



**UNIVERSITY OF KENTUCKY  
RADIATION SAFETY  
ADVANCED COURSE**



## **I. 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 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. The Committee meets at least once each calendar quarter.

Responsibility for administering these policies and procedures rests with the Radiation Safety Officer, who directs the Radiation Safety Office.

Radiation safety philosophy, UK policies and procedures and Kentucky regulations include an objective of maintaining all exposures at levels as far below regulatory limits as can reasonably be achieved. The University strongly supports the "As Low As Reasonably Achievable" (ALARA) safety goal for radiation exposure.

The Nuclear Regulatory Commission has been given the authority by Congress to relinquish certain regulatory responsibilities via a formal agreement with states that have an existing radiation control program. Kentucky is such an Agreement State and has a radiation control program directed by the Cabinet for Human Resources, Radiation Control Branch.

The two broad scope licenses granted to the University of Kentucky are similar to others at academic institutions across the country. A broad license is issued only to institutions that have a wide variety of uses for radioactive material and many individuals using it.

## **II. Administration of the Radiation Safety Program**

The Radiation Safety Manual (<http://www.uky.edu/Fiscal/Environmental/radiation>) is part of the Radioactive Materials License with the State of Kentucky. This manual summarizes the terms of the University's authorization and the regulations applicable to utilization of various radioactive materials. 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.

Prior to the receipt of radioactive material by any researcher at the University, the proposed Authorized User (AU) must submit an application to the Radiation Safety Officer for specific approval of the use. After the R.S.O. reviews the application, it is forwarded for committee review and approval / disapproval. After approval, the AU is authorized for the specific radionuclides, locations, and personnel as well as any special instructions or limitations specified in the license.

Authorized Users are responsible for ensuring that students and staff using radioactive materials under his/her authorization are trained in safe laboratory practices, are familiar with the terms of the authorization and are complying with University policies and applicable regulations.

An Authorized User must submit a new application if other radionuclides are to be used or if procedures change that will significantly alter radiological hazards. Modifying the protocol in an experiment may or may not require a license amendment. Check with the Radiation Safety Office in advance.

A memo/form to the Radiation Safety Officer must be submitted to request an increase in possession limits, changes in lab and storage locations and other minor changes. Email, memos or Radiation Safety Office forms are acceptable for applying for these amendments.

The Radiation Safety Office is to be informed of all changes in personnel working with radiation sources. A worker registration form (Radiation Safety Manual Appendix B) must be provided to the Radiation Safety Office when a worker is added to the lab staff.

### **Inactive Status**

An Authorized User may request in writing to the Radiation Safety Office that his/her authorization to use and store radioactive materials be temporarily changed to Inactive Status. This status allows the Authorized User to retain their Radioactive Materials License and alleviate the survey and inventory requirements while on Inactive Status. The Authorized User may not use radioactive materials with this status (this is a storage only authorization). If the AU has isotopes stored in the lab, the radiation safety office will perform quarterly surveys and track the inventory by computer (decay only), so this paperwork does not have to be performed by the AU. If no inventory is on hand, the labs will be exited and cleared for unrestricted use until such time as Active Status is requested.

The Authorized User must submit a request to the Radiation Safety Officer to return to active status when so desired. The lead-time to return to Active Status need only be a day or two. Inactive Status should be requested when a hiatus of six months is anticipated.

### **III. Ordering Radioactive Materials**

When ordering radioactive materials, completed radioisotope order forms (Radiation Safety Manual Appendix E) should be sent directly to the Radiation Safety Office, 102 Dimock Building 0076 (or fax to 3-4752). All radioactive materials received at UK must be received and processed at the Radiation Safety Office. This includes off campus transfers and free samples.

The Radiation Safety Office processes the order the same day if the request is received by 11:30 a.m. Orders received after 11:30 a.m. will be placed the next business day.

Contact our office for Contract prices with the available vendors, 3-6777.

#### **IV. Radioactive Materials Inventory**

Each order of radioactive materials received at UK is added to the Authorized Users Inventory using the RSO database. The database allows us to check the license and possession limits for each order. The database sums the orders and calculates decay to give an instantaneous amount for each Authorized User. This gives our office a maximum activity for each lab.

