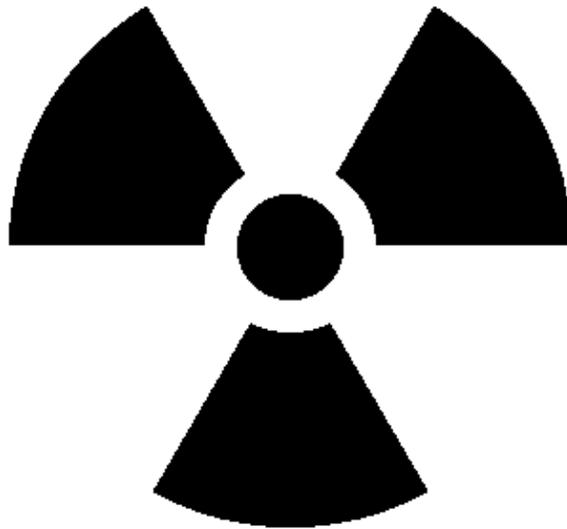


AUBURN UNIVERSITY

RADIATION SAFETY



**POLICY AND PROCEDURES
MANUAL**

2010 Edition

**Auburn University
Risk Management and Safety
316 Leach Science Center
Auburn University, AL 36849
(334) 844-4870**



AUBURN UNIVERSITY

OFFICE OF THE PRESIDENT

DECLARATION

Auburn University is committed to providing a safe and healthful environment for our faculty, staff, students, and visitors. In particular, Auburn University is committed to keeping radiation doses to all individuals as low as is reasonably achievable consistent with our mission to serve the citizens of Alabama through our instructional, research, and outreach programs.

It is the policy of Auburn University to comply with all applicable federal and state regulations and all conditions of licenses and registrations issued by the state.

The Radiation Safety Manual is the official policy document of Auburn University for the use of radioactive materials and radiation-producing machines. The Radiation Safety Committee has the authority and responsibility to establish radiological safety policies for Auburn University and oversees the use of radioactive materials and radiation-producing machines controlled by Auburn University.

G. Jay Gouge, Ph.D.
President

June 30, 2010

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Section 1. GENERAL INFORMATION

INTRODUCTION

This manual describes Auburn University's commitment to providing a safe and healthful environment for our faculty, staff, students, and visitors with regard to the use of radioactive materials and radiation-producing machines.

It is the policy of Auburn University to comply with all applicable federal and state regulations and all conditions of licenses and registrations issued by the state.

Auburn University is also committed to keeping radiation doses to all individuals as low as is reasonably achievable consistent with our mission to serve the citizens of Alabama through our instructional, research, and outreach programs.

RADIATION SAFETY COMMITTEE

The Radiation Safety Committee (RSC) establishes radiological safety policies for Auburn University and oversees the use of radioactive materials and radiation-producing machines controlled by Auburn University.

MEMBERSHIP

RSC members are appointed by the Auburn University President. Members include:

- The Radiation Safety Officer (RSO).
- A representative of the Physics Department.
- A representative of the Facilities Division.
- The Executive Director or Associate Director of Risk Management and Safety.
- Five or more "at-large" faculty or research staff members appointed on the basis of their knowledge and experience in the safe use of radioactive materials or radiation-producing machines.

The Chair of the RSC is appointed from the at-large members who have served at least one year on the Committee.

The RSO serves as Secretary of the RSC.

AUTHORITY AND RESPONSIBILITIES

Authority over issues pertaining to radiological safety has been delegated to the RSC by the President. The RSC has authority and responsibility to:

- Establish radiological safety policies and procedures.
- Ensure radioactive materials and radiation-producing machines are used in accordance with applicable federal and state regulations and Auburn University policies and procedures.
- Review applications for the possession and use of radioactive materials and radiation-producing machines. The RSC may approve, approve with specific conditions, or disapprove each application.
- Amend or rescind previous approvals for the possession and use of radioactive materials and radiation-producing machines.
- Immediately suspend any operation which represents a serious radiological hazard or violation of applicable regulations and policies. Each member of the RSC has the individual authority to order such suspension. Following a suspension by an individual member, the full committee must confirm or rescind the suspension.
- Advise the President on matters concerning radiological safety.
- Interact and coordinate policies and actions with other University committees as necessary.
- Meet to conduct business as described below.

MEETINGS

The RSC has regular meetings once each calendar quarter. The RSC Chair or Secretary may also call special meetings when necessary to carry out urgent business. A simple majority of members shall constitute a quorum for regular or special meetings. A motion is considered approved when a majority of members present at a meeting vote in favor of the motion.

The RSC Chair may cancel up to one regular quarterly meeting each calendar year if no pressing Committee business is pending.

The RSC may also vote on matters requiring prompt attention between meetings. For a motion to pass, the Secretary must solicit votes from all available members and obtain “yes” votes from a majority of members.

RADIATION SAFETY OFFICER

The Radiation Safety Officer (RSO) is appointed by the Executive Director of Risk Management and Safety. In addition to being Secretary of the RSC, the RSO implements and manages the Radiation Safety program.

AUTHORITY AND RESPONSIBILITIES

In addition to the authority and responsibilities as a member of the RSC, the RSO has authority and responsibility to:

- Officially represent Auburn University in all matters pertaining to the possession and use of radioactive materials and radiation-producing machines.
- Implement the policies and procedures established by the RSC and make periodic reports to the RSC.
- Review applications for the possession and use of radioactive materials and radiation-producing machines and make approval recommendations to the RSC.
- Direct and supervise the activities of Risk Management and Safety staff engaged in radiological safety activities.
- Provide radiological safety advice, assistance, and training to members of the Auburn University community.
- Respond to radiological emergencies and investigate radiological incidents.
- Review radiation dose monitoring results.
- Maintain records required by federal and state regulations and university policy.

RISK MANAGEMENT AND SAFETY STAFF

The RSO or other staff members in Risk Management and Safety working under the direction of the RSO perform the following services and activities.

- Receive, process, and deliver incoming radioactive material shipments.
- Prepare outgoing shipments of radioactive materials to ensure compliance with applicable regulations.
- Conduct surveys and reviews of facilities where radioactive materials or radiation-producing machines are used.
- Collect and analyze environmental samples.
- Pick up and process radioactive waste from laboratories.
- Test sealed sources for leakage.
- Calibrate radiation survey instruments.
- Evaluate facilities and equipment, including testing of fume hoods.
- Issue and collect dosimeters.
- Perform bioassay measurements.
- Provide advice and aid in decontamination following spills.
- Provide advice and aid in complying with university policies and procedures.

