

THE UNIVERSITY OF KANSAS

LAWRENCE CAMPUS

RADIATION SAFETY PLAN

Part IV - (Ionizing) Radiation Safety Plan
of the Laboratory Safety Program/Plan

This plan (Part IV) is licensed by the
Kansas Bureau of Radiation Control

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Part IV
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1) RADIATION SAFETY PLAN

1.1) Introduction

The **Laboratory Safety Program/Plan** is a comprehensive safety program planned to ensure that a safe and healthy environment exists for individuals in laboratories at the University of Kansas (Lawrence Campus). This program/plan includes *general* universal safety requirements for all laboratories, and *specific* safety requirements for chemical, biological, radiation, laser, etc., applications. The universal requirements that comprise Part I, and the specific radiation protection requirements that comprise Part IV, complete the University's **Radiation Safety Plan**.

1.2) Purpose

The **Radiation Safety Plan** provides the administrative controls, assigns responsibilities, and specifies management review for the policies, procedures, and instrumentation methods developed and implemented to assure safe operations.

1.3) Requirements

1.3.1) Mandate

The Radiation Safety Plan is mandated by state and federal regulations and is authorized by the policies issued by the Office of the Provost/Executive Vice Chancellor of the Lawrence campus. The University policies that authorize the organizational structure for and the implementation of the Plan are outlined in the Kansas University Safety Program (KUSP). The KUSP precedes Part I of the Laboratory Safety Program. It also assigns the responsibility to the Radiation Safety Service for creating and maintaining a manual with written procedures for implementing administrative responsibilities, policies, and measurement requirements that must be made to document and to monitor the effectiveness of the Radiation Protection Program.

1.3.2) Stipulations and Limitations

The Radiation Safety Plan (only Part IV, not Part I) has been submitted as part of the Radioactive Materials License Application and may not be modified without prior approval by the State of Kansas Bureau of Air and Radiation. Part IV references Part I of the Laboratory Safety Manual, and the Kansas University Safety Program (KUSP). The Kansas University Safety Program (KUSP) and Part I are not part of the license application and may be changed without a license amendment provided that the changes in those documents comply with the commitments and requirements set forth in Part IV of the Laboratory Safety Program/Plan. These parts do not contain procedures and subordinate policies. Part I is important reference material that authorizes the Radiation Safety Plan as described in this Part and its references.

In addition, Guidance Documents and other referenced materials in the Radiation Safety Plan are not part of the license application. These procedures are continually being modified and amended to document and to implement a radiation protection program appropriate to the scope and extent of the activities conducted under the license, to ensure compliance with the regulatory provisions, and to achieve occupational doses and doses to members of the public that are as low as reasonably achievable: (ALARA).

1.4) **Applicability**

All individuals at the University of Kansas (Lawrence Campus) are subject to the conditions and requirements set forth for Authorized Users, Authorized Occupants and/or Visitors, as applicable.

2) ORGANIZATION OF THE RADIATION SAFETY PLAN

2.1) Units of the Program

2.1.1) Introduction

The operating units of the Radiation Safety Plan consist of Management, the University of Kansas (Lawrence Campus) Radiation Safety Committee which is a subcommittee within the Laboratory Safety Committee, the Radiation Safety Service, and Authorized Laboratories. The Radiation Safety Committee will be designated as the "Committee" in Part IV of the Laboratory Safety Manual.

Some portions of Part I are restated in the Radiation Safety Plan so that they may be incorporated as part of the University's Broad Radioactive Materials License. This chapter identifies additional required qualifications for some individuals that are not stated in Part I.

2.1.2) Management at the University of Kansas

The Chancellor of the University has:

2.1.2.1) Ultimate authority over both the Lawrence and Kansas City campuses of the University of Kansas.

University Directors are:

2.1.2.2) Given administrative authority over specific areas of the University by the Chancellor of the University.

The Provost has:

2.1.2.3) Responsibility for the programs at the University of Kansas (Lawrence Campus).

Vice Chancellor and Deans:

2.1.2.4) Have responsibilities for various aspects of operations at the University of Kansas (Lawrence Campus) under the Provost.

Unit Directors and Unit Chairs:

2.1.2.5) Have responsibilities to comply with the requirements of the operations.

2.1.3) Composition of the Radiation Safety Committee

The Radiation Safety Committee shall meet the qualifications and requirements of a Type A Broad Radioactive Materials License under the State of Kansas. The Committee shall be composed of five members and a consultant to represent the following types of Users of radioactive materials and of other sources of ionizing radiations as follows:

2.1.3.1) Two Authorized Laboratory Supervisors with training and experience with the chemical manipulation of radioactive materials. Alternatively, one of these may be an Authorized Laboratory Supervisor with training and experience in the use of machines that generate ionizing radiation.

2.1.3.2) An Authorized Laboratory Supervisor with training and experience in tracer metabolism in biological organisms.

2.1.2.3) The Radiation Safety Officer.

2.1.3.4) A representative of management.

2.1.3.5) A physician from the Student Health Service shall be designated as the medical consultant to the Committee. The medical consultant is not a voting member.

Note: Although the Radiation Safety Committee is a subcommittee within the Laboratory Safety Committee for purposes of coordinating all safety-related programs efficiently and cohesively, it functions independently from the Laboratory Safety Committee as required by State regulations. The Radiation Safety Committee's responsibility to the Laboratory Safety Committee is to formulate and administer its provisions consistently with those created for other health and safety issues within the Laboratory Safety Committee.

2.1.4) Composition of the Radiation Safety Service

2.1.4.1) The Radiation Safety Service is a subunit of the Department of Environment, Health, and Safety.

The Radiation Safety Service (RSS) shall consist of no fewer than two professionals in radiation safety as follows:

2.1.4.2) Radiation Safety Officer (RSO). This person shall be eligible for certification by the American Board of Health Physics and shall have at least five years of professional experience in Health Physics and should have a Master's degree or its equivalent in Health Physics.

2.1.4.3) Assistant Radiation Safety Officer. This person shall be eligible for certification by the American Board of Health Physics and shall have at least two years of professional experience in Health Physics, and should have a Master's degree or its equivalent in Health Physics, or shall have at least five years of professional experience in Health Physics, and should have a Bachelor's degree or its equivalent in Health Physics.

Note: The Assistant Radiation Safety Officer is the Acting Radiation Safety Officer in the absence of the Radiation Safety Officer.

The Radiation Safety Service (RSS) shall consist of no fewer than a half-time equivalent in radiation safety as follows:

2.1.4.4) Radiation Protection Specialist or equivalent. This person shall have completed a Bachelor's degree from an accredited college or university in the natural sciences or engineering, preferably in Health Physics, and have one year of professional experience that includes laboratory work. Experience in radiation safety is preferred. Additional experience in radiation protection or laboratory technology may be substituted for college study on a year-by-year basis. Graduate study in the natural sciences or engineering may be substituted for experience at a rate of 24 hours of graduate study per year of experience.

Note: The program may require additional staff support. Technical staff should have course work in the natural sciences, preferably in Health Physics, experience in the laboratory, preferably in radiation safety, and shall have fifty hours of training in radiation protection.

2.1.5) Composition of the Staff of an Authorized Laboratory

An **Authorized Laboratory** is any unit, the physical facilities and the associated Approved Users, that has been approved by the Committee to use a source(s) of ionizing radiation under a specific permit. Sources of ionizing radiation may only be used by Authorized Laboratories at the University of Kansas (Lawrence Campus). The staff of an Authorized Laboratory shall consist of the following as a minimum:

2.1.5.1) **Authorized Laboratory Supervisor.** This individual is responsible for all operations with sources of ionizing radiation within the Authorized Laboratory subject to federal, state, university and "permit" requirements and regulations. The Authorized Laboratory Supervisor must also be an Authorized User. See Section 2.1.5.2 below.

In addition, an Authorized Laboratory may have one or more of the following:

2.1.5.2) **Authorized User.** An Authorized User is an individual certified by the RSS to have the training and experience necessary to perform the operations authorized under a Committee-approved permit. Only Authorized Users may use sources of ionizing radiation at the University of Kansas (Lawrence Campus) and only as authorized under the certification of their training and as authorized under a permit.

2.1.5.3) **Authorized Occupant (Laboratory Occupants).** These individuals have ongoing working responsibilities in an Authorized Laboratory but are not authorized to handle or work with sources of ionizing radiation.

