RADIATION SAFETY MANUAL

UNIVERSITY OF KENTUCKY

POLICIES AND PROCEDURES
FOR AUTHORIZED USERS

TWELFTH EDITION

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ISSUED BY

UNIVERSITY OF KENTUCKY
RADIATION SAFETY COMMITTEE

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PREFACE

The University of Kentucky strives to provide a safe and healthful environment for all persons associated with the University, including faculty, staff, students, and visitors. Attainment of this goal requires the cooperation and commitment of all persons involved.

The University emphasizes safety education and training as the primary means of achieving this goal. The Radiation Safety Office, the department responsible for radiation safety functions within the University, provides training and performs periodic safety inspections. Department heads, faculty members, and supervisors are directly responsible for maintaining an atmosphere that promotes full compliance with University safety policies and procedures.

With regard to radiation safety matters, the Radiation Safety Committee, appointed by the President, establishes radiation policies and procedures for the University in accordance with requirements set forth by State and Federal regulatory agencies. Responsibility for ensuring compliance of these policies and procedures is the responsibility of the Radiation Safety Officer, who directs the Radiation Safety Office.

Essential elements of the University's radiation safety program are presented in this Radiation Safety Manual. The safety program has been carefully developed to assist all radiation users in utilizing the unique advantages of radiation sources while meeting their safety responsibilities in an efficient and non-intrusive manner. In addition, radiation safety philosophy and regulatory agency licenses include an objective of maintaining all exposures at levels as far below regulatory limits as can reasonably be achieved. The University strongly supports this "As Low As Reasonably Achievable" (ALARA) safety goal. The policies and procedures found in this manual were designed to promote the achievement of this goal.

In this era of increasing concern for occupational safety and for the environment, it is essential that all members of the University community become and remain thoroughly familiar with their responsibilities for compliance with health and safety regulations, including these radiation safety policies and procedures. Please study the contents of this manual. Know and practice these and all other safety rules. Thank you for your cooperation.

Chapter 1

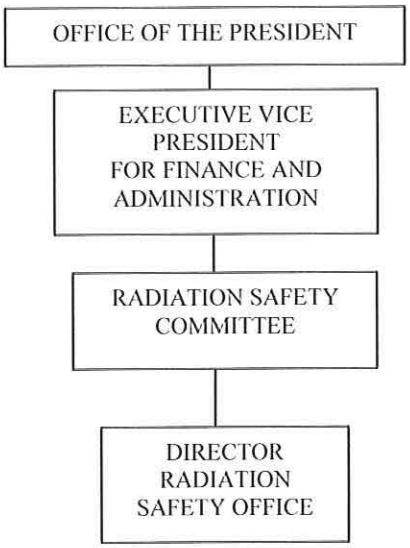
UK RADIATION SAFETY PROGRAM

Introduction

The University of Kentucky is authorized by the State of Kentucky's Cabinet for Health Services, Radiation Health Branch, to use radioactive material in operations, education, research and development activities. The University of Kentucky's Radiation Safety Committee authorizes individuals to use radioactive material. Prospective users must submit proposals to the Committee for review and approval. Although this provision allows the University great flexibility in dealing with the multitude of radioactive materials and research uses encountered on its various campuses, it places equally great responsibility on investigators and administration to handle radioactive materials safely and to comply with state regulations so that this flexibility may continue.

This manual summarizes the terms of the University's authorization and the regulations applicable to utilization of various radioactive material. A copy must be available in each Authorized User's facility where radioactive materials are used. Copies of special precautions, regulations, and other operating procedures specified by the Radiation Safety Committee or Radiation Safety Officer as a condition for approval of radioactive materials authorization must also be maintained and made available to laboratory personnel and Radiation Safety Office staff. As a general principle of radiation safety and a specific policy of the University, exposure to radiation should be maintained at levels that are as low as reasonably achievable (ALARA). Everyone involved with the use of radioactive material in any way is required to be familiar with the provisions of this manual. The manual must be readily available to all interested individuals.

Radiation Safety Organizational Chart



Radiation Safety Responsibilities

Radiation Safety Committee

The Radiation Safety Committee is responsible for establishing policies governing the procurement, use, storage and disposal of radioactive material and radiation producing devices. The Committee includes individuals experienced in the use of radioactive material in research and or clinical work at the University. The Committee consists of a Chairman, Radiation Safety Officer, representatives of management and nursing service, and four members each from the medical and main campus sectors. Committee duties include:

- Monitoring the institutional program to maintain occupational doses as low as reasonably achievable (ALARA).
- Reviewing and approving or disapproving an individual who is to be listed as the Radiation Safety Officer or Teletherapy Physicist before submitting a license application or requesting for amendment or renewal.
- Reviewing and approving or disapproving each proposed method of use of radioactive material.
- Reviewing and approving with the advice or consent of the Radiation Safety Officer and the management representative, or disapproving, procedures and radiation safety program changes prior to submittal to the State Radiation Control Branch for licensing action.
- Review non-compliance reports, including cause, corrective actions and action to prevent recurrence.
- Reviews quarterly, with the assistance of the Radiation Safety Officer, occupational radiation exposure records of personnel working with radioactive material.
- Reviewing quarterly, with the assistance of the Radiation Safety Officer, incidents involving radioactive material with respect to cause and subsequent actions taken.

- Reviewing annually, with the assistance of the Radiation Safety Officer, the radioactive material program.
- Establishing a table of occupational dose levels that, if exceeded, shall initiate investigations and considerations of action by the Radiation Safety Officer.

The Committee meets at least once each calendar quarter. The Committee, along with its Chair, is appointed by the President as a sub-committee of the Committee on Safety and Environmental Health, to which it provides reports at least annually.

Radiation Safety Officer

The Radiation Safety Officer has administrative responsibility for the University's radiation safety program. The Radiation Safety Office staff provides a wide range of specific radiation protection services such as personnel monitoring, waste disposal, laboratory surveys, maintenance of records required by the State, and consultation on the safe use of radioactive materials and training.

The Radiation Safety Officer is responsible for radiation protection at the University, including general surveillance of overall activities involving radioactive material and all areas where sources are used. He/she is also responsible for compliance with state regulations and license conditions.

All applications for radioactive materials use, as well as location, procedures, and possession limit changes, are reviewed by the Radiation Safety Officer. The Radiation Safety Officer recommends approval or disapproval (to the Radiation Safety Committee) of applications for the use of radioactive material. The Radiation Safety Officer may approve an increase in possession limit for radionuclides. He/she may suspend any project that is found to be a threat to health or property.

The Radiation Safety Officer is responsible for investigating overexposures, accidents, spills, losses, thefts, unauthorized receipts, uses, transfers, disposals, and other deviations from approved radiation safety practice, and implementing corrective actions as necessary. The Radiation Safety Officer is also responsible for implementing written policies and procedures for the following:

- authorizing the purchase of radioactive material
- receiving and opening packages of radioactive material
- storing radioactive material
- keeping an inventory record of radioactive material
- using radioactive material safely
- taking emergency action if control of radioactive material is released, spilled, or lost
- performing periodic radiation surveys
- performing checks of survey instruments and other safety equipment
- disposing of radioactive material
- training personnel who work in or frequent areas where radioactive material is used or stored
- keeping copies of records and reports required by state regulations

- assisting the Radiation Safety Committee in the performance of its duties

Authorized Users

An Authorized User is a faculty/staff employee who has been approved to use radioactive material by the Radiation Safety Committee. Authorized Users are responsible for ensuring that students and staff using radioactive materials under his/her authorization are trained in safe laboratory and or clinical practices, are familiar with the terms of the authorization and are complying with University policies and applicable regulations. The Radiation Safety Office offers periodic training sessions to assist the Authorized User in this regard. The Authorized User will normally be the principal investigator of a research project or the faculty member responsible for a course with laboratory or field exercises in which radioactive materials are used or a health practitioner. Although faculty members may use radioactive material under another faculty member's authorization, each faculty member is encouraged to obtain his/her own authorization.

Request for Special Safety Investigations

The Kentucky Administrative Radiation Regulations, 902 KAR 100, makes provisions for employees to request an inspection or evaluation of conditions which they believe may constitute a health or safety hazard. University employees are encouraged to report such conditions to the Radiation Safety Office and to request a "Special Investigation" into the need for corrective action. Employees are encouraged to seek resolution of a hazardous condition through the Radiation Safety Office. A person requesting an inspection may request confidentiality and by law, his/her name will not appear on any record or made available to the public, to his/her immediate supervisor, or department head. After the Radiation Safety Office has concluded its investigation, the results will be communicated, in writing, to the party requesting the investigation and to other appropriate University personnel with due consideration of requests for anonymity. If it is determined that there are reasonable grounds to believe that a violation or danger exists, corrective actions will be initiated. If corrective action cannot be implemented within a reasonable period, the Radiation Safety Officer may terminate the operations until corrective action is taken.

Kentucky Radiation Control regulations also protect employees against discrimination when an employee engages in protected activities. Protected activities include but are not limited to:

1. Providing the Cabinet for Health Services or his or her employer information about alleged violations or possible violations of the radiation safety regulations;
2. Refusing to engage in a practice made unlawful under the regulations, if the employee has identified the illegality to the employer;
3. Requesting the Cabinet to institute action against his or her employer for enforcement of the regulations;
4. Testifying in a Cabinet proceeding, or before Congress, or at a federal or state proceeding.

Chapter 2

RADIOACTIVE MATERIALS AUTHORIZATION

Procedure for Obtaining Authorization to Use Radiation Sources

To obtain authorization to procure and use radioactive material, a prospective Authorized User must complete an "Application for Authorization to Possess and Use Radioactive Material" (see application, Appendix A). The Radiation Safety Officer (or his/her designee) will review the application, evaluating the facilities available, the training and experience of the applicant and staff for the proposed use, and the details of the work to be performed. After the review, including any necessary modifications, the application will be forwarded to the appropriate Radiation Safety Committee with a recommendation for approval or disapproval. The application must be approved by a two-thirds majority vote.

The procedures approved in the application become the conditions under which the researcher and his/her personnel are authorized to use radioactive material. Any subsequent change in procedure regarding the use, storage or disposal of sources must be reviewed and approved in writing by the Radiation Safety Officer prior to instituting the change.

Facilities Evaluation

The review of radioactive material use applications will include an evaluation of the adequacy of the proposed facilities. Depending on the quantity of material involved, the type of source and the complexity of the proposed procedures, the following will be considered:

- isolation from general laboratories and public areas
- availability of radiation detection instrumentation
- adequacy of ventilation and fume hoods
- appropriate work surfaces and floors (non-porous)
- provisions for shielding and secure storage of sources

Amendments to User Authorization

An Authorized User must submit a new application (Appendix A) 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.

Radiation Worker Registration

In order for the University to have a record of the training and experience of persons working with radiation sources, all workers must complete a "Radiation Worker Registration Form"

(see Appendix B). The Radiation Safety Officer (or his/her designee) will review registration forms and schedule necessary training sessions. The Radiation Safety Office is to be informed of all changes in personnel working with radiation sources. An updated worker registration form must be provided when worker transfers, additions, or deletions occur.