INCREASED CONTROLS FOR SOURCES OF SPECIAL CONCERN

In the aftermath of the September 11, 2001 terror attacks, the Nuclear Regulatory Commission (NRC), national security personnel, and agreement states decided that Increased Control (IC) measures be undertaken to secure certain radioactive sources that could be potentially used for malicious purposes. Toward this end, the following orders were issued:

On 14 November 2005, the NRC issued Order No. EA-05-090, **Order Imposing Increased Controls (Effective Immediately)**, which ordered increased security measures for certain radioactive sources of special concern. This guidance was ambiguous at best and included a Question and Answer document. This was followed by two additional Supplemental Question and Answer documents, one in February 2007 and the other in October 2008.

On 4 April 2008, ADPH issued Order No. RC-08-1, **Order Imposing Fingerprinting and Criminal History Records Check Requirements for Unescorted Access to Certain Radioactive Materials (Effective Immediately)**, which clarified the process to institute the IC measures and procedures for Alabama licensees.

The specific procedures used to conduct these two orders can be found in the following Health Physics procedures:

- Health Physics Security Procedure #2, Increased Controls for Radioactive Materials in Quantities of Concern (IC)
- Health Physics Security Procedure #2a, Access Control Information for Radioactive Materials in Quantities of Concern (IC)
- Health Physics Security Procedure #2b, Fingerprinting and Criminal History Records Check for Unescorted access to Certain Radioactive Material
- Health Physics Security Procedure #2c, Protection of Information Gathered Pursuant to Order RC-08-1

Due to the sensitive nature of the information contained in these documents, they have been marked “Withhold From Public Disclosure”. All of these documents are available in the Radiation Safety Officer’s files.

Section 2. AUTHORIZATION TO POSSESS AND USE RADIOACTIVE MATERIAL

INTRODUCTION

Licenses to possess and use radioactive materials have been issued to Auburn University by the Alabama Department of Public Health (ADPH). One is a "broad scope" license which allows for the flexibility required at a dynamic and diverse institution such as Auburn University. As such, it requires the university to maintain a well-managed and documented radiation safety program to ensure that radioactive materials are used safely. Under the terms of the license, the Radiation Safety Committee is delegated the responsibility for authorizing qualified individuals to use radioactive materials. The other licenses issued by ADPH cover certain specific materials and uses.

AUBURN PERMIT

APPLICATION

Faculty members who wish to acquire and use radioactive materials must submit an *Application for Possession and Use of Radioactive Materials* form to the Radiation Safety Committee (RSC) via the Radiation Safety Officer (RSO). A *Principal Investigator's Statement of Training and Experience* must accompany the application form for a new Principal Investigator (PI). In rare cases, the RSC may approve a qualified non-faculty employee as a PI.

Each application must be completed in sufficient detail for evaluation by the RSO and RSC:

- Applications must include the name and contact information for the Principal Investigator, the radionuclide(s), the chemical or physical forms, the maximum possession limits and the locations of use and storage.
- Use protocols must accompany each application, including a description of radiological safety precautions to be taken. Significant non-radiological hazards must also be identified.
- The RSC may require additional information such as facility design, type of radiation detection equipment available, emergency procedures, waste disposal methods, and relevant training and experience of personnel.

INTERIM REVIEW AND APPROVAL BY RSO

The RSO will review each application submitted. As part of this review, the RSO may inspect the proposed use locations and equipment, interview the PI and other individuals listed on the application, request additional written information from the PI, confer with RSC members or other individuals knowledgeable in the protocols to be followed or the hazards involved, or take any other action necessary to evaluate the proposed use.

After reviewing the application, the RSO will submit it to the RSC for review and action. Along with the application, the RSO will submit recommended approval conditions or a recommendation that the application not be approved.

For most proposed uses, the RSO can approve an application on an interim basis until the next regular RSC meeting. This interim approval may include specific approval conditions which must be followed. Once interim approval has been granted, the PI will be notified that an interim permit has been issued. The PI may then obtain and use radioactive material in accordance with that interim permit. Note, however, that interim approval by the RSO does not guarantee final approval by RSC or that final specific approval conditions will be identical to the interim conditions.

The following applications are considered significant enough to require RSC approval before work can commence. Interim approval by the RSO can not be granted.

- Applications for acquisition of Hazard Class I nuclides in unsealed quantities greater than 10 microcuries or Hazard Class II nuclides other than I-125 or I-131 in unsealed quantities greater than 1 millicurie. (See Appendix A for classifications.) The RSO may grant interim approval for up to 10 mCi of I-125 or I-131 for PIs who have substantial experience using radioiodine.
- Applications for experiments or projects which involve substantial airborne hazards from gases, fine powders, or aerosols.
- Applications which the RSO feels should be brought to the attention of the RSC before approval.

APPROVAL BY RSC

After an application is reviewed by the RSO, the RSO forwards the application with recommendations to the RSC. The RSC will generally consider the application at the next regular RSC meeting. However, in rare cases, if urgent consideration by the RSC is required, a special meeting may be called or a vote taken between meetings as described in Section 1. The RSC may approve, approve with special conditions, or disapprove the application.

If the RSC requires additional information before voting, such information will be requested from the PI and final action on the application will be postponed. If interim approval by the RSO has been granted, that approval will remain in force until final action is taken by the RSC unless the RSC rescinds the interim approval.

Once final action is taken by the RSC, the PI will be informed. If approval is granted, a permit will be issued to the PI which will be valid for five years from the date of RSC approval.

AMENDMENT

A PI may request changes to a permit by submitting a written request to the RSC via the RSO. The request must contain sufficient information for evaluation by the RSO and RSC. With the exception of adding additional radiation workers (see below), the approval process for amendments is the same as for initial applications.

RENEWAL

A permit expires five years from the date of approval by the RSC. In order to continue using radioactive materials without interruption, a renewal application must be submitted far enough before the expiration date to allow for RSC review and approval.

TERMINATION

A permit may be terminated at the request of the PI, by revocation by the RSC, or at expiration if a renewal application is not submitted. When a permit is terminated, the RSO will take possession of any radioactive materials still in possession of the PI.

NON-COMPLIANCE

The following items of non-compliance will be investigated by the RSO and will be reported to the RSC. In some instances, the Alabama Department of Public Health must also be notified.

- Willful violation of university policies or state regulations regarding the use of radioactive materials.
- Loss of or inability to account for radioactive material.
- Repeated instances of mid or high level removable contamination (see Appendix C).
- Improper use of radioactive materials which results in a significant danger to personnel or the environment.
- Use of radioactive materials not authorized by the PI's permit.

The RSC will take appropriate action based on the significance of the incident. In severe cases, the RSC can suspend or revoke a PI's permit or ban an individual from working with radioactive materials at Auburn University.

EXCEPTIONS TO THE REQUIREMENTS OF THIS MANUAL

An Auburn University permit is not required for the following categories of radioactive materials and the requirements of this manual do not apply. However, all such materials must be used in a safe and prudent manner. This exception does not limit the RSC's authority over the use of these materials. The RSC may impose any restrictions or conditions deemed appropriate.