2.1.5.4) **Authorized Occupants (Non-laboratory Personnel).** These individuals perform either routine or requested services in the Authorized Laboratory but are not under the direct supervision of the Authorized Laboratory Supervisor.

2.1.5.5) **Visitors.** Any individual other than those specified in Sections 2.1.5.1 to 2.1.5.4 above who enters an Authorized Laboratory.

2.2) Relationships of the Units

2.2.1) Management.

The Chancellor and/or Provost:

2.2.1.1) Assigns the personnel that shall have the responsibility for ensuring that an effective Radiation Protection Program is implemented and supported. It is understood that, although the *reporting and budgetary unit* for the Radiation Protection Program is an assigned office, the Chancellor has ultimate responsibility for the Radiation Protection Program. The *reporting and budgetary unit* shall be an office whose authority is at least equivalent to that of Associate Provost.

2.2.1.2) Issues the policies under which Radiation Protection Program is authorized, established, and implemented.

Note: The Radiation Safety Service (operational arm) reports to the Director of Environment, Health, and Safety, who reports to the Associate Provost under the Provost. The operating budget for the Radiation Safety Service is provided by that office through the Department of Environment, Health, and Safety. The Radiation Safety Committee reports to the Provost through the Environment, Health and Safety Council and its Coordinator. The reporting structure may be changed by notifying the State of Kansas Radiation Control Program. The change will not be considered to be a license amendment if it meets the specifications given in Section 2.2.1.1.

2.2.2) Radiation Safety Committee.

The Provost and/or Associate Provost:

2.2.2.1) Appoints the members of the Radiation Safety Committee and authorizes the Committee, with the RSS, to implement the Radiation Protection Program.

The Radiation Safety Committee is:

2.2.2.2) Responsible for the ongoing Radiation Protection Program and for future changes in the program. The Committee is bound by federal, state, and University regulations in carrying out its responsibilities.

2.2.3) Radiation Safety Service (RSS).

A "Search Committee" selects:

2.2.3.1) Members of the Radiation Safety Service staff. The individuals hired by the University under the recommendations of the "Search Committee" shall meet the minimum qualifications stated in Section 2.1.4 above.

Note: The search committee shall be duly constituted according to university regulations.

The Radiation Safety Officer is:

2.2.3.2) The supervisor of the Radiation Safety Service.

The Radiation Safety Service is:

2.2.3.3) Responsible for administering and carrying out the Radiation Protection Program as specified on a day-to-day basis.

2.2.3.4) Authorized to issue a "stop work" order if conditions and/or operations endanger either individuals or facilities.

Note: Such an order may be appealed to the Radiation Safety Committee which then assumes responsibility for its directives to the Chancellor/Provost.

2.2.4) Authorized Laboratories.

2.2.4.1) No work with sources of ionizing radiation may be performed except as authorized under a specific permit issued by the Committee.

The Authorized Laboratory Supervisor shall:

2.2.4.2) Ensure that all federal, state, university and permit requirements and regulations are met within the laboratory.

Note: This includes the responsibility for ensuring that all individuals as listed in Section 2.1.5 above are qualified at the relevant level. The RSS monitors the activities within the Authorized Laboratories, makes recommendations for changes in safety practices and provides consultation to the Authorized Laboratory Supervisor.

Authorized Users and Authorized Occupants shall:

2.2.4.3) Carry out their activities within an Authorized Laboratory as specified by training and/or instructions. Authorized Users and Authorized Occupants are responsible for performing their work in keeping with the federal, state, university and permit requirements and regulations.

3) POLICIES OF THE RADIATION SAFETY COMMITTEE AND THE RADIATION SAFETY SERVICE

3.1) Policies of the Radiation Safety Committee

The Radiation Safety Committee shall:

- 3.1.1) Support the University-wide policy on safety.
- 3.1.2) Implement a radiation protection program appropriate to the scope and extent of the activities conducted under the license.
- 3.1.3) Ensure compliance with the regulatory provisions.
- 3.1.4) Facilitate the safe use of sources of ionizing radiation in keeping with the principle of keeping collective and individual radiation exposures **AS LOW AS REASONABLE ACHIEVABLE (ALARA)**.

3.2) Policies of the Radiation Safety Service

The Radiation Safety Service staff shall:

- 3.2.1) Serve, on a day-to-day basis, as the agent of the Radiation Safety Committee in carrying out the policies of the Committee as stated in Section 3.1 above.

4) CONTROL OF RADIOACTIVE MATERIALS AND RADIATION-GENERATING DEVICES

4.1) Requirements

4.1.1) Introduction

This chapter describes the general responsibilities of Authorized Users of radioactive materials and radiation generating devices (RGDs) and the interaction of the Radiation Safety Committee and the RSS with other departments, units and users at the University of Kansas. The responsibilities include managing the safe use of radioactive materials and radiation generating devices in compliance with applicable state and federal regulations and University requirements, and achieving the objective of keeping exposures **as low as reasonably achievable (ALARA)**.

4.1.2) Authorized Users, Authorized Occupants, and Authorized Laboratory Supervisors

Individuals on the Lawrence campus shall:

4.1.2.1) **Not** possess, use or work with sources of ionizing radiation until an Authorized Laboratory Supervisor, an alternate, and an Authorized Laboratory have been approved under a specific permit by the Committee.

Note: An Authorized Laboratory Supervisor must also be an Authorized User.

4.1.2.2) **Not** work with sources of ionizing radiation unless users are carrying out that use under the specific conditions of a valid permit issued by the Committee.

4.1.2.3) **Not** work with sources of ionizing radiation in areas or rooms controlled for the purpose of radiation protection unless users have been appropriately trained and authorized for that use or occupancy by the Committee.

Note: An individual properly trained to handle and manipulate radioactive materials or radiation generating devices is designated an **Authorized User** in this manual. An appropriately trained individual working in an area controlled for purposes of radiation protection, but not with the sources of ionizing radiation contained therein, is an **Authorized Occupant** in this manual. There are different categories of Authorized Users. See Chapter 12, Radiation Safety Training.

Authorized Users shall:

4.1.2.4) Handle and/or use only sources of ionizing radiation for which they have been trained and authorized, and only in Authorized Laboratories. (Laboratories authorized by the Committee for the anticipated use.)

4.2) Responsibilities of Authorized Users and Authorized Laboratory Supervisors

4.2.1) Actions by Authorized Users

Authorized Users shall:

4.2.1.1) Follow all applicable federal and state regulations, and laboratory safety procedures adopted by the University of Kansas for the safe use of radioactive materials and radiation generating devices, including the requirements set forth in this Part of the Laboratory Safety Plan/Program.

4.2.1.2) Fulfill all conditions of a permit applicable to the particular use and laboratory.

Note: No individual may handle sources of ionizing radiation until appropriate training has been certified.

4.2.1.3) Keep individual and collective radiation exposures **AS LOW AS REASONABLY ACHIEVABLE (ALARA)**.

4.2.2) Authorized Laboratory Supervisors

Authorized Laboratory Supervisors shall:

- 4.2.2.1) Follow all requirements of Authorized Users.
- 4.2.2.2) Prepare and submit permit applications, renewal applications, and amendment requests as needed or required.
- 4.2.2.3) Provide and maintain all required engineered safeguards specified in the applicable permit.
- 4.2.2.4) Implement the applicable standard operating procedures. This includes licensed procedures, standard permit conditions, and laboratory-specific procedures.
- 4.2.2.5) Ensure that the conditions of the permit and this plan are met in the laboratory under the supervision of the Authorized Laboratory Supervisor. (Laboratory includes all rooms and facilities specified in the permit.)
- 4.2.2.6) Ensure that all individuals (except for Facilities Operations personnel) carrying out activities in the permit-specified laboratories are appropriately trained for the level of involvement.
- 4.2.2.7) Escort and direct visitors in areas controlled for the purpose of radiation protection so that measurable radiation exposures meet the ALARA values.
- 4.2.2.8) Keep all records required by these responsibilities.
- 4.2.2.9) Maintain secure control over all radioactive materials and radiation generating devices until they have been transferred to another unit in an Committee-approved fashion.

Note: No Radiation Generating Device, Electron Beam Device or radioactive material may be transferred to another individual (inclusive of any form of disposal) unless prior approval has been obtained from the RSS. This applies to radioactive sources in devices such as liquid scintillation counters, chromatography devices, etc. There is no exception.

