

## SECTION 5

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### PRACTICE

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#### 5.1 INTRODUCTION

Guidelines, policies, and rules for the practice of radiation safety on the Louisiana State University and Agriculture and Mechanical College are presented in this Section.

#### 5.2 GENERAL RULES FOR RADIOACTIVE MATERIALS

1. Eating, drinking, storage of eating utensils, smoking, or application of cosmetics are not permitted in areas where radioactive materials are used or stored.
2. Personnel monitoring devices (body badge, finger badge, wrist badge, etc.) prescribed for the area must be worn.
3. Protective clothing (gloves, laboratory smock, coveralls, goggles, respirator, shoe covers, etc.) prescribed for the area must be worn.
4. Proper containment (absorbent paper, trays, secondary liquid containers, etc.) required for the operations must be in place.
5. Fume hoods are to be used for all operations that potentially involve release of air-borne materials, including gases, volatile compounds, dusts, and aerosols.
6. Prescribed radiation detection equipment and calibrated survey instruments must be available and known to be working.
7. Radioactive materials must be stored and shielded in the manner prescribed for the area and secured to restrict unauthorized persons from using or removing the material.
8. All bottles, jars, boxes, and cabinets containing radioactive materials must be clearly labeled as to the radionuclide, quantity, and date, and initialed by the responsible person.
9. All entrances must be properly labeled with signs appropriate to the hazard and posted with the names and telephone numbers of individuals to be contacted in case of emergencies.
10. Initial runs or pilot studies on new procedures should be made with non-radioactive materials or less than 10 microcurie amount of radioisotopes.
11. Procedures should be designed to reduce to a minimum transfers from container-to-container, bench-to-bench, and room-to-room as a means of reducing spills.
12. Radiation levels in work areas should be determined before an operation is begun so that proper shielding and remote-handling equipment can be employed to reduce individual exposures.

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13. Individuals unfamiliar with radiation hazards and emergency procedures must not be permitted to work with radioactive materials.
14. Pipetting by mouth in areas where radioactive materials are being used is forbidden.
15. All equipment, glassware, and other contents of an area in which radioactive materials are being used or have been used should be considered as contaminated until properly monitored.
16. Any injury, no matter how slight, involving radioactive materials must be monitored by the Radiation Safety Office to determine if the wound is contaminated. Contact the Radiation Safety Office immediately if any injury involving radioactive materials occurs.

### 5.3 GENERAL RULES FOR RADIATION-PRODUCING MACHINES

The following rules apply to machines that yield intentionally externalized beams of ionizing radiation:

1. All operating personnel must have read the Campus Radiation Safety Manual and be thoroughly familiar with the principles of operation, the principles of radiation safety, and the potential general and specific hazards of their particular machine.
2. Radiation surveys by the Radiation Safety Office must be made annually, whenever beam-target specimen-detector geometry is changed, whenever shielding arrangements are altered, and after maintenance work.
3. System interlocks should be installed to assure that the equipment can not be operated in an unsafe manner or when personnel are in exposure areas. **NOTE:** Overriding an interlock requires prior written approval by the Campus Radiation Safety Officer.
4. For irradiation vaults, target rooms, and x-ray therapy and diagnostic rooms, both voice communication and visual monitoring are desirable.
5. Master-switch keys and secondary keys should be in the possession of the first person entering an exposure room, and that person should be the last to leave the room.
6. Situations which require interlocks to be temporarily disabled require prior written approval of the Campus Radiation Safety Officer.
7. For multiple x-ray beam port instruments, beam port shields should be brightly colored to allow quick visual checks that they are properly positioned.
8. All radiation producing equipment must have clearly visible warning lights to indicate when the equipment is generating radiation. Additional caution lights are recommended as a redundant system for showing the machine status. Warning light systems shall be fail-safe.
9. Permanently-installed radiation monitors and portable survey instruments prescribed for the installation should be available and known to be calibrated and functioning prior to operation or activation of equipment.

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10. All operating personnel must be properly badged with individually assigned integrating dosimeter devices.
11. A written and oral practical examination for new operating personnel, with results kept on file, is desirable before a new operator is allowed to work without supervision.
12. Operators should check radiation levels before entering an irradiation room. This is usually accomplished by observing lights and/or audible alarms.
13. Emergency notification procedures must be posted and emergency response procedures should be reviewed with all personnel annually and documented.
14. Approved warning signs indicating the nature of the hazards must be posted at entrances to radiation hazard areas and the instrument console must be posted with a sign indicating the nature and quality of the radiation produced.
15. Unusual operations or unexpected radiation producing machine behavior must be reported to the Campus Radiation Safety Office immediately.