- Commercially produced standards or sealed sources containing up to the activity listed in Schedule B of Rule 420-3-26-.02 of the Alabama Radiation Control Rules. For example, most liquid scintillation counter standards are exempt.
- Commercially produced items containing radioactive materials which are exempt from Alabama Department of Public Health licensing requirements. For example, lantern mantles and welding rods containing thorium, watches containing tritium, and smoke detectors containing Am-241 are exempt.
- Devices containing radioactive materials for which a general license is issued by the Alabama Department of Public Health. For example, liquid scintillation counters containing sealed sources are generally licensed. All conditions of the general license must be followed and the Radiation Safety Officer must be informed of the acquisition, relocation, or transfer of any such devices.

A PI may request an exemption from licensing or other requirements in this manual. The RSC will grant such a request only if it will maintain compliance with the Alabama Radiation Control Regulations and conditions of Auburn University's license, it will not result in a significantly higher radiation dose to any individual, and it will significantly enhance the ability of Auburn University to fulfill its mission.

EMAIL POLICY

A Principal Investigator must include a valid email address when submitting an application to use radioactive materials. It is the responsibility of the PI to inform the Radiation Safety Officer of any change of email address.

Except as noted below, communications via email from the RSO, Assistant RSO, or any member of the Radiation Safety Committee to a PI or vice versa carry the same authority and significance as written communications. Under certain circumstances, such as unreliable access to email at a remote location or the strong desire of a PI not to correspond by email, the RSO will strive to communicate with the PI by additional means.

An initial application for the use of radioactive materials requires the signatures of multiple individuals and must currently be submitted in hard copy. Once electronic signature capabilities and policies are established at Auburn University, applications may be signed and submitted electronically.

DUTIES OF THE PRINCIPAL INVESTIGATOR

The Principal Investigator is responsible for ensuring that all radioactive materials are used in accordance with applicable regulations, university policies, and conditions of the PI's permit. Specifically, the PI must ensure that:

- Appropriate safety precautions are taken to keep radiation doses to individuals as low as is reasonably achievable. (See Section 4.)
- Radioactive materials are used only as authorized by the PI's permit.
- Radioactive materials are used only by properly trained individuals qualified as radiation workers on the PI's permit. (See below.)
- Radioactive materials are securely stored and updated inventories are kept. (See Section 4.)
- Contamination surveys are performed and documented as required. (See Section 4.)
- Radioactive materials are transferred only to authorized individuals. (See Section 3.)
- Dosimeters are properly worn by radiation workers and required bioassays are performed. (See Section 6.)
- Radioactive waste is properly collected. (See Section 4.)

RADIATION WORKERS

Radiation workers are individuals who use radioactive materials under the direction of a Principal Investigator. In order to be designated as a radiation worker, the PI must request that the worker be added to the PI's permit and the worker must receive orientation and training as described below.

ORIENTATION AND TRAINING

Each new radiation worker will attend an orientation with the Radiation Safety Officer (RSO) or Assistant RSO. This is usually a one-on-one or small group meeting and the topics covered depend on the experience and knowledge of the new worker and the work to be performed. The RSO may waive the orientation requirement for students taking an academic course where appropriate topics are presented.

Training for each radiation worker is also provided in the laboratory by the Principal Investigator (PI) or an experienced worker designated by the PI. Topics covered during this training include, as appropriate:

- Safe use of laboratory equipment and materials, including protective clothing.
- Experiment procedures and protocols.
- Safe handling, storage, and disposal of radioactive materials.
- Methods to control and measure radiation levels and contamination.
- Proper maintenance of required records.
- Emergency procedures.

RESPONSIBILITIES

Each radiation worker is responsible for using radioactive materials only as directed by the PI and in accordance with the PI's permit, applicable regulations, and university policies.

Section 3. PROCUREMENT AND TRANSFER OF RADIOACTIVE MATERIALS

GENERAL

Radioactive materials may be brought onto university property only with the prior approval of the Radiation Safety Officer (RSO).

All radioactive materials must be covered by a valid permit as described in Section 2. The procedure for obtaining radioactive materials is outlined below.

ORDERING

Approval must be obtained from the RSO prior to ordering any radioactive materials. For some users, the RSO may issue a standing approval for routine purchases up to a certain limit.

Notify the RSO indicating the vendor, the material (nuclide, activity, and form), the PI's name, the user's name, and the lab where the RSO should deliver the material.

NON-PURCHASED MATERIAL

The same requirements apply to non-purchased radioactive materials (e.g. material from researchers at other universities, free samples from vendors) as apply to purchased materials. It is especially important to make sure the sender addresses the package properly. (See below.)

RECEIPT

Except as noted below, all radioactive materials coming to Auburn University should be addressed to:

Radiation Safety
Attn: *user's name*
316 Leach Science Center
Auburn University, AL 36849

SPECIAL HANDLING

With prior approval, large, heavily shielded orders or materials requiring special handling may be delivered directly to the end user. However, such orders may only be opened under the supervision of Radiation Safety.

VETERINARY MEDICINE

Radioactive materials used in the diagnosis and treatment of animals at the College of Veterinary Medicine complex may be shipped directly to the Nuclear Medicine Laboratory and opened by an authorized technician or veterinarian. Package opening and inventory procedures specific to the Nuclear Medicine Laboratory must be followed.

OTHER FACILITIES

With prior approval of the RSO, a facility outside of the main campus and College of Veterinary Medicine complex may have radioactive materials shipped directly to that facility. Packages received at that facility may be opened only by Radiation Safety personnel or by an individual at the facility specifically trained and authorized by the RSO.

INVENTORY

Radiation Safety will assign inventory tracking numbers to incoming shipments of radioactive materials. For unsealed radioactive materials, an inventory use log will be prepared and delivered to the user. This log must be updated as the material is used or placed in waste.

TRANSFER TO ANOTHER AUBURN PRINCIPAL INVESTIGATOR

With prior approval from the RSO, radioactive materials may be transferred from one PI to another PI at Auburn University. The RSO will make appropriate changes to each PI's inventory records.

TRANSFER AND SHIPPING OFF CAMPUS

Radioactive materials may be shipped from the university or otherwise taken off campus only by Radiation Safety (except for certain field instruments as described below).

FIELD INSTRUMENTS

Certain portable instruments containing radioactive sealed sources may be authorized by the Radiation Safety Committee for use at locations not owned or controlled by the university. Users of such instruments must follow specific procedures for transportation, storage, and use of the instruments.

Section 4. POLICIES AND PROCEDURES FOR RADIONUCLIDE USE IN THE LABORATORY

POSTING AND MARKING OF AREAS AND EQUIPMENT

ENTRANCE

Each laboratory or area where radioactive materials are used or stored must be posted at the entrance with a *CAUTION RADIOACTIVE MATERIAL* sign. (This can be incorporated in a laboratory's hazard communication sign.) The sign must include the name and after-hours phone number of the Principal Investigator or other knowledgeable individual designated by the PI. Entrance caution signs are to be removed only by the Radiation Safety Officer after a laboratory is decommissioned.