4.3) Responsibilities of the Radiation Safety Committee

4.3.1) Actions by the Radiation Safety Committee:

The Radiation Safety Committee shall:

4.3.1.1) Specify adequate and reasonable health and safety regulations based upon prudent practice, upon official handbooks and publications, and upon state and federal laws governing the use of sources of ionizing radiation. This is normally accomplished through recommendations made by the RSS.

4.3.1.2) Ensure that the University of Kansas prepares and maintains valid licenses as required by state and federal regulations appropriate for the acquisition, possession and uses of sources of ionizing radiation as carried out on the Lawrence campus.

Note: The RSS has the responsibility to prepare the applications for review and submission by or for the Committee.

4.3.1.3) Ensure that all records and documentation required by state and federal regulations are appropriately maintained. Keep files of all correspondence between supervisors and the Committee.

Note: Many of these files and records may be kept and maintained by the RSS for the Committee.

4.3.1.4) Ensure that appropriate procurement and disposal procedures for all sources of ionizing radiation are provided.

4.3.1.5) Provide consultation and make recommendations on the location and design of new laboratories and facilities or concerning modifications of existing facilities in which sources of ionizing radiation are to be used.

Note: If such recommendations are not solicited or followed, the Committee may refuse to issue a permit for the projected use or revoke an existing permit. See Section 4.3.1.2 above.

4.1.1.6) Assist University personnel in obtaining the qualifications necessary to use radioactive materials and/or other sources of ionizing radiation.

4.3.1.7) Receive and review permit applications (proposals for the use of sources of ionizing radiation) and approve, approve with added conditions, or disapprove these applications based only upon the adequacy of protection of health and safety and/or the protection of the other activities in adjoining facilities.

Note: For certain low level uses, the Committee delegates this authority to the RSS subject to Committee's post facto review. The RSS makes its recommendations to the Committee concerning all permit applications prior to action by the Committee. See Chapters 5 and 7.

4.1.1.8) Assist Authorized Users in obtaining the use of special facilities and services when these are needed for specific applications that require use of radioactive materials and/or sources of ionizing radiation.

4.3.1.9) Maintain contact, through the RSS, with Authorized Laboratory Supervisors for the purpose of ensuring that unnecessary hazards are avoided and that corrective actions are initiated and taken for any work in progress that is not performed in compliance with applicable federal, state, and University regulations and permit conditions.

Note: To accomplish this, the Committee may revoke permits if flagrant or repeated violations occur under a permit.

4.3.1.10) Provide consultation, advice and aid in solving problems of radiation health and safety encountered by individuals associated with Authorized Laboratories or by individuals in adjoining areas.

4.3.1.11) Review and, if appropriate, take action on investigative activities and reports submitted to the Committee by the RSS.

4.3.1.12) Make recommendations, as requested, concerning the staffing of the RSS and the required budgetary support.

4.3.1.13) Review the performance of the RSS as deemed necessary or as directed by management.

4.3.1.14) Recommend or require medical examination of personnel who may have been exposed to hazardous levels of ionizing radiation or who may have been contaminated with radioactive isotopes.

Note: The type and extent of the examination shall be determined by the Chief of Staff of the Student Health Service.

4.3.1.15) Act on issues presented to it by the EHS Coordinator.

4.3.1.16) Prepare a report as part of the annual report of the Laboratory Safety Committee to the EHS Council.

Note: Some of the responsibilities specified for the Committee may be met through the actions of the RSS. The Committee has the responsibility of taking definitive action when an appeal is made or if it judges that additional action should be taken.

4.3.1.17) Convene annually to review pertinent issues in this section.

Note: The Committee routinely interacts with the Chair of the Committee on voting issues.

4.4) Responsibilities of the Radiation Safety Service

4.4.1) Actions by the Radiation Safety Service

The Radiation Safety Service shall:

4.4.1.1) Provide consultation and guidance to departments or units concerning their initial purchase, initial and continued use, and transfer or shipment of radioactive materials or radiation generating devices to ensure that all applicable safety standards and requirements, including engineered safety, are addressed by those departments or units.

4.4.1.2) Ensure that the laboratory supervisor listed in a permit application is qualified by training and experience to direct the activities associated with the relevant permit.

4.4.1.3) Review and recommend to the Committee for approval, modification, or disapproval of permit applications for all activities involving radioactive materials and radiation generating devices. Approval shall be based upon criteria required by the state, city, and the Radioactive Materials License. This includes training of the Authorized Users.

4.4.1.4) Approve all orders for radioactive materials, other sources of ionizing radiation, and radiation generating devices before they are placed based upon verification that Sections 4.4.1.1 to 4.4.1.3 have been satisfied.

4.4.1.5) Inspect all shipments of radioactive materials received at KU for integrity, appropriate contents and compliance with DOT shipping requirements (radiation and contamination levels, labeling, shipping papers) ~~and to~~, approve, and deliver the shipment to the requisitioning departments or units. This includes verification that the receiving departments or units have the appropriately approved permits and trained personnel. Records of these inspections and approvals shall be kept.

4.4.1.6) Perform an initial radiation survey before a radiation generating device is placed into service and verify that all safety requirements for the operation of the radiation generating device, including the appropriate permits and procedures, are met.

4.4.1.7) Perform initial radiation surveys and/or leak tests of radioactive materials before they are placed into service.

4.4.1.8) Perform periodic audits, announced and/or unannounced, of the Authorized Laboratories that use sources of ionizing radiation for compliance with the provisions of applicable permits and procedures.

4.4.1.9) Perform required leak tests on sealed sources at the required interval.

4.4.1.10) Perform periodic radiation and/or contamination surveys of radioactive sources and/or radiation generating device installations, as appropriate.

4.4.1.11) Perform decommissioning procedures to ensure that future occupants and the environment are not subjected to unacceptable risks from residual radioactivity when research activities are concluded in an Authorized Laboratory.

4.4.1.12) Approve proposed transfers of radioactive materials or radiation generating devices from one Authorized Laboratory Supervisor to another. Approval is to be based upon an assessment that radioactive materials to be transferred have been properly packaged for "on campus" transfer, that the appropriate documentation has been prepared, and that the receiving departments or units are Authorized Laboratories for the materials or radiation generating devices. All transfers are to be completed by the RSS unless specific authorization has been granted by the RSS.

4.4.1.13) Evaluate any "off normal" events that are reported and implement actions designed to keep exposures ALARA.

4.4.1.14) Maintain a current inventory of radioactive materials and radiation generating devices within the facility and their locations.

4.4.1.15) Ensure that Visitors, Authorized Occupants, and Authorized Users are provided training and retraining appropriate to the level of risk for the radioactive materials or sources of ionizing radiation in the areas to which they have access.

4.4.1.16) Require timely submission of renewal permits for review and approval.

4.4.1.17) Ensure that an adequate supply of appropriate portable and laboratory radiation measurement systems is available, functioning properly, and calibrated as specified by the License with respect to frequency and method.

- 4.4.1.18) Establish and maintain a personnel dosimetry service that has NVLAP accreditation, perform required bioassays and maintain all required dosimetry records.
- 4.4.1.19) Process all radioactive waste. See Section 4.9.
- 4.4.1.20) Arrange for external audits of the Radiation Protection Program if deemed necessary by the Committee.
- 4.4.1.21) Ensure that RSS personnel in radiation safety have the appropriate training and retraining.
- 4.4.1.22) Ensure that the ALARA Program approved by the Committee is operational, and that the necessary reports associated with the operation of the program are generated.
- 4.4.1.23) Periodically review the Radiation Protection Program and recommend changes to the Committee that will improve the Program.
- 4.4.1.24) Ensure that auditable records as stipulated by State regulations are kept of all the activities described above.
- 4.4.1.25) Acquire the necessary permits, certifications, and licenses for activities involving the transfer of radioactive material/waste to other facilities.
- 4.4.1.26) Terminate unsafe operations that would be in violation of licensing conditions under which the University is required to operate by state and/or federal regulations. The Committee will be notified as soon as possible of such action.
- 4.4.1.27) Provide the Committee with pertinent information regarding new developments and changes in applicable state and federal regulations.
- 4.4.1.28) Provide reports to the Committee immediately for any flagrant violations, timely for other incidents, and during the annual meeting and/or as necessary for summaries of Low Level Applications, noncompliance, remedial actions for contamination, investigation levels for personnel dosimetry, details of emergency actions, License status, untoward incidents, package and source receipts, trained personnel, active permits, new user permits, etc.