This summation does not, however, take into account the activity that is used in the lab and moved to various waste streams. Each month, the Radiation Safety Office will mail a form to the Authorized User along with the latest printout of their inventory. This Monthly Inventory Form must be returned to our office by the 15<sup>th</sup> of the month it is received.

Best estimates for each waste stream should be assigned for each vial. Only vials used that month need to be listed on the form. Enter non-decayed amounts on the form. The database automatically calculates decay. Correlating *volume used* versus the *original activity* in the vial is a way to estimate the activity going into the waste streams.

If no radionuclides were used that month, circle 'No Change' on the form.

Enter the date on the last column of the Monthly Inventory Form when the vial is completely used/discarded. The shipcode will be archived in the RSO database and will not show up on the Authorized User's future inventory printouts.

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. No prior permission is needed from the RSO, however the users receiving the materials must be authorized to use the radionuclides and they must stay within their possession limits.

#### **V. Laboratory Protection Policies**

Prevention of the spread of contamination and minimizing radiation exposure is the responsibility of the Authorized User. The Authorized User 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.).

#### **VI. RADIATION SAFETY OFFICE SURVEYS**

Compliance 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 will be surveyed. Surveys will also include an examination of the presence and condition of warning signs, instructions and other necessary postings and thorough review of the record keeping system.

Radiation Safety Office personnel will periodically (at least quarterly) inspect the laboratories of Authorized Users to monitor the lab's radiation safety program.

The Radiation Safety Office will perform periodic inspections of Labs and deficiencies will be reported to Principal Investigators. Certain citations require notification of the AU. Other citations require notification and a written response from the AU. If deficiencies are not corrected, are repeated, or situations occur that compromise the safety of people at the University, the Radiation Safety Office may increase sanctions including suspension or loss of ordering privileges, surrender of material, or deauthorization of use.

## **VII. 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 is to survey after each use and perform a **MONTHLY** survey and wipe test, with written documentation. Removable contamination must be recorded in units of dpm/100 cm<sup>2</sup>. Authorized Users are responsible for including the following items as part of the written survey record:

- a) Date of the Survey
- b) Diagram of area surveyed
- c) Specific locations where wipe tests were taken
- d) Contamination levels found with appropriate results (DPM/100 cm. sq.)
- e) Name of the person making the survey and recording the results

### **Meter Surveys**

When beta emitters (except H-3, C-14 and S-35) and gamma emitters are used in the laboratory the Authorized User must conduct an instrument survey.

The meter survey shall include:

- a) Date of the Survey
- b) A diagram of the area surveyed
- c) Measured dose rate at several points in each area expressed in millirems per hour
- d) Make, model, calibration date and serial number of survey instrument used
- e) Background levels (millirem/hr)
- f) Signature of the individual who performed the survey

Removable contamination must be recorded in units of dpm/100 cm<sup>2</sup>. 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.

## VIII. Wipe tests for 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. Laboratories may use these same counting efficiencies for wipes or use their own established efficiencies.

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.

### Contamination Limits for Radiation Use Areas

$\leq 1000$  dpm/100 cm<sup>2</sup> beta/gamma

$\leq 100$  dpm/100 cm<sup>2</sup> alpha

### Contamination Limits for Non-Restricted Non-Use Areas

$\leq 200$  dpm/100 cm<sup>2</sup>

## IX. TRAINING

The Radiation Safety Office provides a Basic Radiation Safety Orientation training course for all Radiation Workers. Workers must complete the course within four months of initial employment. A quick start video is mandatory for those wishing to start working with radioactive materials before taking the training class.

A test will follow each session, with a minimum passing grade of 80%. Upon satisfactory completion of the course, a certificate will be issued.

## X. SURVEY INSTRUMENTS AND CALIBRATION

To facilitate safe practice in the University, the Radiation Safety Committee requires that an appropriate calibrated survey meter be available in each authorized laboratory area. "Appropriate" in most cases means a thin window Geiger-Mueller type meter (end window or pancake type) that will detect nanocurie quantities of the particular radioisotopes utilized in the laboratory. A "laboratory area" may be one laboratory or a series of connecting laboratory spaces. Labs located on different floors or in different buildings each need their own meter. Labs only using C-14, Tritium and S-35 will not be required to have a meter.