WORK AREAS

Areas in the lab used for work with unsealed radioactive materials must be clearly marked with *CAUTION RADIOACTIVE MATERIAL* tape or signs whenever radioactive materials are present.

STORAGE

Refrigerators, freezers, and other areas and containers in which radioactive materials are stored must have a visible *CAUTION RADIOACTIVE MATERIAL* label. Labels should be removed from containers that are empty and not contaminated.

EQUIPMENT

Laboratory equipment (flasks, beakers, centrifuges, etc.) containing or contaminated with radioactive materials should be marked with *CAUTION RADIOACTIVE MATERIAL* tape or labels.

CONTAMINATED AREAS

Radiation Safety may mark areas and equipment to indicate significant levels of contamination found during surveys. These markings are to be removed only after the article or area has been decontaminated.

RADIATION AREA

Areas where radiation levels could result in an individual receiving a dose equivalent in excess of 5 millirem in any one hour must be posted with a *CAUTION RADIATION AREA* sign.

OTHER

The Radiation Safety Officer may require additional postings to control access or ensure safe operations.

LABORATORY SAFETY PRACTICES

CLOTHING

A lab coat or apron, disposable gloves, and appropriate eye protection should always be worn whenever unsealed sources of radioactive material are handled.

FOOD

Do not smoke, eat, drink, store food, or apply cosmetics in any laboratory where unsealed radioactive materials are used or stored.

HAND WASHING

After handling radioactive materials, be sure to wash hands thoroughly before handling food, tobacco, etc.

SHIELDING

Appropriate shielding material should be used when working with radioactive materials that present a significant external radiation exposure hazard.

When not in use, radioactive sources and stock solutions should be stored or shielded in a manner such that radiation levels in occupied areas will be as low as is reasonably achievable.

CONTAMINATION CONTROL

To limit the spread of contamination when working with unsealed radioactive materials, work surfaces should be covered with absorbent paper. Any container holding radioactive liquids should be kept in a secondary container such as a tray or bucket.

AEROSOLS, DUSTS, AND VOLATILE MATERIAL

Procedures involving aerosols, dusts, or volatile materials must be conducted in fume hoods or suitable closed systems approved by the Radiation Safety Officer.

SPECIFIC PERMIT CONDITIONS

As part of the radioactive material use approval process described in Section 2, the Radiation Safety Committee may specify additional safety practices which must be followed.

GUIDELINES FOR LABORATORY SURVEYS

FREQUENCY OF SURVEYS

Users of radioactive materials should survey their work areas (hoods, bench tops, sinks, floors, refrigerator, etc.) after each experiment and at any time there is a reason to suspect a spill or contamination incident. These surveys do not have to be documented.

Documented surveys must be performed monthly for any laboratory in which unsealed radioactive materials are used or stored. The results of these surveys must be submitted to the Radiation Safety Officer (RSO). The Radiation Safety Committee or the RSO may require more frequent documented surveys for some laboratories.

Radiation Safety conducts documented audits of laboratories in which unsealed radioactive materials are used or stored at least twice each year. This audit includes a contamination survey.

CONTAMINATION LEVELS AND REQUIRED ACTIONS

Contamination levels requiring action are shown in Appendix C. Note that any contamination (greater than twice background) discovered in accessible areas or on items outside of a clearly marked radioactive use benchtop or fume hood must be decontaminated promptly even if below the "Low" level in Appendix C.

SURVEY INSTRUMENTS

Principal Investigators must provide radiation survey meters or appropriate counting instruments for use in laboratories where radioactive materials are used.

Radiation Safety will calibrate portable survey meters at least annually and will replace weak or defective batteries and attempt minor repairs as needed.

It is the Principal Investigator's responsibility to make survey meters available for calibration and to obtain any other servicing or repairs necessary to keep them operational.

Recommended survey instruments are shown in the table below.

RECOMMENDED INSTRUMENTS

RADIATION

Low energy beta (H-3)

Intermediate energy beta (S-35, C-14, P-33)

High energy beta (P-32, Sr-90)

Low energy gamma (I-125)

High energy gamma (Cr-51, Co-60)

INSTRUMENT

Liquid scintillation counter for wipe surveys

G-M survey meter with a thin window (~2mg/cm²) detector;
Liquid scintillation counter for wipe surveys

G-M survey meter with a thin window detector

Survey meter with a thin NaI crystal scintillation detector;
Liquid scintillation counter or gamma counter for wipe surveys

G-M survey meter

CONTROL OF RADIOACTIVE MATERIAL

Principal Investigators and radiation workers must ensure that radioactive materials are used only as described on the applicable permit. Materials must not be loaned or transferred to persons not named on the permit without the prior approval of the RSO. (See Section 3.)

INVENTORY

As described in Section 3, all incoming radioactive materials are assigned inventory tracking numbers. For unsealed materials, use logs are prepared. PIs must ensure that these logs are kept updated.

SECURITY OF RADIOACTIVE MATERIALS

Radioactive material in its original delivery vial or in any other single container with an activity requiring labeling according to the Alabama Radiation Control Rules, 420-3-26-.03 Appendix C (*Quantities of Licensed Material Requiring Labeling*) must be kept under direct supervision, in locked storage (e.g. a locked cabinet or refrigerator), or in a locked laboratory. Material with a low specific activity (e.g. contaminated waste) is not included in this requirement. However, reasonable measures should be taken to secure those materials.

LOSS OR DAMAGE

The loss of any radioactive materials or damage to any sealed source must be reported to the Radiation Safety Officer immediately upon discovery. The RSO will determine what actions must be taken, including whether notification of the Alabama Department of Public Health is required.

RADIOACTIVE WASTE DISPOSAL

Radioactive waste may only be disposed of by calling Radiation Safety for pick up. No radioactive waste is to be disposed of in ordinary trash receptacles. No liquid waste may be disposed of in drains or other sewer openings by laboratory personnel without prior approval of the RSO. (However, after the first rinse, glassware and other items may be washed in laboratory sinks.)

A Radioactive Waste Disposal Sheet must be properly completed for each container of waste to be picked up.

Do not wait for a container to completely fill up before calling for a pick up.

MIXED HAZARDOUS/RADIOACTIVE WASTE

Radioactive waste containing any other hazardous material requires special handling. Radiation Safety must be consulted before any such waste is generated.

Any items that may be considered hazardous waste (e.g. mercury thermometers, lead pigs) which become contaminated should not be placed in the solid waste containers. Radiation Safety will collect any such items separately.

SOLID WASTE

Radiation Safety provides containers (e.g. fiberboard drums) for the collection of solid radioactive waste. Depending on the laboratory, there may be separate solid waste containers for different radionuclides based on their half-lives.

