

UNIVERSITY OF LOUISVILLE

RADIATION SAFETY MANUAL

ACADEMIC LICENSE

# **RADIATION SAFETY MANUAL**

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# CHAPTER 1

## RADIATION SAFETY PROGRAM ALARA

### INTRODUCTION

The purpose of this program is to provide researchers who use radioactive material with policy/direction and procedure regarding the safe use and disposal of radioactive material as approved by the University Radiation Safety Committee under the University's Broad Research License 203-034-71.

The Administration of the University of Louisville has a commitment to providing a safe environment for faculty, staff and the researcher's use of radioactive material. It is the responsibility of all Deans, Department Chairs and researchers to implement radiation safety policy and procedure as approved by the University Radiation Safety Committee under the authority delegated by Administration. Oversight of this policy and procedure is carried out by the University Radiation Safety Office under the supervision of the University Radiation Safety Officer.

A specialized part of the University's overall safety program is radiation safety. The elements of our Radiation Safety Program for research & animal use are contained in the following sections and exhibits. They have been carefully developed to help all involved individuals conduct their duties in an efficient and safe manner.

Radiation health and safety standards are among the best studied and most thoroughly applied in the safety field. While allowable human exposures are set well below the hazardous levels, this university also strongly supports the "As Low As Reasonably Achievable" (ALARA) radiation safety philosophy regarding radiation dose. It is essential that all staff members know their duties and responsibilities regarding radiation safety, and constantly practice good safety technique.

### ALARA PROGRAM

The University license requires a Radiation Safety Committee be formed and monitor all aspects of radiation use within the facilities. See the Radiation Safety Committee Charter for the duties of the Committee.

As stated before, we support the ALARA philosophy. Part of this program requires the use of individual radiation monitoring devices to ensure the exposure to personnel stay As Low As Reasonably Achievable. These records will be monitored at least each quarter by the Radiation Safety Officer; attention will be given to individuals or groups of workers whose occupational exposure appears excessive. These results will be reviewed at the Radiation Safety Committee meetings. Investigational levels will be set as listed below. Generally, any doses that are above normal exposures for personnel will be investigated.

AREA OF EXPOSURE	LEVEL 1	LEVEL 2
WHOLE BODY DOSE	125 mRem	375 mRem
EYE DOSE	500 mRem	1500 mRem
EXTREMITY DOSE	1250 mRem	3750 mRem

The levels listed above are based on the occupational dose limits as set forth in 902 KAR 100:019 section 3. If the occupational dose exceeds level 1 within a year, the dose is noted and if found to be normal, no action is required. If the occupational dose exceeds level 2, an investigation will be made and any recommendations will be given and recorded.

The following policies and procedures are utilized to keep radiation exposures ALARA:

- The Radiation Safety Committee will review quarterly and annually radiation worker doses, investigating ALARA notifications to determine whether exposures are being kept to a minimum.
- The Radiation Safety Officer will brief management once per year regarding occupational exposure levels.
- The Radiation Safety Committee will carefully review applications for radioactive material authorization, to ensure that the applicant is qualified and that the proposal incorporates the ALARA philosophy.
- Investigation levels for occupational radiation exposures will be adopted by the Radiation Safety Committee. When these levels are exceeded, the Radiation Safety Officer will notify the recipient and review work practices, etc., in order to attempt to lower the exposure if possible. See levels listed in the table above.
- The Radiation Safety Officer will provide training classes to radiation workers and ancillary personnel regarding the ALARA philosophy and methods to keep exposures ALARA.

**CHAPTER 2**  
University of Louisville  
Radiation Safety Committee  
Charter

The Vice President supervising the Department of Environmental Health and Safety Department shall appoint members to the Radiation Safety Committee. Recommendations may be taken from the RSO, the Dean of the Medical School, and Vice President for Research.

**ROLE:**

The Committee shall:

1. Ensure that licensed material will be used safely. This includes review as necessary of training programs, equipment, facility, supplies, and procedures;
2. Ensure that licensed material is used in compliance with Cabinet regulations and the institutional license;
3. Establish a table of investigational levels for individual occupational radiation exposures;
4. Ensure that the use of licensed material is consistent with the ALARA philosophy and program;
5. Identify program problems and solutions.

**MEMBERSHIP:**

Membership of the Committee will consist of persons that understand and represent responsibilities of maintaining an ongoing radiation safety program. The Radiation Safety Office will act as the chair of the committee. The membership must include but is not limited to the following:

- Radiation Safety Officer
- A representative of management who is not an authorized user or the RSO
- A representative of the nursing service
- An authorized user for each type of use authorized by the license
- Other members as deemed appropriate.

**RESPONSIBILITIES:**

The Committee shall:

1. Be familiar with all pertinent Cabinet regulations, the license application, the license and amendments;
2. Review the training and experience of the proposed authorized users and the Radiation Safety Officer (RSO) to determine that their qualifications are sufficient to enable the individuals to perform their duties safely and are in accordance with the regulations and the license;
3. Review on the basis of safety and approve or deny, consistent with the limitation of the regulations, the license and the ALARA philosophy, all requests for authorization to use radioactive material within the institution;

4. Prescribe special conditions that will be required during a proposed method of use of radioactive material such as requirements for bioassays, physical examinations of users, and special monitoring procedures;
5. Review the RSO's summary report of the occupational radiation exposure records of all personnel, giving attention to individuals or groups of workers whose occupational exposure appears excessive;
6. Establish a program to ensure that all persons whose duties may require them to work in or frequent areas where radioactive materials are used (e.g., nursing security, housekeeping, physical plant) are appropriately instructed as required in 902 KAR 100:165;
7. Review at least annually the RSO's summary report of the entire radiation safety program to determine that all activities are being conducted safely, in accordance with Cabinet regulations, and the conditions of the license, and consistent with the ALARA program and philosophy. The review must include an examination of records, reports from the RSO, results of Cabinet inspections, written safety procedures, and the adequacy of the management control system;
8. Recommend remedial action to correct any deficiencies identified in the radiation safety program;
9. Maintain written minutes of all Committee meetings, including members in attendance and members absent, discussions, actions, recommendations, decisions, and result of all votes taken;
10. Ensure that the byproduct material license is amended, if required, prior to any changes in facilities, equipment, policies, procedures, and personnel.

**ADMINISTRATIVE INFORMATION:**

- The Committee shall meet as often as necessary to conduct its business but no less than annually;
- Membership of the Committee must include the RSO, a representative of management who is not an authorized user or the RSO, authorized users as approved by the committee, and other as deemed necessary.
  
- To establish a quorum, one-half of the Committee's membership, including the RSO and the management representative, must be present.
  
- To the extent that they do not interfere with the mission of the Committee, management may assign other responsibilities such as x-ray radiation safety, quality assurance oversight, and research project review and approval.

## CHAPTER 3

### PERSONNEL EXPOSURE MONITORING PROGRAM

Any personnel who might be likely to require individual monitoring of external and internal occupational dose as listed in 902 KAR 100:019 section 13 will be monitored for exposure. This institution will follow the program:

1. The RSO will promptly review all exposure reports to look for workers or groups of workers whose exposure is unexpectedly high or low.
2. All individuals who are occupationally exposed to ionizing photon radiation on a regular basis will be issued a dosimetry whole body monitor that will be processed by a contract service on a regular basis.
3. All individuals who, on a regular basis, handle radioactive material that emits ionizing photons will be issued a dosimetry finger monitor that will be processed by a contract service on a regular basis.
4. Any individuals who are exposed to radiation on an occasional basis such as security personnel who deliver packages, secretarial personnel who work in the research area but do not work with directly with radioactive material will not normally be issued exposure monitors.
5. All individuals who are less than 18 years of age and are likely to receive a radiation dose in any calendar quarter in excess of 10 percent of the dose limits listed below will be issued a dosimetry badge.
6. All individuals who are radiation workers and have declared a pregnancy or planned pregnancy may be issued a dosimetry badge based on review by the Radiation Safety Officer.
7. All individuals who meet special criteria as assessed by the Radiation Safety Officer or his/her delegated representative may be issued a dosimetry badge.

Occupational exposures will not exceed the annual limits as listed below:

Whole Body, Total effective dose equivalent:	5000 mRem
Eye dose equivalent:	15000 mRem
Shallow-dose equivalent to skin and extremities	50000 mRem
Fetal Dose: (limit for the gestational period)	500 mRem

**Overexposure** (902 KAR100:019 sections 39 & 40) a written report in 30 days of occurrence shall be submitted to the state. If an exposure exceeds the maximum allowable dose, the employee and supervisor will be notified and the required reports will be filed with the State of Ky. Radiation Control Branch.

## PROCEDURES FOR RECEIVING DOSIMETRY BADGES

During Radiation Safety Orientation Training, personnel will be assessed as to whether a dosimetry badge is required. Further evaluations, and re-evaluations, will be made through radiation employees' registration updates, application reviews, personnel monitoring reports, ALARA investigations, surveys, and individual interviews by responsible Radiation Safety staff members. To receive a radiation badge, the following procedures must be followed:

1. The radiation worker must complete a dosimetry badge application. For each individual who may work with radiation sources. During Radiation Safety Training Orientation, personnel will be assessed as to whether a dosimetry badge is required.
2. The application is to be completed and turned into the Radiation Safety Office
3. Upon receiving the application, the Radiation Safety Office will order the badge.
4. When the badge is received, a list of instructions and the badge will be sent to the badge coordinator of the department.
5. Badges are exchanged on a monthly or quarterly basis. Badges must be returned to the Radiation Safety Office by the 10th of the month (or start of the new quarter) so that they may be properly processed.

