**Table 3 Radioactive contamination limit of air and water \* (μCi/ml)**

Isotope	Form	Restricted areas		Unrestricted areas	
		Air	Water	Air	Water
Hydrogen 3	Soluble	$5 \times 10^{-6}$	$1 \times 10^{-1}$	$2 \times 10^{-7}$	$3 \times 10^{-3}$
	Insoluble	$5 \times 10^{-6}$	$1 \times 10^{-1}$	$2 \times 10^{-7}$	$3 \times 10^{-3}$
	Submersion**	$2 \times 10^{-3}$	—	$4 \times 10^{-5}$	—
Carbon 14	Soluble	$4 \times 10^{-6}$	$2 \times 10^{-2}$	$1 \times 10^{-7}$	$8 \times 10^{-4}$
	Submersion	$5 \times 10^{-5}$	—	$1 \times 10^{-6}$	—
Phosphorous 32	Soluble	$7 \times 10^{-8}$	$5 \times 10^{-4}$	$2 \times 10^{-9}$	$2 \times 10^{-5}$
	Insoluble	$8 \times 10^{-8}$	$7 \times 10^{-4}$	$3 \times 10^{-9}$	$2 \times 10^{-5}$
Phosphorous 33	All	$3 \times 10^{-9}$	$9 \times 10^{-5}$	$1 \times 10^{-10}$	$3 \times 10^{-6}$
Sulfur 35	Soluble	$3 \times 10^{-7}$	$2 \times 10^{-3}$	$9 \times 10^{-9}$	$6 \times 10^{-5}$
	Insoluble	$3 \times 10^{-7}$	$8 \times 10^{-3}$	$9 \times 10^{-9}$	$3 \times 10^{-4}$
Iodine 125	Soluble	$5 \times 10^{-9}$	$4 \times 10^{-5}$	$8 \times 10^{-11}$	$2 \times 10^{-7}$
	Insoluble	$2 \times 10^{-7}$	$6 \times 10^{-3}$	$6 \times 10^{-9}$	$2 \times 10^{-4}$

\* Prepared by referring the requirement of Arkansas State Board of Health *Rules and Regulations for Control of Ionizing Radiation RH-2200*. Values are above natural background.

\*\* Submersion in a semi-spherical infinite cloud of airborne material

## 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 RSO 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, chewing tobacco and gum are not permitted in areas where work with unsealed 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, disposable gloves shall be worn whenever handling radioactive materials.
- 8) All individuals handling radioactivity shall wear laboratory coats. The laboratory coat will be left inside the lab or surveyed prior to exiting the laboratory area.
- 9) 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 showing higher count-rates shall either be stored until the count-rate is less than two times background (cpm) or disposed of through an appropriate route, at the discretion of the RSO.

## 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 5 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 PREMISES

- 1) All transportation of radioactive materials will be accomplished by personnel with appropriate radiation safety training.
- 2) Radioisotopes requiring a “Radioactive Materials” label must be enclosed in non-breakable carrying cases or containers, before being transported through corridors or between buildings.
- 2) Containers for the transportation of beta sources requiring a “Radioactive Materials” label must provide shielding thicker than the maximum range of the beta rays.
- 3) Gamma-ray emitters shall be transported in closed containers with shielding such that the external radiation measured with an appropriate survey meter does not exceed two times background (cpm).
- 4) Do not use public transportation.

## 6.9 RADIOACTIVE WASTE DISPOSAL

All radioactive waste should be transported under the supervision of the RSO to the Office of Environmental Health and Safety in closed or sealed containers. All waste should be transported on carts to minimize potential spills and accidents. Waste should be segregated by types (*e.g.* Solid, Liquid/gas, Liquid scintillation waste, Biological) and radionuclides. Waste should be in proper containers or bags and be appropriately labeled. Consult the appropriate section below for packaging and handling of specific waste types.

### 6.9.1 WASTE INFORMATION

Blank waste tags or waste information sheets are provided by the RSO when waste pick-up is requested. The users should complete these as much as possible. The following information is necessary:

- 1) Approved radioactive material user's name.
- 2) Isotope - Short-lived nuclides (Half-life less than or equal to 90 days) and long-lived nuclides (Half-life longer than 90days) should not be mixed.