### 5.4 SIGNS, NOTICES AND LABELS

Regulations of the Louisiana Department of Environmental Quality and the University require that signs be posted to inform the public of the existence of a radiation hazard in areas where radioactive materials and radiation producing machines are used and stored. Posted signs must comply with federal regulations, which are in agreement with international symbols for recognition of hazards. These signs are printed with magenta ink on a yellow background and bear the word "caution" at the top, the standardized three-bladed "propeller" symbol for radiation, and a descriptive prescribed phrase denoting the magnitude of the hazard. The prescribed phrases are "RADIOACTIVE MATERIALS" for any area where radioactive materials are used or stored, "RADIATION AREA" where it is possible for a person to receive a dose equivalent in excess of 5 mrem in one hour at 30 centimeters from the radioactive source, "HIGH RADIATION AREA" where it is possible for a person to receive a dose equivalent in excess of 100 mrem in one hour at 30 centimeters from the radioactive source, and "VERY HIGH RADIATION AREA" where it is possible for a person to receive an absorbed dose in excess of 500 rads in one hour at one meter from the radioactive source.

Radiation Safety Office personnel will determine which regulation signs are appropriate for a given location and will supply the signs to the users. Users are required to notify the Radiation Safety Office promptly if a sign is removed or defaced so that it can be replaced.

Two modifications of the legal signs are permitted under the radiation safety program. These include the addition of the phrase "X RADIATION" across the bottom blade of the propeller symbol on a radiation-area sign to be posted where x-rays are present in an external beam and the phrase "CONTAMINATION ZONE" across the bottom of the symbol on a radiation-area or high-radiation-area sign to be posted where uncontained radioactive material exists in a hazardous condition. Hand-lettered signs bearing other phrases are not acceptable substitutes.

In addition to signs indicating the presence of a radiation hazard, each area must be marked with a notice identifying individuals to be called in an emergency and their current telephone numbers at the University and at home. Individuals to be listed on the notice include:

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1. Principal user,
2. Alternate person knowledgeable of the specific area (if possible), and
3. Radiation Safety Office and emergency contact numbers

EMERGENCY NOTICES will be supplied by the Radiation Safety Office, which should be informed promptly of any changes.

### **5.5 GENERAL RULES FOR ANIMAL HANDLING INVOLVING RADIOACTIVE MATERIALS**

Because of the variety of experimental animals and locations where they are employed for radioactive studies, only guidelines for handling such animals can be covered in this manual. It is the responsibility of each user to supply detailed procedures with the User Application.

The general rules for the use of radioactive materials in experimental animals are:

1. All project personnel, including animal handlers, farm workers, students, and technical personnel, must be fully informed of the hazards posed by the project specifically (and radioactive materials generally), emergency procedures, restrictions on areas, waste handling, carcass disposal, and procedures for cleaning facilities when the experiment or medical application is terminated.
2. All areas where experimental animals are housed, including holding pens, must be clearly posted with proper signs commensurate with potential radiation hazards.
3. No animal is to be kept, even temporarily, in an area not previously designated and posted for radioactive-materials use.
4. Each cage, pen, or stall in which an animal dosed with radioactive materials is held must be clearly marked as to the nature, quantity, and date of administration of the material. Access should be restricted to only those who need to be in the area.
5. Cages, pens, and stalls must be designed to facilitate thorough collection of excreta to reduce contamination levels. Additional measures may be required for control of special hazards, such as feather dust from poultry or saliva from cattle and other animals.
6. Dirt-floored holding areas are not acceptable for animals dosed with radioactive materials.
7. Unless specifically authorized for a project, animals dosed with radioactive materials may not be pastured. Similarly, small animals may not be returned to stock colonies.
8. Animal sacrifice is permitted only in an area previously designated for this purpose and properly outfitted with necessary decontamination gear and waste handling facilities. Unless specifically exempted, blood can not be drained to the sanitary sewer for disposal.
9. All personnel must wear approved work clothes and protective equipment when handling radioactive animals and excreta or working in the area where dosed animals are being held.