Body badges are assigned to workers who use one (1) millicurie or more of unshielded radioactive material at any one time. Ring badges are assigned to workers who use one (1) millicurie or more of unshielded radioactive material with high energy beta radiation (P-32, Sr-90, etc) or unshielded gamma radiation emitters at any one time. Individuals who work solely with low-energy beta emitters (such as H-3, C-14, S-35 or Ca-45) when quantities used at any one time are less than one (1) millicurie do not need badges. The Radiation Safety Officer may require the use of pocket dosimeters, ring badges, or other monitoring devices when particular procedures are in operation.

## PERSONNEL MONITORING PROTOCOL

- 🔥 The Radiation Safety office will request prior dose histories from all past employers.
- 🔥 The Radiation Safety Office will maintain all personnel occupational dose records.
- 🔥 It will be the responsibility of each individual badge recipient to wear and use the badge(s) properly.
- 🔥 Authorized users are responsible for assuring their radiation workers are wearing badges appropriately and that badges are returned on time for processing.
- 🔥 Authorized Users/Radiation workers may be penalized for late or lost badges.
- 🔥 The Radiation Safety Office will monitor proper use of the badges during their periodic inspections.
- 🔥 The Radiation Safety Office will contact personnel when they receive an exposure reading on their badge that warrants an investigation.
- 🔥 The Radiation Safety Office has records of all personnel past dosimetry.
- 🔥 Each department receives a report of the readings of the badges after they are received.

## USE OF PERSONNEL MONITORING DEVICES

- 🔥 The whole body badge (or other device) is to be worn on the body where it will most likely approximate the radiation exposure to the head and torso of the wearer.
- 🔥 A badge assigned for whole body monitoring is not to be used to monitor the extremities (hands, forearms, feet, ankles). Separate badges must be assigned for extremity monitoring.
- 🔥 Badges shall be worn only by the person they are assigned to and only at the facility they work in.
- 🔥 Whole body badges are to be worn between the waist and neck.
- 🔥 When a lead apron is worn the badge will be worn outside the apron at the collar level.
- 🔥 The Radiation Safety Officer should be consulted for guidance in these circumstances.

- Ring badges are to be worn whenever working with applicable sources. They come in large or small sizes, and should be worn with the monitoring element (label area) turned toward the palm. Gloves should be worn over the ring badge when contamination is possible.

\*KAR 100:105, 2(g) prohibits exposure to a monitoring device deceptively to indicate a dose delivered to an individual that is not true.

## *INTERNAL DOSE*

### **Bioassay Program** (902 KAR 100:019 section 6)

Bioassay is the determination of the kind, quantity or concentration, and location of radioactive material in the human body by direct (in-vivo) measurement or by analysis (in-vitro) of materials excreted from the body. Commonly employed bioassay techniques include urinalysis and thyroid monitoring. U of L bioassay program provides the necessary personnel monitoring to measure operation or accidental uptake by radiation workers.

Radioactive material usage is approved only when the associated safety program, equipment, facilities and staff experience assures that safe use will be routinely maintained,. The potential for radiation exposure due to inadvertent failure of procedures and equipment may increase, however, when certain combinations of radionuclides, chemicals or physical forms and activities are involved.

Current health physics practices and safety survey result provide evidence that few, if any, radioactive material procedures currently in use allow routes for personnel uptakes. Some procedures do incorporate radionuclide form and activity combinations which warrant bioassay monitoring to assure that designated precautions remain effective.

The Radiation Safety Officer, during the review of applications of personnel monitoring needs and frequency, will make a determination of bioassay needs. The status of usage programs is periodically reviewed through radiation worker registrations, surveys, inventory records, and verification of radiation staff and radionuclide use limits.

**UNIVERSITY RADIATION SAFETY OFFICE  
ROOM 102 Library Building, HSC  
PERSONNEL MONITORING BADGE APPLICATION FORM**

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

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

(LAST) (FIRST) (MI)  
SOCIAL SECURITY #: \_\_\_\_\_ D.O.B. \_\_\_\_\_ SEX \_\_\_\_\_

TYPE OF BADGE: CHEST: (G1) \_\_\_\_\_ COLLAR (G13) \_\_\_\_\_ (Lead Apron Wearers ONLY)

RING: (CIRCLE ONE) Right Finger (U3) Left Finger (U4) Small \_\_\_\_\_ Medium \_\_\_\_\_ Large \_\_\_\_\_

DEPARTMENT: \_\_\_\_\_ PHONE NUMBER: \_\_\_\_\_

CAMPUS MAILING ADDRESS: \_\_\_\_\_ POSITION: \_\_\_\_\_

PRINCIPAL INVESTIGATOR PRINTED NAME: \_\_\_\_\_

U OF L SPEEDTYPE TO BE CHARGED: \_\_\_\_\_ (Not Applicable for U of L Hospital)

SIGNATURE OF INDIVIDUAL APPROVING EXPENDITURE: \_\_\_\_\_

**FOR URSO USE ONLY:**

TEMPORARY BADGE ISSUED: yes \_\_\_ no \_\_\_ TEMPORARY BADGE NUMBER: \_\_\_\_\_

DATE TRANSMITTED TO VENDOR: \_\_\_\_\_ GROUP #: \_\_\_\_\_

VENDOR REPRESENTATIVE NAME: \_\_\_\_\_ BADGE #: \_\_\_\_\_

HAVE YOU EVER WORN A BADGE BEFORE: YES \_\_\_ NO \_\_\_

IF YES, GIVE THE COMPLETE NAME AND ADDRESS OF THAT EMPLOYER AND THE TIME EMPLOYED THERE.

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

ADDRESS: \_\_\_\_\_

CITY: \_\_\_\_\_ STATE/COUNTRY: \_\_\_\_\_ ZIP: \_\_\_\_\_

DATES EMPLOYED: FROM \_\_\_\_\_ TO \_\_\_\_\_

(M/Y)

(M/Y)

I HEREBY AUTHORIZE MY PREVIOUS EMPLOYER TO RELEASE MY PAST RADIATION EXPOSURE HISTORY.

SIGNATURE OF INDIVIDUAL BEING BADGED: \_\_\_\_\_

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

**PERSONNEL RADIATION MONITORING BADGE PROGRAM**

FULL NAME (print): \_\_\_\_\_  
(Last) (First) (MI)

GROUP # \_\_\_\_\_ BADGE # \_\_\_\_\_ DATE ISSUED \_\_\_\_\_

I understand that in conjunction with my application for and issuance of a "Personnel Radiation Monitoring Badge," I will comply with the following instructions:

- Pick up my badge for each new cycle from my designated "Badge Coordinator".
- Wear my badge whenever I am working in the vicinity of radiation or radioactive material.
- Return my old badge at the end of the wear cycle (last date on badge) to my designated "Badge Coordinator".
- Wear my badge according to the appropriate type:

1. Chest Badge – wear between shoulders and waist.



The chest badge measures the deep dose equivalent or "whole body" radiation dose. If worn with a lead apron, wear this badge on the outside of the lead apron.

2. Collar Badge – wear on collar of lab coat or scrubs.

The collar badge measures the radiation dose to the lens of the eye.



If you are assigned a chest and a collar badge, the chest badge must be worn underneath the lead apron. A special calculation is done with this two badge method that ensures proper recording of radiation dose.

3. Fetal Badge – worn low in center of abdomen.



The fetal badge measures the radiation dose to the unborn child. The fetal badge will be exchanged monthly, even if your chest badge is exchanged quarterly.

4. Ring Badge – wear on hand.

The ring badge measures radiation dose to the most exposed extremity, typically the dominant hand. Wear the ring on the hand closest to the source of radiation.

- If this is a Fetal Badge I have been counseled by the Radiation Safety Office about "Declaration of Pregnancy".
- I understand returning my badge for reading is important and the best way to document my radiation dose.
- ***I UNDERSTAND THAT FAILURE TO RETURN MY BADGE WHEN DUE WILL RESULT IN A \$20.00 LATE FEE.***

I have read the above information and will comply with the best of my ability.

SIGNATURE: \_\_\_\_\_

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

## CHAPTER 4

### FETAL DOSE POLICY PREGNANT EMPLOYEES

The U of L fetal dose policy incorporates safety information and radiation dose guidelines for ensuring safe radiation limits for the embryo/fetus of occupationally exposed employees.

Radiation workers are strongly advised to notify the Radiation Safety Office as soon as possible after pregnancy is confirmed. The declaration of pregnancy is voluntary, but it must be made known in writing.

If an employee decides to declare her pregnancy in writing, the University will then take steps to ensure that the occupational radiation dose received by the embryo/fetus does not exceed the limit specified by the State and Federal regulations of 500 millirem for the remainder of the gestation period. In addition the National Council on Radiation Protection Measurements (NCRP) recommends that the dose for any one month during pregnancy not exceed 50 millirems.

It is the responsibility of the employee and her supervisor to observe the principles of radiation safety and use standard precautionary procedures in the performance of her duties to keep her radiation dose to as low as reasonably achievable (ALARA) at all times and especially during the gestation period. The Radiation Safety Office will provide training and assistance in maintaining doses ALARA.