4.5) RSS Assistance For the Planned Use of Sources of Ionizing Radiation

4.5.1) The Radiation Safety Service

The RSS shall:

4.5.1.1) Evaluate and make recommendations during the planning stages concerning location and engineered safeguards in facilities designed for the use of radioactive materials or radiation generating devices. This applies to plans for new facilities and for remodeling old facilities. Recommendations are to be based upon applicable NCRP and ICRP documents, and ANSI standards.

4.5.1.2) Provide guidance in the planning stages concerning engineered safeguards directly associated with the radiation generating devices or radioactive sources in the preparation of necessary permits, and in formulating specifications on the purchase requisitions.

4.5.1.3) Perform a safety review whenever radioactive sources and/or radiation generating devices are involved in proposals for the development of equipment. This would normally be accomplished during the review of the permit application covering the proposed use.

4.5.1.4) Perform a prior safety review whenever alterations in Radiation generating devices are proposed.

4.6) RSS Role in the Continued Use of Sources of Ionizing Radiation and Related Facilities

4.6.1) Actions by the Radiation Safety Service

The RSS shall:

4.6.1.1) Upon receiving notification of completion of an installation, or of modification of existing installations involving radiation generating devices or facilities for the use of radioactive materials, perform an appropriate inspection to verify that RSS-mandated engineered radiation safety features have been appropriately incorporated.

NOTE: The permits specifying the nature of engineered safe-guards should have had prior RSS approval.

- 4.6.1.2) Upon receipt of notification that a radiation generating device has been received, inspect the radiation generating device and the installation for appropriate radiation safety features and perform an initial radiation survey and/or leak test (if appropriate) prior to approving the radiation generating device for use within the facility.
- 4.6.1.3) Review and recommend approval, approval with modifications or disapproval of renewal requests for permits, requests for amendments to permits involving new uses of radiation generating devices or radioactive materials and/or any modification of radiation generating devices or their installations that might affect radiation safety.
- 4.6.1.4) Respond to any notification of concern by an individual that radiation safety might have been compromised--such as possible damage to sealed sources, possible impairment of radiation shielding, etc., and plan and execute appropriate remedial action.
- 4.6.1.5) Perform leak tests and/or radiation surveys according to the schedules given in the specific procedures for the performance of these activities.
- 4.6.1.6) Perform scheduled and/or unannounced audits as required by the specific procedures for the performance of the audits.
- 4.6.1.7) Approve the transfer of radioactive materials and/or radiation generating devices from one Authorized Laboratory to another **prior to the transfer** based upon the possession of an appropriate permit by the proposed recipient.
- 4.6.1.8) Stop any activity that, in its judgment, has an immediate and unacceptable radiation risk associated with it. Report its findings to the Committee. Work shall not begin again until the issues have been resolved and RSS and/or Committee approval for resumption of activities has been given.

4.7) RSS Interaction with the Office of Purchasing

4.7.1) Actions by the Radiation Safety Service

The RSS shall:

4.7.1.1) Ensure that Purchasing/unit guidelines provide for RSS approval prior to processing Purchase Requisitions and/or Purchase Orders for radioactive materials.

4.7.1.2) Return Purchase Requisitions and/or Purchase Orders with RSS approval to Purchasing and/or the unit accountant, if the laboratory or unit initiating the requisition and/or order has the necessary permit and Authorized Users.

4.8) RSS Role in Packaging and Shipping Radioactive Material

4.8.1) Actions by the Radiation Safety Service

The RSS shall:

4.8.1.1) Approve and or prepare shipment or transfer of radioactive materials after verifying that the intended recipient has the necessary authorization to possess and use the materials. (For example, NRC or state license or an appropriate permit.)

4.8.1.2) Review and approve purchase requisitions for the performance of paid services involving radioactive materials or other items in which radiation safety is a factor. Verify that all radiation safety standards will be met with respect to the services performed.

4.8.1.3) Provide guidance to Authorized Laboratories in the shipment of radioactive materials to ensure that the correct information has been included for the following and any other DOT requirements.

- a.) Proper Shipping Name
- b.) Hazard Classification
- c.) Identification Number (UN or NA)
- d.) Radioactivity Level

4.8.1.4) Provide guidance and consultation on DOT packaging requirements and supervise the packaging process.

4.8.1.5) Perform/oversee the final required contamination checks and radiation surveys on the packages, verify that the information on the package is correct and that the package is ready for shipment.

4.8.1.6) Prepare or assist in the preparation of the required bill of lading and/or manifests.

4.9) RSS Role in Radioactive Waste Management

4.9.1) Actions by the Radiation Safety Service

The RSS shall:

4.9.1.1) Prepare and maintain written procedures for the management of radioactive waste by the Authorized Laboratories based upon License conditions, and state, federal, and local regulations.

4.9.1.2) Collect, appropriately accumulate, and obtain disposal capacity for the radioactive waste according to License conditions, and state, federal, and local regulations.

4.9.1.3) Keep all required records with respect to the radioactive waste disposal.

Note: Unless specifically granted written alternatives, Authorized Laboratories must arrange for all waste to be collected by the RSS according to the written procedures, except for tertiary aqueous rinses of glassware, etc. Any alternative procedure must be approved in the permit.

4.10) RSS Role in Transferring, Disposing, or Discontinuing Use of Radiation Generating Devices

4.10.1) Actions by the Radiation Safety Service

The RSS shall:

4.10.1.1) Ensure that any radiation generating device to be used for parts or to be disposed of has been rendered fully inoperative and that it contains no radioactive sources before it is approved for disposal.

4.10.1.2) Ensure that any radiation generating device to be used for parts or to be disposed of has had all labels and markings removed, and that appropriate release surveys have been performed before it is approved for disposal.

4.10.1.3) Ensure that the recipient is appropriately authorized to receive the radiation generating devices if the devices are to be transferred to another laboratory or institution.

5) PROCEDURES FOR OBTAINING A PERMIT TO POSSESS AND USE RADIOACTIVE MATERIALS

5.1) Introduction

The possession, use, and disposal of any radioactive material are allowed only under an **Approved Permit** in an Authorized Laboratory. This chapter describes how such a permit may be obtained. Application packets are available from the RSS.

It is important to recognize that laboratory instruments which contain radioactive materials **are not exempt from this condition** even if they contain what is designated as a "generally licensed" radioactive material.

Permits are valid only for one year and must be renewed annually. See Chapter 6 for renewal procedures.

Permits are approved for the specific uses and conditions specified in the application and in the conditions attached to it by the RSS and the Committee. No significant changes may be made in the conditions of the permit until an "amendment application" covering those changes has been approved. See Chapter 6 for procedures and a partial list of significant changes.

5.2) Types of Permits for the Use of Radioactive Materials

5.2.1) "Low Level" Permits:

5.2.1.1) To expedite the process for obtaining a permit to use low levels of radioactive materials, the Committee has authorized the Radiation Safety Officer to act on its behalf in approving an application for a "Low Level" permit. IF no more than the quantities listed in Appendix IV-A are to be used or possessed, a "Low Level" permit is sufficient.

5.2.1.2) This permit is valid only for the specific procedures and for the specific isotope for which the request is made.

5.2.1.3) An Authorized Laboratory Supervisor so approved may not possess more than ten (10) such specified quantities at any time.

5.2.1.4) The procedure for obtaining such a permit is given in Section 5.3 below. Such approvals may be reviewed and amended by the Committee, if the Committee chooses to do so. Application packets are available from the RSS.

5.2.2) Standard Permits.

The procedures for obtaining a standard permit are described in Section 5.4 for all other cases. An initial consultation with the Radiation Safety Service concerning the proposed use may be helpful in completing the application. Such consultation is invited. The goal of the RSS and the Committee is to complete review of applications as quickly as possible. In general, two weeks should be allowed for the process. The review process might take longer in some cases.

5.3) Preparation of an Application for a "Low Level" Permit

5.3.1) Actions by the Prospective Authorized Laboratory Supervisor

The prospective Authorized Laboratory Supervisor shall:

5.3.1.1) Determine whether or not the total activity (quantities) to be used under the proposed permit is within the limitations specified in Appendix IV-A of this part.