Instruments must be calibrated annually. The Radiation Safety Office will perform these calibrations without charge. The Radiation Safety Office should be informed of the purchase of a new instrument, or repair 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 use in a non-radioactive laboratory, transfer to a repair shop, or transfer to Surplus Property. UK Trucking will not pick up any item with a radioactive sticker that does not have clearance from the Radiation Safety Office

#### **XI. VACATING LABORATORY SPACES**

The Radiation Safety Office must be informed of all changes in authorized laboratory spaces, including transfers, laboratory relocations or departures from the University.

The Authorized User is responsible for cleaning and surveying all spaces and equipment and proper removal of all radioactive waste and radioactive sources prior to the changes. Upon notification, the Radiation Safety Office will complete a final clearance survey of the authorized spaces. Radiation warning signs may be removed only by the Radiation Safety Office.

#### **XII. SEALED SOURCE LEAK TESTS**

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 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.

#### **XIII. NEW LABORATORY SETUP**

New laboratories will be posted and the Radiation Safety Office will supply waste containers. The Authorized User should contact the Radiation Safety Office to schedule the set-up.

#### **XIV. POSTING AND LABELING**

The Radiation Safety Office is responsible for posting areas with radiation warning signs. The Authorized User is responsible for labeling equipment and lab supplies.

All doors accessing areas which contain radioactive materials must be posted. All refrigerators, freezers and other equipment which contains radioactive materials must be labeled with "Caution: Radioactive Material" signs or tape.

Any unattended container of radioactive material, such as beakers or flasks, are required to be labeled.

## **XV. EATING, DRINKING, SMOKING, COSMETIC APPLICATION IN LABORATORIES**

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.

## **XVI. 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:

1. Iodinations
2. Evaporations
3. Use of gaseous radioactive material

The airflow in a hood when doing these procedures must indicate a rate of 80 to 150 linear feet per minute. The Environmental Health Department at UK can test hoods for compliance.

## **XVII. PERSONAL PROTECTIVE MEASURES**

The use of personal protective equipment such as laboratory coats, disposable gloves and safety glasses can minimize contamination of personnel and thus keep radiation exposures low. Gloves should be monitored and changed when needed. Researchers must be aware that some chemical compounds may require specific material for complete protection.

Long-sleeved lab coats, long pants and closed toe shoes increase the protection of the radiation worker from spills and accidental contamination. Any contamination of personnel must be reported to the RSO immediately.

### **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). Powdered radioactive materials should be handled in a glove box, negating any need for a respirator.

No respirator-requiring activities shall be conducted without approval of the Radiation Safety Officer. Users must be fit-tested and have an approved Respirator Protection Plan by the UK Office of Occupational Health and Safety.

## **XVIII. 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. A secondary container can be used to avoid breakage of the primary container.

## **XIX. SECURITY OF RADIOACTIVE MATERIALS**

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

### **WASTE PROCEDURES**

Labeled waste containers, plastic liners and radioactive labels may be obtained by contacting the Radiation Safety Office. As with all radioactive materials, contaminated waste must be secured from unauthorized removal. Plastic solid waste containers provided by the RSO come in sizes: 10 and 32 gallons.

#### **Regarding waste forms:**

The Radiation Safety Office will provide "Radioactive Waste Receipt" forms to all laboratories. The Authorized User (or designee) must complete all applicable information. Use a separate ticket for each container. Attach the yellow copy to the waste container and mail the white copy to the Radiation Safety Office. You may bring the copies to the Radiation Safety Office to avoid the time required for campus mail, but do not fax the ticket.