**DECLARATION OF PREGNANCY**

Name: \_\_\_\_\_

Department: \_\_\_\_\_

Work Phone #: \_\_\_\_\_

**TYPE OF POTENTIAL RADIATION EXPOSURE**

**Please check which applies to your job duties:**

**Ionizing radiation producing machines:**

Radiographic:     Fluoroscopic:     Special Procedures and Cardiac Cath:   
Therapeutic:     Dental:     Other (Specify) \_\_\_\_\_

**Radioactive Material:**

Research     Diagnostic     Radiopharmaceutical Therapy     Teletherapy   
Brachytherapy/HDR     Other (Specify) \_\_\_\_\_

**DOSIMETRY INFORMATION**

Do you wear a film badge?    Yes     No

**MONTH OF PREGNANCY**

Current month of pregnancy (circle)    1    2    3    4    5    6    7    8    9

“I hereby authorize and consent to disclosure of my declared pregnancy to the Authorized User or other personnel who need to be aware of the radiation exposure restrictions for me including those who must cooperate with such restrictions.”

I \_\_\_\_\_ have chosen to declare my pregnancy to the Radiation Safety Office of the University of Louisville.

Signature \_\_\_\_\_ Date \_\_\_\_\_

## CHAPTER 5

### CRITERIA FOR EVALUATING USER QUALIFICATIONS FOR THE USE OF RADIOACTIVE MATERIALS

#### Authorized Users

An authorized user is an individual who by virtue of position, training and experience is designated by the RSC as a user of radioactive material under the University of Louisville broad radioactive material license. This authorization permits the procurement and use of radioactive material within a defined protocol or work activity under the supervision of the authorized user provided that the materials are used within the guidelines of safe practice, and within the rules, regulations and recommendations of the RSC and U of L policy.

#### HOW TO BECOME AN AUTHORIZED USER

Anyone who would like to become an authorized user must complete the “Application for Authorization to Use Radioactive Material”, and sign the “Radiation Protection Guidelines”. The completed forms and a CV including the experience with radioactive material must be sent to the Radiation Safety Office for review. The RSO, the Radiation Safety Committee Chair and at least half of the Committee must sign and approve the Authorized use of radioactive material. The approval will be based upon experience and the evaluation of the the proposed locations of use. Upon authorization, the Radiation Safety Office will notify the new user and meet in the lab to go over the responsibilities of the Authorized User and the lab. This will include, but not be limited to:

- 📌 Responsibilities of the Authorized User
- 📌 Responsibilities of the lab workers
- 📌 Ordering material
- 📌 Receiving material
- 📌 Shielding
- 📌 Surveys
- 📌 Required training
- 📌 Dosimetry
- 📌 Waste
- 📌 Security

#### AMENDMENT TO AN AUTHORIZATION

An Authorized User must submit an amendment request if other radionuclides are to be used or if procedures change that will significantly alter radiological hazards. A memo to the Radiation Safety Officer must be submitted for an increase in possession limits, changes in use and storage areas and other minor changes.

#### INACTIVE STATUS

An Authorized User may request in writing to the Radiation Safety Officer that his/her authorization to use and store radioactive materials be temporarily changed to an Inactive Status. This status allows survey/wipe tests and inventories on a less frequent basis (quarterly). This provision is designed for laboratories that are not planning on using radioactive materials for at least six months. The Authorized User may not use radioactive materials with this status (this is a storage only authorization). The Authorized User must submit a request to the Radiation Safety Officer to return to active status when so desired.

### **Responsibilities of the Authorized User:**

A fundamental principle governing work with radioactive materials is that the users not only assume responsibility for their own safety but must also ensure that their actions do not result in hazards to others. Faculty members who wish to become an Authorized User of radioactive materials will obtain the necessary application forms from the Radiation Safety Office, HSC, Room 102, Library/ Commons Bldg.

All personnel who will be working with radioactive material will be take radiation safety training either by class or online.

All Authorized Users of radioactive materials must comply with the conditions of their authorization and of the radioactive material licenses that U of L has been granted. A partial list of specific responsibilities of the Authorized User is provided below to assist the user in maintaining good safety practice. (Additional information is included throughout this manual.)

The Authorized User shall:

1. Establish and maintain an awareness of the need for radiation safety in the workplace. This shall include control of radiation exposure to the lowest reasonable level (ALARA).
2. Ensure the following services for laboratory areas and radiation workers under their supervision are provided:
  1. appropriate personnel dosimetry if likely to exceed 10% of dose limits;
  2. bioassay services if applicable;
  3. personal protective equipment;
  4. availability of appropriate and calibrated survey instrumentation;
  5. availability of appropriate radiation detector for wipe tests; and
  6. facility maintenance.
3. Follow procedures for procurement of radioactive materials and radiation-producing devices.
4. Provide correct and current posting of laboratory areas, radioactive material containers and radiation-producing equipment.
5. Ensure maintenance of accurate and current inventory records for all radioactive materials under his or her responsibility.
6. Follow established procedures for packaging, inventory listing, disposal and notification of the Environmental Protection Program for collection of radioactive wastes.
7. Report immediately to the RSC any potentially hazardous spills, suspected radiation overexposures, loss or theft of radioactive materials, or other incidents having possible radiation safety implications.
8. Perform radiation and contamination monitoring as required by applicable regulations, procedures in this manual, and commitments to the RSC. Maintain accurate records of such monitoring results.
9. Provide adequate use-specific safety training for all radiation workers under their supervision. This supplements the general employee radiation safety training provided by the RSO.
10. Notify the RSO of any need for changes in the authorized use of licensed materials or registered equipment. This includes changes in use as well as for a need for larger quantities. As determined by the RSO, such changes may require the review and approval of the full RSC.
11. Obtain the prior approval of the RSO during procurement of radioactive materials.
12. Follow established procedure for transfer of licensed radioactive materials to other authorized U of L users.

13. Arrange with the RSO for appropriate actions in the event of anticipated extended absence from U of L.
14. Arrange for disposal or transfer of all radioactive materials promptly upon termination of the authorized use or application.

**Individual User Responsibilities:**

1. Each individual is responsible for maintaining his/her exposure As Low As Reasonably Achievable (ALARA).
2. All users must adhere to proper handling and radiation safety procedures when working with radioactive materials. Each individual who works with radioisotopes is responsible for the proper disposal of radioactive waste, maintenance of records of all disposal and proper identification of radioactive materials and identification of contaminated equipment with RSO approved labels.
3. The individual user is responsible for being familiar with radiation survey procedures and checking work areas for contamination periodically or after each radioisotope procedure. He/she is also responsible for checking hands, body and clothing for radioactivity and removing contamination before leaving the laboratory.
4. The individual user is responsible for the proper use and handling of his/her personnel monitoring badge, furnishing bioassay samples to the Radiation Safety Office for analysis when requested and obtaining periodic thyroid uptake measurements when working with radioiodine as applicable.
5. Each individual who works with radioisotopes must be familiar with the basic elements of decontamination procedures and is responsible for the cleanup of contamination for which he/she is responsible.
6. All users should be familiar with the characteristics of the radioisotopes they are working with.
7. Incidents involving contamination of personnel, uncontained spills, theft or loss of radioactive material and suspected overexposure must be reported immediately to the Radiation Safety Office.

**UNIVERSITY OF LOUISVILLE RADIATION SAFETY COMMITTEE  
APPLICATION FOR AUTHORIZATION TO USE RADIOACTIVE MATERIAL**

NEW APPLICATION \_\_\_\_\_

AMENDMENT TO EXISTING APPLICATION \_\_\_\_\_

5 YEAR RENEWAL \_\_\_\_\_

BROAD MEDICAL LICENSE (HSC) HUMAN USE _____ NON-HUMAN USE _____ IN VIVO _____ IN-VITRO _____	BROAD ACADEMIC LICENSE (BELKNAP) IN-VIVO _____ IN-VITRO _____
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Authorized User Information

Name \_\_\_\_\_ Department \_\_\_\_\_ Phone # \_\_\_\_\_

**RADIONUCLIDE USE (ATTACH PROTOCOL FOR EACH RADIONUCLIDE)**

Radionuclide(s)	Chemical Form	Physical Form	Possession	Limit	Specific Use
			Total	Single	(Attach Protocol)

Facility and Protection Devices

Rooms where material will be used? Building \_\_\_\_\_ Rooms \_\_\_\_\_

Radiation Protection Devices: List devices for conducting surveys and wipe tests, personnel dosimetry, shielding, fume hoods and biological cabinets and other protective devices and clothing in attached radiation protection protocol.

Does use produce any gaseous products? Y N, Does use involve heating above 100° C? Y N

Are there any "Non-Radioactive " methods available? Y N Are there any shorter half-life radioactive materials available? Y N

**TRAINING AND EXPERIENCE OF APPLICANT FOR AUTHORIZATION AND ANY OTHER USERS INCLUDING LAB PERSONNEL**

APPLICANT NAME (INCLUDE TITLE, DEGREE AND DATE)

APPLICANT _____  OTHER _____	DESCRIPTION OF EXPERIENCE _____
------------------------------------	---------------------------------

Signatures

Applicant \_\_\_\_\_ Date \_\_\_\_\_ Department Chair \_\_\_\_\_ Date \_\_\_\_\_

Reviewed & Approved By:

Radiation Safety Officer \_\_\_\_\_ Date \_\_\_\_\_

Committee Members \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_  
 \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_

Chair, Radiation Safety Committee \_\_\_\_\_ Date \_\_\_\_\_

## ATTACHMENT TO AUTHORIZATION APPLICATION

### RADIATION PROTECTION GUIDELINES

By signing below, you agree to follow the guidelines listed below and ensure that all individuals working under your authorization also follow the protocols. These guidelines help to facilitate working with radioactive material in a safe environment. If you have any questions regarding the use of radioactive material, please contact the Radiation Safety Office at 852-5231.