Record Keeping

A copy of the approved worker registration form must be maintained in the Authorized User's radiation safety records. The original form is kept at the Radiation Safety Office. Forms must be maintained by the Authorized User and the Radiation Safety Office as long as the individual's employment actively involves use of radiation sources. Upon termination or transfer, the form may be archived or removed from the records after a two year time period has elapsed.

All records required for decommissioning by 902 KAR 100:040, Section 15, will be maintained by the UK Radiation Safety Office at 102 Dimock Building (Animal Pathology), University of Kentucky, Lexington, KY.

These records will include licensed material use and storage locations.

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.

Chapter 3

RADIATION PROTECTION PRINCIPLES

The body may be irradiated in two general ways: externally from radioactive material or radiation sources, or internally from radioactive material deposited in the body. External doses can be the result of exposure to gamma, X-ray, neutron, or high-energy beta emitters. Low-energy beta and alpha emitters lack the energy needed to penetrate the outer layer of skin and subsequently present less of an external hazard; they are of more concern when ingested. The external dose an individual receives depends on the following factors: exposure, time, distance, and shielding.

Exposure. The "strength" (activity, mrem/hr, etc.) of the radiation source. By reducing the amount of radioactive material used (lowering the current settings on a radiation-producing machine), dose can be reduced.

Time. The total dose received from an external source also depends on the amount of time actually exposed to the source. Therefore, any time that is spent near a source should be minimized and used effectively.

Distance. By increasing the distance between the source of exposure and an individual, the dose received can be significantly reduced. When an individual doubles his/her distance from a source, the dose will usually be reduced by approximately three-fourths.

Shielding. When radiation sources are being used, absorbing material or shields can be incorporated to reduce exposure levels. The specific shielding material and thickness is dependent on the amount and type of radiation involved.

Internal exposure results from the absorption, ingestion or inhalation of radioactive material. This material can be incorporated in the body in several ways: (1) by breathing radioactive gases, vapors or dust; (2) by consuming radioactive material transferred from contaminated hands, tobacco products, food or drink; (3) by entering through a wound; and (4) by absorption through the skin.

The fundamental objectives of radiation protection measures are: (1) to limit entry of radionuclides into the human body (via ingestion, inhalation, absorption, or through open wounds) to quantities as low as reasonably achievable and always within the established limits; and (2) to limit exposure to external radiation to levels that are within established dose limits and as far below these limits as is reasonably achievable.

Radiation Safety Rules

1. Eating, drinking, smoking, and the application of cosmetics are prohibited in a room where radioactive materials are used or stored.

2. Protective gloves shall be worn when handling contaminated or potentially contaminated items.

3. Pipetting radioactive solutions by mouth is prohibited.

4. Persons with open wounds should be particularly careful when working with radioactive materials (the wound should be properly covered).

5. Disposable absorbent pads and remote handling devices shall be utilized whenever possible.

6. Hands should be washed thoroughly after handling radioactive materials, especially before eating.

7. Food items shall not be stored in areas or equipment designated for radioactive materials.

8. Personnel monitoring badges shall be worn in restricted areas, as applicable.

9. Radioactive waste shall be kept in labeled containers.

10. Stock shipments shall be handled and stored in specially designated locations.

11. Good housekeeping shall be maintained at all times. Contamination/spills shall be cleaned up immediately.

12. Follow the established emergency procedures in the case of an accident.

13. Conduct radiation meter surveys after each use and wipe test surveys frequently (document at least monthly). When measurements are abnormal, find the cause and correct.

14. When using volatile radionuclides (e.g. iodine) or heating radioactive solutions, always perform work in a properly operating fume hood.

15. Transport radioactive materials in such a manner as to prevent spillage or breakage and ensure adequate shielding.

16. Label all containers of radioactive materials, including radionuclide, amount and date. All containers except those in immediate use must be labeled.

17. Utilize shielding when necessary to maintain radiation levels as low as reasonably achievable (ALARA).

18. Store radioactive material in locked cabinets/refrigerators or keep the laboratory door locked when lab personnel are not present.

Chapter 4

ACQUISITION OF RADIOACTIVE MATERIALS

Purchasing Radioactive Materials

When ordering radioactive materials, completed radionuclide order forms (Appendix C) should be sent directly to the Radiation Safety Office, 102 Animal Pathology Building 0076 (or fax to 3-4752). The Radiation Safety Office will place the order the same day if the request is received by 11:30 a.m. (if the approval requirements listed below are met). Orders received after 11:30 a.m. will be placed the next business day.

Radiation Safety Office Review

The Radiation Safety Office will review the order request to determine the following:

1. That the user has been authorized to use the type and quantity of radioactive material being ordered. The name of the Authorized User must be clearly indicated on the order.

2. That the radioactive material being ordered will not cause the Authorized User's inventory limits to be exceeded.

3. That the Authorized User has no unresolved items of safety noncompliance, including responses to survey reports and training notices.

4. That the Authorized User's radionuclide inventory reports are current.

When the above criteria are met, the order will be approved and placed. If the above criteria are not met, the Authorized User will be notified by telephone to expedite acquisition of the necessary information.

Receipt and Delivery of Orders

The Radiation Safety Office is open for receipt of radioactive material shipments 8:00 a.m. - 4:30 p.m., Monday - Friday, University holidays excepted. Upon receipt of a shipment the exterior of the package is checked for removable contamination and dose rate (as required by regulations), added to the Authorized User's inventory record and the package is delivered to the Authorized User's lab. If desired, a radiation worker from the lab may pick up a package at the Radiation Safety Office.

When ordering radioactive materials, completed radioisotope order forms (Appendix C) should be sent directly to the Radiation Safety Office, 102 Animal Pathology Building 0076 (or fax to 3-4752). The Radiation Safety Office will place the order the same day if the request is received by 11:30 a.m. (if the approval requirements listed below are met). Orders received after 11:30 a.m. will be placed the next business day.

Exceptions

Due to time constraints and variable patient needs, Nuclear Medicine normally orders and receives its radiopharmaceuticals directly. The Radiation Safety Office processes the invoices.

For similar reasons, Radiation Medicine (therapy services) directly orders its implant seeds. A copy of the order is sent (fax) to the Radiation Safety Office, which confirms the order, provides a purchase order number and receives the material. This exception currently applies only to I-125 seed orders.

Sealed Sources

Sealed, or encapsulated, sources of radioactive materials may be listed by specific reference in the University's radioactive materials license, which means that the license must be amended for each additional source. Application for authorization to possess and use a sealed source must be made using the application form (see Appendix A). The application will be reviewed by the Radiation Safety Officer and transmitted to the Radiation Safety Committee for its approval. After approval, the source(s) will be purchased as any other radioactive material.

Gas Chromatographs

Gas chromatographs using H-3 or Ni-63 foils in electron capture detectors must be equipped with a temperature limiting device and may need to be vented to a hood or air handling system which exhausts directly to the outside. Ni-63 sources will be leak-tested semi-annually by the Radiation Safety Office. The source holder must be labeled with the radiation symbol. These sources must be disposed of through the Radiation Safety Office. Any change in location or status of a gas chromatograph must be reported to the Radiation Safety Office.

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 and gas chromatographs. 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. Notify the Radiation Safety Office prior to any changes in the location of these instruments.

Chapter 5

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 Authorized User for at least three (3) years and be readily available for periodic review by Radiation Safety Office and/or regulatory personnel.

A seven-digit number called the ship code number is assigned to each radioactive item/vial logged in through the Radiation Safety Office. This number is physically attached to each radioactive source vial. The first two digits indicate the year the materials were received (02-----). The last five digits ascend sequentially for each shipment that is received during the year (0200033, 0200034, etc.). The ship code provides a unique means for identifying each item in a shipment.

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.

A total inventory for the Authorized User is available for the Authorized User to access via the Website http://ehsapp0.ad.uky.edu:1568 This website may also be accessed through the Radiation Safety Home Page http://ehs.uky.edu/radiation/ and by clicking on EHS Online Inventory. At appropriate intervals, each Authorized User shall access the Inventory Database and update it to reflect the current inventory of radionuclides in the lab.

The user can click on Inventory/Disposals to access the list of vials in their inventory. Each vial will be listed by its unique ship code on the report. The user may select each vial by clicking Select to review the activity in the vial.

The Authorized User must click the Mark As Reviewed radio button for each of the vials in their lab during the appropriate reporting period. This is required for each vial in the Authorized User's possession, whether the vial was used or not. The total number of vials in the database must match the number of vials in the Authorized User's possession.

If any aliquots have been removed from the vial, the Authorized User shall update the new activity in the vial by clicking the Add Disposal radio button for that vial. If they can estimate which waste stream the radionuclide was disposed, they may add estimates for Dry Solid, Liquid, etc. If not, then the total aliquot may be entered in the Adjustment field.

All entries are to be in Non-Decayed activity, i.e. percentage of original activity. The EHS Assist program will calculate total decayed activity for each vial.

The User shall use the Adding Disposal feature for each vial that has been used during the reporting period.

If the Authorized User no longer needs the vial, then they can dispose it according to RSO waste protocols, and click the ☐ Totally Disposed box and click Save. This will remove the vial from the Authorized User's list of vials, whether or not they add any disposals.

If the Authorized User has 'Zero' inventory, the program will not show any vials to review.

Chapter 6

LABORATORY PROTECTION POLICIES AND PROCEDURES

Prevention of the spread of contamination and minimizing radiation exposure is the responsibility of the Authorized User. The AU is also responsible for providing: (1) radiation detection equipment to monitor removable contamination and external radiation exposure levels as appropriate; and (2) appropriate laboratory safety equipment and supplies (shielding, gloves, fume hood, etc.).

Radiation Safety Office Surveys

Surveys will include measurements of external radiation levels near sources in use, storage, waste containers, etc. and of removable contamination by wipe testing. Both restricted areas (areas posted with radiation warning signs and labels) and adjacent unrestricted areas should be surveyed as applicable. Surveys will also include an examination of the presence and condition of warning signs, instructions and other necessary postings and a thorough review of the record keeping system.

Radiation Safety Office personnel will periodically (typically quarterly) inspect the laboratories of Authorized Users to monitor the lab's radiation safety program. Radiation exposure rates and removable contamination levels will be measured and record-keeping systems reviewed during the surveys. Each AU radiation safety inspection is recorded. A report of each inspection is routed to the Assistant RSO. The Assistant RSO reports significant findings to the AU, with a timetable for correction. If satisfactory correction is not achieved in a timely manner, the AU's radioactive material ordering privileges are terminated. Any situations that the Assistant RSO can not resolve are remanded to the RSO, and as necessary, to the UK Radiation Safety Committee.

The frequency of surveys will be determined by the quantity of radioactive material used, results of previous surveys, and general compliance with State regulations and University policies. Although the Radiation Safety Office inspections fulfill a need for supervisory overview, they do not provide adequate day-to-day information regarding the effectiveness of radiation control procedures used in the laboratory. Therefore, laboratory personnel must routinely monitor their laboratories when using radioactive material.