LIQUID WASTE

Radiation Safety provides containers (e.g. plastic carboys) for the collection of liquid radioactive waste. Depending on the laboratory, there may be separate liquid waste containers for different radionuclides based on their half-lives.

SCINTILLATION VIALS

Radiation Safety provides containers (e.g. fiberboard drums) for the collection of scintillation vials with scintillation fluid still in them. Do not mix full scintillation vials with solid waste.

SCINTILLATION FLUID

As an alternative to collecting full scintillation vials, fluid from the vials may be poured into a waste container supplied by Radiation Safety. The empty vials may then be placed in the solid waste. This option may only be used if the scintillation fluid is non-hazardous.

SHARPS

Razor blades, needles, and other sharps which are contaminated should be placed in a separate sharps container marked with a *CAUTION RADIOACTIVE MATERIAL* label. Do not place sharps in the solid waste drums.

SMALL CONTAINERS

For convenience, small, properly-labeled containers may be used on the bench top to collect waste during an experiment.

ANIMAL WASTE

Disposal of animal carcasses, tissue, and excreta is handled on a case-by-case basis. Contact the Radiation Safety Officer to determine the proper method for handling any animal wastes generated.

USE OF RADIOACTIVE MATERIALS IN ANIMALS

APPROVAL BY IACUC

Use of radioactive materials in animals for research requires the approval of the Institutional Animal Care and Use Committee (IACUC) as well the approval of the Radiation Safety Committee (RSC) as described in Section 2.

Section 5. RADIATION-PRODUCING MACHINES

GENERAL

DEFINITIONS

A *radiation-producing machine* is any device capable of producing ionizing radiation when the associated control devices are operated, except devices which produce radiation only by the use of radioactive material. X-ray diffraction machines, diagnostic x-ray units, and particle accelerators are common examples of radiation-producing machines.

An *analytical x-ray machine* is a radiation-producing machine utilizing x-rays to determine the elemental composition or examine the microstructure of materials. The most common type of analytical x-ray machine on campus is the x-ray diffraction machine.

REGULATION

Use of radiation-producing machines is regulated by the state. A copy of the Alabama Radiation Control Rules (ARCR) is available for review at Risk Management and Safety, 316 Leach Science Center. Auburn University's policies for the use of radiation-producing machines are designed to meet the applicable requirements of the ARCR and to ensure the safety of users and other personnel. Individuals using radiation-producing machines should be familiar with the applicable provisions of the ARCR.

REGISTRATION

Radiation-producing machines must be registered with the Alabama Department of Public Health. Registration will be in the name of the university, with the Radiation Safety Officer (RSO) as the point of contact. The RSO must be notified of the acquisition, transfer, or disposal of any radiation-producing machine.

DOSIMETRY

Dosimetry requirements, described in Section 6, will be established by the Radiation Safety Officer upon a review of each facility. An individual issued a dosimeter must wear it while involved in any operation of a radiation-producing machine.

AUBURN PERMIT

APPLICATION FOR USE

Faculty members who wish to operate a radiation-producing machine must submit an *Application for Use of Radiation-Producing Machine* form to the Radiation Safety Committee (RSC) via the Radiation Safety Officer (RSO).

Each application must be completed in sufficient detail for RSC evaluation. Applications must include a description of the machine (including maximum operating parameters), description of proposed use, and for machines operating above 100 kV, a description of the facility.

Particle accelerators and certain other radiation-producing machines which may present special hazards require operating conditions beyond those listed in this chapter. The RSO will work closely with the PI to ensure appropriate facility designs and operating procedures are developed.

APPROVAL BY RSC

All applications for use of radiation producing-machines are reviewed by the RSO and then forwarded to the RSC in the same manner as described in Section 2 for applications to use radioactive materials. Upon approval, a permit is issued, listing any special conditions specified by the RSC.

AMENDMENT TO PERMIT

A Principal Investigator (PI) may request changes to a permit by submitting a written request to the RSC via the RSO. The request must contain sufficient information for evaluation by the RSO and RSC. The procedure for adding a new radiation worker to a permit is similar to that described in Section 2.

RENEWAL

A permit expires five years from the date of approval by the RSC. In order to continue using a radiation-producing machine without interruption, a renewal application must be submitted far enough before the expiration date to allow for RSC review and approval.

TERMINATION

A permit may be terminated at the request of the PI, by revocation by the RSC, or at expiration if a renewal application is not submitted. When a permit is terminated, the RSO will take appropriate steps to ensure the machine is not operated.

NON-COMPLIANCE

The following items of non-compliance will be investigated by the RSO and will be reported to the RSC. In some instances, the Alabama Department of Public Health must also be notified.

- Willful violation of university policies or state regulations regarding the use of radiation-producing machines.
- Improper use of a radiation-producing machine which results in a significant danger to personnel.

The RSC will take appropriate action based on the significance of the incident. In severe cases, the RSC can suspend or revoke a PI's permit or ban an individual from working with radiation-producing machines at Auburn University.

POLICIES AND PROCEDURES FOR USE OF ANALYTICAL X-RAY MACHINES

AUTHORIZED OPERATORS

Principal Investigators are responsible for ensuring that only authorized individuals are allowed to operate their machines. Authorized individuals are those listed on the original application or added using the New Radiation Worker Form.

TRAINING

New personnel must be trained by the Principal Investigator (or an experienced qualified operator designated by the PI) and must satisfactorily demonstrate knowledge of operating and safety procedures before independently operating a radiation-producing machine.

Depending on prior experience and the type of machine to be operated, new personnel may be required to attend an orientation with the Radiation Safety Officer and/or complete a short written test to demonstrate knowledge of operating and safety procedures.

POSTING

A sign bearing the radiation symbol and the words CAUTION X-RAY EQUIPMENT (or similar wording) must be posted at the entrance to each laboratory containing a radiation-producing machine.

A label bearing the words CAUTION THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED (or similar wording) must be affixed to the control device of each machine.

A label bearing the words CAUTION HIGH INTENSITY X-RAY BEAM (or similar wording) must be affixed on or near the tube of an x-ray unit.

An X-RAYS ON warning light, labeled as to its meaning, shall be located on or near an x-ray tube to indicate when x-rays are being produced.

ACCESS CONTROL

Key control or equivalent access control must be maintained for each machine. For older machines which do not have a keyed control device, this requirement may be fulfilled by controlling access to the laboratory.

OPERATING PROCEDURES

Operating procedures for each machine must be available near the machine.

UNUSED PORTS

All unused x-ray ports must be permanently blocked or be interlocked so that x-ray production is stopped if the port is opened. Material used to block unused ports must be of sufficient density and thickness to attenuate the primary beam to acceptable levels.