- 3) Activity - If not known, this should be an upper estimate of how much activity is in each container. The unit of activity should be specified.
- 4) Dates - Date the waste container is closed or the date it is taken to EH&S by the RSO.
- 5) Hazard - Any other potential hazards (chemical, biological). 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 bags. These should be transported and processed separately. Manufacturer vials containing unused activity should not be placed in a bag. Because of the higher specific activity in the unused isotope, these should also be processed separately. Call the RSO (ext. 575-5448) if there are any questions about proper packaging or handling of waste.

## 6.9.2 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 disposable liner is recommended 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, animal carcasses, bulk liquids and small liquid vials)
- 3) Waste should also be separated by half-life. Isotopes with half-lives greater than 90 days should not be mixed with isotopes having a half-life shorter than 90 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 removal by any unauthorized personnel. Waste must be clearly labeled as radioactive and authorized users are required to verify security measures are in place.
- 5) Liquid wastes should be stored in sealed containers (no open beakers), preferably in polyethylene bottles. 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. In certain cases, liquid wastes may be stored in glass containers (to control radiation), but then those glass containers must be contained within a closed, plastic container. Both containers must be properly labeled with the isotope, activity, and date the activity was established.

## 6.9.3 SOLID WASTES

Solids with a short half-life ( $\leq 90$  days) will be stored at the generating unit for decay through ten half-lives at the discretion of the RSO. Upon decay they are surveyed to verify that the waste is at background levels and then disposed of as non-radioactive waste. The RSO has the responsibility to determine that the radioactive waste has

decayed 10 half lives, that the activity has been properly surveyed in a low background area and determined to be indistinguishable from background readings.

Solids with a long half-life ( $>90$  days) will be transported under the RSO's supervision to and temporarily stored at EH&S and eventually shipped out of UA by a commercial disposal service. Small vials containing liquid should not be placed in a dry solids bag.

All radiation labels must be defaced or removed from containers and packages prior to disposal as ordinary trash. For compacted waste, all labels that are visible in the compacted mass must be defaced or removed.

#### 6.9.4 LIQUID AND GASEOUS WASTES

Liquid waste may be brought to EH&S for disposal under the supervision of the RSO. 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 ( $\leq 90$  days) will be stored for decay through ten half-lives in the generating unit. 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 to the Hazardous Materials Specialist (BUT ONLY AFTER DECAY OR RADIOACTIVE MATERIAL). Small vials containing liquid should not be placed in a dry solids bag.

#### 6.9.5 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. 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 ( $\leq 90$  days) should be stored in a secured area in the generating unit ten half-lives. Upon decay they are surveyed to verify that the waste is at background levels and then disposed as non-radioactive waste.

Liquid scintillation vials containing C-14, H-3, or I-125 at concentrations below  $0.05 \mu\text{Ci}$  per gram of cocktail ( $0.00005 \text{ mCi/gm}$ ) are disposed as deregulated radioactive waste. Discharge of the cocktail need to be performed under the RSO supervision. Liquid scintillation vials containing C-14 or H-3 in concentrations greater than  $0.05 \mu\text{Ci /gm}$  are temporarily stored and eventually shipped out of UA by a commercial disposal service.

### 6.10 TRAINING OF PERSONNEL

It is mandatory that all workers, including principal investigators attend a new radiation worker course prior to start any work using radioactive materials on the University of Arkansas Campus. This session covers basics of radiation fundamentals, general laboratory safety, and the University of Arkansas radiation safety program review. The RSO shall be notified by the user when new laboratory personnel enter the laboratory. All radiation workers should attend annual refresher course to maintain their active status. The refresher course will cover review of laboratory practices, any changes of radiation safety programs, routine RSO site visit results and any other topics related to the University radiation safety program. These training sessions will be conducted by the RSO with assistance of the Office of Environmental Health and Safety staff.