Authorized User Surveys

Formal Authorized User survey schedules will be established by the Radiation Safety Officer during application reviews. Unless otherwise instructed, the typical schedule will be to survey after each use. At least once per calendar month, a meter and or wipe test survey must be performed and documented. Removable contamination must be recorded in units of dpm/100 cm2. The Radiation Safety Officer may, according to particular conditions (such as quantities or types of materials used and an Authorized User's safety record), set radiation safety survey schedules specifically designed for named laboratories of Authorized Users.

Authorized Users are responsible for including the following items as part of the survey record:

- Diagram of area surveyed
- List of items and equipment surveyed
- Specific locations where wipe tests were taken
- Ambient radiation levels with appropriate units (mrem/hr)
- Contamination levels found with appropriate results (dpm/100 cm. sq.)
- Make and model number of survey instrument used
- Background levels (mrem/hr)
- Name of the person making the survey and recording the results, and date

Meter Surveys

When beta (except H-3, C-14 and S-35) and gamma emitters are used in the laboratory the Authorized User must conduct an instrument survey using a portable, handheld meter. The surveyor, instrument make, model number, serial number, calibration date, and readings must be recorded on the written survey report.

During the monthly Authorized User survey, recordskeeping, waste storage, security, and the overall laboratory radiation safety program should also be reviewed.

Wipe Tests

Wipe tests are performed by wiping the areas of interest with a filter paper disk and then determining the activity in a counter calibrated for the suspected radionuclide. Wipe tests are more sensitive than instrument surveys and should especially be used when instrument surveys indicate possible contamination. They are the only practicable method of monitoring for weakly penetrating beta emitters, such as H-3, C-14 and S-35. They should be used for all surveys conducted for the purpose of identifying and/or documenting removable contamination levels.

Radiation Levels

External radiation levels should be kept to less than 0.1 mrem/hr at contact with the source surface and to levels as low as reasonably achievable.

For most energetic beta and gamma emitters roentgen, rad, and rem may be said to be equivalent.

Removable Contamination

The Radiation Safety Office records removable contamination levels in terms of disintegrations per minute (dpm) per 100 square centimeters (standard areas to be covered by a "wipe"). Typical liquid scintillation counting efficiencies are 25 percent for H-3; 65 percent for C-14, S-35, and I-125; and 100 percent for P-32. The actual measurements need be recorded only for the required monthly survey. Laboratories may use these same counting efficiencies for wipes or use their own established efficiencies. The following actions are to be taken as a function of contamination levels:

Research Laboratories (Radiation Use Areas)	Actions
<1000 dpm/100 cm^2 beta/gamma <100 dpm/100 cm^2 alpha	Cleanup recommended to as low as practicable levels.
≥1000 dpm/100 cm^2 beta/gamma ≥100 dpm/100 cm^2 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.

Patient Rooms & General Use Areas	Actions
<200 dpm/100 cm^2	Record actual measurement for formal survey. Clean up recommended to as low as practicable levels.
≥200 dpm/100 cm^2	Record actual measurement for formal survey. Clean up to less than 200 dpm and as far below as practicable is required. **This is a non-compliance item.**

Nuclear Medicine - hot lab / clinic area	Actions
<2000 dpm/100 cm^2	Clean up recommended to as low as practicable levels.
≥2000 dpm/100 cm^2	Record actual measurements for formal survey. Clean up to less than 2000 dpm and as far below as practicable is required. **This is a non-compliance item.**

Training

The specifics of how to perform contamination and radiation surveys will be covered in the training sessions which all laboratory personnel and new Authorized Users are required to attend. During the first month following authorization of a new user, Radiation Safety Office personnel will assist, as requested, in establishing routine surveys that are required by conditions of the user's authorization.

The Radiation Safety Office provides a series of training courses. Initial training by the Radiation Safety Office and On-Site training by the AU enables all new employees to be registered and start work. The Basic course consists of a more extensive lecture or on-line segment for those with little previous training or experience. Radiation workers new to UK but with significant training and experience, including new faculty, will take an Advanced lecture or on-line course. The Radiation Safety Committee requires all radiation users to attend these classes. Topics include rules and regulations, general laboratory safety, physics and instrumentation, dosimetry, bio-effects, and emergency procedures. A short test will be given at the end of the Basic and Advanced courses, with a minimum passing grade of eighty percent.

Upon satisfactory completion of each course, a certificate will be issued.

Annual training by lecture, video or on-line, will be provided for ancillary personnel.

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 radionuclides utilized in the laboratory. A "laboratory area" may be one laboratory or a series of connecting laboratory spaces. Labs located on different floors or in different buildings each need their own meter. Authorized "low energy beta only" Users (H-3, C-14, S-35) are not required to have a survey meter.

Instruments must be calibrated annually. Calibrations will be performed by the Radiation Safety Office without charge. The Radiation Safety Office should be informed of the purchase of a new instrument or repair and factory calibration of an existing instrument.

Removal or Transfer of Laboratory Equipment

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

The acceptable surface contamination levels for uncontrolled release of equipment, and as far below as reasonably achievable, is established by the following Table (adopted from NRC Reg. Guide 8.23, Radiation Safety Surveys at Medical Institutions).

Acceptable Surface Contamination Levels for Uncontrolled Release of Equipment*

Nuclides	Average[b, c]	Maximum[b, d]	Removable[b, c]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm αa/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1,000 dpm $\beta\gamma$/100 cm^2

* Adapted from NRC Regulatory Guide 1.86.

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d] The maximum contamination level applies to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionately and the entire surface should be wiped.

Vacating Laboratory Spaces

The Radiation Safety Office must be informed of all changes in authorized laboratory spaces, including transfers or departures from the University and laboratory relocations. The Authorized User is responsible for surveying all spaces and equipment and proper removal of all radioactive waste and radioactive sources prior to the changes. Upon notification, the Radiation Safety Office will complete a final clearance survey of the authorized spaces. Only the Radiation Safety Office may remove radiation warning signs.

Sealed Source Leak Tests and Inventories

The Radiation Safety Office performs all sealed source leak tests. All beta/gamma and neutron sealed sources (greater than 100 microcuries) will be tested for leakage and inventoried at intervals not to exceed six months. All sealed sources (greater than 10 microcuries) designed for the purpose of emitting alpha particles will be tested at intervals not to exceed three months. Ni-63 foil sources (greater than 100 microcuries) will be tested at intervals not to exceed six months.

New Laboratory Setup

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

Posting and Labeling

The Radiation Safety Office is responsible for the posting of all radiation warning signs. Labeling equipment and lab supplies is the responsibility of the Authorized User. The "Notice To Employees" Form KR-441, and Emergency Procedures also must be posted by the user. A copy of the UK Radiation Safety Manual must be readily available. All doors accessing areas that contain radioactive materials must be posted. All refrigerators, freezers and other equipment which contain radioactive materials must be labeled with "Caution: Radioactive Material" signs or tape.

Any unattended container of radioactive material, such as beakers or flasks, must be labeled. A rack of radioactive test tubes should be labeled, but not necessarily each test tube. Common sense should prevail. Labeling prevents someone from unknowingly disturbing the materials or getting unnecessary exposure from them.

Eating, Drinking, Smoking and Cosmetic Application in the Laboratory

Eating, drinking, smoking and cosmetic application in any laboratory where radioactive materials are used is prohibited. This is in recognition of the potential inhalation and ingestion hazards and is consistent with good health physics practices.

Laboratory Control Measures

Time/Distance/Shielding

The principal objective of radiation protection is to ensure that the dose received by any individual is as low as reasonably achievable (ALARA), while not exceeding the maximum permissible limit. Any one, or a combination of, the following methods may achieve this objective:

Time. Limit the time of exposure. For illustrative purposes, a person entering a relatively high radiation field of 1000 millirems/hr, but for only a 30-second period, would receive a relatively low dose of 8 millirems. The maximum permissible whole body dose is 5000 millirems per calendar year for occupational workers.

Distance. The inverse square law states that radiation intensity from a point source varies inversely as the square of the distance from the source. The formula is:

$$\frac{I_1}{I_2} = \frac{(D_2)^2}{(D_1)^2}$$

where I_1, I_2 = intensities and D_1, D_2 = distances

Shielding. Most radionuclides used are relatively easy to shield, particularly the beta emitters. Utilize plastic or glass (approximately 3/8") to shield energetic beta emitters, such as P-32. Lead shielding is generally used to shield X-ray and gamma emitters. The Radiation Safety Office will assist laboratories in locating appropriate shielding.

Fume Hoods

To protect personnel from exposure to airborne radioactive material generated by laboratory procedures, a properly ventilated fume hood should be used. There are three procedures that specifically require the use of a fume hood:

- iodinations
- evaporations
- use of gaseous radioactive material

The most effective way to use the hood is to place your apparatus at least six inches inside the hood with the sash no higher than that needed to allow unobstructed use of your hands. Also, the sash bottom should be no higher than the mark that indicates an adequate airflow (A simple method for monitoring the airflow of a hood is to tape a strip of tissue paper to the bottom of the sash). If you have questions or doubts concerning the proper functioning of the

hood you intend to use for volatile radioactive experiments, call the Radiation Safety Office. Do not use a hood that is not working properly when handling such material. All UK fume hoods are inspected and face velocity measured annually by the UK Occupational Safety Department. Any hoods needing service are reported to the applicable Physical Plant shop. Each hood is posted with a notice which specifies the measured face velocity, date and person performing the inspection.

Few radioactive material procedures require the use of a hood, although hood use is recommended. This is more due to the well-confined workstation than ventilation protection. Annual hood inspections are believed to be adequate.

Personal Protective Measures

The use of personal protective equipment, such as laboratory coats, disposable gloves and respirators, can minimize contamination of personnel and thus keep radiation exposures low.

Protective Clothing

Wearing laboratory coats shall be worn to protect the user of radioactive materials against accidental skin exposure and possible absorption of the radionuclide. Decontamination of the skin can be difficult and uncomfortable.

Disposable Gloves

Disposable gloves shall be worn whenever working with radioactive material or else contaminated hands may result. Once a glove is contaminated, it should never come into contact with anything that is to be kept contamination free. Removal of the gloves before touching anything should always be the rule. Gloves should be removed from the inside out to prevent contaminating your hands during removal.

Respiratory Protection

The use of respirators is generally not necessary. A properly operating fume hood provides adequate protection for most procedures (such as iodinations and evaporations). Powdery radioactive materials should be handled in a glove box, negating any need for a respirator. Only operations involving potential room releases of radioactive materials, such as the changing of hood air filters, would require a respirator. No respirator-requiring activities should be conducted without approval of the Radiation Safety Officer. Users must be fit-tested and have an approved Respiratory Protection Program (contact UK Occupational Health and Safety).

Transporting Radioactive Materials (On Campus)

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

Security of Radioactive Materials

Radionuclides must be secured from the possibility of unauthorized removal during times when authorized laboratory personnel are not present. This may be accomplished by locking the door(s) to the laboratory and/or using locked cabinets or refrigerators.