5.3.1.2) Satisfy the remaining parts of Section 5.3 if the quantities are within the limits of Appendix IV-A. If the quantities are greater than the limits of Appendix IV-A, proceed to Section 5.4 below and follow the steps described there.

5.3.1.3) Be certified by the Radiation Safety Service as having training appropriate for the "low levels" and types of radioactive materials to be used. See Chapter 12 for the procedures to become an "Authorized Laboratory Supervisor" under a "low level" permit.

5.3.1.4) Submit to the Radiation Safety Service the names and signatures of all Authorized Users and Authorized Occupants under the proposed permit on the certified training documentation.

5.3.1.5) Ensure that all listed individuals are appropriately certified as having the required training by the Radiation Safety Service.

Note: No one may work in an Authorized Laboratory that has restrictions for the purpose of radiation protection until he/she has certified training appropriate to their involvement. Even individuals (Authorized Occupants) not using any radioactive materials must be given certain instructions in safety.

5.3.1.6) Contact the Radiation Safety Officer and describe the proposed use of the radioactive materials.

5.3.1.7) Establish, in consultation with the Radiation Safety Service, that the proposed physical facilities are adequate for the proposed uses and have the required engineered safeguards. See Appendix IV-B for applicable design criteria for laboratories in which radioactive materials are to be used.

5.3.1.8) Based upon the advice provided by the Radiation Safety Officer, prepare an abbreviated application requesting approval to use the materials.

The application shall:

- a.) Include the first and second page of the Application form (items 1- 8) that lists the supervisor, the alternate, the isotopes to be used, the location of use, the training and experience of the laboratory supervisor, and the radiation detection instrumentation.
- b.) Provide a brief description of the experimental procedures together with the levels and type of radioactive materials to be used subject to the "low level" limitations.
- c.) Provide a brief description of the laboratory-specific radiation protection program.
- d.) Describe any required safety procedures or safeguards not addressed under the Standard Permit Conditions.
- e.) Request and justify any condition of the Standard Permit Conditions for Permits Involving Radioactive Materials that cannot be met.

5.3.1.9) May possess and begin work with radioactive materials only after an approval letter (with possible added conditions) has been received from the RSS **and** the Acknowledgment/Agreement Letter has been signed and returned to the Chair and to the RSS.

5.4) Preparation of an Application for a Standard Permit

5.4.1) Actions by the Prospective Authorized Laboratory Supervisor

The prospective Authorized Laboratory Supervisor shall:

5.4.1.1) Be certified by the Radiation Safety Service as having training appropriate for the levels and types of radioactive materials to be used. See Chapter 12 for the procedures to obtain the certification necessary for an Authorized Laboratory Supervisor.

5.4.1.2) Establish, in consultation with the Radiation Safety Service, that the proposed physical facilities are adequate for the proposed uses and have the required engineered safeguards.

5.4.1.3) Complete and submit to the Radiation Safety Service six copies of all portions of the **Application Form for a Standard Radioactive Materials Permit**. Application packets are available from the RSS.

Note 1: The **Standard Permit Conditions** for the Use of Radioactive Materials is automatically part of every permit. Equivalent alternate conditions may be submitted with justification for any proposed changes.

Note 2: An initial consultation with the RSS concerning the proposed use may be very helpful in completing the application. Such consultation is invited.

5.4.1.4) Submit to the Radiation Safety Service the names and signatures of all Authorized Users and Authorized Occupants under the proposed permit on the certified training documentation.

5.4.1.5) Ensure that all listed individuals are appropriately certified as having the required training by the Radiation Safety Service.

Note: No one may work in an Authorized Laboratory that has restrictions for the purpose of radiation protection until he/she has certified training appropriate to his/her involvement. Even individuals (Authorized Occupants) not using any radioactive materials must be given certain instructions in safety.

5.4.1.6) May possess and work with radioactive materials only after the Acknowledgment/Agreement Letter has been signed and returned to the Chair of the Committee and to the Radiation Safety Service. See Section 5.5.3.5 below.

5.5) Review and Approval of Permits

5.5.1) Action of RSS on "Low Level" Permit Applications

The Radiation Safety Officer (RSO) shall:

5.5.1.1) Evaluate the abbreviated application for its adequacy in terms of radiation safety based upon the requirements of this Part, the License, state regulations, federal regulations and recommendations of other applicable standards--such as ANSI standards, NCRP and ICRP publications.

5.5.1.2) Provide consultation to the prospective Authorized Laboratory Supervisor concerning any deficiencies in the proposed radiation safety or administrative procedures.

5.5.1.3) Provide written approval of the application to the Authorized Laboratory Supervisor on behalf of the Committee when no unresolved safety or administrative issues remain.

The written approval shall contain:

- a.) The Standard Permit Conditions.
- b.) Special conditions applicable to the permit, if any.
- c.) Completed Page 1 of the Permit Application.
- d.) A copy of "Notice to Employees."
- e.) A copy of "Emergency Procedures."

5.5.1.4) Submit copies of the permit application together with all associated commitments and documentation and the approval letter to the Chair of the Committee.

5.5.2) Action of RSS on "Standard Permit Applications"

The Radiation Safety Officer (RSO) shall:

5.5.2.1) Evaluate the application for its adequacy in terms of radiation safety and in terms of protecting other KU facilities based upon the requirements of this Part, the License, state regulations, federal regulations and recommendations of other applicable standards-- such as ANSI standards, NCRP and ICRP publications.

5.5.2.2) Consult with the applicant concerning changes that need to be made in the application if any deficiencies are found.

Note 1: Depending upon the nature of the deficiencies, the RSO will request a revised application, submission of additional information in writing, or offer to incorporate additional conditions into the permit in the RSO's letter of recommendation that is sent with the application to the Committee.

Note 2: If there are disagreements between the applicant and the RSO with respect to identified "deficiencies," the applicant may request Committee review "as is." The RSO would then document his concerns to the Committee with the forwarding letter.

5.5.2.3) Forward a copy of the application, the voting-comment form and the letter of recommendation to each member of the Committee.

5.5.3) Action of the Radiation Safety Committee on Permit Applications

The members of the Radiation Safety Committee shall:

5.5.3.1) Evaluate standard permit applications and associated materials for adequacy in radiation safety and in protecting other KU facilities using the same guidance listed in Section 5.5.2.1 above.

5.5.3.2) Send the chair of the Committee the recommended action on the application using the voting-comment form for standard permit applications.

Note 1: The action may be approved, approved with additional conditions, or not approved.

Note 2: No action needs to be taken concerning Low Level permits unless a member identifies a safety concern. If there is a concern, the RSS and/or the Chair may be consulted directly. If the member is not satisfied with the results of the consultation, Section 5.5.3.3. should be followed.

5.5.3.3) Request a meeting of the Committee if the member feels that there are issues that need to be discussed.

The Chair of the Committee shall:

5.5.3.4) Convene a meeting of the Committee if any member has requested a meeting or voted "not approved."

Note: This includes the Chair and the RSO who are both members of the Committee.

5.5.3.5) Write a letter of approval to the prospective Authorized Laboratory Supervisor specifying any conditions added by the Committee upon receiving the votes from each of the Committee members.

Note: The letter shall require a signed acknowledgment/agreement (commitment to observe added conditions, if any) from the prospective Authorized Laboratory Supervisor. The letter shall contain all of the items listed in Section 5.5.1.3 above.

5.5.3.6) Carry out any agreements made by the Committee in any convened meeting. Agreement is defined as a majority vote of the Committee members.

6) RENEWAL OF AND/OR AMENDMENTS TO RADIOACTIVE MATERIALS PERMITS

6.1) Expiration Date of Permits

6.1.1) All permits expire on October 31 of each year unless the **initial** permit was approved within the six months preceding the October 31 deadline.

6.2) Renewal of Permits

6.2.1) Re-certification Training and Renewal of Permits **without** Projected Changes

The Authorized Laboratory Supervisor shall:

6.2.1.1) Ensure that each individual completes the required re-certification materials provided by the RSS. The RSS will provide the appropriate re-certification materials and/or "open material" exams by October 1 of each year.

6.2.1.2) Complete the certified training documentation.

6.2.1.3) Sign the renewal application form.