In addition to training sessions conducted by the RSO, each approved user should occasionally hold review sessions of laboratory practices and radiation safety. The topics covered, the date, and the names of attendees must be recorded and available in the laboratory's radiation records. The topics for this training shall include, but are not limited to, the following:

- 1) Work habits including how to plan procedures utilizing radiation.
- 2) External exposure (time, distance, and shielding) and contamination control, particularly how to shield and handle radioactive materials to minimize personnel exposure and radioactive contamination.
- 3) How to properly monitor for radiation and contamination levels and how to correctly document the results.
- 4) Inventory and control of radioactive materials.
- 5) Documentation and reporting.

## 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. "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.

A performance check and calibration of meters will be coordinated annually by the RSO. A certificate of calibration is returned with each instrument. This certificate must be on file in the laboratory for review during regulatory inspections. The RSO should be informed of the purchase of a new instrument or repair and factory calibration of an existing instrument. Before each use, meters will be tested by the users with the battery check mode and external sources. The results of these tests will be included in the survey log by users.

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 RSO 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 by the RSO or his/her designee before removal to another laboratory, transfer to a repair shop, or transfer to Surplus Property (proposed UA policy). All equipments used in conjunction with licensed material are surveyed for contamination prior to transfer or release by the RSO or his/her designee. Before the equipment is transferred and following satisfactory survey, the RSO will remove all warning signs and stickers. Transfers to Surplus Property must be cleared by the RSO.

## 6.13 VACATING LABORATORY SPACES

The RSO must be informed of and approve all changes in authorized laboratory spaces, including transfers or departures from the University and laboratory relocations. The Authorized User must notify the RSO 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 RSO will complete a final clearance survey of the authorized spaces. Radiation Warning signs may be removed only by the RSO.

All unused radioactive materials must be accounted for and turned over to the RSO 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 RSO. The Authorized User should contact the RSO 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 RSO (479-575-5448 or after hours, 479-575-2222 or 911 if warranted) 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. A detailed personnel decontamination procedure is outlined in Appendix VIII.
- 7) The RSO 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 RSO 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.

### 7.2.1 MINOR SPILL

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.

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) Wear 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.

### 7.2.2 MAJOR SPILL

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 RSO or his/her designee immediately, as required by state and federal law. Call the RSO (479-575-5448 or 575-3379) during working hours or Campus Police (479-575-2222) during non-working hours.

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 RSO.
- 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.

### 7.3 EMERGENCY

An emergency is an incident which involves serious injury or death, fire, explosion, or significant release of health or life threatening material, which is or may be coupled with a minor or major radiological incident. **NOTIFY UNIVERSITY POLICE IMMEDIATELY IF AN EMERGENCY HAS OCCURRED!! 911. If time allows, follow with a call to RSO at 575-5448.**

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 presents.
- b) Notify the RSO (575-5448) during the work day or the University Police (5-2222 or 911 if warranted) after hours 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.

## **8.0 IONIZING RADIATION PRODUCING EQUIPMENTS**

### 8.1 GENERAL

The purchase, installation, and safe use of all ionizing radiation producing equipments at the University of Arkansas Campus is subject to the policies established by the Radiation Safety Committee and regulations promulgated by the Arkansas Department of Health.

### 8.2 REGISTRATION

All machines capable of producing ionizing radiation **must** be registered with the UA RSO. Registrants using ionizing radiation producing machines shall provide the RSO with documentation of the type, make, model, location, and maximum output of the devices before installation.

### 8.3 INSPECTIONS

The RSO inspects equipments annually.

### 8.4 PERSONNEL MONITORING

Personnel who use radiation generating equipment must use personal dosimeters. Signs warning of radiation must be posted near radiation producing equipment.

## **APPENDIX I**

### **RADIATION SAFETY COMMITTEE (appointed by the Provost)**

Recommends policies and monitors implementation of policies and practices regarding the license, purchase, shipment, use, control, transfer and disposal of radioisotopes and sources of ionizing radiation; recommends policies and monitors implementation of policies and practices regarding the purchase, shipment, use, control, transfer, and disposal of sources of non-ionizing radiation.

Copies of meeting minutes and annual reports will be forwarded to the chairperson of the Health and Occupational Safety Council, as that council is responsible for coordinating the activities of the committees assigned to specific health-related or occupational safety areas.