RADIATION SAFETY SURVEYS

Radiation Safety performs inspections of analytical x-ray machines when first installed, periodically, and whenever significant changes to the machine, facility, or operating procedures are made.

POLICIES AND PROCEDURES FOR USE OF VETERINARY X-RAY MACHINES

AUTHORIZED OPERATORS

Principal Investigators are responsible for ensuring that only authorized individuals are allowed to operate their x-ray machines. Authorized individuals are those listed on the original application or added using the New Radiation Worker Form.

TRAINING

Any person participating in the performance of x-ray procedures must have received radiation safety training prior to performing these duties. New personnel must satisfactorily demonstrate knowledge of operating and safety procedures before independently operating an x-ray machine. (This training is included in academic courses taken by students in the College of Veterinary Medicine.)

RADIATION SAFETY PRACTICES

No x-ray exposure will be permitted of any animal unless ordered in writing or verbally by a veterinarian. Standing orders from a veterinarian are acceptable.

Mechanical aids will be used to hold an animal in position if practical. Any person holding an animal during an x-ray procedure must wear a lead apron and gloves of at least 0.5 millimeter lead equivalence. (The condition of aprons and gloves should be checked periodically.)

No person shall be allowed to be in the primary x-ray beam at any time.

No person other than those involved in the procedure shall be in the x-ray room while an exposure is being made.

POLICIES AND PROCEDURES FOR OTHER RADIATION-PRODUCING MACHINES

The Radiation Safety Officer and Radiation Safety Committee will set specific policies and procedures for those types of radiation-producing machines not described above.

Section 6. RADIATION DOSE LIMITS AND PERSONNEL MONITORING

GENERAL

Permissible occupational radiation dose levels are set by the Alabama Radiation Control Rules (ARCR). The levels are based on recommendations by the International Commission on Radiation Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), and by federal and state regulatory agencies.

ALARA

In practice, radiation doses should be kept *As Low As is Reasonably Achievable*. ALARA is a guideline meant to strike a balance between the costs of radiation protection, the health benefits derived from that protection, and the benefits from the use of radioactive materials and radiation-producing machines.

Auburn University is committed to keeping radiation doses of all individuals as low as is reasonably achievable consistent with its mission to serve the citizens of Alabama through its instructional, research, and outreach programs.

It is the responsibility of everyone including radiation workers, principal investigators, Radiation Safety, and the administration to operate within the ALARA guideline. This is achievable by developing and following radiation safety procedures and by monitoring workplaces to control contamination and minimize doses.

DOSE HISTORY

Radiation workers interested in reviewing their dose history records should contact the Radiation Safety Officer. A written authorization signed by the radiation worker is required to release dose history records to a third party (except for certain government agencies).

DOSE LIMITS

The ARCR dose limits for adult radiation workers are listed in the table below.

<u>Dose Category</u>	<u>Adult Occupational Dose Limit</u>
Total Effective Dose Equivalent (TEDE)	5 mm per year
Total Organ Dose Equivalent (TODE)	50 rem per year to any individual organ or tissue except the lens of the eye
Lens Dose Equivalent	15 rem per year to the lens of the eye
Shallow Dose Equivalent	50 rem per year to the skin or to any extremity

It should be noted that the above dose limits are permissible *occupational* dose limits. These dose limits are in addition to the background radiation dose or medical radiation dose received by the worker. The average annual background radiation in the U.S. due to natural sources is approximately 300 millirem per year.

MINORS

Radiation dose limits for radiation workers under eighteen years old are ten percent of the adult limits shown above. Except under exceptional circumstances, minors will not be authorized to use radioactive materials or radiation-producing machines.

PREGNANCY

The dose limit to the embryo/fetus of a declared pregnant woman is 0.5 rem. Efforts must also be made to avoid substantial variation above a uniform monthly exposure rate. A declared pregnant woman means a woman who has voluntarily informed the Radiation Safety Officer, in writing, of her pregnancy and the estimated date of conception.

The dose to an embryo/fetus is the sum of the deep-dose equivalent to the declared pregnant woman and the dose from internally deposited radionuclides in the embryo/fetus and in the woman.

EXTERNAL DOSE MONITORING

The Alabama Radiation Control Rules (ARCR) specify individuals who must be monitored for exposure to radiation. They include individuals

- Entering a high or very high radiation area.
- Operating a panoramic irradiator or entering the irradiation room.
- Operating photofluoroscopic equipment in the healing arts.
- Operating mobile x-ray equipment in the healing arts.
- Performing certain maintenance operations on x-ray equipment.
- Likely to receive an external dose greater than ten percent of the occupational dose limits shown above.
- Likely to receive more than 25 mrem per week from operating x-ray equipment in the healing arts.

Experience has shown that very few radiation workers at Auburn University will require monitoring based on the ARCR. However, Auburn University policy is that in addition to those requiring monitoring by the ARCR, whole-body dosimeters will be worn by individuals frequently handling one millicurie or more of a radionuclide with a beta energy of greater than 600 keV or with a gamma of any energy. Individuals handling higher activities of such radionuclides may also be required to wear ring dosimeters.

The Radiation Safety Officer (RSO) may also designate other individuals to be monitored.

DOSIMETERS

Generally, an optically stimulated luminescence (OSL) dosimeter is used for whole-body dose monitoring and a thermoluminescent dosimeter (TLD) ring is used for monitoring dose to the hands. In most cases, dosimeters are exchanged quarterly or semiannually.

The RSO may authorize or require additional or other types of dosimeters to be used, increase the exchange frequency, or post environmental dosimeters in areas near radiation sources.

Dosimeters are processed commercially and dose reports are generated. These reports are reviewed by the RSO. Any unusual or excessive doses are investigated by the RSO and, when appropriate, additional measures are implemented to prevent a recurrence.

PRECAUTIONS

If an individual is issued a whole-body dosimeter, it is to be worn when in an area in which radioactive materials are used or radiation-producing machines are being operated. The ring dosimeter is to be worn when handling radioactive materials. Both dosimeters register radiation from gamma rays, x-rays and high-energy beta particles. Neither dosimeter detects radiation from low energy beta emitters such as H-3, C-14, and S-35. In the case of neutron radiation, special dosimeters are issued.

The whole-body dosimeter should be worn at the collar or chest level to measure the radiation dose received by the trunk of the body. The ring dosimeter is worn under the glove on a finger of the hand expected to receive the larger radiation dose.

The radiation dose recorded by the dosimeters is entered into the occupational dose record of the individual. To ensure that this record is valid and accurate, the following precautions must be observed:

- A dosimeter must only be worn by the individual to whom it has been issued.
- When not in use, a dosimeter should be left in a place free from radiation, moisture, and high temperatures.
- A dosimeter must not be deliberately exposed to radiation.
- The dosimeter packet must not be tampered with.
- The Radiation Safety Officer must be notified as soon as possible if there is reason to believe that a dosimeter has been damaged, lost, or accidentally exposed or contaminated.