- 🦉 Any personnel who will work with the radioactive material will go through the radiation safety training provided by the Radiation Safety staff.
- 🦉 Any personnel who work in the areas where radioactive material is used will go through the radiation safety training provided by the Radiation Safety staff.
- 🦉 All radioactive material shall be ordered by the Radiation Safety Office unless an exception has been made that has been approved by the Radiation Safety Committee.
- 🦉 All radioactive material shall be received by the Radiation Safety Office unless an exception has been made that has been approved by the Radiation Safety Committee.
- 🦉 All experiments will be carried out in the designated areas in the lab.
- 🦉 Radioactive material will be used on areas that are covered with material that will help to absorb any spills.
- 🦉 Surveys will be performed at the end of the experiment to ensure no contamination is present; results of all surveys shall be recorded for review
- 🦉 Protective clothing such as lab coats and gloves shall be worn at all times while working with radioactive material.
- 🦉 All radioactive material shall be shielded appropriately to ensure the surrounding radiation exposure is as low as reasonably achievable.
- 🦉 Radiation monitoring badges will be worn by personnel using radioactive material when appropriate.
- 🦉 All waste will be stored appropriately and picked up by the Radiation Safety Office unless an exception has been made that has been approved by the Radiation Safety committee
- 🦉 All procedures will be abided by as listed in the Radioactive Material User Guide found on the U of L website: <http://louisville.edu/dehs/rad/radiationsafety.html>

\_\_\_\_\_  
Signature of Applicant

\_\_\_\_\_  
Date

**CHAPTER 6**  
**RADIATION SAFETY OFFICE RESPONSIBILITIES**

1. Inventory radioactive material.
  - a. The Radiation Safety Office will either order, or approve lab orders of radioactive materials received as well as any material shipped by the University. Some laboratories may order and receive based on the half-life of the material; this is approve on a case by case basis. Radioactive materials may be ordered by the Authorized User, or duly appointed representative, by contacting the Radiation Safety Office.
2. Provide radiation monitoring services for employees when appropriate.
  - a. The badges are returned to the Radiation Safety Office at monthly or quarterly intervals to be processed and evaluated. Exchanged film and ring badges are received from the Authorized User or his/her authorized representative by the date listed on the envelope for timely exchange.
3. Disposal of all radioactive wastes from the various laboratories.
  - a. Radioactive waste received by the Radiation Safety Office is allowed to be held for decay or shipped to an outside vendor for disposal. On a case by case basis, the RSC may permit individual labs to hold waste for decay but this must be approved.
4. Calibration of radiation protection survey instruments.
  - a. Most survey instruments require annual calibration; the RSO performs this function and keeps records of the calibration. In certain cases, equipment may be sent out for calibration.
5. Compliance surveys of radiation producing machines
  - a. Any radiation producing machines require registration with the state of Kentucky; the Radiation Safety Office registers each unit and keeps a file of all units at the Unviersity. Surveys are required upon installation of the machine, and periodically thereafter. The RSO can perform these function.
6. Sealed radioactive source leak test and inventory
  - a. Radioactive material regulations require leak tests and inventory of all sealed sources kept by the University. The Radiation Safety Office performs this function and keeps record of all material kept at the University.
7. Assistance in decontamination and consultation on all aspects of radiation use and protection.
  - a. The Radiation Safety Officer performs training, consultation, emergency response and decontamination of radioactive material.

## 8. Compliance inspections of radioisotope labs

- a. The Radiation Safety Office performs inspections of labs that use radioactive material on a periodic basis. This helps to ensure that we all work within the regulations to keep in compliance and promote safety. The inspection will include, but not be limited to:
  - i. **MANAGEMENT OVERSIGHT:**  
(control by authorized users; appropriate follow up on events and previous audit/inspection findings)
  - ii. **AMENDMENTS AND PROGRAM CHANGES:**  
(Amendments to the license were properly implemented; if applicable, program and procedural changes were approved and implemented in accordance with license condition).
  - iii. **FACILITIES:**  
(Facilities as described in license; uses; control of access; engineering controls; calibration facilities; shielding; air flow)
  - iv. **EQUIPMENT AND INSTRUMENTATION:**  
(Operable and calibrated survey equipment; procedures; 10 CFR Part 21)
  - v. **MATERIAL USE, CONTROL, AND TRANSFER:**  
(Materials and uses authorized; security and control of licensed materials; and procedures for receipt and transfer of licensed material)
  - vi. **AREA RADIATION SURVEYS AND CONTAMINATION CONTROL:**  
(Radiological surveys; air sampling; leak tests; inventories; handling of radioactive materials; contamination controls; records; and public doses)
  - vii. **TRAINING AND INSTRUCTIONS TO WORKERS:**  
(Training and retraining requirements and documentation; interviews and observations of routine work; staff knowledge of all routine activities; 10 CFR Parts 19 and 20 requirements; emergency situations; and supervision by authorized users)
  - viii. **RADIATION PROTECTION:**  
(Radiation protection program with ALARA provisions; external and internal dosimetry; exposure evaluations; dose and survey records and reports; annual notifications to workers; bulletins and other generic communications)
  - ix. **RADIOACTIVE WASTE MANAGEMENT:**  
(Disposal; effluent pathways and control; storage areas; transfer; packaging, control, and tracking procedures; equipment, hoods, vents, and compactors; license conditions for special disposal method)
  - x. **POSTING AND LABELING:**  
(Notices; license documents; regulations; bulletins and generic information; posting of radiation areas; and labeling of containers of licensed material)
  - xi. **INDEPENDENT AND CONFIRMATORY MEASUREMENTS:**  
(Areas surveyed, both restricted and unrestricted, and measurements made; comparison of data with staff's results and regulations)
  - xii. **AUDIT FINDINGS:**

Any employee may also request a special lab inspection concerning regarding radiation use. This will be performed with no discrimination against the employee.

## CHAPTER 7

### PERSONNEL TRAINING PROGRAM

All personnel like to receive in 1 year during the course of employment, an occupational dose in excess of 100 millirems shall receive proper instruction, appropriate to their activities. Other personnel will be trained as deemed appropriate by the Radiation Safety Officer. Personnel include radiation workers, clerical, nursing, housekeeping, security and others. Records with the date, names of persons who attended training, and what was included in the training will be kept for review:

Personnel will be properly instructed:

- a. Before assuming duties with, or in the vicinity of radioactive materials.
- b. During annual refresher training.
- c. Whenever there is a significant change in duties, regulations, or the terms of the license.

Instruction to personnel will include the following subjects:

- a. All terms of the license pertinent to their duties.
- b. Areas where radioactive material is used or stored.
- c. Potential hazards associated with radioactive material in each area where the employees work.
- d. Radiological safety procedures appropriate to their respective duties.
- e. Pertinent Kentucky Administrative Regulations, 902 KAR 100.
- f. Licensee's in-house work rules.
- g. Obligation to report unsafe conditions to the radiation safety officer.
- h. Appropriate response to emergencies or unsafe conditions.
- i. Right to be informed of their radiation exposure and bioassay results.
- j. Locations where the licensee has posted or made available notices, copies of pertinent regulations, and copies of pertinent licenses and license conditions (including applications and applicable correspondence), as required by 902 KAR 100:065.

## CHAPTER 8

### SEALED SOURCES

A list of all sealed sources are kept in the Radiation Safety Office. Sealed sources above the exempt quantities listed in 902 KAR 100:080 will be inventoried at least every 6 months and records showing quantities and kinds of radioactive material, location of sources, date of inventory and survey of storage location shall be maintained for review.

#### **LEAK TESTING**

Sealed, foil or plated sources of gamma and beta emitting radioactive materials that require leak testing will be will be leak tested by the Radiation Safety Office personnel not to exceed every 6 months and be counted in a suitable counter using the following procedure:

1. The closest accessible surface of the source, or source housing, will be wiped with an appropriate “swipe” (usually a cotton swab or filter paper).
2. The test samples will be immediately monitored with a suitably sensitive survey instrument in a low background area (0.05 mR/hr). If no significant radiation levels (twice background) are detected, the samples will be placed in a plastic envelope and returned to the laboratory for counting.
3. Counting will be done in an appropriate laboratory counting system.
4. The efficiency of the counting system will be determined to show that it will read below 0.005 uCi.
5. The results of the leak test will be reported in “DPM” and include:
  - a. Model and serial number of the source if one is assigned.
  - b. Identity of each source radionuclide and its activity
  - c. Measured activity of each test sample
  - d. Date of the test
  - e. Name of the person who performed the test.

#### **SEALED SOURCE INVENTORY**

A physical inventory of all sealed sources that are required will be performed at least semiannually. Records will be kept and with appropriate information including:

- a. model and serial number of source if one is assigned
- b. identity of each source radionuclide and it estimated activity
- c. location of each source
- d. date of inventory
- e. name of the person who performed the inventory

#### **INVENTORY OF DEVICES, GAS CHROMATOGRAPHS, AND LIQUID SCINTILLATION COUNTERS**

The Radiation Safety Office has an inventory of the instruments emitting radiation or containing sealed sources or foils, such as liquid scintillation counters. Each instrument will be posted with an identification sticker designating the radiation source information. The Radiation Safety Office must be notified if the location or status of this type of instrument changes. The radiation source in these instruments will be removed by the Radiation Safety Office prior to transferring them to Surplus Property.