Membership consists of three faculty members experienced in the safe use of radioactive materials, one each from the College of Engineering, Bumpers College of Agricultural, Food and Life Sciences, and Fulbright College of Arts and Sciences; one faculty member experienced in the safe use of sources of non-ionizing radiation from any of the above colleges; the director of the Southwest Radiation Calibration Center; a representative from the University Health Center; a graduate student; ex officio, the Radiological Safety Officer, the Environmental Health & Safety Manager, and the Manager of the Southwest Radiation Calibration Center; and, ex officio and non-voting, Vice Provost for Research and the Director of Research and Sponsored Programs.

The Provost will designate a chairperson from the members and may appoint additional members, as appropriate.

Intentionally left blank  
(reserved for future use)

## APPENDIX II

### 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 6.2.2). Declared pregnant or declared fertile employees are subject to more restrictive radiation exposure limits. These employees should contact the RSO for consultation about ways of minimizing their radiation exposure during the pregnancy and other information related to the UA policy for pregnant employees. Ring thermo luminescent 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 RSO, when his (her) activities may result in exposures greater than 10% of the annual dose limits (see section 6.2.2). Types of dosimeters available at the University are whole-body (gamma sensitive, of TLD design), neutron (not gamma sensitive, of TLD design rather than CR-39 design), extremity (ring, beta and gamma sensitive, of TLD design). Note the TLD means thermo luminescent dosimeter and CR-39 refers to a proprietary patented neutron sensitive film-track material.

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 to request their exposure history from their previous employers. Forms will be provided.

#### USE:

There are three primary reasons for wearing a personal 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.
- 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 University's 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 dosimeter in the laundry. Do not staple, paperclip, or tape the dosimeter.
- 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) Body badge should be worn on the side of the body nearest the radiation source. The badge should be worn between collar and waist.
- 7) Ring TLDs should be worn beneath protective gloves to prevent contamination of the ring or accidental disposal when the gloves are removed.
- 8) Ring TLDs may be rinsed in tap water, but excessive soap should not be used.
- 9) Lost, damaged or contaminated dosimeters should be reported immediately to the RSO.
- 10) TLDs are replaced quarterly. Film badges are replaced monthly. All used dosimeters must be returned to the RSO within one week of receiving a replacement dosimeter. If you do not receive replacement dosimeters, please notify the RSO (575-5448).

## EXPOSURE REPORTS

Exposure reports will be sent to the authorized user annually. These reports are to be distributed to all monitored personnel in his/her working group. All monitored personnel are responsible to return signed copy by due date (will be stated at the time of distribution) to the RSO indicating they have reviewed their exposure record. If employees have questions concerning their occupational radiation exposure, they may contact the Office of Environmental Health & Safety at 575-5448.

Whole body, deep dose exposures exceeding 300 mrem per month will be investigated by the RSO. The RSO evaluate procedures and duties following the investigation. Recommendations may be made to reduce future exposures.

## **APPENDIX III**

### Application forms for Radioactive Material Use

Form 1- Application for Radionuclide Use

Form 2- Training and Experience Supplement

**University of Arkansas**  
**FORM 1 - APPLICATION FOR RADIONUCLIDE USE**

APPLICATION CLASS:  New  Renewal  Amendment Date: \_\_\_\_\_

1. TITLE OF PROJECT: \_\_\_\_\_

2. INVESTIGATOR NAME: \_\_\_\_\_

DEPT.: \_\_\_\_\_

TITLE: \_\_\_\_\_

PHONE: \_\_\_\_\_

Campus Address: \_\_\_\_\_

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

NAME: \_\_\_\_\_

DEPT.: \_\_\_\_\_

TITLE: \_\_\_\_\_

PHONE: \_\_\_\_\_

Campus Address: \_\_\_\_\_

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.  $\mu$ Ci/experiment: \_\_\_\_\_

e. Waste Disposal<sup>(1)</sup>: \_\_\_\_\_

mCi/month and volume (gals. or lbs.)

Nuclide	Dry Waste	Liquid Scint.	Aqueous Liquid	Non-aqueous liquid
---------	-----------	---------------	----------------	--------------------

Note 1: Review rules for radioactive waste disposal.