Chapter 7

RADIOACTIVE WASTE GUIDELINES

Disposing of radioactive waste is a complex and expensive process. The Radiation Safety Office working with UK Environmental Management developed guidelines for handling and disposing of radioactive waste. The Radiation Safety Committee has approved these guidelines. The University has adopted a goal of waste minimization and must implement strategies to reduce the amount of radioactive waste that needs to be disposed of, using techniques such as waste segregation, compaction, and holding for decay. Universal cooperation is needed in order to ensure safety, comply with state regulations, reduce costs and minimize environmental hazards. Compliance will also help avoid regulatory penalties and possible loss of radioactive material use privileges.

Specific rules governing waste disposal are changing constantly; therefore, our waste procedures will be revised as needed. The current Radioactive Waste Guidelines are found in Appendix E.

Chapter 8

PERSONNEL EXPOSURE MONITORING

External Exposure

Personnel monitoring devices (film badges, thermoluminescent dosimeters (TLD), pocket dosimeters, etc.) are provided by the Radiation Safety Office to measure an individual's radiation exposure from gamma, neutron, energetic beta and X-ray sources. The standard monitoring device is a clip-on badge or ring badge bearing the individual assignee's name, date of the monitoring period and a unique identification number. The badges are provided, processed and reported through a commercial service company that meets current requirements of the National Institute of Standards and Technology National Voluntary Laboratory Accreditation Program (NVLAP).

Monitoring Requirements

Radiation protection regulations and UK policy require that appropriate personnel monitoring equipment be provided to individuals who:

- are likely to receive an annual radiation dose in excess of 10 percent of any of the following annual dose limits:
  - total effective dose equivalent of 5 rem, sum of the deep dose equivalent and the committed dose equivalent to an individual organ or tissue (other than the lens of the eye) being equal to 50 rem
  - eye dose equivalent of 15 rem
  - shallow dose equivalent of 50 rem to the skin or to an extremity
  - intake of the applicable annual limits of intake listed in Section 44 (9), Table 1, 902 KAR 100.

- are under 18 years of age and are likely to receive a radiation dose in any calendar quarter in excess of 1 percent of the doses listed above.

- are radiation workers and have declared a pregnancy or planned pregnancy.

- enter a High Radiation Area (exposure to greater than 100 millirems in any one hour).

- operate analytical x-ray devices (ring and whole body badges).

- meet special criteria as assessed by the Radiation Safety Officer or his/her delegated representative.

Procedures for Monitoring Devices (Badges)

Authorized Users must file a Radiation Worker Registration Form (Appendix B) for each individual who may work with radiation sources. This form provides for the basic information regarding training and experience and personnel monitoring needs. Initial personnel monitoring decisions will be based on this information. Further evaluations, and re-

evaluations, will be made through radiation employee registration updates, application reviews, personnel monitoring reports, ALARA investigations, surveys and individual interviews by responsible Radiation Safety staff members.

Badges are exchanged on a monthly or quarterly basis. Badges must be returned to the Radiation Safety Office by the tenth of the month (or start month of the new quarter) so that they may be properly processed.

Body badges are assigned to workers who use one (1) millicurie or more at any one time. Ring badges are assigned to workers who use one (1) millicurie or more of higher energy beta (P-32, Sr-90, etc.) or gamma 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) do not need badges or when quantities used at any one time are less than one (1) millicurie. 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 radiation dose histories from all past employers. The Radiation Safety Office will maintain all personnel occupational radiation 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.

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 University facilities.

Generally, whole body badges are to be worn between the waist and the neck. When a protective apron is worn, the badge is to be worn at the collar, outside the apron.

Extremity monitoring badges (rings) are available in large or small sizes for the right or left hand. Ring badges should be worn whenever working with applicable sources. When using radioactive materials, the ring monitoring element (label area) should be turned toward the palm. Gloves should be worn over the ring badge when contamination is possible.

The exposure of a personnel monitoring device to deceptively indicate a dose delivered to an individual by an x-ray device is prohibited by state regulations, KAR 100:105,2(g).

Personnel Monitoring Reports

Routine monitoring periods are currently monthly and quarterly. Each report includes the name, monitoring period date, dose (millirems) for the immediate past period, current calendar quarter and calendar year.

The personnel monitoring reports are on file in the Radiation Safety Office. They are available for all badged employees to review. The reports are considered medical records; therefore, individual's exposures are not released except with written consent.

UK Pregnant Employee - Fetal Dose Policy

The UK 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 a pregnancy is confirmed. The declaration of pregnancy is voluntary, but it must be made in writing. The University is then obliged to take steps to ensure that the occupational radiation dose received by the embryo/fetus does not exceed the limit specified by State and Federal regulations of 500 millirem for the remainder of the gestation period. In addition the National Council on Radiation Protection and Measurements (NCRP) recommends that the dose for any one month during the pregnancy not exceed 50 millirem. The University policy includes this NCRP recommendation on the monthly limit as well as the stated regulatory limit for the gestation period.

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 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.

ALARA Notifications

The Radiation Safety Committee may adopt different, higher ALARA levels for some specific job functions.

Part of Body	Notification Level I (millirem per month)	Notification Level II (millirem per month)
Whole body (head, trunk), gonads, upper arms or legs	125	375
Lens of the eye	375	1125
Skin of whole body; extremities (hand, elbow, lower arms or legs, foot, knee)	1250	3750
Embryo-fetus	20	30

Overexposure

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 Kentucky Radiation Control Branch.

Internal Exposure

Bioassay Program

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. Our bioassay program provides the necessary personnel monitoring to measure operational or accidental uptakes 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 failures 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 results 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 personnel monitoring needs and frequency, makes 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.

Routine bioassay monitoring will be conducted when any individual is working with radionuclide form/activity combinations exceeding established limits. "Working with" includes withdrawing an aliquot from a stock supply which itself exceeds a limit, even though the activity actually used is below the bioassay limit.

Notification Requirements

Before utilizing tritium or radioiodine in excess of quantities listed in the following section, radiation workers shall contact the Radiation Safety Office so that baseline bioassays may be established. Radiation workers must also notify the Radiation Safety Office whenever tritium or radioactive iodine is used in excess of quantities listed in the following section.

Tritium (H-3). Urinalysis is required within 24 hours, if possible, but not later than 72 hours after working with 100 millicuries or more of tritiated water or tritium compounds. This is the total quantity of tritium used in any one month period.

Iodine (I-125, I-131). An external thyroid bioassay by external counting is required within 24 hours, if possible, but not later than 72 hours after working with the following limits or greater:

- processes in open room or bench with possible escape of iodine from process vessels: a) 1 mCi, if volatile form and b) 10 mCi, if bound to nonvolatile agent
- processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability: a) 10 mCi, if volatile form and b) 100 mCi, if bound to nonvolatile agent
- processes carried out within gloveboxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage: (a) 100 mCi, if volatile form and (b) 1000 mCi, if bound to nonvolatile agent

NOTE: Quantities may apply to the cumulative amount handled during a 3-month period.

Other Radionuclides. Urinalysis is required within 24 hours, if possible, but not later than 72 hours following potential ingestion, inhalation, or skin contamination of personnel. Baseline bioassays will be conducted for anyone who may use 10 mCi or more of radioactivity in a gaseous or volatile form. Additional urinalysis or external organ counting may be conducted, depending on the biological attributes of a specific radionuclide.

Analysis and Recordskeeping

Standard methods for bioassay evaluations are normally sufficient to measure body or organ uptakes of radionuclides to a small fraction of a maximum permissible body burden. An outside laboratory specializing in bioassay services will be used for any analysis requiring extraordinary equipment or procedures. Bioassay results will be recorded and maintained as part of the radiation worker's overall personnel monitoring history.

Chapter 9

NUCLEAR GAUGES

Nuclear gauge design incorporates operator safety as a prime consideration. However, as with any device containing radioactive materials, some general precautions must be observed.

Moisture/Density Gauges

- Do not operate or attempt to operate the instrument unless you have been trained and authorized to do so. Personnel are required to have attended a Nuclear Regulatory Commission approved training course before operating any nuclear gauge.

- While radiation exposure levels are low due to shielding in storage and during proper use, never expose yourself to the source except as necessary in routine operation or emergency situations. Maintain exposure as low as reasonably achievable (ALARA).

- Keep all unauthorized persons out of the operation area. A suggested distance is 5 meters (15 feet).

- Maintain security of the instrument at all times. The instrument must be kept in a locked vehicle or room when not in use. Not only is the gauge an expensive piece of equipment but, if lost or stolen, a potentially hazardous situation to the general public could be created.

- The gauge shall be transported only by an approved operator. During transportation, the gauge shall be packaged in its shipping-storage container, secured and locked in the closed vehicle. The emergency telephone number, a copy of UK Radiation Emergency Procedures, and a completed bill of lading shall accompany the gauge. The shipping container shall meet U.S. DOT Type A specifications. The container shall be inspected prior to each shipment to ensure it is physically sound.

- When not in use, the gauge must be stored in a locked room approved by the Radiation Safety Office. The room must be posted with UK Radiation Emergency Procedures, a State of Kentucky Form KR-441 "Notice to Employees", and a "Caution: Radioactive Materials" sign. The Type A package used in transportation of the source shall be locked and labeled with the appropriate DOT label, a reportable quantities designation if applicable, and be accompanied with a document indicating the results of the latest sealed source leak test.

- Authorized Users shall wear an appropriate radiation badge, which will be supplied by the Radiation Safety Office.

- No maintenance will be performed by the moisture/density gauge users that involve removal of the source rod unless a procedure for the maintenance has been approved by the RSO.

- Moisture/density gauge(s) will not be stored overnight at temporary job site(s) unless procedures for doing so are approved by the RSO.

- If the instrument is damaged in any manner, or fails to function properly, contact the Radiation Safety Officer immediately (after hours through the University Police at 911).

Leak tests and an inventory of each gauge shall perform every 6 months by the Radiation Safety Office.

Fixed Gauges

- Authorized Users shall follow manufacturers training, maintenance and operating procedures.

- The shutter on-off system on fixed nuclear gauges will be checked at the frequency required by the manufacturer.

- Security for the gauges shall be maintained by the Authorized User, and shutters and collimators shall be kept in the closed position unless in use.

- Leak tests and an inventory of each gauge shall be performed every 6 months by the Radiation Safety Office.

Chapter 10

AUTHORIZED USER RECORDS AND REQUIRED NOTIFICATIONS

Under the terms of the University's authorizations to use radioactive materials, the Radiation Safety Office is charged with maintaining control of all radioactive materials on the campus. To facilitate this oversight and to ensure that a high awareness of the rules and regulations governing the safe use of radioactive materials is maintained, it is required that certain records and reference materials be maintained by the Authorized User. The Authorized User is required to keep the records current and to make them readily available to laboratory workers, the Radiation Safety Office, and the Kentucky Cabinet of Health Services. It is recommended that a notebook be maintained with the required information. Records are to be maintained by the Authorized User for a period of three (3) years unless advised otherwise.