## CHAPTER 9

### PROCEDURE FOR ORDERING AND RECEIVING PACKAGES

Radioisotopes orders are placed by the Radiation Safety Office (RSO) only, unless approved by the Radiation Safety Office. The following procedures will be performed when ordering and receiving packages:

1. The AU or an authorized individual within that lab will order radioactive material by contacting the Radiation Safety Office. In certain instances, radioactive material may be ordered by approved laboratories based on the half-life of the material if approved by the Radiation Safety Office.
2. The Radiation Safety Office will check the authorization of the user to ensure they are authorized for the isotope and amounts prior to ordering the material.
3. All radioisotope orders are delivered to the RSO office by the various transportation companies during normal business hours unless the material has been approved to be received by the lab based on the half-life of the material. After hours or weekend deliveries are not allowed. Should an off hours delivery occur, the Campus Police will call an RSO representative to take custody of the package.
4. Upon the arrival of the package, the order is reviewed with the placed order and all the pertinent data is checked to ensure that the correct item was shipped with the correct AU listed.
5. The package is then checked in using U of L's Package Opening Procedure. Receipt information such as wipe test and radiation reading results on the package if required will be documented.
6. An inventory sheet is generated for the particular shipment. A copy of the inventory sheet is given to the lab personnel when the package is picked up in the office.
7. The lab is then called regarding the arrival of their order, and either pickup or delivery of the package is arranged. The user signs a copy of the Inventory Sheet as proof of receipt of the item.

#### EXCEPTIONS TO RSO PLACING ORDER AND RECEIVING ALL MATERIAL DIRECTLY

*In certain cases with the half-life of the isotope being so short, the lab may need to place an order and receive the material directly. **This must be approved by the Radiation Safety Office and is granted on a case by case basis.** The lab must notify the Radiation Safety Office of their order. The lab will follow the procedures for opening packages containing radioactive material.*

## CHAPTER 10

### PROCEDURE FOR OPENING PACKAGES CONTAINING RADIOACTIVE MATERIAL

Monitoring of packages as required by 902 KAR 100:019 section 28 will be performed as soon as practicable after receipt, but not later than 3 hours after being received during normal working hours. Packages of radioactive material may not be delivered outside of normal working hours.

The facility shall immediately notify the delivery carrier and the Manager of the Radiation Control Branch if the external radiation levels exceed the 2200 dpm/100 cm<sup>2</sup>, or 200 mR/hr at the surface, or 10 mR/hr at 1 meter.

The external surfaces of a package shall be monitored for:

- Radioactive contamination (by wipe testing) unless the package contains only radioactive material in the form of a gas or in special form
- Radiation levels (by survey meter) unless the package contains quantities of radioactive material that are less than or equal to Type A quantity defined in 902 KAR 100:010.
- Any package received that is known to contain radioactive material and has evidence of potential contamination such as being crushed, wet, or damaged will be monitored by wipe test and survey meter.
- Make a record of the receipt.

Receiving packages:

1. Visually inspect that package for any sign of damage. If damage is noted, stop, notify the RSO, and monitor the packages as listed above.
2. If no damage is suspected, monitor the package as listed above.
3. Remove the packing slip if there is one.
4. Open the outer package, following any instructions that may be provided by the supplier.
5. Open the inner package and verify that the contents agree with the packing slip.
6. Check the integrity of the final source container. **Notify the RSO of any broken seals or vials, loss of liquid, condensation, or discoloration of the packing material.**
7. If there is any reason to suspect contamination, wipe the external surface of the final source container and remove the wipe sample to a low-background area. Assay the wipe sample to determine if there is any removable radioactivity. An appropriate instrument with sufficient sensitivity will be used to assay the sample. Take precautions against the potential spread of contamination.
8. Check the user request to ensure that the material received is the material that was ordered.
9. Monitor the packing material and the empty packages for contamination with a radiation detection survey meter before discarding. If contaminated, treat this material as radioactive waste; otherwise remove or obliterate the radiation label before discarding in regular trash.

## CHAPTER 11

### RADIOACTIVE MATERIAL INVENTORY

The University is required to maintain accurate, timely records of the receipt, use, transfer and disposal of radioactive material in its possession. Authorized Users have this same responsibility for their sources. These records must be maintained by the Radiation Safety Officer for at least three (3) years and be readily available for review by regulatory personnel.

A radioactive material record of use form will be provided with each vial of radioactive material received by the Authorized User. This is a disposition sheet to record each use of the material in that specific vial used in research labs. Upon the exhaustion or disposal of the radioisotope, the completed form is to be returned to the Radiation Safety Office.

A copy of the order of radioactive material for the Authorized User is kept in the Radiation Safety Office. The Radioactive Materials form will be completed by each user to document the additions of radioactive materials to waste in the lab and documentation of the use of material.

Transfers to dry solid, bulk liquid, liquid scintillation, animal waste, transfers to other users, transfers to the Radiation Safety Office, and amounts down the drain will be updated on an ongoing basis. Waste data must be accurate to ensure the University does not exceed the total possession limit for each radionuclide.

## CHAPTER 12

### GENERAL RULES FOR USE OF RADIOACTIVE MATERIAL

All personnel who work with radioactive materials are responsible for protecting themselves and others from any radiation hazards arising from their work. Personal cleanliness and careful techniques are the primary means of preventing contamination and ingestion of radioactivity.

**The following rules are observed:**

#### **1. Protective Clothing**

Wear a lab coat and gloves whenever the possibility of contamination exists. Change gloves frequently if contaminated items are being handled. Contaminated lab coats should not be worn outside the laboratory.

#### **2. Work with High-Energy Radiations**

When possible, use remote handling devices such as tongs or forceps when working with significant activities of gamma emitters or high-energy beta emitters. Work must take place behind protective shields.

#### **3. Work Surfaces**

Use disposable absorbent pads and/or lipped trays to protect work surfaces and confine spills.

#### **4. Eating, Drinking**

Eating, drinking, smoking, the application of cosmetics and other similar activities which could lead to the uptake of radioactive contamination, are prohibited in areas where unsealed radioactive materials are being used. Hands should always be washed with mild soap or detergent after handling radioactive materials, especially before eating.

#### **5. Containers**

Radioactive materials should not be left in uncovered containers. Glass containers should be placed inside larger break-resistant secondary containers. All containers should be clearly labeled to indicate the nature of contents.

#### **6. Pipetting**

Pipetting by mouth suction or similar operations is strictly prohibited.

#### **7. Monitoring**

Routine monitor hands, feet, clothing, and work area with a radiation survey instrument equipped with a thin window probe to detect the presence of contamination of gamma and/or high energy beta radionuclides. Use wipe test technique to detect the presence of low energy beta emitters such as H-3, C-14, and/or S-35.

#### **8. Badges**

The need for personal radiation monitoring devices will be determined by the Radiation Safety Office and will be done in accordance with 902 KAR 100:019 section 13, which states persons likely to receive in excess of 10% of the annual dose limit should be monitored. When monitoring devices are required, they must be worn at all times when in restricted areas.

#### **9. Transporting Radioactive Materials within the University**

Radioactive materials should be “doubly-contained” when in transit within the confines of the University property. Packaging should be adequate to contain potential breakage. Adequate shielding must be provided to maintain exposures to <2 mR/hr at 1 meter.

## **10. Storage**

Areas where radioactive materials are used, should be supervised, or in locked areas where unauthorized persons cannot handle or remove them. Return them to storage as soon as possible after use. All radioactive material must be appropriately labeled or marked. Food and beverages shall not be stored in the same place as radioactive material (e.g., in the same refrigerator or the same room where radioactive material is opened and in use). Any refrigerators and freezers positioned outside the lab (i.e. in hallways) that store radioactive material must also be locked.

## **11. Loss or Theft**

Loss or theft of radioactive materials is to be reported immediately to the Radiation Safety Office.

## **12. Warning Signs**

Post Radioactivity work areas, laboratories and containers of radioactive materials with appropriate warning signs. Post "NOTICE TO EMPLOYEES", KR-441, in a conspicuous place for employee review.

## CHAPTER 13

### RADIATION SURVEYS

Ambient radiation surveys with an appropriate meter such as a geiger meter are performed to ensure the radiation levels in the surrounding areas are below acceptable levels (0.2 mR/hr). Contamination surveys (wipe tests) are performed on an as needed basis. Shielding or decontamination may be required.

1. Contamination can be detected by using an appropriate survey meter to scan the suspect area or by conducting a wipe test of the surface and counting it for radioactivity in a suitable counter.
2. If appropriate, Geiger Mueller surveys must be performed after each use of radioactive material. Records of those surveys must be documented and available for review by Radiation Safety. Radiation exposures to unrestricted areas must be maintained to less than, 0.2 mR/hr. Appropriate shielding must be used if the exposure rate is greater than, 0.2 mR/hr.
3. Contamination wipe tests are to be conducted if appropriate. Records of the wipe tests must be documented and available for review by Radiation Safety. The wipe tests results shall be recorded in disintegrations per minute (DPM). DPM is derived from the formula CPM (counts per minute) divided by the instrument efficiency. Any contamination greater than 200 dpm for Iodine or 2000 dpm for any other nuclide must be cleaned.
4. If radioactive material is not used during a particular time period, records of inactivity must be documented and available for review by Radiation Safety.
5. Each individual who uses radioactivity is personally responsible for checking the area of use for contamination prior to leaving the controlled radioisotope areas. Additionally, each individual user is responsible for checking herself/himself for contamination of clothing, shoes and hands prior to leaving the controlled area.
6. The results of the surveys shall be kept in a log book for review by Radiation Safety and/or regulatory officials. The record should include:
  - a. Model number and the serial number of the instrument used in the survey
  - b. Date the survey was done
  - c. Areas surveyed or map indicating the areas surveyed
  - d. The survey results
  - e. Background survey
  - f. Person who performed the survey.
7. In the event personal clothing is contaminated, remove the clothing as quickly as possible, store in a plastic bag, seal the bag and mark the bag with a "Radioactive Material" label, sticker or flow pen, listing the isotope, date, and time of the incident, as appropriate. As soon as practical, phone the Radiation Safety Office, with pertinent information and await assistance from Radiation Safety personnel.