Applicant Signature: \_\_\_\_\_

Date: \_\_\_\_\_

DATE RECEIVED: \_\_\_\_\_

DATE APPROVED: \_\_\_\_\_

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

**Applicant Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**University of Arkansas - 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.**

    . Survey meter type:

**Probe Type:**

**f. Shielding devices.**

**g. Personnel Dosimetry.**

    \_\_\_\_\_ Ring badge \_\_\_\_\_ Body badge \_\_\_\_\_ Bioassay \_\_\_\_\_ Others

**h. Other.**

**Applicant Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

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

1. NAME: \_\_\_\_\_ TITLE: \_\_\_\_\_ DEPT.: \_\_\_\_\_  
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, other dosimeters) 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 IV**

Radioactive material laboratory survey form

LAB NO. : \_\_\_\_\_  
 Authorized user : \_\_\_\_\_  
 Surveyor Name : \_\_\_\_\_

Nuclides used and swipe result  
 (cpm/100cm<sup>2</sup>)

BG			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

**CHECK LIST : (Items marked "NO" require corrective action, check "COMMENTS"**

Item	Description	YES	NO	N/A
1	Room properly posted			
2	Notice to employees posted (Yellow sheet)			
3	Storage area properly posted			
4	Work area & sink properly labeled			
5	Source security adequate			
6	Radiation levels acceptable			
7	Smear results acceptable			
8	Proper storage of radiation materials			
9	Surveys & wipes are current			
10	Disposal records current			
11	Receipt and usage records are current			
12	Inventory current			
13	Food and other consumables 'not' present in radioisotope and chemical use/ storage area			
14	Dosimeters worn by Lab. personnel			
15	Fume hoods used properly			

**Meter used for the frisk survey**

Make \_\_\_\_\_ Model \_\_\_\_\_ serial# \_\_\_\_\_  
 Probe model \_\_\_\_\_ Probe serial # \_\_\_\_\_ Calibration date: \_\_\_\_\_

**Survey meter**

	Type	Manufacturer	Model	Serial #	Last calibration

<b>1</b>					
<b>1-probe</b>					
<b>2</b>					
<b>2-probe</b>					

**Fume hood**

<b>Location</b>	<b>Condition</b>	<b>Criteria</b>	<b>Measured value</b>	<b>Pass/Fail</b>
<b>Inside hood</b>		<b>100 Linear feet/minute</b>		

**Remarks**

# APPENDIX V

## PROPOSED POLICY FOR THE UNIVERSITY OF ARKANSAS

### PURPOSE

This policy concerns employees who become pregnant who, in the course of their duties, are occupationally exposed to ionizing radiation (X-rays, gamma rays, or radioactive materials). The purpose of this policy is (1) to provide information, training, and options to employees so that they can make informed decisions in the best interest of themselves and their fetuses; and (2) to provide a mechanism whereby the University of Arkansas (UA) can manage or implement appropriate safety practices. No employee shall be discharged, transferred, or otherwise have her employment affected without her agreement solely because she is pregnant. On the other hand, employees can be required to perform the essential functions of their positions as a condition of continuing their positions.

### PROCEDURE

1. This policy shall be invoked when employees (faculty and staff) or students in one of the following categories become aware of their pregnancy or state an intention of becoming pregnant in the near future:

- A) Any employee who receives (as demonstrated by dose reports), or is likely to receive (as determined by the RSO's evaluation of duties) a radiation dose in excess of 40 millirems per month, averaged over a nine month period. This is the "action" level dose, not the permissible dose.
- B) Persons engaged in the following activities may be "at risk" as defined in (A) above:

Laboratory personnel working with radioactive materials  
or X-ray generators.

2. Employees do not have to notify anyone of their pregnancy or intention of becoming pregnant. However, an employee who decides to notify the University of her pregnancy or intended pregnancy has the following responsibilities:

- A) Notify her immediate supervisor OR the RSO of her pregnancy or intended pregnancy.
- B) Assist her supervisor and the RSO in evaluating the level of risk to a fetus from her particular working conditions and in evaluating the reasonableness of modifications to her working conditions to reduce risk. She shall sign a Female Radiation Exposure Declaration Form acknowledging that she has officially notified her supervisor of her pregnancy or intended pregnancy and knows the possible risks to her fetus from ionizing radiation exposure.
- C) Notify her supervisor of any changes in her work or any problems in her pregnancy which may relate to exposure to radiation.