6.2.1.4) Submit the appropriately signed certification of Section 6.2.1.2 with the signed renewal application form to the Radiation Safety Service **prior to October 31**, if **no** significant changes in the laboratory experiments are required for the next year. See Section 6.3.

6.2.1.5) Include an "amendment application" with the renewal if significant changes are anticipated. See Section 6.3.1.1 below.

Note: The permit continues to be valid for the Authorized Laboratory if the renewal request was submitted on time unless or until notified to the contrary by the RSS on behalf of the Committee. However, requests for changes in the permit (amendments) are not part of the permit until an approval letter from the Chair of the Committee has been acknowledged with a signature by the Authorized Laboratory Supervisor.

6.3) Amendment Applications for Approved Permits

6.3.1) Actions by the Authorized Laboratory Supervisor

The Authorized Laboratory Supervisor shall:

6.3.1.1) Evaluate the need for an "amendment application" **prior to initiating any new procedures or levels of use** that are not addressed in the permit.

6.3.1.2) Prepare an amendment application as specified in Section 6.3.1.3, if the anticipated changes involve any significant safety issues. Consultation with the RSS is encouraged if there is any doubt about whether or not the anticipated changes are covered under the existing permit. All of the following are considered significant changes. This list is not exhaustive.

Any change

- a.) in the isotope being used.
- b.) to a chemical form of the isotope with an increased biological hazard, or form that has not been approved in the approved permit.
- c.) in the level of activities used in the procedures.
- d.) in methods of chemical and physical manipulation that lead to increased or different hazards.
- e.) in supervisory staff. An absence of greater than 60 days by the Authorized Laboratory Supervisor requires that the RSS be notified.
- f.) in the location of use.

6.3.1.3) Submit to the RSS six copies of the written "amendment application" that contains the information relevant to the change being proposed for Sections 6.3.1.2.a to 6.3.1.2.d.

Note: All the information needed to evaluate adequacy of the training, engineered safeguards, and handling procedures as specified in the permit application procedure of Chapter 5 needs to be submitted. The application may be in letter form if only one or two aspects are changed. IF the changes are substantial in all areas, the full application form should be used.

6.3.1.4) Submit to the RSS a letter that contains the information relevant to the change being proposed for sections 6.3.1.2.e and 6.3.1.2.f.

6.3.1.5) Begin work in keeping with the requested changes and attached conditions only after a signed acknowledgment/agreement of an approval letter from the Chair of the Committee has been returned both to the Chair and to the RSS.

6.4) Responsibilities of the RSS Concerning Renewal Applications

6.4.1) Actions of the Radiation Safety Service:

The Radiation Safety Service shall:

6.4.1.1) Send the Authorized Laboratory Supervisor copies of the permit renewal application form listing current approvals and amendments, the certified training documentation, and the re-certification training materials. This should be accomplished by October 1 of each year.

The Radiation Safety Officer shall:

6.4.1.2) Upon receiving the renewal materials for a permit, review all the application materials, review the re-certification materials, and sign the permit renewal application if all requirements are satisfied.

6.4.1.3) Notify the laboratory supervisor concerning issues that are not satisfactory, if any.

Note: If the re-certification of training for any Authorized User cannot be given, arrangements must be made before work with radioactive materials continues.

6.4.1.4) Forward signed permit renewal applications to the Chair of the Committee for the Chair's signature and approval.

6.4.1.5) Follow the procedures in Section 6.5 below for any amendment applications that accompany a renewal request.

6.4.1.6) File the records on training and a copy of the final approved version of the renewal upon receiving it from the Chair of the Committee.

6.5) Responsibilities of the RSS Concerning Amendment Applications

6.5.1) Actions of the Radiation Safety Officer:

The Radiation Safety Officer shall:

6.5.1.1) Follow the steps given in Section 5.5 of this Part as appropriate.

6.6) Responsibilities of the Radiation Safety Committee Concerning Renewal Applications

6.6.1) Actions by the Chair of the Committee

The Chair of the Committee shall:

6.6.1.1) Review the renewal applications forwarded by the RSS.

6.6.1.2) If the materials are satisfactory, sign the renewal application, and return the original copy to the RSS.

Note: The RSS will make copies of the signed application and file one copy, send one copy to the Authorized Laboratory Supervisor and return one copy to the Chair.

6.6.1.3) Consult with the Authorized Laboratory Supervisor and the RSS if there is any issue that does not appear to be satisfactory.

6.6.1.4) Convene a meeting of the Committee if the issues are not satisfactorily resolved.

6.6.1.5) Carry out the directives agreed upon by any convened meeting of the Committee.

6.7) Responsibilities of the Radiation Safety Committee Concerning Amendment Applications

6.7.1) Actions by the Committee

The Radiation Safety Committee and Chair shall:

6.7.1.1) Follow the steps specified in Section 5.5.3 with respect to those issues addressed by the amendment application.

7) PROCEDURE FOR OBTAINING A PERMIT TO POSSESS AND USE RADIATION GENERATING DEVICES (RGDs)

7.1) Introduction

The possession, use, and disposal of any radiation generating device are allowed only under an approved permit in an Authorized Laboratory. This chapter describes how such a permit may be obtained. Application packets are available from the RSS.

Permits are valid only for one year and must be renewed annually. See Chapter 8 for renewal procedures.

Permits are approved for the specific uses and conditions specified in the application and in the conditions attached to it by the RSS and the Committee. Significant changes may not be made in the conditions of the permit until an "amendment application" covering those changes has been approved. See Chapter 8 for procedures and a partial list of significant changes.

The procedures for obtaining a standard permit are described in this chapter. An initial consultation with the Radiation Safety Service concerning the proposed use may be helpful in completing the application. The RSS invites such consultation. The goal of the RSS and the Committee is to complete review of applications as quickly as possible. In general, three weeks should be allowed for the process. In some cases it might take longer.

7.2) Types of Machines & Devices Requiring a Radiation Generating Device Permit

7.2.1) Devices and machines requiring a Radiation Safety Committee-approved permit include:

7.2.1.1) All machines designed to produce x-rays, whether enclosed or not. This includes all X-ray Diffraction Units, Diagnostic X-ray units, Cabinet X-ray Units, and Industrial X-ray Units.

Note: Devices, machines, or instruments that contain radioactive sources require a radioactive materials permit. See Chapter 5 of this Part for the requirements. A unit that is both a radiation generating device and contains a radioactive source must meet the requirements of this chapter and Chapter 5.

7.2.1.2) All particle accelerators including neutron generators with beams that produce external ionizing radiation hazards.

Note: See Section 7.3 below for requirements and procedures for obtaining the necessary permit.

7.2.1.3) All devices that use electron beams, but for which the production of ionizing radiation is incidental to their intended use. This includes electron microscopes, scanning electron microscopes, electron probes, etc.

Note: The procedure for obtaining permits and all the remaining requirements for prospective users of Electron Beam Devices is given in Chapter 9.

7.2.2) Television sets, video monitors and other appliances normally available in the home are not covered by this plan and are exempt from any of its requirements.

7.3) Procedure for Obtaining Permits to Possess and Use Devices Generating Ionizing Radiation

7.3.1) Actions by the Authorized Laboratory Supervisor

The prospective Authorized Laboratory Supervisor shall:

7.3.1.1) Consult with the Radiation Safety Service concerning the engineered safety provisions, if any, that will be needed and for an assessment of the impact of the radiation generating device placement on adjacent facilities and personnel.

7.3.1.2) Be certified by the Radiation Safety Service as having training appropriate for the radiation generating device to be used. See Chapter 12 for the procedures to become an Authorized Laboratory Supervisor.

7.3.1.3) Complete and sign the permit application for a radiation generating device.

Note: A provision is made for the submission of the manufacturer's name, model, and serial number after the unit is purchased. Unless specific waivers are requested and adequately justified, the permit is subject to all of the conditions of the standard permit conditions for users of radiation generating devices.

7.3.1.4) Ensure that all those who are to use the radiation generating device have received the required training including documented proficiency as specified in Chapter 12, Radiation Safety Training.

7.3.1.5) Complete the certified training documentation.

7.3.1.6) Submit six copies of the permit application and of the form specified in Section 7.3.1.5 to the Radiation Safety Service for its recommendations and distribution to the Committee.