Copies of the following shall be available in the laboratory:

- radiation and contamination surveys performed by the Authorized User
- radiation worker training certificates

Copies of the following shall be available from the Authorized User:

- authorization to use radioactive materials and attachments
- radiation worker registration forms
- the University's current Radiation Safety Manual

The following incidents shall be reported to the Radiation Safety Office immediately:

- contamination of personnel
- the ingestion, inhalation, or any internal deposition of radionuclides
- a lost or missing radioactive source (including waste)
- radioactive spills involving 10 or more microcuries (uCi's)
- a laboratory accident (fire, explosion, etc.) which may result in the release or breach of security of radioactive materials

Chapter 11

TRANSFER OF RADIOACTIVE MATERIALS

On Campus Transfers

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

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 work with the Radiation Safety Office to assure compliance with the regulations.

Package radiation surveys, wipe tests and labeling are provided by the Radiation Safety Office. A limited supply of Type A shipping containers, required labels and shipping papers is available. One day notice to ship is preferable; the package must be received by 11:30 a.m. the day of shipment in order to be processed the same day.

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 12

ALARA PROGRAM

The University is committed to minimizing radiation exposure to all persons associated with the University. Therefore, the As Low As Reasonably Achievable (ALARA) philosophy is adopted as policy for the University. The Radiation Safety Committee, with the Radiation Safety Officer as its delegated representative, will develop and implement policies and procedures to ensure radiation exposures are ALARA.

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.

- 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 13

ANIMAL HANDLING PROCEDURES

The Radiation Safety Office requires information for the authorization of projects involving the administration of radionuclides to animals. 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 uCi's/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^2 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.

Division of Laboratory Animal Resources (DLAR) must be notified of the need for cages to be used in studies with radionuclides. Contact DLAR for assistance.

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 DLAR.

Chapter 14

USE OF RADIONUCLIDES IN THE HEALING ARTS

Purpose

This chapter provides physicians and other health care providers policies and procedures regarding the safe acquisition, use and disposal of radioactive materials. These policies and procedures for human use are approved by the University's Radiation Safety Committee under the University's Broad Medical License issued by the KY Cabinet for Health Services. Since most requirements are very specifically stated in the state regulations, the reader is referred to the State's Radioactive Material Regulations, 902 KAR 100:072. Policies and procedures specific to the University of Kentucky are contained in this chapter.

Authorization of Physicians to Administer Radionuclides

A physician must submit an "Application For Authorization to Possess and Use Radioactive Materials" (see Appendix A) to the Radiation Safety Office. The Radiation Safety Officer will review the application, evaluate the facilities available, the training of the physician, and the details of the procedures to be performed. Training requirements are provided in the State's Radioactive Material Regulations, 902 KAR 72, Sections 65-78.

After the review, including any necessary modifications, the application will be forwarded to the Radiation Safety Committee. The application must be approved by a two-thirds majority vote.

The procedures described in the application, as modified by the Radiation Safety Officer and/or the Radiation Safety Committee, become the conditions under which the applicant is authorized to use radioactive materials. Any subsequent change in procedure regarding the use, storage or disposal of materials must be reviewed and approved in writing by the Radiation Safety Officer prior to instituting the change(s).

Procurement of Radioactive Materials

To procure radioactive material for human use, a Nuclear Medicine physician and/or Radiation Oncologist must be authorized by the Radiation Safety Committee to possess and administer radioactive materials. The physician, Nuclear Medicine technologist and/or the Radiation Medicine physicist should submit orders for radionuclides to the Radiation Safety Office. Inventory records for these materials must be submitted monthly to the Radiation Safety Office.

A written radionuclide order form will be submitted by the requesting department (if possible place order one day prior to the day it is needed). A disposition sheet will be maintained by the ordering department for all radionuclides to be administered. Upon administration of the

radionuclide the completed disposition sheet will be returned to the Radiation Safety Office for record keeping.

Radionuclides utilized by Nuclear Medicine will primarily be received and processed by a Nuclear Medicine technologist. All personnel involved in the receipt and processing of radioactive material shipments must be instructed in the proper procedures and safety precautions. Survey and wipe results must be documented and forwarded to the Radiation Safety Office for record keeping. There are some exceptions for delivery due to licensing requirements for specific vendors. These packages are delivered to the Radiation Safety Office and are received, processed and delivered by the Radiation Safety Office.

All radionuclides for Radiation Medicine are received and processed at the Radiation Safety Office (except I-125 seeds). For disposal of sealed sources contact the Radiation Safety Office.

Waste Procedures

Radioactive waste disposal is expensive and must be done in accordance with many rules and regulations. In order to assure safety, save money and reduce the amount of waste handling, the following guidelines must be followed.

Excreta from patients undergoing medical diagnosis or therapy is exempt from radioactive waste regulations and may be disposed of via the sanitary sewerage system. Waste that contains 0.05 microcuries or less of C-14, H-3, or I-125 per gram of medium and has been used for liquid scintillation counting or in-vitro clinical or in-vivo laboratory testing is exempt from radioactive waste regulations.

Non-exempt radioactive waste products are to be separated into biohazardous waste and non-biohazardous waste. Biohazardous waste shall be placed in an appropriate container displaying a biohazard symbol, as well as a radioactive material symbol. Biohazardous, radioactive waste shall be further segregated into waste that can be stored at room temperature and perishable waste that must be stored in a freezer. Radionuclides with a half-life ≤120 days will be held for decay and disposed of by the Radiation Safety Office after an appropriate survey. Radionuclides with a half-life >120 days will be disposed of at a licensed radioactive waste site.

Waste from diagnostic studies shall be stored in appropriate (labeled, shielded) receptacles in patient areas until transfer to radioactive waste storage rooms. Waste from patient therapies shall be handled as to minimize any contamination of other objects or personnel. Reusable items that become contaminated shall be held for decay or decontaminated to a level of <200 dpm/100cm^2 before they can be released for unrestricted use.

In order to have a waste container picked up by Radiation Safety, a complete Online Waste Ticket must be generated. This Online ticket may be found at the Radiation Safety home page, http://ehs.uky.edu/radiation/ or http://ehs.uky.edu/radiation/wasteticket.php

All pertinent fields including User Information, Isotope and Activity, Waste type, container type and size, and liquid pH and constituents must be documented on the ticket.
The User then clicks the 'Submit' radio button and is prompted to print the ticket. The User must put the ticket printout on the waste container to indicate which container is being picked up.

Non-perishable items shall be held until final disposition by the Radiation Safety Office. Food and other perishable items shall be held frozen until final disposition.

Accurate tracking of waste radionuclides is required by regulations. Waste generators (departments) are responsible for the proper preparation and segregation of waste, and for the accuracy of the reporting data on the waste ticket. Departments are responsible for the security of radioactive waste until it is transferred to the Radiation Safety Office.

Chapter 15

EMERGENCY PROCEDURES

In any radiation emergency, personnel protection and emergency medical care have priority over radioactive decontamination of the building and equipment. For all cases, the Radiation Safety Office (phone # 669-6084, # 229-2228, # 338-7787 or campus 911 after hours) must be notified as soon as possible. However, the emergency may demand other immediate action by those on the scene before this can be done. It is impossible to draw up a set of specific rules and procedures that would cover each eventuality. Therefore, the following paragraphs present a set of general guidelines that all radiation workers should study, remember and implement as circumstances and common sense dictate.

It is further hoped that radioactive material users will develop a safety-oriented attitude that actively anticipates potential hazards and accidents with an eye towards prevention as well as a predisposition to appropriate response to the unexpected. The Authorized User should be prepared for minor spills and reasonably anticipated emergencies. He/she can prearrange to have on hand specific equipment and supplies uniquely required by her/his operation to minimize hazards and enhance recovery.

Serious Injury with Radiation Exposure or Contamination

If personnel have received high radiation exposure or radioactive contamination in addition to physical injury requiring immediate medical assistance, call Campus Police (911). When emergency personnel arrive, inform them that the patient might be contaminated or exposed to radiation.

Someone familiar with the incident should accompany the injured to provide information, such as the nature of the injuries, radiation levels, the physical and chemical nature of the contamination, etc. Also, follow instructions for Major Radioactive Spills below.

Fire or Explosion in a Radionuclide Area

In case of fire or explosion, call Campus Police (911). If possible, stay on the scene to acquaint emergency personnel with the nature of the radiation hazards present and to assist them as required. Also, follow instructions for Major Radioactive Spills below.

High Radiation Exposure Without Contamination

In case of an overexposure, do what can be done to terminate or limit the exposure and to prevent others from being exposed. The individual must report to the University Hospital for examination. Notify the Radiation Safety Officer and assist in collecting data to estimate the nature and extent of the exposure.

Major Radioactive Spills

In case of an accident involving contamination of personnel, the following steps should be taken in the order listed.

Personnel Protection

1. If hazard is extreme (high radiation level or suspect air contamination), evacuate the area immediately; close and lock the door.
2. Remove contaminated clothing and wash contaminated parts of the body thoroughly with detergent.
3. Contact the Radiation Safety Office (323-6777), after hours Campus 911.
4. Warn fellow workers of the spill hazard and keep others out of the area.

Contamination Control

1. Localize and control area of spill. Place absorbent material over a liquid spill.
2. Do not track contamination out of the spill area, if possible. Remove shoes at the edge of contaminated area if they may be contaminated.
3. If contamination is widespread outside the laboratory, it may be necessary to call Campus Police (911) to assist in securing the area.
4. Check all objects and clothing for contamination before leaving the area.

Minor Radiation Spills

A minor spill does not involve contamination of personnel, is generally less than 100 microcuries and does not involve airborne contamination. The following steps should be taken in the order listed:

1. Warn fellow workers of the spill hazard and keep others out of the area.

2. Place absorbent material over a liquid spill.

3. Be careful not to track contamination out of the spill area. Remove shoes at the edge of the contaminated area. Use disposable gloves to prevent contamination of the hands and to prevent cross-contamination.

4. Check all objects and clothing for contamination before leaving the area.

5. Call the Radiation Safety Office if assistance is needed.

Decontamination Procedures

Abortive attempts at decontamination can make things much worse. Unless immediate action is demanded to safeguard personnel, decontamination should be done under the supervision of Radiation Safety Office personnel.

Laboratory personnel are normally required to perform the major portion of the decontamination. Radiation Safety personnel will determine the procedures and equipment to be used and will render assistance as necessary.

All personnel and areas involved must be monitored to assure adequate decontamination before normal work is resumed.

University of Kentucky Radiation Safety Manual Revision

Revision Date	Description	Revised By:
06/14/2018	Revision to address the new/revised Radiation Safety Worker Forms	Radiation Safety Committee

Approval

Name	Title	Signature	Date
William St. Clair	RSC Chairman	William St Clair	7/25/2018
Gerald Schlenker	Director, Radiation Safety	Gerald Schlenker	7/23/18

APPENDIX A

Obtaining Authorization to Use Radioactive Material

The "Application for Authorization to Possess and Use Radioactive Material", RSO-1 is to be used when applying for use of radioactive sealed and unsealed sources, use of material in animals or humans. It must be completed in full and all pertinent documentation attached to be considered for review by the Radiation Safety Committee. This includes a response to each item in section 9 under the radioactive material use category. In addition, a curricula vita (resume) and Radiation Worker Registration form is needed for the Authorized User and a Radiation Worker Registration form for each of his/her research staff.