- Dry waste - indicate container size (in gallons) and total activity of each radionuclide. Liquids shall not be placed in solid waste containers. Relatively small volumes (one ml) of aqueous liquid may be transferred onto absorbent material and placed in an appropriate solid radioactive waste container. Lead must not be placed in solid waste containers; it must be picked up separately.
- Aqueous waste (generally carboys) - indicate volume (in gallons) and total activity of each radionuclide. Indicate the pH. List all constituents of liquid waste such as buffers, etc, and list the percent of each constituent. Hazardous materials are not allowed in aqueous waste.
- Liquid scintillation vials - indicate container size and total activity of each radionuclide. Scintillation drum forms are available from the RSO to aid in tracking.

- Animal/biological - indicate approximate volume, radionuclide(s), and total activity. This waste form must be frozen at the time of pickup.
- Mixed waste – Document chemical constituents and radionuclide activities

### **Solid Waste**

Segregate solid waste according to radionuclide half-life, as follows:

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

**For solid waste with half-lives <120 days, remove or deface all radiation labels before placing materials in waste containers. The waste will not be picked up if this is not done.**

General labware - Paper, plastic (including plastic pipettes), gloves, unbroken glassware, etc. must be placed in dry waste containers, lined with a clear plastic bag. The bag allows inspection of contents. These bags will be provided by the RSO.

All glass pipettes and broken glassware must be placed in a cardboard box and lined with a clear plastic bag. It may then be placed in the "general labware" waste container of the same radioisotope category or held separately for RSO pickup.

Do not place radioactive biohazard material in "red bags" unless the radioactivity is in exempt quantities.

Radioactive biohazardous waste is a special case. Contact the RSO about disposing of it.

Sharps (needles and syringes, scalpels, etc.) must be placed in sharps containers and properly labeled. Biohazard is a specific category that does not apply to all sharps. Syringes used on animals or to transfer materials in vitro may not be classified as biohazardous. Sharps containers that do not contain biohazards or that have been autoclaved/ deactivated must reflect the category by having the label defaced. Then it may be placed in the "general labware" waste container of the same radioisotope category or held separately for RSO pickup.

### **Aqueous Liquids**

Liquid waste is defined as easily soluble in water. 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.

Aqueous liquids may be released to the sewer system in specified laboratories in quantities not to exceed 10 uCi per day. Contact the Radiation Safety Office for permission.

Liquids containing biohazards must be sterilized (by autoclave or chemical methods) prior to pick up by the Radiation Safety Office.

### **Scintillation fluids –**

Scintillation vials should remain intact with the cap on when put in the waste. All vials except transuranics may be combined.

Non-Biodegradable and Biodegradable vials are to be combined.

Normally, vials will be placed in plastic containers with clear liners provided by the RSO. Metal drums require special procedures denoted in appendix G.

Multiple users of scintillation vial drums require the approval of the RSO and also require approval by Hazardous Materials Management. All users must document what isotope and activity they are disposing in the drum. One Authorized User must take ultimate responsibility for the container. All Authorized Users must be specifically approved for use of the room. The room must be posted and locked when unattended. Wipe surveys of the room must be available in all of the AU's authorized to keep waste there.

### **Mixed Waste**

Waste that contains hazardous and radioactive components is mixed waste. This waste must not be released to the sewer system (this includes biodegradable scintillation fluid). All mixed waste is to be picked up and disposed of by UK personnel. The total mixed and hazardous waste in a laboratory cannot exceed 55 gallons.

Containers for mixed waste are not provided.

### **Animal Waste**

The Radiation Safety Office must pick up all animal waste contaminated with radioactivity. Animals with an activity  $\leq .05$  microcuries per gram of *C-14*, *H-3*, or *I-125* averaged over the initial weight of the animal are exempt from certain waste requirements. The RSO encourages maintaining a concentration in animal experiments below this level. However, these must be kept out of any food supply.

Freezing of the animals is the responsibility of the AU until they may be picked up by the RSO. Animals must be frozen and kept separate from excrement and bedding. The Authorized User must have freezer space to adequately store animals waste.

The Radiation Safety office may provide boxes and liners for animal carcasses/bedding depending on availability.

Segregate the isotopes into half-lives <120 days and half-lives >120 days

## **XX. Personnel monitoring**

Radiation badges and other dosimeters 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.