7.3.1.7) Proceed with procurement and installation of the device only after receiving written approval of the permit application from the Chair of the Committee **and** the Acknowledgment/Agreement Letter has been signed and returned to the Chair and to the RSS.

7.3.1.8) Request a radiation survey from the RSS immediately after installation and before use.

7.3.1.9) Operate the device according to the commitments made with the permit application and any special conditions specified by the Committee.

Note: The conditions and procedures of the Standard Permit Conditions for Users of Radiation Devices are part of every permit unless alternative safety provisions have been submitted and justified by the User and approved by the Committee.

7.4) Review and Approval of Radiation Generating Device Permits

7.4.1) Actions by the Radiation Safety Officer

The Radiation Safety Officer (RSO) shall:

7.4.1.1) Evaluate the application for its adequacy in terms radiation safety and in terms of protecting other KU facilities based upon the requirements of this Radiation Safety Plan, the License, state regulations, federal regulations and recommendations of other applicable standards--such as ANSI standards, NCRP and ICRP publications.

7.4.1.2) Consult with the prospective Authorized Laboratory Supervisor concerning changes that need to be made in the application if any deficiencies are found.

Note 1: Depending upon the nature of the deficiencies, the RSO will request a revised application, submission of additional information in writing, or offer to incorporate additional conditions into the permit in the RSO's letter of recommendation that is sent with the application to the Committee.

Note 2: If there are disagreements between the prospective Authorized Laboratory Supervisor and the RSO with respect to identified "deficiencies," the prospective Authorized Laboratory Supervisor may request Committee review "as is." The RSO would then document his concerns to the Committee with the forwarding letter.

7.4.1.3) Forward a copy of the application, the voting-comment form and the letter of recommendation to each member of the Committee.

7.4.2) Actions by the Radiation Safety Committee

The Radiation Safety Committee members shall:

7.4.2.1) Evaluate the application and associated materials for adequacy in radiation safety and in protecting other KU facilities using the same guidance listed in 7.4.1.1 above.

7.4.2.2) Send the Chair of the Committee action on the application using the voting form. The action may be approved, approved with additional conditions, or not approved.

7.4.2.3) Request a meeting of the Committee if the prospective Authorized Laboratory Supervisor feels that issues need to be discussed.

7.4.3) Actions by the Chair of the Committee

The Chair of the Radiation Safety Committee shall:

7.4.3.1) Convene a meeting of the Committee if any member has requested it or voted "not approved" and carry out its agreed directives. (A majority vote of the Committee is needed).

Note: This includes the Chair and the RSO who are both members of the Committee.

7.4.3.2) Write a letter of approval to the prospective Authorized Laboratory Supervisor specifying any conditions added by the Committee upon receiving the votes from each of the Committee members. The letter shall require a signed acknowledgment (and commitment to observe added conditions, if any) from the prospective Authorized Laboratory Supervisor.

The written approval shall contain:

- a.) The Standard Permit Conditions.
- b.) Special conditions applicable to the permit, if any.
- c.) A copy of "Notice to Employees."
- d.) A copy of "Emergency Instructions."

8) RENEWAL OF "RADIATION GENERATING DEVICE" (RGD) PERMITS AND AMENDMENT APPLICATIONS

8.1) Expiration Date of Radiation Generating Device Permits

8.1.1) All permits expire on October 31 of each year unless the **initial** permit was approved within the six months preceding the October 31 deadline.

8.2) Renewal of Permits

8.2.1.) Actions by the Authorized Laboratory Supervisor

The Authorized Laboratory Supervisor shall:

8.2.2.1) Ensure that each individual completes the required re-certification materials provided by the RSS. The RSS will provide the appropriate re-certification materials and/or "open material" exams by October 1 of each year.

8.2.2.2) Complete the certified training documentation.

8.2.2.3) Sign the permit renewal form after careful review of the uses of the radiation generating device(s) planned for the next year to ensure that significant changes are not required for the permit.

Note: No significant changes in use should have been made during the previous year unless an "amendment" application was first filed. See Section 8.3 below.

8.2.2.4) Go to Section 8.3 if significant changes are proposed.

Note: See Section 8.3.2 for a partial list of significant changes.

8.2.2.5) Submit the signed renewal form, and the certified training documentation to the RSS **prior to October 31** if **no** significant changes are required.

8.3) Procedure for Amendment Applications to Radiation Generating Device Permits

8.3.1) Actions by the Authorized Laboratory Supervisor.

The Authorized Laboratory Supervisor shall:

8.3.1.1) Make a prior review of any anticipated changes in personnel, procedures or engineered safeguards to identify significant impacts on radiation safety and/or protection of adjacent facilities.

Significant changes include all of the following:

- a.) modification of the radiation generating device that may affect radiation safety.
- b.) modification of required engineered safeguards.
- c.) modification of radiation shielding
- d.) change in supervisory personnel. (Note that this precludes the transfer of a radiation generating device to another individual without Committee approval.) An absence of 60 days by the Authorized Laboratory Supervisor requires that the RSS be notified.
- e.) relocation of the radiation generating device (even within the same room)
- f.) change in "open beam" procedures, such as "alignment."

Note: This is not an exhaustive list of significant changes.

8.3.1.2) Submit six copies to the RSS of an "amendment application" covering any changes that might have caused a significant change in radiation hazards.

8.3.1.3) Proceed with such changes only after receiving written approval from the Chair of the Committee **and** the Acknowledgment/Agreement Letter has been signed and returned to the Chair and to the RSS.

Note: The permit continues to be valid for the laboratory if the renewal request was submitted on time unless or until notified to the contrary by the Radiation Safety Service on behalf of the Committee. However, requests for changes in the permit (amendments) are not part of the permit until notified by the Chair.

8.4) Actions by the RSS Concerning Renewal Applications

8.4.1) Actions by the Radiation Safety Service or RSO

The Radiation Safety Service shall:

8.4.1.1) Send the Authorized Laboratory Supervisor copies of the permit renewal form listing current approvals and amendments, the certified training documentation, and the re-certification training materials. This should be accomplished by October 1 of each year.

The Radiation Safety Officer shall:

8.4.1.2) Upon receiving the renewal materials for a permit, review all the application materials, review the re-certification materials, and sign the permit renewal application if all requirements are satisfied.

8.4.1.3) Notify the Authorized Laboratory Supervisor concerning issues that are not satisfactory, if any.

Note: If the re-certification of training for any Authorized User cannot be given, arrangements must be made before the device may be continued to be used.

8.4.1.4) Forward signed permit renewal applications to the Chair of the Committee for the Chair's signature and approval.

8.4.1.5) Follow the procedures in Section 8.5 below for any amendment applications that accompany a renewal request.

8.4.1.6) File the records on training and a copy of the final approved version of the renewal upon receiving it from the Chair of the Committee.

8.5) Responsibilities of the RSS Concerning Radiation Generating Device Amendment Applications

8.5.1) Actions by the RSS or the RSO

The Radiation Safety Officer shall:

8.5.1.1) Perform the applicable steps specified in Section 7.4

8.6) Responsibilities of the Chair of the Radiation Safety Committee Concerning Radiation Generating Device Renewals

8.6.1) Actions by the Chair of the Committee

The Chair of the Radiation Safety Committee shall:

8.6.1.1) Review the renewal applications forwarded by the RSS.

8.6.1.2) If the materials are satisfactory, sign the renewal application; and return the original copy to the RSS.

Note: The RSS will make copies of the signed application and file one copy, send one copy to the Authorized Laboratory Supervisor and return one copy to the Chair.

8.6.1.3) Consult with the Authorized Laboratory Supervisor and the RSS if there is any issue that does not appear to be satisfactory.

8.6.1.4) Convene a meeting of the Committee if the issues are not satisfactorily resolved.

8.6.1.5) Carry out the directives agreed upon by any convened meeting of the Committee.

8.7) Responsibilities of the Radiation Safety Committee Concerning Radiation Generating Device Renewal Applications

8.7.1) Actions by the Radiation Safety Committee concerning radiation generating device amendment applications

The Radiation Safety Committee and the Chair shall:

8.7.2.1) Follow the applicable steps specified in Section 7.4.