BIOASSAY GUIDELINES

When using radioactive materials, accidental ingestion, inhalation, or absorption may occur. This can happen as the result of loose surface contamination or as the result of volatile chemical forms of radionuclides. The latter is of special concern when individuals are working with I-125 or I-131.

For example, some radioiodine compounds undergo decomposition that could result in the volatilization of the radioiodine. If this happens, accidental uptake of radioiodine may occur. In the body, iodine concentrates in the thyroid and irradiates that organ.

The bioassay program is designed to enable Radiation Safety to determine the amount of radioactivity in the body and to calculate the radiation dose. Any unusual or excessive doses are investigated by the Radiation Safety Officer and, when appropriate, additional measures are implemented to prevent recurrence.

PROGRAM PARTICIPATION

Any individual working with unsealed sources in amounts exceeding the levels described below will be included in the bioassay program.

<u>Nuclide</u>	<u>Activity</u>	<u>Form</u>
I-125 or I-131	10 mCi	Volatile (e.g. NaI)
I-125 or I-131	100 mCi	Non-volatile (e.g. protein bound)
H-3, C-14, P-32, P-33, or S-35	100 mCi	Any (except H-3 accelerator targets)
Other	As determined by the Radiation Safety Officer	

Note that:

- All volatile forms of radioiodine must be used inside an approved fume hood or glove box (except for the administration of veterinary treatments).
- All non-volatile forms of radioiodine over 1 mCi must be used inside an approved fume hood or glove box.
- For I-131 solutions used in veterinary treatments given by subcutaneous injection (typical method), a thyroid assay will be required for any single procedure involving greater than 10 mCi or cumulative use greater than 15 mCi in any one week.

USE OF I-125 OR I-131

Required Thyroid Assays

<u>Type of Assay</u>	<u>Necessary When...</u>	<u>Done...</u>
Baseline	Beginning work with I-125 or I-131 in quantities stated above.	Before beginning work with radioiodine.
Routine	Working with quantities stated above (at any time or cumulatively over a one month period.	Within 7 days for I-125 or 3 days for I-131.
Special	Determining internal uptake after an incident involving radioiodine.	As determine by Radiation Safety Officer.
Follow-up	Monitoring existing Internal contamination.	As determine by Radiation Safety Officer.

USE OF OTHER RADIONUCLIDES

Required Urinalyses

<u>Type of Assay</u>	<u>Necessary When...</u>	<u>Done...</u>
Routine	Working with quantities stated above (at any time or cumulatively over a one month period.	Within 7 days or as determined by the Radiation Safety Officer.
Special	Determining internal uptake after an incident involving radioiodine.	As determine by Radiation Safety Officer.
Follow-up	Monitoring existing Internal contamination.	As determine by Radiation Safety Officer.

Section 7. EMERGENCY PROCEDURES

INTRODUCTION

During the course of routine operations, radioactive material may be spilled resulting in contamination of personnel or lab equipment and areas. Correct action taken during such an incident can prevent unnecessary doses to personnel and further spread of contamination.

GENERAL PROCEDURES

Medical attention takes precedence over radiological or other concerns in the case of a serious injury. Inform emergency personnel if there is the possibility of contamination.

Do not risk an external or internal radiation dose in order to save equipment or an experiment. An exception to this should only be made at the direction of a person qualified to evaluate the hazards involved.

Take all reasonable precautions to limit the spread of the radioactive contamination.

- Limit access to the area.
- Turn off ventilation system, if possible.
- Prevent spread of liquid or powdered contaminants.

SERIOUS INJURY INVOLVING RADIOACTIVE MATERIAL

1. Dial 911 and request emergency medical services. Tell the 911 operator that it is also a radiation emergency and request notification of the Radiation Safety Officer.
2. When emergency personnel arrive, inform them of the possibility of radioactive contamination.
3. Follow the steps for a major or minor spill as appropriate.
4. Try to determine the radionuclide, activity, and chemical form of the material involved.

MAJOR SPILL

A radioactive material spill is considered major if it results in any of the following:

- Internal radiation dose to personnel (inhalation/ingestion of radioactive material).
 - Excessive external radiation dose to or contamination of personnel.
 - Contamination of large areas.
 - Considerable delay in work.
1. Notify personnel not involved in the spill to vacate the laboratory. Prevent other personnel from entering the contaminated area.
 2. Monitor personnel for contamination.
 3. Remove contaminated clothing. If skin is contaminated, flush thoroughly with water and wash with mild soap.
 4. Confine movement of all potentially contaminated personnel to prevent further spread of contamination.
 5. Cover a liquid spill with absorbent paper or pads. Dampen dry powders, being careful not to spread contamination. Use oil if material is water reactive. Do not attempt to clean up the spill.
 6. Notify the Radiation Safety Officer (ext. 4-4870). If after working hours, dial 911 and instruct operator to contact the Radiation Safety Officer. Also notify the laboratory supervisor or Principal Investigator.
 7. If possible, turn off fans or ventilation that might spread vapors or dust.
 8. Try to determine the radionuclide, activity, and chemical form of the material involved.
 9. Assist Radiation Safety in evaluation and decontamination.

MINOR SPILL

A radioactive material spill can generally be considered minor if it contaminates small areas or equipment and results in:

- No external or internal contamination of personnel.
 - No excessive external radiation dose to personnel.
 - No serious delay in work.
1. Notify personnel in the area that a spill has occurred.
 2. Monitor personnel leaving the area and remove any contaminated clothing.
 3. Cover a liquid spill with absorbent paper or pads. Dampen dry powders, being careful not to spread contamination. Use oil if material is water reactive.
 4. Call the Radiation Safety Officer (ext. 4-4870) if assistance is needed.
 5. Plan the decontamination procedure before proceeding. Keep in mind these points:
 - Limit personnel to a minimum.
 - Wear appropriate protective clothing.
 - Dispose of all contaminated material as radioactive waste.
 - Use appropriate survey instruments. Perform wipe tests if necessary.
 - After decontamination, check all areas around the spill and all personnel for contamination. Be sure to check hands and shoes.

RADIATION-PRODUCING MACHINE

In the event of an accident or unusual incident involving a radiation producing machine:

1. If there is a serious injury or fire, call 911 and request emergency medical services or the fire department.
2. **TURN OFF THE MACHINE.** If possible, turn off the circuit breaker for the machine.
3. Notify the Radiation Safety Officer (ext. 4-4870). If after working hours, call 911 and have the 911 operator contact the Radiation Safety Officer.
4. Notify the laboratory supervisor or Principal Investigator.
5. Record information about the incident (e.g. operating voltage and current, exposure time, distance from radiation source).