Provide the information about yourself in section 1. It is important that you provide a telephone number where we may reach you during the day. Section 2 is self-explanatory. In section 3, name the room(s) and building(s) where you will be using and storing radioactive material. List all radionuclides to be used and the pertinent information in section 4. Total quantities means total amounts you may have on hand at any one time. The maximum quantities per experiment are the largest amount you would use when conducting an experiment. If the radioactive material is in a hazardous form, document that in section 5. In section 6 check off all safety precautions to be used in your research. See the radiation safety website for suggested safety precautions. Describe waste disposal procedures in section 7. In section 8 describe the methods and procedures for ensuring that radioactive material will be secured from unauthorized access.

Please note that you must complete the appropriate category in section 9 for each radionuclide. For example, if you are working with tritium and P-32 in an unsealed form, you will respond to items 1 through 7 in category B for both tritium and P-32. However, in some cases the response may be the same.
If you have any questions regarding the application, feel free to contact the Radiation Safety Office. We will be glad to answer questions and set up a meeting with you to go over the application prior to submittal for approval.

Upon completing the form with attachments send five (5) copies of the document to the Radiation Safety Office, 102 Animal Pathology Building, Speed Sort 0076.
Applications will be processed within four weeks and the applicant notified of the results.* If the authorization is for a new user, the Authorized User will be contacted by the Radiation Safety Office to schedule an initial inspection of the laboratory prior to use of material.

*Note: More time may be required to process the application if information is missing.

University of Kentucky
Application for Authorization to Possess and Use Radioactive Materials

INSTRUCTIONS: Complete (please type) and forward five copies of all information to the Radiation Safety Office, Room 102 Dimock Building, Speed Sort 0076. A copy of the application with a designated authorization number will be returned to the authorization user when approved by the Radiation Safety Committee.

Authorized User:

Name:	UK Title:	Building & Room:
Department:	Tel. No., Office: Lab:	E-mail Address:

2. Project title: _____

3. Building/Room # where material will be located for:

Use:	Material Storage:
Waste Storage:	

4. List radionuclides and limits (Item 9 requires handling procedures for **each** radionuclide):

Radionuclide	Half-life	Total Quantity (mCi)	Max. Amount per Experiment (mCi)	Chemical Form

5. Is the material to be obtained or used in especially hazardous form? (e.g. carcinogen, highly toxic) No: ____ Yes: ____
If yes, please explain: _____

_____

6. Radiation Protection: Check special equipment to be used to control radiation exposure:

Protective Gloves: ____	Lab coat: ____	Eye Protection: _____	Mechanical Pipettes: _____
Shielding: Lead: _____ Lucite: _____	Shielded storage: ____	Fume hood: ____	Absorbent liner & Tray: ____
Radiation signs & labels: ____	GM survey meter: ____	Handling tools: ____	Transport Container: ____
Shoe covers: ____	Liquid scintillation counter:	Gamma well counter:	Ion chamber: ____

7. Waste Disposal: Check the appropriate item(s). Describe all waste streams. Include information on any hazardous materials- biohazards, carcinogens, toxic chemicals, etc.*

	Solid	
	Aqueous	
	Organic	
	Animal	

8. Describe the method/procedure to be taken for ensuring radioactive material is **secure against unauthorized access**:

_____

_____

9. Please check the type of application below and submit a separate paper describing the use of the radioactive material by supplying the requested information.

A. Use as a sealed source: ____

Rationale for experiment
Description of experimental technique
Description of sealed source; chemical form and type of seal (single or double seal).
Describe handling procedures for each radioactive source listed in section 4.
Describe storage area and when applicable describe any containers to be used in transporting the source.
Describe radiation monitoring equipment; including methods and frequency of surveys.

B. Use in unsealed applications: ____

Give a brief rationale of experiment
Provide a description of experimental techniques, especially those phases of the experimental procedures where handling of radioactive material is involved. This should be provided for each radionuclide listed in section 4.
Indicate those steps in the experimental procedure where loss of radioactive material is possible and describe the measures to be taken to control contamination.
List precautions to be taken to eliminate contamination of the personnel such as the use of protective clothing and gloves. Also describe the use of any special shielding devices to be used to limit personnel exposure.
Describe material and waste storage area.
Describe radiation monitoring equipment; including methods and frequency of contamination surveys.

C. Use as on ionization source for an electron capture detector in gas chromatography: ____

Describe the type of analysis to be performed.
Describe any operating limits to be imposed on the system to prevent loss of radioactive material.
Describe the system used for discharging the effluent of the apparatus to controlled ventilation such as a fume hood.
If you plan to perform source cleaning operations and/or install new sources, describe the procedure and list the precautions to be taken to control contamination and to limit exposure to personnel.

* Note: Please refer to the Radiation Safety Manual for the proper guidelines for the segregation and consolidation of waste.

D. Use in animal studies: ____

Answer all the questions in either A or B, depending on whether the radioactive material is sealed or unsealed.
How (and where) will animals be housed.
Provide the concentration (in units of uCi/gram) of the radionuclide averaged over the entire weight of the live animal.
Describe the kind and number of animals to be used in the study.
Describe the radionuclide (including activity) to be administered per animal and how administered.
The ultimate fate of the animal and suspected excretion rate of the radionuclide
Describe handling and monitoring of the animals and proposed method of disposal of the animal(s) and excreta.

E. Human Use: ____

Purpose for conducting study.
State whether human use is considered routine or non-routine. Include the research protocol for non-routine use.
Give the plan of investigation in sufficient detail to permit a critical evaluation of the radionuclide methodology to be employed and the radiation safety controls to be established.
Describe the human subjects. Include their statement of consent.
Give the quantity of radioactive material to be administered (in millicuries).
Calculation of radiation dose.
Give a statement on the adequacy of the physical facilities and equipment for supporting the proposed study.
Provide the qualification of the individuals responsible for the study.
Estimated time needed for completion of the study.
Schedule for reporting the results of the study.

I affirm that the foregoing facts are correct to the best of my knowledge and that I shall conduct and/or supervise the described work with full regard for the safety of those engaged in the work and of the general public. I have received a copy of the Radiation Safety Manual for the University of Kentucky and understand that I am to abide by the policies and procedures contained therein.

Upon terminating my authorization and prior to departing the University, I agree to contact the Radiation Safety Office to arrange for the close out of my laboratory and the disposal of radioactive material and waste.

Applicant: _____(PLEASE PRINT)

Signed:_____ Date: _____

APPENDIX B

Obtaining Radiation Badges

Personnel monitoring devices (film badges, thermoluminescent dosimeters (TLD), pocket dosimeters, etc.) are issued by the Radiation Safety Office to measure an individual's exposure to radiation. A personnel monitoring device is issued only upon the completion of a "Radiation Worker Registration" form and completing the **On-Site** and **Initial** training requirements.

Additional radiation safety training provided by the Radiation Safety Office will be required as soon as possible, but no less than 1 month upon filing a "Radiation Worker Registration" form.

Badges are not needed by individuals working solely with low energy beta emitters (H-3, C-14, S-35, Ca-45) or when quantities used at any one time are less than one (1) millicurie. Body badges are assigned to workers who use one (1) or more millicurie at any one time of higher energy beta, a gamma emitter or x-ray device. Ring badges are issued to individuals in Nuclear Medicine and Radiation Medicine and individuals working with one (1) millicurie or more of higher energy beta, gamma emitters or x-ray devices. They may also be required for other uses of radioactive material or radiation producing devices.

The Radiation Safety Officer may require the use of pocket dosimeters, ring badges, or other monitoring devices when particular procedures are in operation.

Monitoring Requirements

Radiation protection regulations and UK policy require that appropriate personnel monitoring equipment be provided to individuals who:

* are likely to receive an annual radiation dose in excess of 10 percent of any of the following annual dose limits:

  - total effective dose equivalent of 5 rem
  - sum of the deep dose equivalent and the committed dose equivalent to an individual organ or tissue (other than the lens of the eye) being equal to 50 rem
  - eye dose equivalent of 15 rem
  - shallow dose equivalent of 50 rem to the skin or to an extremity
  - intake of the applicable Annual Limits of Intake listed in Section 44(9), table 1, 902 KAR 100.

* are under 18 years of age and are likely to receive a radiation dose in excess of 1 percent of the occupational exposure listed above.

* are radiation workers and have declared a pregnancy or planned pregnancy.

Office Use Only

Wear Date _____

Spare Badge # _____

Binary # _____

PARTICIPANT NUMBER

APPENDIX B

UNIVERSITY OF KENTUCKY
RADIATION WORKER REGISTRATION FORM

LAST NAME	FIRST NAME	MI	SEX	SOC. SEC. NO.	BIRTH DATE

UK ID	LINK BLUE	DEPARTMENT	ROOM #	BUILDING

WORK PHONE	START DATE	PREVIOUS AUTHORIZED USER (S) AT UK

RADIATION SOURCES

TYPE OF TRAINING	WHERE TRAINED Date	DURATION OF TRAINING	ON THE JOB (circle one)		FORMAL COURSE (circle one)	
Principles and practices of radiation protection			YES	NO	YES	NO
Radioactivity measurement standardization and monitoring techniques and instruments			YES	NO	YES	NO
Mathematics and calculations basic to the use and measurement of radioactivity			YES	NO	YES	NO
Biological effects of radiation			YES	NO	YES	NO

PREVIOUS EXPERIENCE WITH RADIATION

RADIOACTIVE MATERIALS	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DATES OF USE	TYPE OF USE

☐ I HAVE HAD *NO* PREVIOUS OCCUPATIONAL EXPOSURE

☐ I HAVE HAD PREVIOUS OCCUPATIONAL EXPOSURE (COMPLETE EXPOSURE HISTORY BELOW)

NAME & ADDRESS OF EMPLOYER(S	DATES EMPLOYED

To (last employer): _____ You are hereby authorized to furnish the University of Kentucky all available information concerning my radiation exposure history. I was associated with your organization from: _____ to _____

Radiation Worker Signature _____ Date _____

AUTHORIZED USER (PRINT)	AUTHORIZED USER (SIGNATURE)	DATE

LAST NAME FIRST NAME MI SEX SOC. SEC. NO. BIRTH DATE

DEPARTMENT BUILDING/PAVILION ROOM # WORK PHONE START DATE

WORKER TYPE:
(Circle One) Physician Nurse Technician/Technologist Support Staff Student Other