3. Employee's options:

- A) Continue in employment in her current position.
- B) If the supervisor offers the employee an alternative position with less radiation risk, she may accept such position.
- C) Take a leave of absence for a period of time not exceeding the duration of the pregnancy.
- D) Resign from employment.

4. Supervisor's responsibilities:

- A) Contact the RSO and schedule a conference with the employee.
- B) Implement any modifications in working conditions which the supervisor deems appropriate.
- C) Establish the duration and conditions of any leave of absence or transfer to another position allowed under other provisions of this policy.
- D) Provide the employee with information furnished by the RSO regarding the nature of potential radiation injury associated with in utero radiation exposure and the regulatory limits established by the National Council on Radiation Protection.

5. Radiation Safety Officer's responsibilities:

- A) Develop information to be furnished to employees regarding the nature of potential radiation injury associated with in utero radiation exposure and the regulatory limits established by the National Council on Radiation Protection. (This information is provided later in this policy.)
- B) Advise the supervisor regarding the nature, the magnitude, and appropriate preventive measures associated with the employee's exposure to ionizing radiation.
- C) Provide dosimeters and keep the supervisor and employee advised of exposure readings.

ACKNOWLEDGEMENT OF TRAINING:

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## FEMALE RADIATION EXPOSURE DECLARATION

I understand that UA is obliged by applicable law to take the position that protection of the health of the embryo/fetus is the immediate and direct responsibility of the prospective parent(s). While the medical profession and the UA can support the parent(s) in the exercise of this responsibility, the UA cannot assume it for the parent(s) without, according to the courts, simultaneously infringing upon individuals' rights. I also understand that policies which, as a rule, inhibit a woman's activities in the workplace on the basis of fetal protection concerns, are improper under the law of the United States, unless a woman voluntarily requests more protective dose limits be applied to her or in cases in which sex or pregnancy actually interferes with the employee's ability to perform the job.

I have received training from UA concerning the radiological hazards of employment. I have also received training regarding the effects of radiation on an embryo/fetus (such as mental retardation and birth size, childhood cancer, radiation-induced genetic effects, and the radio-sensitivity of the embryo/fetus.)

I have had opportunity to ask questions concerning all aspects of the presentation.

I understand that the National Council on Radiation Protection and Measurement has recommended a separate dose limit of 500 mrem (not to exceed 50 mrem/month) to the embryo/fetus from occupational exposure of the expectant mother for the term of the pregnancy. I understand that limiting the dose to the embryo/fetus for any Declared Fertile Female or Declared Pregnant Female, for the term of the pregnancy may result in lowering the occupational dose which I may receive. I understand that I must declare whether I wish to be considered a Declared Fertile Female (may become pregnant) or a Radiation Worker. As a Declared Fertile Female, under UA policy, I will be restricted to a radiation dose of 40 mrem/month. If I choose instead to be considered a Radiation Worker, my radiation dose will be the same dose limits applicable to male workers.

I understand that if I become pregnant, I have the option to formally choose to be considered a Declared Pregnant Female. If I make that choice, under UA policy I will be restricted to a radiation dose of 400 mrem for the entire gestation period, not to exceed 40 mrem per month. If I do not formally declare my pregnancy, my radiation dose limits will continue to be the same as they were before I became pregnant.

I understand that I may be excluded from certain jobs or tasks that would require high radiation exposure if I choose to be a Declared Fertile Female or a Declared Pregnant Female. I understand that these declarations and lower limits, however are strictly voluntary and will be implemented by UA only upon request. I understand that I may change my declaration at any time by notifying my supervisor and signing a new declaration form.

Based on the above information, I believe I adequately understand the risks of radiation related to employment and the choices available to me.

CHOOSE ONE:

Initial yes for one of the classifications below; initial no for the other two classifications.

\_\_\_\_\_  
Yes                  No

Radiation Worker. Based on the above information, I do want to be subject to the full occupational exposure limits which are 5000 mrem/calendar year.

\_\_\_\_\_  
Yes                  No

Declared Fertile Female. Based on the above information, I voluntarily elect to be considered a fertile female (may become pregnant) and to be subject to the lower dose limit of 40 mrem/month or 400 mrem/rolling quarter.