Appendix A CLASSIFICATION OF RADIONUCLIDES ACCORDING TO RELATIVE HAZARD POTENTIAL

HAZARD POTENTIAL

VERY HIGH

(HAZARD CLASS I)

RADIONUCLIDES

Sr-90, Pb-210, Po-210, At-211, Ra-226, Ac-227, Th-228, Th-229, Th-230, Th-231, U-233, Pu-238, Pu-239, Am-241, Cm-242, Cf-252, other transuranic nuclides

HIGH

(HAZARD CLASS II)

Ca-47, Fe-59, Co-60, Sr-85, Sr-89, Y-91, Ru-106, Cd-109, Cd-115, I-125, I-131, Ba-140, Ce-144, Sm-151, Eu-152, Eu-154, Tm-170, Hg-203, Bi-207, Th-232, natural thorium, natural uranium.

MODERATE

(HAZARD CLASS III)

Na-22, Na-24, P-32, P-33, S-35, Cl-36, K-42, Ca-45, Sc-46, Sc-47, Sc-48, V-48, Mn-56, Fe-55, Co-57, Co-58, Ni-59, Ni-63, Cu-64, Cu-67, Zn-65, Ga-67, Ga-68, Ga-72, As-74, As-76, Br-82, Kr-85, Rb-84, Rb-86, Y-90, Zr-95, Nb-95, Mo-99, Tc-99, Rh-105, Pd-103, Ag-105, Ag-111, Sn-113, Te-127, Te-129, I-132, Xe-133, Cs-137, La-140, Pr-143, Pm-147, Ho-166, Lu-177, Ta-182, W-181, Re-183, Ir-190, Ir-192, Pt-191, Pt-193, Au-196, Au-198, Au-199, Tl-200, Tl-202, Tl-204, Pb-203, Hg-197

LOW

(HAZARD CLASS IV)

H-3, Be-7, C-14, F-18, Cr-51, Ge-68, Ge-71, Sr-87m, Tc-99m, In-111, Tl-201

The hazard potential of a radionuclide is considered during the evaluation of an application to use radioactive material. It is used when determining the workplace type and other approval conditions.

These classifications are based on various published data, Auburn University experience, and the judgment of the Radiation Safety Officer.

Appendix B WORKPLACE STANDARDS FOR OPERATIONS WITH UNSEALED RADIOACTIVE MATERIAL

The Radiation Safety Committee (RSC) will specify the minimum required workplace type as one of the approval conditions for each permit for unsealed radioactive material. The RSC takes into account the nature of the operation, the radionuclide involved, the physical and chemical form of the radionuclide, the activity to be used, and other possible hazards.

Below are the minimum requirements for each workplace type.

TYPE A – Laboratory

1. Must have a ventilation system that provides at least four air changes per hour.
2. Must have smooth and impermeable work surfaces for experiments involving radioactive material.

TYPE B - Laboratory with Fume Hood

1. Must satisfy Type A requirements.
2. Must be equipped with a fume hood. The hood must have an average face velocity of at least 100 feet per minute with the sash at a workable height.

TYPE C - Restricted Use Laboratory

1. Must satisfy Type B requirements.
2. Must be used primarily for radioactive material work. No area of the laboratory may be used as a study area.

TYPE D - High Hazard Laboratory*

1. Must satisfy Type C requirements.
2. Additional requirements will be determined by the RSC on a case by case basis. These requirements may include some or all of the following:
 - Glove boxes
 - High efficiency filtration of exhaust air
 - Contamination control at exit points
 - Remote handling facilities
 - High level waste collection facilities
 - Alarm systems to signal high levels of airborne radioactivity or high radiation fields.

*As of May 2010, there is only one Type D laboratory on campus.

Appendix C CONTAMINATION LEVELS AND REQUIRED ACTIONS

Any contamination (greater than twice background level) discovered in accessible areas or on items outside of a clearly marked benchtop or fume hood radioactive use work area must be decontaminated promptly even if below the “Low” level in this table.

Type of Contamination	Removable Contamination Levels (pCi/100cm ²)*		
	Low	Mid	High
Alpha Emitter (e.g. Am-241)	5 - 10	10 - 100	> 100
Example instrument readings**	Any 10-20 cpm with LSC, 2-4 cpm with alpha detector	Any 20-200 cpm with LSC, 4-40 cpm with alpha detector	Any >200 cpm with LSC, >40 cpm with alpha detector
Gamma or High Energy Beta Emitter (e.g. I-125, P-32)	100 - 250	250 - 1000	> 1000
Example instrument readings**	P-32 200-500 cpm with LSC, 75-200 cpm with G-M I-125 100-250 cpm with LSC, 150-400 cpm with LEGS	P-32 500-2000 cpm with LSC, 200-800 cpm with G-M I-125 250-1000 cpm with LSC, 400-1500 cpm with LEGS	P-32 >2000 cpm with LSC, >800 cpm with G-M I-125 >1000 cpm with LSC, >1500 cpm with LEGS
Low or Intermediate Energy Beta Emitter (e.g. H-3, C-14, P-33)	1000 - 2500	2500 - 10000	> 10000
Example instrument readings**	H-3 detectable with LSC only, 1000-2500 cpm C-14 1500-4000 cpm with LSC, 75-200 cpm with G-M	H-3 detectable with LSC only, 2500-10000 cpm C-14 4000-15000 cpm with LSC, 200-800 cpm with G-M	H-3 detectable with LSC only, >10000 cpm C-14 >15000 cpm with LSC, >800 cpm with G-M
Required Actions	Should be decontaminated promptly, but may be tolerated in a particular work situation. (Must be in a clearly marked radioactive work area.)	Must be decontaminated promptly. If repeated instances occur or large areas are discovered, the PI may be required to report to the RSC stating the reason for the incident(s) and actions taken to minimize the risk of a repeat.	Requires immediate action. The PI and RSO must be informed. Depending on the extent of the contamination, further use may be suspended until decontamination is completed. The PI may be required to report to the RSC stating the reason for the incident and actions taken to minimize the risk of a repeat.

* “Removable contamination” means the amount of radioactive material which would be removed by wiping a surface with an absorbent material (e.g. filter paper) using moderate pressure. The RSO may designate higher limits for a Type D laboratory or lower limits for certain nuclides.

** Example instrument readings are given in counts per minute (cpm) above background for counting wipes in a liquid scintillation counter (LSC); direct measurements using a thin-window Geiger-Mueller (G-M) detector or low energy gamma scintillator (LEGS) detector at 1 inch from the surface; or direct measurements using an alpha detector on contact with the surface. The examples are based on typical values for the efficiencies of different types of detectors and the percentage of material which would be removed by a wipe of the area. Refer to the *Radiation Safety Reference Handbook* for more information on the selection and use of detection instruments.

The degree of hazard involved with radioactive contamination is dependent on a number of factors such as total area, radionuclide, chemical/physical form, accessibility to the area, and permeability of surface. Radiation Safety Office professionals are available to assess hazards and to provide guidance and assistance in decontamination.