UK ID# _____ LINK Blue Account _____

Sub-Group	UKHC Sub-Group Description	CHECK One
A11	ANESTHESIOLOGY	
C2	CARDIAC CATH LAB	
D1	DENTISTRY (College of Dentistry, OMS, FPC, Periodontics, Turfland Clinic, Dan Martin Clinic)	
E01	ENTERPRISE QUALITY & SAFETY	
E2	ENDOSCOPY	
G3	GAMMA KNIFE	
G5	GI / GASTROENTEROLOGY (Internal Medicine)	
M4	MARKEY NURSING (Markey Cancer Center)	
O2	OPERATING ROOM / PERIOPERATIVE SERVICES (Chandler Medical Center)	
OP4	ORTHOPAEDIC SURGERY RESIDENTS (Kentucky Clinic)	
PCC	PAIN CARE CLINIC / PAIN CARE SERVICES (Kentucky Clinic South)	
P15	PULMONARY, CRITICAL CARE & SLEEP MEDICINE	
R1	RADIATION MEDICINE	
R4	CSD(Communication Sciences & Disorders), VS (Voice Swallow), BC (Comprehensive Breast Care Ctr)	
R7	SATELLITE CLINICS (Morehead Cancer Clinic, Polk Dalton Clinic)	
SUR	SURGERY / PERIOPERATIVE SERVICES (Good Samaritan Hospital)	
S02	NEUROSURGERY (Neurological Surgery)	
S1	STRESS LAB – SPECIAL DIAGNOSTIC (Gill Heart Institute)	
S3	SURGERY (General Surgery & Orthopaedic Surgery)	
S4	CAS / CENTER FOR ADVANCED SURGERY (Gill Heart Institute)	
U	UROLOGY (Kentucky Clinic)	
OTHER	List Working Location --	

UNIVERSITY OF KENTUCKY MEDICAL ENTERPRISE
RADIATION WORKER REGISTRATION FORM

In order to receive a dosimeter/badge, the sub-group must be marked by the department to ensure proper assignment and delivery

☐ I HAVE HAD ***NO*** PREVIOUS OCCUPATIONAL EXPOSURE

☐ I HAVE HAD PREVIOUS OCCUPATIONAL EXPOSURE (COMPLETE EXPOSURE HISTORY BELOW)

NAME & ADDRESS OF EMPLOYER(S)	DATES EMPLOYED

To (last employer): _____ You are hereby authorized to furnish the University of Kentucky all available information concerning my radiation exposure history. I was associated with your organization from: _____ to _____

Radiation Worker Signature _____ Date _____

MANAGER/SUPERVISOR NAME (PRINT) MANAGER/SUPERVISOR NAME (SIGNATURE) DATE

MANAGER/SUPERVISOR PHONE #

Office Use Only

	UK		GS		EHS
	QTR		MTH		

Wear Date _____

Spare Badge # _____

Spare Ring# _____

Sub Account _____

PARTICIPANT NUMBER

Initial Training
Monday – Friday @ 1:30 p.m.
Radiation Safety Office
102 Dimock/Animal Pathology Bldg
859-323-6777

Required Forms: (Signed by Supervisor)
**X-Ray Worker Registration Form*
**Onsite Training Form*

UNIVERSITY OF KENTUCKY MEDICAL ENTERPRISE
RADIATION WORKER REGISTRATION FORM

LAST NAME FIRST NAME MI SEX SOC. SEC. NO. BIRTHDATE

DEPARTMENT BUILDING/PAVILION ROOM # WORK PHONE START DATE

UK ID #_____ LINK BLUE ACCOUNT #_____

Circle one that applies

Med Student MD RN Resident Support Staff Technologist

☐ I HAVE HAD NO PREVIOUS OCCUPATIONAL EXPOSURE

☐ I HAVE HAD PREVIOUS OCCUPATIONAL EXPOSURE (COMPLETE EXPOSURE HISTORY BELOW)

NAME & ADDRESS OF EMPLOYER(S) DATES EMPLOYED

To (last employer): _____ You are hereby authorized to furnish the University of Kentucky all available information concerning my radiation exposure history. I was associated with your organization from: _____ to _____.

Radiation Worker Signature Date

Office Use Only
UK GS EHS

QTR MTH

Wear Date _____
Spare Badge # _____
Spare Ring# _____
Sub Account _____
PARTICIPANT NUMBER

Initial Training
Monday – Friday @ 1:30p.m.
Radiation Safety Office
102 Dimock/Animal Pathology Bldg
859-323-6777

Required Forms: (Signed by Supervisor)
**X-Ray Worker Registration Form*
**Onsite Training Form*

In order to receive a dosimeter/badge, the sub group must be marked by the department to ensure proper assignment and delivery PLEASE COMPLETE REVERSE SIDE OF THIS FORM

APPENDIX C
PURCHASING RADIOACTIVE MATERIALS

The Radiation Safety Office must order, receive and process all radioactive material shipments. This includes purchases, replacements, gifts and samples of material.

When ordering radioactive materials, completed radionuclide order forms (Appendix C) must be delivered, faxed (3-4752) or emailed (tdcays1@email.uky.edu) to the Radiation Safety Office, 102 Animal Pathology Building, 0076, The Radiation Safety Office will place the order the same day if the request is received by 11:30 A.M. (if the approval requirements listed below are met). Orders received after 11:30 A.M. will be placed the next business day.

Complete the top portion of the order form. The following **MUST** be provided:

Supplier	Department
Catalog Number	Authorized User
Quantity, in mCi	Phone Number
Radionuclide(s)	Account Number
Chemical Form (Compound)	Signature

Radiation Safety Office Review

The Radiation Safety Office will review the order request to determine the following:

1. That the user has been authorized to use the type and quantity of radioactive material being ordered. The name of the Authorized User must be clearly indicated on the order.
2. That the radioactive material being ordered will not cause the Authorized User's inventory limits to be exceeded.
3. That the Authorized User is in full safety noncompliance, including responses to survey reports and training notices.
4. That the Authorized User's radionuclide inventory reports are current.

When the above criteria are met, the order will be approved and placed. If the above criteria are not met, the Authorized User will be notified by telephone to expedite acquisition of the necessary information.

Receipt and Delivery of Orders

The Radiation Safety Office is open for receipt of radioactive materials shipments 8:00 A.M. - 4:30 P.M., Monday - Friday, University holidays excepted. Packages are processed and monitored (as required by regulations), added to the Authorized User's inventory record and delivered to the lab, normally by 2:30 P.M., on the day of receipt.

APPENDIX C

UNIVERSITY OF KENTUCKY
RADIATION SAFETY OFFICE

RADIOISOTOPE ORDER FORM

DATE _____ SHIPCODE NUMBER _____

Preferred Supplier _____ Department Catalog _____
Number _____ Authorized User _____
Quantity in mCi _____ Person Making Request _____
Element and Isotope _____ Phone Number _____
Chemical Form _____ Delivery Location _____
Assay Date _____ Amount in Possession _____
Lot number _____ Account Number _____
Other Specifications Cost _____
_____ Signed By _____

The purchased radioactive material is only to be ordered, purchased and used per the UK AU's Radiation Safety Committee approved authorized protocol.

****

1. **Condition of Package:** _____OK _____ Punctured _____ Crushed _____Wet _____Other

2. **Transport Index** (as read on package label) _____mrem/hr Measured Transport Index _____mem/hr @ 1 meter

   Measured Radiation Units _____ (surface mrem/hr) Meter SN _____ Bkg., mrem/hr _____

3. **Confirm Packing Slip/ Vial Content/ Package Label Agreement above.** _____ Yes _____ No

4. **Wipe Results (DOT labeled packages):**

LSC Results:	Outer	Inner	dpm / cm^2

RHT (initials) _____

****

Date Order Placed _____ Date Received _____

By _____ Supplier _____ Via _____

P.O. Number _____ _____

Invoice Number _____ _____

To Be Shipped/Delivered _____ _____

Revised: April 11, 2013

APPENDIX E

RADIOACTIVE WASTE GUIDELINES

WASTE PROCEDURES

Labeled waste containers, plastic liners and radioactive labels may be obtained by contacting the Radiation Safety Office, unless otherwise indicated below. Use the following procedures for all radioactive waste. As with all radioactive materials, contaminated waste must be secured from unauthorized removal. Always contact the Radiation Safety Office if you have any questions.

A. Solids

Solid waste containers will be provided in two primary sizes: 10 and 32 gallons. Liquids shall not be placed in solid waste containers. Relatively small volumes (a few ml's) of aqueous liquid may be transferred onto absorbent material and placed in an appropriate solid radioactive waste container. Do not use this technique for organic solvents; flammable materials must never be placed in solid waste containers. Lead must not be placed in solid waste containers; it must be picked up separately. Segregate solid waste according to radionuclide half-life, as follows:

- ≤120 days
- >120 days
- transuranics elements (atomic numbers greater than 92)

For solid waste which will be held for decay (i.e., radionuclides with half-lives ≤ 120 days), remove or deface all radiation labels before placing materials in waste containers. Additionally, solid waste shall be handled as follows.

1. All glass pipettes and broken glassware must be placed in a cardboard box, lined with a clear plastic bag. When full, secure the box with the lid closed (please use tape) and place it into a 10 or 32 gallon "general labware" waste container of the same radioisotope category. The Radiation Safety Office can provide boxes and liners.

2. General labware - Paper, plastic (including plastic pipettes), gloves, unbroken glassware, etc. must be placed in 10 or 32 gallon containers, lined with a clear plastic bag.

3. Biohazards - As a general rule, if you generate waste that is both radioactive and biohazardous, you should contact both the Biosafety Officer and the Radiation Safety Officer for proper handling procedures. Prior to pickup by the Radiation Safety Office, any solid waste contaminated with potentially infectious material must be sterilized. Do not place radioactive biohazard material in "red bags" unless the radioactivity is in exempt quantities. Red bags are only to be used for materials that are to be incinerated. Sharps (needles and syringes, scalpels, etc.) must be placed in special sharps containers and properly labeled; contact the Radiation Safety Office for handling. "Clinical waste" that contains only H-3, C-14, or I-125 in concentrations <0.05 uCi/gram is not regulated as radioactive waste and may be disposed of as medical waste.

B. Liquids

All liquid waste must be stored in labeled containers that are compatible with the waste materials. Contact UK Environmental Management for questions about compatibility. The Radiation Safety Office can provide 5 gallon plastic carboys for aqueous waste. Liquid wastes must not contain solids; such as pipette tips, gels, or filters. Liquid waste should be segregated into the following categories.

1. Water soluble, biodegradable, non-hazardous aqueous liquids

Any liquid radioactive waste released via the sanitary sewerage system must be water soluble, biodegradable, non-hazardous liquids.

a. Liquids containing less than 10 uCi may be poured down the sewer system in quantities not to exceed 10 uCi total per Authorized User per day. These disposals must be made only at designated, posted sinks or other release points. Records must be kept of all these disposals (in uCi) and the information must be provided to the Radiation Safety Office on a monthly basis. The intent of this permission is to dispose of small quantities of radioactivity contained in large volumes of fluid (>1 liter). Examples of such solutions are rinse water and buffer solutions. Radioactive liquids discharged to the sanitary sewer should be flushed with large amounts of running water. Liquid waste contaminated with plutonium or hazardous chemical constituents may not be poured down the sewer system.

b. Liquids containing greater than 10 uCi will be picked up by the Radiation Safety Office for disposal. If the radionuclides have half-lives ≤ 120 days, the waste may be held for decay in the laboratory and then disposed of into the sanitary sewer system (as described above) after it has decayed to 10 uCi or less.

c. Liquids containing biohazards must be sterilized (by autoclave or chemical methods) prior to pick up by the Radiation Safety Office. Contact the Radiation Safety Officer for specific approval. Segregate waste according to isotope and half-life, as follows:

- H-3, C-14, or I-125 in concentrations <0.05 uCi/gram of waste
- half-life ≤ 120 days
- half-life > 120 days

2. Hazardous liquids (mixed waste)

Waste that is hazardous and radioactive is called mixed waste. This waste is not permitted to be poured into the sewer system (this includes biodegradable scintillation fluid). All mixed waste will be picked up and disposed of by UK Environmental Management. The total mixed and hazardous waste in a laboratory cannot exceed 55 gallons.