\_\_\_\_\_  
Yes                  No

Declared Pregnant Female. I currently am pregnant, and I voluntarily elect to be subject to the lower dose limit for pregnancy of 400 mrem for the gestation period, not to exceed 40 mrem per month.

Employee's Social Security No.

\_\_\_\_\_

Employee's Name

\_\_\_\_\_ Date: \_\_\_\_\_

Please Print

Employee's Signature

\_\_\_\_\_

Signature

Supervisor's Name

\_\_\_\_\_ Date: \_\_\_\_\_

Please Print

Supervisor's Signature

\_\_\_\_\_

Signature

Estimated date of Delivery

\_\_\_\_\_

## **APPENDIX VI**

### **Radioisotope Inventory and Disposal Log Sheet Quarterly Inventory Report**

All use and disposal of radioisotopes should be recorded on the appropriate radioisotope inventory and disposal log sheet. Log sheet (Form ORS-29, a copy attached) will be provided for each unsealed source delivered to the RSO. Users may use their own format to keep usage record for their convenience, but those forms should contain at least same information on the Form ORS-29. All usage should be recorded with appropriate unit of radioactivity (millicuries, microcuries). Using unit of volume, such as microliters, is ineffective because the specific activity of each shipment is not known and the conversion to units of activity cannot be done. Radioisotope decay can be ignored for the purposes of recording usage and disposal on the log sheet.

Authorized users are responsible to prepare inventory report of radioactive materials used in your approved area quarterly based on the purchase and usage record. The RSO will send reminder of report submission.

Workers are responsible for providing quarterly inventories and must also maintain current accurate inventories, which must include all radioactive materials on hand, those materials that being used in experiments and/or stored as radioactive waste.

## APPENDIX VII

### Removal, disposal, and/or transfer of equipment with possible contamination

#### **PROPOSED POLICY:**

The purpose of this policy is to notify departments within the University of Arkansas (UA) of the procedures to be followed in the removal, disposal, and/or transfer of equipment that has been used in conjunction with radioactive materials. This equipment may contain radioactive contamination or may contain an internal radioactive calibration source. Equipment which may be affected by this policy, but not limited to, is: liquid scintillation counters, gamma counters, centrifuges, vacuum pumps, refrigerators, freezers, water baths, gel dryers, ovens, incubators, fume hoods, and biological hoods.

#### **PROCEDURES:**

- I. Before equipment can be sent to the Office of Environmental Health & Safety (EH&S), returned to the vendor, transferred to another institution, or sent for repairs, it must be cleared of containing radioactive contamination or containing an internal source of radioactivity (calibration source).
- II. Each affected department or research laboratory is responsible for notifying the RSO before the equipment is removed from the area.
- III. The RSO will conduct contamination swipes to determine the presence of radioactive material. If the equipment is free of contamination, a notice is placed on the equipment declaring it clean. The device may then be sent for repairs, returned to the vendor, transferred to another institution, or sent to EH&S for disposal.
- IV. If contamination is present on swipes, the requesting department or laboratory is responsible for cleaning the device and requesting a re-survey from the RSO. No equipment is to leave the UA Campus before it is cleared by the RSO.

## Appendix VIII

### Personnel Decontamination

*First define the areas of contamination by means of proper monitoring techniques. Place special emphasis on ant hot spots on the individual. Attempt the mildest method of cleansing first, progressing to more harsh methods when necessary. Cleansing methods in order of harshness:*

1. *Lift off with sticky tape.*
2. *Flushing with water.*
3. *Soap and warm water, commercial skin cleaner.*
4. *Mild abrasive soap, soft brush and water.*
5. *Skin cleaner with mild abrasive, e.g. cornmeal.*
6. *Complexing solution.*
7. *Mild organic acid (citric acid)*

*After removal of contamination, individuals should take a thorough shower with special attention to washing hair, hands and fingernails. Every effort should be made to prevent the spread of contamination.*

*All cleaning action should be from the periphery of contaminated area towards the center to avoid spreading contamination.*

*Be aware of personal and ethnic privacy issues when initiating any body surveys or decontamination procedures.*