**Research Laboratories  
(Radiation Use Areas)**

**Actions**

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<1000 dpm/100 cm<sup>2</sup> beta/gamma  
<100 dpm/100 cm<sup>2</sup> alpha

Cleanup recommended to as low as practicable levels.

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≥1000 dpm/100 cm<sup>2</sup> beta/gamma  
≥100 dpm/100 cm<sup>2</sup> alpha

Record actual measurements for formal survey.  
Cleanup to less than 1000 dpm beta/gamma or 100 dpm alpha and as far below as practicable is required.

## CHAPTER 14

### EMERGENCY PROCEDURES

#### MINOR SPILLS:

1. Notify persons in the area that a spill has occurred.
2. Prevent the spread of contamination by covering the spill with absorbent paper.
3. Clean up the spill using disposable gloves and absorbent paper. Carefully fold the absorbent paper with the clean side out and place in a plastic bag for transfer to a radioactive waste container. Also put contaminated gloves and any other contaminated disposable material in the bag.
4. Survey the area with a low-range radiation detector survey meter. Check the area around the spill. Also check your hands, clothing and shoes for contamination.
5. The Radioactive Material Spill Report should be documented of the spill and cleanup
6. Report incident to the Radiation Safety Officer (RSO).

#### MAJOR SPILLS:

1. Clear the area. Notify persons not involved in the spill to vacate the room.
2. Prevent the spread of contamination by covering the spill with absorbent paper, but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.
3. Shield the source if possible. This should be done only if it can be done without further contamination or a significant increase in radiation exposure.
4. Close the room and lock or otherwise secure the area to prevent entry.
5. Notify the RSO or alternate immediately.

RADIATION SAFETY OFFICER: Sarah Hughes

PHONE: Office: 852-5231 Cell phone: 502- 552-5454

STATE RADIATION CONTROL BRANCH: 502-564-3700

6. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and washing with mild soap. If contamination remains, induce perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.

DETERMINATION OF MAJOR AND MINOR SPILLS:

Spills above the amounts listed below are considered major. Spills below the listed amounts are considered minor.

Nuclide	Millicurie amount
P-32	10
Co-57	100
Tc-99m	100
In-111	10
I-123	10
I-131	1
Tl-201	100

LABORATORY FIRES:

In the event of a laboratory fire, the following procedure is recommended:

- A. Report the fire by calling DPS at 852-6111 or 911. The following information should be given:
  - 1. Identify yourself and phone number;
  - 2. Exact location of fire (building, laboratory number of the specific area);
  - 3. Extent of personnel injuries;
  - 4. Type of fire (electrical, flammable liquid, trash, *etc.*); and
  - 5. Extent of fire (severity of fire and smoke).
- B. Close laboratory doors to contain the fire as you leave the laboratory area.
- C. Activate the fire alarm system as you exit to the stairwell. Fire alarm pull stations are generally located near stairwells.
- D. Evacuate to safe area after exiting through the stairwell.
- E. Contact the Radiation Safety Office Immediately.

INCIDENTS INVOLVING AIRBORNE RADIOACTIVE MATERIAL:

- A. Notify all personnel to vacate the room immediately.
- B. Shut down ventilation system, if possible, unless it is determined that the room ventilation system needs to be used to clear the air for access purposes.
- C. Vacate the room. Seal the area, if possible.
- D. Notify the RSO immediately.
- E. Ensure that all access doors to the area are closed and posted with radiation warning signs, or post guards (trained) at all access doors to prevent accidental opening of the doors or entry to the area.

- F. Survey all persons who could have possibly been contaminated. Decontaminate as directed by the RSO.
- G. Promptly report suspected inhalations and ingestions of licensed material to the RSO.
- H. Decontaminate the area only when advised and/or supervised by the RSO.
- I. Allow no one to return to work in the area unless approved by the RSO.
- J. Cooperate with the RSO and/or the RSO's staff (e.g., investigation of root cause, provision of requested bioassay samples).
- K. Follow the instructions of the RSO and/or the RSO's staff (e.g., decontamination techniques, surveys, provision and collection of bioassay samples, requested documentation).

DEFINING INCIDENTS OR EMERGENCIES:

The following may constitute an incident or emergency:

- A. Loss or theft of any radioactive material or radiation producing device.
- B. High or potentially high radiation exposure to an employee or member of the general public. For example:
  1. Greater than 1000 mrem whole-body in one month to an occupationally exposed individual;
  2. Greater than 10000 mrem in one month to the extremities of an occupationally exposed individual; or
  3. Greater than 100 mrem to any member of the general public.
- C. Intake of radioactive material by inhalation, ingestion, skin absorption, or injection through the skin or wound.
- D. Deceptive or potentially deceptive exposure of a dosimeter.
- E. Personnel contamination which cannot be removed after two washes with soap and water.
- F. Spills involving significant activities of  $^{125}\text{I}$  or  $^{131}\text{I}$  with the potential for inhalation.
- G. Removable contamination in unrestricted areas (e.g. hallways, offices, vehicles, etc.) which exceed 200 dpm/100 cm<sup>2</sup>.
- H. Radiation fields in unrestricted areas which exceed the limits specified for members of the general public of 2 mR/hr.
- I. Accidental or unmeasured releases of radioactive material to the environment.
- J. Fire or floods which threaten to release radioactive material to the environment or which threaten to expose emergency response personnel.

## RADIOACTIVE SPILL REPORT

The spill occurred at \_\_\_:\_\_\_ pm on \_\_\_/\_\_\_/\_\_\_ in room \_\_\_\_\_

Instrument used to check for contamination:

G.M. Meter model: \_\_\_\_\_ Serial #: \_\_\_\_\_

Wipe test counter used: \_\_\_\_\_ Serial #: \_\_\_\_\_

**Survey of the area of the spill:**

AREA OR PERSON SURVEYED:	GM METER SURVEY: mR/hr	WIPE TEST READING: DPM	COMMENTS

Report results of survey after cleaning; make sure to survey all material used in the cleanup including any personnel. Area is not considered clean until G.M. meter readings are below 0.2 mR/hr and wipe tests are below 200 dpm/100 cm<sup>2</sup>.

\* On the back of the sheet, indicate any personnel decontamination, additional monitoring, or care instituted.

\* Survey the spill area to identify hot spots, then begin decontamination. When finished, conduct a post cleaning contamination wipe-test.

\* Radioisotopes present or suspected in the spill:

\_\_\_\_\_ mCi of \_\_\_\_\_ as \_\_\_\_\_

\_\_\_\_\_ mCi of \_\_\_\_\_ as \_\_\_\_\_

\_\_\_\_\_ mCi of \_\_\_\_\_ as \_\_\_\_\_

Give a brief description of the accident:

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Give a brief description of follow up actions taken to prevent recurrence:

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

## CHAPTER 15

### ANIMAL HANDLING PROCEDURES

The Radiation Safety Office requires information for the authorization of projects involving the administration of radionuclides to animals. IACUC proposals are reviewed and approved by the Radiation Safety Office. The information required includes:

- The kind and number of animals to be used in the study (number per experiment and total number of experiments).
- The radionuclide (including chemical form and activity) to be administered per animal and how administered.
- The ultimate fate of the animal and suspected excretion rate of the radionuclide.
- Instructions for handling and monitoring of the animals and proposed method of disposal of the animal and excreta. These instructions shall be posted in the animal housing area prior to administering the radionuclide to the animals.
- The concentration (in units of microCi/g) of the radionuclide averaged over the entire weight of the live animal must be provided.
- The location(s) where the animals will be housed (building, room number).

#### *Specific Requirements for Animal Use*

Animals, bedding and excrement are to be collected as radioactive waste. Please see the animal section of the waste procedures in this manual for disposal information.

Cages and other potentially contaminated items are to be cleaned and checked for contamination at the end of each individual experiment. Acceptable levels for these items are less than 200 dpm/100 cm<sup>2</sup> removable contamination and background (~0.05 mrem/hr) when measured with a thin end window GM counter. Survey records are to be maintained by the Authorized User.

All cages or pens containing animals with radioactivity must be labeled with a "Caution: Radioactive Materials" sign. Outside doors to animal rooms in which radioactive material is present must be posted with a "Caution: Radioactive Materials" sign. The Radiation Safety Office's Emergency Procedures must be conspicuously posted near the animal cages. All animals containing radioactive materials shall be secured by the Authorized User and/or RRC.

## CHAPTER 16

### WASTE DISPOSAL

All waste generated in the research labs shall contact the Radiation Safety Office to be picked up for disposal. Labs shall not hold or dispose of any contaminated waste unless approved by the Radiation Safety Office on a case by case basis.