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 rems
- Eye dose equivalent of 15 rems
- Shallow dose equivalent of 50 rems to the skin or to an extremity
- Persons under 18 years of age and are likely to receive a radiation dose in excess of 500 millirems in one year.
- Radiation workers who have declared a pregnancy or planned pregnancy.
- Persons who enter a High Radiation Area (exposure to greater than 100 millirems in any one hour).
- Persons operating analytical X-ray devices.

### **Procedures for Monitoring Devices**

Every individual who may work with radiation sources must file a Radiation Worker Registration Form with the Radiation Safety Office. 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 and surveys.

Radiation- badges are exchanged on a routine basis. Replacement badges are sent to departments either monthly or quarterly by the RSO. These must be returned to the Radiation Safety Office by the tenth of the month so that they may be properly processed.

Film badges are not needed by individuals who work with less than 1 (one) millicurie of any radionuclide.

### **Personnel Monitoring Protocol**

The Radiation Safety Office will request prior radiation dose histories from all past employers. All personnel occupational radiation dose records will be maintained by the Radiation Safety Office.

It will be the responsibility of the Authorized User and each individual badge recipient to wear and use the badge(s) properly and ensure that badges are returned on time for processing.

Unused or late return of badges may invalidate the personnel monitoring record of an individual.

### **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. Badges shall be worn only by the person they are assigned to and only at University of Kentucky 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 outside the apron. The Radiation Safety Officer may be consulted for advice in these circumstances.

Extremity monitoring badges (rings) are available from the RSO. Ring badges should be worn whenever working with applicable sources. Gloves should be worn over the ring badge when contamination is possible.

Deliberate exposure of a monitoring device will be reported to the person's supervisor and the State of Kentucky Radiation Control Branch.

### **Personnel Monitoring Reports**

Routine monitoring periods are currently quarterly for research personnel. Annual reports are provided in writing to radiation workers.

The personnel monitoring reports are on file in the Radiation Safety Office. They are available for all badged employees to review.

### **ALARA Notifications**

There are two notification levels for the ALARA program, Level I and Level II. Level I notifications involve a radiation worker receiving greater than 10 percent of the maximum allowable dose (prorated for a month's exposure period). The recipient is notified in writing when their exposure meets this level's criteria. The notification requests that the worker review their work procedures in order to reduce exposure, if feasible.

Level II notifications involve a radiation worker receiving greater than 30 percent of the maximum allowable dose (prorated for a month's exposure period). The recipient is notified when their exposure meets this level's criteria. In addition to reviewing procedures as with Level I, Level II requires the worker to respond in writing to the Radiation Safety Office in order to reduce the probability of a recurrence.

Part of Body	Notification Level I	Notification Level II
	<b>(millirems per month)</b>	
Whole body (head, trunk), gonads, upper arms or legs	40	125
Eye	125	375
Skin of whole body; extremities (hand, elbow, lower arms or legs, foot, knee)	400	1250
Embryo-Fetus	N/A	10

#### 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 at UK include urinalysis and thyroid monitoring. A background bioassay should be completed before use with radioactive materials begins.

- Tritium (H-3). Urinalysis is required when 100 millicuries or more of tritiated water or tritium compounds are used in one month.
- Iodine (I-125, I-131). A thyroid bioassay by external counting is required if:
  1. One (1) mCi is used in a 3-month period on the tabletop in a volatile form.
  2. 10 mCi is used in 3 months on the tabletop if bound to a nonvolatile agent.
  3. 10 mCi is used in a Fume Hood in a volatile form.
  4. 100 mCi is used if bound to a nonvolatile agent

## **UK Pregnant Employee - Fetal Dose Policy**

A potentially harmful situation arises when a pregnant female is exposed to radiation. Exposure of such a worker to ionizing radiation from either external or internal sources would also involve exposure of the embryo or fetus. A number of studies have indicated that the embryo or fetus is more sensitive than an adult, particularly during the first three months after conception, when a woman may not be aware that she is pregnant.

Federal and state regulations and UK policy require that special precautions be taken to limit exposure to radiation sources when an occupationally exposed woman could be pregnant. The current maximum permissible radiation exposure is 500 millirems for the duration of the gestation period, and the monthly exposure should be limited to 50 millirems. Fetal monitoring (double badging) is available at the Radiation Safety Office.