Mixed waste containers must comply with all the rules for radioactive waste and hazardous waste (e.g., must have a "Hazardous Waste" label, date the container is full, list of the contents, etc.). The Hazardous Materials Management Office will provide containers for scintillation vials (30 or 55 gallon drums). Labs generating very few vials may be provided 10-gallon waste receptacles. Containers for bulk liquid mixed waste are not provided. Mixed waste must be segregated into scintillation fluid waste or non-scintillation fluid waste.

a. Scintillation fluids - Segregate scintillation fluids into transuranics and non-transuranics. Normal, flammable cocktail (flash point less than 140_F) and "biodegradable" cocktail should be combined. Use of biodegradable fluid is encouraged, as it minimizes the amount of flammable liquid in the laboratory, but it still must be treated as hazardous. The fluid may be in vials or in bulk form.

Vial Drums - Proper packaging for vials drums (30 or 55 gallons) is as follows:

1) place a 4-mil clear liner in the drum;
2) pour approximately 4 inches of absorbent material inside the liner;

3) place a second 4 mil clear liner inside the first liner in drum; and
4) fill inner container with vials (caps must be tightly fastened).

The top must be kept on the drum at all times, except when filling with vials. Leave a few inches of room at the top so that the waste technician may properly close the drum. Note: Do not place absorbent or other waste in with vials. Our waste vendor requires this packaging method. If a smaller container is utilized, follow the above directions.

Bulk Liquids - Bulk scintillation fluids must be placed into appropriate containers. The recommended containers are 1-gallon glass jars with screw tops. Do not mix bulk scintillation fluid with non-scintillation radioactive waste or with other hazardous fluids.

b. Non-scintillation fluids - The production of this waste is strongly discouraged by the Radiation Safety Office. They are extremely expensive to dispose of and, in some cases, impossible. Some examples of difficult wastes are radioactive materials mixed with any:

- flammable liquids (e.g., xylene)
- corrosive liquids (pH less than 2 or greater than 2.5)
- reactives (e.g., peroxides)
- toxics (e.g., mercury)

The Radiation Safety Office and UK Environmental Management shall be contacted prior to producing any of this type of waste to see if it is banned and, if not, to determine proper handling procedures. Laboratory procedures may have to be altered to render the materials non-hazardous (for example, by neutralizing acids or destroying peroxides).

c. Animals, Animal Excrement and Bedding

Unless exempt (see below), all animal waste contaminated with radioactivity must be picked up by the Radiation Safety Office, including carcasses, excrement and bedding. Animals must be kept separate from excrement and bedding. The Authorized User should have freezer space to adequately store animals for a minimum of 90 days. If space is not available, contact the Radiation Safety Office prior to generating animal waste.

Animal waste must be placed in a clear, 4 mil plastic bag prior to pick up by the Radiation Safety Office. Freeze animals in an elongated position to facilitate packing into a drum. Authorized Users are responsible for insuring that the frozen carcasses will fit into 30-gallon drums. Animal waste shall be segregated according to radionuclide half-life and concentration:

- H-3, C-14, or I-125 in concentrations ≤0.05 uCi/gram, averaged over the initial weight of the animal (This material is not regulated as radioactive waste and may be treated as normal animal waste.)
- half-lives ≤120 days or I-125 in concentrations >0.05 uCi/gram
- half-lives >120 days or H-3 or C-14 in concentrations > 0.05 uCi/gram
- transuranics

WASTE PICK UP

In order to have a waste container picked up by Radiation Safety, a complete Online Waste Ticket must be generated. This Online ticket may be found at the Radiation Safety home page:
http://ehs.uky.edu/radiation/ or http://ehs.uky.edu/radiation/wasteticket.php

All pertinent fields including User Information, Isotope and Activity, Waste type, container type and size, and liquid pH and constituents must be documented on the ticket.
The User then clicks the 'Submit' radio button and is prompted to print the ticket. The User must put the ticket printout on the waste container to indicate which container is being picked up.
Use a separate ticket for each container.

List all constituents of liquid waste, such as xylene, benzene and methanol, and the percent of each. Record a pH measurement on the aqueous portion of any waste. Describe any chemical or biological hazards present in the waste. Mixed waste must follow all procedures required for hazardous waste. The following will help in completing the waste forms:

1. Dry waste - indicate container size (in gallons) and total activity of each radionuclide.

2. Aqueous waste (generally carboys) - indicate volume (in gallons) and total activity of each radionuclide.

3. Liquid scintillation vials - indicate container size (in gallons), approximate number of vials, and total activity of each radionuclide.

4. Animal/biological - indicate approximate volume, radionuclide(s), and total activity per gram averaged over the initial weight of the animal(s).

SHARED ROOMS FOR RADIOACTIVE WASTE CONTAINERS

Because of safety and regulatory problems, the practice of shared waste containers is strongly discouraged. Use of shared containers requires pre-approval. The Radiation Safety Office can approve shared use upon application and review. Mixed waste (e.g., scintillation vials) will also require approval by UK Environmental Management. Approval will require one Authorized User to take responsibility for the container and its contents and may be terminated if the specific requirements below are not met.

- all Authorized Users must be specifically approved for use of the room
- the room must be posted and locked when unattended
- each Authorized User is responsible for conducting and documenting at least monthly surveys and wipes of the area (one designated individual may perform this function, but copies must be kept by all Authorized Users involved)
- waste records must be kept by each Authorized User
- when the container is full, a radioactive waste ticket must be filled out for each Authorized User.

APPENDIX F

RADIATION GLOSSARY

These selected definitions are provided by the State of Kentucky's Radioactive Material Regulations, 902 KAR 100:010, Section 1. The complete section of regulations is available at the Radiation Safety Office.

"Annual limit on intake (ALI)" means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of five (5) rems (0.05 Sv) or a committed dose equivalent of fifty (50) rems (five-tenths (0.5) Sv) to an individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in 902 KAR 100:019, Section 44, Table 1, Columns 1 and 2.)

"As low as reasonably achievable (ALARA)" means making every reasonable effort to maintain exposures to radiation as far below the dose limits in 902 KAR 100:019 as practical, consistent with the purpose for which the licensed activity is undertaken. ALARA shall take into account the state of technology, the economics of improvement in relation to benefits to the public health and safety, and other societal and socio-economic considerations, in relation to the utilization of nuclear energy and radioactive materials in the public interest.

"Curie" means a quantity of radioactivity. One (1) curie (Ci) is that quantity of radioactive material which decays at the rate of 3.7×10^{10} disintegrations per second (dps). Commonly used submultiples of the curie are the millicurie and the microcurie. One (1) millicurie (mCi) = 0.001 curie = 3.7×10^{7} dps. One (1) microcurie (uCi) = 0.000001 curie = 3.7×10^{4} dps.

"Exposure" means being exposed to ionizing radiation or to radioactive material.

"Extremity" means hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

"High radiation area" means an area, accessible to individuals, in which radiation levels may result in an individual receiving a dose equivalent in excess of one-tenth (0.1) rem (1 mSv) in one (1) hour at thirty (30) centimeters from the radiation source or from a surface that the radiation penetrates.

"Human use" means the internal or external administration of radiation or radioactive materials to human beings.

"Medical Event" means the administration of radioactive material or radiation from radioactive material results in:

(a) A dose that differs from the prescribed dose or dose that would have resulted from the prescribed dosage by more than 0.05 Sv (5 rem) effective dose equivalent, five-tenths (0.5) Sv (50 rem) to an organ or tissue, or five-tenths (0.5) Sv (50 rem) shallow dose equivalent to the skin and:
1. The total dose delivered differs from the prescribed dose by twenty (20) percent or more;
2. The total dosage delivered differs from the prescribed dosage by twenty (20) percent or more or falls outside the prescribed dosage range; or
3. The fractionated dose delivered differs from the prescribed dose, for a single fraction, by fifty (50) percent or more.

(b) A dose that exceeds 0.05 Sv (5 rem) effective dose equivalent, five-tenths (0.5) Sv (50 rem) to an organ or tissue, or five-tenths (0.5) Sv (50 rem) shallow dose equivalent to the skin from any of the following:
1. An administration of a wrong radioactive drug containing radioactive material;
2. An administration of a radioactive drug containing radioactive material by the wrong route of administration;
3. An administration of a dose or dosage to the wrong individual or human research subject;
4. An administration of a dose or dosage delivered by the wrong mode of treatment; or
5. A leaking sealed source.

(c) A dose to the skin or an organ or tissue other than the treatment site that exceeds by five-tenths (0.5) Sv (fifty (50) rem) to an organ or tissue and fifty (50) percent or more of the dose expected from the administration defined in the written directive (excluding, for permanent implants, seeds that were implanted in the correct site but migrated outside the treatment site).

(d) Any event resulting from intervention of a patient or human research subject in which the administration of radioactive material or radiation from radioactive material results or will result in unintended permanent functional damage to an organ or a physiological system, as determined by a physician.

"Rad" means the special unit of absorbed dose. One (1) rad equals an absorbed dose of 0.01 joule per kilogram (0.01 gray) or 100 ergs per gram.

"Radiation area" means an area, accessible to individuals, in which there exists radiation at levels that an individual may receive in excess of five (5) millirems (0.05 mSv) in one (1) hour at thirty (30) centimeters from the radiation source or from a surface that the radiation penetrates.

"Recordable event" means the administration of:

(a) A radiopharmaceutical or radiation without a written directive if a written directive is required;

(b) A radiopharmaceutical or radiation if a written directive is required without daily recording of each administered radiopharmaceutical dosage or radiation dose in the appropriate record;

(c) A radiopharmaceutical dosage greater than thirty (30) microcuries of sodium iodide I-125 or I-131 if:

1. The administered dosage differs from the prescribed dosage by more than ten

(10) percent of the prescribed dosage, and

2. The difference between the administered dosage and prescribed dosage exceeds fifteen (15) microcuries;

(d) A therapeutic radiopharmaceutical dosage, other than sodium iodide I-125 or I-131, if the administered dosage differs from the prescribed dosage by more than ten (10) percent of the prescribed dosage;

(e) A teletherapy radiation dose if the calculated weekly administered dose is fifteen (15) percent greater than the weekly prescribed dose; or

(f) A brachytherapy radiation dose if the calculated administered dose differs from the prescribed dose by more than ten (10) percent of the prescribed dose.

"Rem" means a special unit of quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (one (1) rem = 0.01 sievert).

"Restricted area" means an area access to which is limited by the licensee or registrant for purposes of protection of individuals against undue risks from exposure to radiation and radioactive materials. A restricted area shall not include areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area.

"Roentgen" means the special unit of exposure. One (1) roentgen ® equals 2.58×10^{-4} coulombs per kilogram of air (see "Exposure").

"Sealed Source" means radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent leakage or escape of the radioactive material.