When radioactive waste is ready for pick-up, either complete an electronic radioactive waste pick-up disposal form found on the DEHS website, or contact the Radiation Safety Office. The lab personnel will be responsible for completing a hand written form describing the contents for the radiation safety worker retrieving the container. They may also call the Radiation Safety Office for assistance. Upon receipt of the pick-up request form, Radiation Safety will contact the lab to set up a time for pick-up. All radioactive waste must be labeled and shielded if required.

Waste will not be picked up by the RSO personnel for any of the following reasons:

1. The waste is not properly identified on the waste receipt form
2. Area was locked or no one was present to identify the waste to be taken
3. The liquids contain organic material and an approved container was not available to use for transport.

#### EXCEPTIONS TO THIS RULE:

*A lab may hold their waste for decay if it has been approved by the Radiation Safety Office on a case by case basis. This will only be approved based upon the half-life or location and the use of the material. Upon approval, the lab will have to hold waste for decay as per procedures listed below and have documentation of the waste being held that is kept for review during inspections. To get this approval and be trained on this procedure and documentation, contact the Radiation Safety Office.*

#### 1. Solid Waste.

1. Solid waste will be held for decay, disposed as deminimis as per 902 KAR 100:021 or transferred to an NRC or Agreement State or NRC licensed disposal service. All material transferred to another licensee will be shipped in accordance with applicable state or U.S. DOT regulations. Records of such transfers will be kept. The Hazardous Waste Room is (B 10) is located in the basement of B Building/Instructional building on the HSC campus. See Maps.
2. Solid waste (gloves, plastic, glassware, and paper) can be classified as “long half-life” (greater than or equal to 120 days). “Short half-life” (less than 120 days) or deminimis. Deminimis waste, as stated in 902 KAR 100:21-2 is: 0.05 microcurie or less of  $H^3$ ,  $C^{14}$ , or  $I^{125}$  per gram used for liquid scintillation counting or in -vitro clinical or in -vivo laboratory testing, and 0.05 microcurie or less of  $H^3$ ,  $C^{14}$ , or  $I^{125}$  per gram of animal tissue averaged over the weight of the entire animal.
3. Solid waste containers will be clearly marked with the “Radioactive Waste” stickers and radiation symbol on each side of the container.
4. All waste must be in clear plastic bags, and different nuclides must be stored separately. It must have a *Radioactive Waste Card* attached with the AU name, date, nuclide, chemical form, and amount of nuclide.
5. Deminimis waste: of  $H^3$ ,  $C^{14}$ , or  $I^{125}$  that is calculated to contain less than 0.05 uCi/gm of solid waste.

## **2. Liquid Waste**

1. No liquid radioactive waste will be released via the sanitary sewerage system by laboratories. Liquid waste consist of stock solution and liquid scintillation vials. Relatively small volumes (a few ml's) of aqueous liquid may be transferred onto absorbent material and dispose of per the solid waste procedures. Record, and date the activity of all disposal of liquid in the appropriate column on the *Radioactive Material Usage Record* form. When material is disposed, copies of this form must be sent to the RSO monthly.
2. Stock solution must be stored in separate containers per nuclide and the container must be compatible with the waste stored.
3. Liquid scintillation vials must be stored separately according to nuclide, and packaged in easily movable containers (i.e. the plastic, blue tubs).
4. Each bottle or container of liquid scintillation vials must have a Radioactive Waste Card attached with the authorized user name, date, nuclide, chemical form, and amount of nuclide.
5. All liquid must also be labeled as biodegradable or organic material.
6. Any liquid containing the organic material must be stored in plastic tubs labeled that are labeled as hazardous material.

### **Hold for Decay**

All waste will be held for decay in the Hazardous Waste Storage Room B -10 and (<120 day half-life) will be disposed of in the following manner.

1. Waste will be stored in containers that are shielded appropriately.
2. All waste will be held in a secured area where untrained personnel do not have access.
3. Waste will be held for 10 half- lives.
4. Waste will be surveyed with a suitably sensitive survey meter in a low background area (0.05 mR/hr) with no interposed shielding. No waste may be disposed in the regular trash unless it is at background levels.
5. When the above conditions are met, remove all radioactive markings or labels and dispose of the waste in regular trash.
6. Records of such disposals, including: date into storage, date to regular trash, survey instrument readings of the waste, the isotope being held, background, serial number of instrument and name of the person performing the survey are kept for review.

### **Deminimis**

According to 902 KAR 100:021 -2 sections 5 a & b,  $H^3$ ,  $C^{14}$ , and  $I^{125}$ , from in-vitro clinical or in-vivo laboratory testing, procedures may be disposed in the ordinary trash as long as it's specific activity is less than or equal to 0.05 microcuries per gram. All Deminimus waste is first collected by the RSO staff.

The RSO determines:

1. The specific activity of the waste mathematically or by radio assay of the waste.
2. Remove all radioactive labels or markings.
3. Dispose in the ordinary trash
4. Record the activity disposed in the radioactive material disposal record.

### **Animal Carcasses**

When using radioactivity in animals or animal carcasses, the authorized user must provide an auxiliary protocol to Radiation Safety for approval. This protocol must detail the kind and quantity of radioactivity to be used methods of disposal and contamination control. An "Animal Use Proposal Clearance Form" will be

provided by Research Resources, or can be obtained from Radiation Safety. Before this protocol is presented to Research Resources it must be approved and signed off by the Radiation Safety Office. All animals which have been given radioactive material should be isolated from animals that do not contain radioactive material. The cages which house the animals containing radioactive materials must be labeled with an appropriate radioactive materials warning sign. The cages must be locked, or otherwise secured unless attended. Surveys and contamination checks must be performed of the area which includes the bedding and animal housing.

### **Disposal summary for animal carcasses**

1. Animals receiving deminimus levels of radioactive material must be prepared for disposal as infectious waste and then brought to Radiation Safety for disposal.
2. If the radioactive material in the animals is not deminimis, but has a half life less than 120 days, the animal must be stored in the lab in an appropriate area for 10 half lives, labeled as infectious waste, then brought to Radiation Safety to be disposed.
3. A yellow *Radioactive Waste Card* must accompany all bags that will be taken by Radiation Safety.

### **Waste Pick-up**

When radioactive waste is ready for pick-up an electronic radioactive waste pick- up disposal form will be completed by the AU's office from the U of L web-site. They will also be responsible for completing a hand written form describing the contents for the radiation safety worker retrieving the container. They may also call the Radiation Safety Office for assistance. Upon receipt of the pick-up request form, Radiation Safety will contact the lab to set up a time for pick-up. A Radioactive Waste card must be attached to each bag or container before Radiation Safety will pick-up.

Waste will not be picked up by the RSO personnel for any of the following reasons:

- The waste is not properly identified on the waste receipt form
- Area was locked or no one was present to identify the waste to be taken
- The liquids contain organic material and an approved container was not available to use for transport.

## CHAPTER 17

### RADIOACTIVE MATERIAL TRANSFERS

#### On Campus Transfers

Any transfer of materials on campus between Authorized Users must be documented on the radioactive material inventory form provided by the Radiation Safety Office. The users transferring the materials must be authorized to use the radionuclides and they must stay within their possession limits. Any transfer of radioactive material between campuses will be the responsibility of DEHS.

#### Off Campus Transfers

Any shipment of radioactive material off campus from the University must be in full compliance with U.S. DOT, U.S. Nuclear Regulatory Commission and State of Kentucky requirements. Persons contemplating shipping radioactive materials should contact the Radiation Safety Office to assure compliance with the regulations. The Radiation Safety Office will have direct oversight over the shipping process.

Package radiation surveys, wipe tests and labeling are provided by the Radiation Safety Office as needed or required per Radiation Safety Office.

#### Requirements

- Shipments may be made only to persons who are licensed to receive radioactive materials and in accordance with procedures established by such persons.
- Prior to making a shipment of radioactive materials, a copy of the recipient's radioactive materials license must be on file in the Radiation Safety Office.
- All aspects of the shipment (container, packaging, labeling, surveys, shipping papers, etc.) must be in accordance with U.S. DOT requirements.

# CHAPTER 18

## RADIATION DETECTING EQUIPMENT QC

The Radiation Safety Office and research labs employ equipment to monitor contamination and external radiation levels. The most commonly used equipment is the GM meter. This requires annual calibration; the procedures is listed below. Any other equipment used will be maintained per manufacturer's recommendations; pulsar calibration is used a most equipment; procedures are listed below.

### Survey Meter Calibration Procedure

**1. PURPOSE:** To establish the procedures used for calibration and maintenance of radiation detection equipment at Uof L Radiation Safety Office (RSO).

**2. SCOPE:** This SOP is applicable to the RSO, Health Science Center, Uof L Hospital, and other parties requesting calibration or maintenance service of radiation detection equipment.

**3. REFERENCES:**

- A. 902 KAR 100:073
- B. NCRP Report 112.
- C. ANSI N323A-1997.
- D. Uof L Human Use Radiation Safety Manual.
- E. Uof L Radioactive Material User's Guide.
- F. Instrument manufacturer's individual equipment manuals.

**4. RESPONSIBILITIES:**

- A. The Assistant Radiation Safety Officer will:
  - 1) supervise the daily operation of the calibration and maintenance program.
  - 2) train RSO personnel in performance of this procedure.
- B. RSO personnel will:
  - 1) perform calibrations and recordkeeping IAW this procedure.
  - 2) insure uncalibrated and non-servicable instruments are removed from use; calibrated or repaired; and returned to service promptly.
- C. Instrument Owners will:
  - 1) become familiar with requirements of this procedure.
  - 2) provide timely access to survey equipment needing calibration or repair.