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10. Portable survey meters sensitive to the emitted radiation from the radioactive materials must be available, calibrated, and known to be in working order, and all personnel must be capable of using and interpreting the readings from these instruments.
11. All wounds on animals incurred in posted areas must be monitored for radioactive contamination and reported immediately to the Radiation Safety Office if contamination is detected. Any bites, scratches, or uncontrolled body fluid contamination of personnel must be reported immediately to the Radiation Safety Office.
12. Specific instructions for the collection, storing, and disposal of excreta and carcasses must be approved for each user project.
13. Animals dosed with radioactive materials may not be sold, nor may they be used for human consumption. This does not apply if a period equal to 10 physical half-lives of the radioactive material has elapsed.
14. Milk from lactating animals must be treated as excreta and may not be sold or consumed. This does not apply if a period equal to 10 physical half-lives of the radioactive material has elapsed.
15. Areas where animals are dosed with radioactive materials must be checked frequently for contamination by instrument surveys and wipe tests according to approved procedures.

### 5.6 GENERAL RULES FOR FIELD USE OF SEALED RADIATION SOURCES

Sealed sources constitute a class of radioactive materials in which the radionuclides are compacted as high-integrity solids and then encapsulated into two successive and independently sealed capsules to prevent the escape of the central radiation source. These capsules are designed to allow useful radiation to penetrate the walls, while containing the radioactive material. Both gamma-emitting and neutron-emitting sources are in the possession of the University and are available for both laboratory and field experimental uses.

Gamma sources (and neutron sources to a lesser extent) designed for field use offer intense radiation fields and therefore require special precautions, particularly when exposed in open areas such as rice ponds and forest plots. Field uses include radiographic inspections of the interior of test specimens, determination of soil density, and the estimation of soil moisture content.

Although gamma-emitting sources ( $^{60}\text{Co}$ ,  $^{137}\text{Cs}$ ,  $^{192}\text{Ir}$ , and  $^{226}\text{Ra}$ ) and neutron-emitting sources (polonium-beryllium, radium-beryllium, plutonium-beryllium, americium-beryllium, and californium-252) are designed and used for a wide variety of *laboratory* procedures, similarities in *field* use exist. The following general rules are applicable, subject to specific stipulations by the Campus Radiation Safety Officer and Campus Radiation Safety Committee after review of a user's application form:

1. Two individuals (e.g., a principal user and a helper) must be present whenever a sealed source is being used in normally uncontrolled areas.
2. All personnel who may be involved as principal users and helpers must be trained in the operation of the sealed source device and in the specific hazards relating to the device.

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3. Users, helpers, and alternates must be knowledgeable of proper emergency procedures for the source in their possession.
4. Except for moisture/density gauge use, appropriate survey instruments, known to be calibrated and operational, must be in the possession of the source users in the field. Users must be capable of operating and interpreting the readings of the instruments.
5. The principal user must be capable of predicting and determining the extent of radiological exclusion areas for the specific source in use.
6. Signs reading "CAUTION RADIATION AREA" must be posted at distances from the exposed source where meter readings indicate a dose equivalent rate of 5 mrem/hr or greater. A physical barrier (e.g., high-visibility rope) must be placed to enclose the area in which the dose equivalent rate may exceed 100 mrem/hr and signs reading "CAUTION HIGH RADIATION AREA" must be posted at this perimeter.
7. A source must be logged out of and back into a storage area by the principal user.
8. Either the principal user, the helper, or a knowledgeable alternate must be within controlled distance when the source is in their possession in the field and must have visual supervision of the source when it is exposed.
9. Sources must be locked and the keys to source locks must be in the possession of either the user or the helper whenever a source is not under visual supervision.
10. The user and helper, and any other knowledgeable alternates, must be provided with badges appropriate for the radiation emitted by the source.
11. Vehicles may require warning signs and shipping documents when sources are moved between the storage location and the use site. This will be determined at the time the user-project application is approved.
12. Personnel in the Radiation Safety Office are available for discussion of special hazards, rules, regulations, and standards of good practice for field use of sealed radiation sources.

### **5.7 GENERAL RULE FOR FIELD USE OF UNSEALED RADIATION SOURCES**

Field use of unsealed sources can not be undertaken without specific approval of the Campus Radiation Safety Officer and the Campus Radiation Safety Committee following review of environmental impacts for the use.