In order to be recognized as pregnant, for the purpose of exposure limits, a person must declare in writing to the Radiation Safety Office that she is pregnant. It is recommended that the pregnant person avoid higher radiation exposure procedures and those that could result in internal exposure.

### **Records Requirements**

The Radiation Safety Office is charged with maintaining control of all radioactive materials on the campus. The Authorized User is therefore required to maintain certain records. 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:

- radioactive material inventory records submitted to the Radiation Safety Office
- radiation and contamination surveys performed by the Authorized User
- radioactive waste disposal ticket receipts
- 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 100 or more uCi's
- a laboratory accident (fire, explosion, etc.) which may result in the release or breach of security of radioactive materials

**XXI. OFF CAMPUS TRANSFERS**

Any shipment of radioactive materials 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 shipping radioactive materials must ship them through the UK 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 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.

Shipments may be made only to persons who are licensed to receive radioactive materials and a copy of the recipient's radioactive materials license must be on file in the Radiation Safety Office.

**XXII. ANIMAL HANDLING PROCEDURES**

The Radiation Safety Office requires information for the authorization of projects involving the administration of radionuclides to animals. The information required is on the original application form.

Instructions for handling and monitoring of the animals and proposed method of disposal of the animal and excreta shall be posted in the animal housing area prior to administering the radionuclide to the animals.

**XXIII. ACADEMIC X-RAY MACHINES REGISTRATION**

All machines capable of producing ionizing radiation must be registered with the UK Radiation Safety Office. The following types are included:

- X-ray diffraction/fluorescence units
- particle accelerators
- neutron generators
- any other equipment that may produce ionizing radiation

A label bearing the words, "Caution - Radiation - This Equipment Produces Radiation When Energized" shall be placed near the switch that energizes the tube.

A sign bearing the words, " High Intensity X-ray Beam" shall be in place adjacent to each tube housing. Unused ports on radiation source housings shall be secured in the closed position. Under no circumstances shall shutter mechanisms or interlocks be defeated or in any way modified except as approved in writing by the Radiation Safety Office.

### **REQUIREMENTS FOR X-RAY MACHINE OPERATORS**

No person shall be permitted to operate academic X-ray machines until they have:

- received instructions in relevant radiation hazards and safety
- received instructions in the theory and proper use of the machine
- demonstrated competence, under supervision, to safely use the machine

### **XIV. 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 # 323-6777, or- 911 after hours) must be notified as soon as possible. The emergency may demand other immediate action by those on the scene before this can be done.

The Authorized User should be prepared for minor spills and reasonably anticipated emergencies. The individual can prearrange to have on hand specific equipment and supplies uniquely required by his operation to minimize hazards and enhance recovery.

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.

### **MAJOR RADIOACTIVE SPILLS**

#### **Personnel Protection**

- If hazard is extreme (high radiation level or suspect air contamination), evacuate the area immediately; close and lock the door.
- Remove contaminated clothing and wash contaminated parts of the body thoroughly with detergent.
- Contact the Radiation Safety Office (323-6777)/after hours Campus 911.
- Warn fellow workers of the spill hazard and keep others out of the area.
- Localize area of spill. Place absorbent material over a liquid spill.
- Do not track contamination out of the spill area, if possible. Remove shoes at the edge of contaminated area.
- If contamination is widespread outside the laboratory, it may be necessary to call the Campus Police (911) to assist in securing the area.
- Check all objects and clothing for contamination before leaving the area.

## **MINOR RADIATION SPILLS**

A minor spill does not involve contamination of personnel and is generally less than 100 microcuries.

The following steps should be taken:

- Warn fellow workers of the spill hazard and keep others out of the area.
- Place absorbent material over a liquid spill.
- Be careful not to track contamination out of the spill area.
- Use disposable gloves to prevent contamination of the hands and to prevent cross-contamination.
- Check all objects and clothing for contamination before leaving the area.

Call the Radiation Safety Office if assistance is needed.