**5. PROCEDURE:**

- A. Pulser Calibration Procedure
- B. Cs-137 Range Calibration Procedure
- C. Utilization of Health Physics Assistant Database

## PULSER CALIBRATION OF COUNT RATE INSTRUMENTS

1. All information will be recorded on the following form, "Instrument Calibration Record– Count Rate".
2. Record the instrument type, serial#, probe type, calibration date, and the person calibrating.
3. Check the instrument high voltage and battery. Replace battery if necessary. Verify 'high voltage' is appropriate for the detector. Record the battery status and the high voltage.
4. If the instrument will be calibrated with the detector connected (it is preferable that the instrument be calibrated with the detector disconnected), record the instrument reading on its lowest normally used scale. This will be the background which will be subtracted from each reading.
5. If the detector will be calibrated with the detector disconnected verify that the instrument reads zero with no pulses applied. If the meter does not read zero adjust the meter face and record the initial and final readings.
6. Determine the input sensitivity using the following method:
  - a) Select the most sensitive amplitude range on the pulser
  - b) Set the pulse frequency to the midpoint of one of the counting ranges.
  - c) Observe the meter on the survey instrument.
  - d) Set the pulse amplitude to zero
  - e) Increase pulse amplitude, switching to next higher range if necessary, until the rate meter indicates a stable reading (i.e., further increases of pulse amplitude do not cause an increase in the meter reading). Now decrease the pulse height until the meter reading drops. Record this pulse height as the input sensitivity.
7. For calibration purposes set the pulse height to twice the input sensitivity of the detector. Record the pulse height, pulse polarity, pulser model#, and the pulser serial #.
8. All instruments will be calibrated at two points on each scale. The points shall be in the lower and upper third of the normally used span. If a range is not calibrated, note this on the instrument and on the instrument record. The instrument may then be used only on the calibrated ranges. (This is aimed at probes whose useful range is smaller than the range the instrument is capable of measuring).
9. If the detector does not automatically perform a dead time correction proceed to step 10. If the instrument performs a correction for detector dead time this will need to be compensated for at high count rates, otherwise a perfectly good instrument will appear to be over responding. The dead time correction becomes significant (>2%) at a count rate that depends on the dead time setting.

Dead time (usec)	Significant Count rate (cpm)
1	1,175,000
5	235,000
10	117,000
20	59,000
30	39,000
50	23,500
80	14,700
100	11,700
110	10,700
120	9,800
130	9,000

To compensate for dead time consult the appropriate instrument manual.

10. Apply a pulse rate appropriate for the calibration point. If the meter reading fluctuates, the meter reading will be defined as the center point of the needle movement, or in the case of digital meters, as the average of several meter readings. Record the meter range, the pulser reading (and if applicable, the desired reading) and the net meter reading (meter reading less background).
11. Repeat step 10 for each calibration point.
12. An instrument will be considered passing if it agrees to within +/- 10% of the pulser reading. If an instrument fails at any calibration point it will be removed from service until repaired or adjusted.
13. For GM probes, expose the detector to a radiation source. Verify the detector responds to the radiation. Indicate yes or no on "probe check" space on record sheet. If probe fails, meter will be removed from service until probe is repaired or replaced.
14. For NaI probes, expose the detector to a low energy gamma check source. Verify the detector responds to the radiation. Indicate yes or no on "probe check" space on record sheet. If probe fails, meter will be removed from service until probe is repaired or replaced.
15. Expose the probe to the instrument's dedicated check source (if available). Record the indicated value onto the calibration record. This will be used to verify daily operation by the user. If, during daily check, the reading varies by more than +/- 20% of the indicated value, the instrument will be removed from service until repaired or adjusted.
16. Factory calibrations will be evaluated on a case by case basis. If the calibration is judged to have been performed acceptably it will be accepted by Uof L RSO.
17. Probe efficiency will not be calculated until RSO acquires NIST traceable calibration source for mid range beta.

## **CALIBRATION OF DOSE RATE INSTRUMENTS**

1. All information will be recorded on the following form, "Instrument Calibration Record Dose Rate".
2. Record the instrument type, serial#, probe type, calibration date, and the person calibrating.
3. Check the instrument high voltage and battery. Replace battery if necessary. Verify high voltage is appropriate for the detector. Record the battery status and the high voltage.
4. Print a decay/output table for the Amersham Model 77302 calibration source, serial number S-706 [Cs137: 142.7 mCi, reference date 01-29-1990], for the week of calibration. The source certificate is kept on file at RSO.
5. Meters that have linear read dials two points on each scale on the meter to be calibrated are chosen for calibration checks. These points are generally approximately 1/3 from lower side of scale and 1/3 from upper side of scale. These points are found on the decay/output table, or as close as possible, and recorded on the calibration log sheet, as well as how far from the calibration source they occur in centimeters.
6. Meters with logarithmic readout several points on the scale are chosen. These points should cover the entire range of the meter from the lower decade to the upper decade. These points are found on the decay/output table, or as close as possible, and recorded on the calibration log sheet, as well as how far from the calibration source they occur in centimeters.
7. The meter and/or probe, as needed, is placed the correct distance from the calibration source, the sensor is placed so as to make the correct distance 1 centimeter inside of the detector. The detector is then raised to the correct height, center point of detector in line with center point of source output, using a lab ring stand and equipment clamp. Note distance from source is marked on calibration table in centimeters and height is verified using ruler kept with the calibration source.
8. Once the meter is at the predetermined distance from the calibration source, the source is unlocked and opened. The correct combination of attenuators is place in front of the output point to provide the desired reading for the calibration source for the scale being read; generally the lower point is read first followed by the upper point. The reading on the meter is checked to verify that it falls within + or – 10% of desired. If the reading is outside of the +or– 10% range the other point on the scale is checked and appropriate adjustments are made using the calibration controls for that scale. As adjustments are made the scale is checked at both the upper and lower point to gain the best result for both points. If it is not possible to bring the scale to within the 10% range but within +or– 20% a correction factor maybe calculated and applied. This information is then recorded on the calibration log sheet. Once a scale has been satisfactorily calibrated the next scale is checked and adjusted as needed. Calibration is generally conducted from the farthest point from the calibration source and moved in as needed. If it is not possible to bring any give scale to within the +or- 20% range that scale is listed as out of service and the meter it taken out of service pending repair and recalibration.
9. Once a meter has been successfully calibrated a calibration certificate is prepared for the meter with name of the user, the calibration date, date of next calibration, calibration source output @ 1 meter, the check source value and the name and title of the person performing the calibration. A small copy of this is attached to the meter and a full size copy is provided to the user for their records. Once this is done the meter is either returned to the lab or the lab is contacted to pick up their meter.

**References:**

This procedure has been prepared in accordance with the following documents;

“American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments” i.e. ANSI N323A-1997.

Radioactive Material User Guide, February 3, 1999, page 11, item 7.

University of Louisville Human Use Radiation Safety Manual, February 2, 1999, Appendix G.

**Attachments:**

“American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments” i.e. ANSI N323A-1997

Amersham Model 77302 142.7 mCi Cs-137 calibration source serial number S-706 reference date 01-29-1990, certificate.

Decay/Output Table for Cs-137 s/n S-706.

Instrument Calibration Log Sheet.

Instrument Constancy Check/Calibration Certificate.

U.S. Nuclear Regulatory Commission 35.61 Calibration of survey instruments.

Calibration Procedure.doc

## INSTRUMENT CONSTANCY CHECK

A battery check and an instrument constancy check must be conducted each time your survey instrument is to be used.

### CALIBRATION:

Calibration will be performed at two points in each scale used for radiation protection purposes. The two points will be approximately 1/3 and 2/3 of full scale. A survey instrument may be considered properly calibrated when the instrument for each point checked. Readings within plus or minus twenty percent are considered acceptable if a calibration chart, graph, or response factor is prepared, and attached to the instrument, and used to interpret readings to within plus or minus ten percent.

### BATTERY CHECK:

Turn the instrument scale to battery check, or push battery check button. The instrument needle should deflect to the area on the scale that says battery o.k. If the needle does not go to this area, replace the batteries.

### INSTRUMENT CONSTANCY CHECK

Turn the instrument scale switch to the appropriate scale.

Expose the sensitive area of the detector against the affixed or attached check source and observe the deflection of the meter. (The instrument needle should deflect upward and read approximately the same as the check source reading at time of calibration recorded on the calibration label.)

If the instrument does not conform to the battery and check source criteria, contact the Radiation Safety Office as the instrument may be in need of repair.

These operational checks are used to make certain your instrument is operating properly prior to and during the survey.

### EXAMPLE:

### SURVEY METER CALIBRATION

For	URSO		
	A-Bldg Room 106		
Meter	Inovision	Serial #	6100
Calibration Source	RANGE	Correction	Factors
Cs-137		Lower Half	Upper Half
Radiation Output	Auto 10% ±	O.K.	O.K.
27.95 mR/hr@1 meter	Ran ging 10% ±	O.K.	O.K.
Batteries	10% ±		
Batteries O.K.	10% ±		
Calibration Date	10% ±		
August 3, 2010			Radiation Safety DEHS
Re-Calib. Due Before	Patrick C Glisson RRPT	HSC	Rm 102, Commons Bldg,
August 3, 2011	Health Physicist Technologist	Louisville, KY 40202	
URSO6100			(502) 852-5231