9) ACQUISITION AND USE OF ELECTRON BEAM DEVICES

9.1) Introduction

9.1.1.) Definition of Electron Beam Devices (EBDs)

All devices that use electron beams, but for which the production of ionizing radiation is incidental to their intended use, and which are designed by the manufacturer to produce negligible external radiation fields are designated electron beam devices under the Laboratory Safety Program. This normally includes electron microscopes, scanning electron microscopes, electron probes, etc. Any unit that does not meet the above definition or is used in such a manner that the definition does not apply is a radiation generating device, and the radiation generating device requirements of Chapters 7 and 8 of this Part must be met.

Exemptions: Electron beam devices that are part of household appliances or commercial electronic testing equipment are not subject to the requirements of this chapter **if** they are used only for the purposes for which they were manufactured and are not altered or modified in any way by the users. Examples are TV's, PC monitors, and oscilloscopes.

9.1.2) The acquisition and use of such a device requires an approved permit. See Section 9.2 below.

9.2) Procedure for Obtaining Electron Beam Device Permits

9.2.1) Actions by the Prospective Authorized Laboratory Supervisor

The prospective Authorized Laboratory Supervisor shall:

9.2.1.1) Complete and sign the permit application for an electron beam device.

Note: A provision is made for the submission of the manufacturer's name, model, and serial number after the unit is purchased. Prior consultation with the RSS is encouraged.

9.2.1.2) Submit six copies to the Radiation Safety Service for distribution to the Radiation Safety Committee.

9.2.1.3) Proceed with procurement and installation of the device only after receiving written approval of the permit application from the Chair of the Committee **and** the Acknowledgment/Agreement Letter has been signed and returned to the Chair and to the RSS.

9.2.1.4) Request a radiation survey from the RSS immediately after installation.

9.2.1.5) Operate the device according to the conditions and requirements specified in:

a.) Standard Permit Conditions.

b.) Commitments made with the permit application.

c.) Any special conditions specified by the RSO or Committee.

Note: Permits are valid only for a period of one year. See section 9.3 below.

9.2.2) Actions of the RSO on electron beam device Permit Applications

The Radiation Safety Officer (RSO) shall:

9.2.2.1) Follow the procedures described under Section 7.4.

9.2.3) Actions by the Radiation Safety Committee and its Chair on electron beam device Permit Applications

The Radiation Safety Committee Members shall:

9.2.3.1) Follow the procedures described under Section 7.5.

9.3) Procedure for the Annual Renewal of Electron Beam Device Permits

9.3.1) Actions by the Authorized Laboratory Supervisor

The Authorized Laboratory Supervisor shall:

9.3.1.1) Sign the renewal form provided by the RSS and return it to the RSS prior to October 31 of each year IF no changes in the initial permit are to be requested. (If the initial permit was granted within 6 months prior to October 31, a renewal is not required for that year.)

9.3.1.2) Submit an amendment request whenever needed because a significant change in the conditions of the permit are planned. **Such changes are not to be implemented until the proposed amendment has been approved in writing from the Committee and acknowledgment of the conditions of the updated permit has been returned to the Committee and the RSS.**

Significant changes include all of the following:

- a.) Change in the approved laboratory supervisor.
- b.) Change in the location of the electron beam device even within the same room.
- c.) Any change that might affect the shielding integrity of the device.
- d.) Any change that might result in a higher level of radiation exposure.

This is not an exhaustive list of significant changes.

Note: No electron beam device may be discarded or transferred to another person unless prior approval from RSS has been obtained. Before such devices may be discarded, the RSS must document that the capability for the production of the electron beam has been destroyed.

10) PLACING ORDERS FOR RADIOACTIVE MATERIALS

10.1) Introduction

10.1.1) Orders for radioactive materials to the RSS may be placed only by laboratories authorized by the Committee to possess and to use specific radioisotopes or specific compounds.

10.1.2) All orders placed for radioactive materials shall be made by the RSS. Authorized Users may arrange for special shipments directly from collaborative Laboratory Supervisors, etc., only if permission and approval have been granted by the RSS.

10.1.3) Only Authorized Users and/or individuals designated by the Authorized Laboratory Supervisor shall place orders for the Authorized Laboratory.

10.1.4) All radioactive materials must be shipped directly to the Radiation Safety Service unless a specific waiver of this requirement has been approved by the RSS. Waivers must have appropriate justification.

10.2) Order by Telephone Through the Radiation Safety Service

10.2.1) Actions by the Authorized User and/or Designated Individual:

Note: The Designated Individual is an individual authorized by the Authorized Laboratory Supervisor to place the order. This may be a secretary or an accountant. The order must be prepared by an Authorized User.

The Authorized User and/or Designated Individual should:

10.2.1.1) Verify that the permit authorizes the type and activity of material to be ordered.

10.2.1.2) Prepare the components of the order prior to calling RSS. These include:

- a.) the identity of the Authorized Laboratory Supervisor for whom the order is being placed.
- b.) the name of the Authorized User/Designated Individual placing the order.
- c.) the radioisotope and chemical form.

- d.) the name of the vendor and applicable catalog number.
- e.) number of units to be ordered (and the total activity).
- f.) date that the materials are needed.
- g.) the department to be billed and the purchase order number.

10.2.1.3) Call RSS and provide the information prepared in Section 10.2.1.2.

10.2.2) Actions by the RSS upon receiving an order:

The Radiation Safety Service should:

- 10.2.2.1) Record the prepared information (special forms may be used)
- 10.2.2.2) Verify that the type of radioisotope is authorized under the permit and that the possession limits of the Authorized Laboratory and of the University will not be exceeded by receipt of the order.
- 10.2.2.3) Enter the applicable information concerning the order in the RSS records.
- 10.2.2.4) Place the telephone order as soon as possible.
- 10.2.2.5) Notify the Authorized User of delays in shipment or of difficulties in obtaining the requested radioactive materials.
- 10.2.2.6) Coordinate the purchase with the appropriate accounting office, if necessary.

10.3) Order by Purchase Order

10.3.1) Actions by the Authorized User/Designated Individual in coordinating the order with the appropriate accountant:

The Authorized User or Designated Individual working with the accountant should:

- 10.3.1.1) Prepare the purchase order so that all of the information stipulated in Section 10.2.1.2 is included.
- 10.3.1.2) Send the prepared purchase order to the RSS to obtain the required authorization.

10.3.2) Actions by the RSS upon receiving the purchase order:

The Radiation Safety Service should:

10.3.2.1) Complete Sections 10.2.1.1 to 10.2.1.3 above and verify that the billing and shipping addresses are correct.

10.3.2.2) Stamp/sign the purchase order documenting that all conditions have been met.

10.3.2.3) Either forward the purchase order to Purchasing or return the purchase order to the accountant.

10.4) Order by Purchase Requisition

10.4.1) Actions by the Authorized User/Designated Individual in coordinating the order with the appropriate accountant:

The Authorized User or Designated Individual working with the accountant should:

10.4.1.1) Include all of the information specified in Section 10.2.1.2 above.

10.4.1.2) Forward the completed purchase requisition to Radiation Safety Service for the proper authorization.

10.4.2) Actions by the RSS upon receiving the completed purchase requisition.

The Radiation Safety Service should:

10.4.2.1) Complete Sections 10.2.2.2 to 10.2.2.3 above and verify that the billing and shipping addresses are correct.

10.4.2.2) Stamp/sign the purchase requisition documenting that all conditions are met.

10.4.2.3) Forward the purchase requisition to Purchasing or return the purchase order to the accountant.

10.5) Orders from Government Laboratories

10.5.1) Orders from government laboratories very frequently require special forms. Consult with RSS prior to preparing such an order.

10.6) Shipping and Billing Instructions

10.6.1) All radioactive materials must be shipped to and received on campus by the RSS unless otherwise authorized by the RSS and/or the Committee.

10.6.2) All radioactive materials must be shipped to the following address:

University of Kansas
Radiation Safety Service
Burt Hall
Lawrence, KS 66045

Attn: "Supervisor"

11) THE ALARA PROGRAM

11.1) Introduction

11.1.1) As Low As Reasonably Achievable (ALARA)

All Authorized Users of sources of ionizing radiation are expected to conduct their work in such a manner that the collective exposure of all individuals is kept **As Low As Reasonably Achievable (ALARA)**. In general, this means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical consistent with the purposes for which the licensed activity is undertaken. Clearly, any action that has no cost in time or money and that will decrease the collective exposure shall be adopted. To exceed ALARA is not to violate the regulations. ALARA is a professional standard of excellence.

Although protection against external radiation fields needs to be and is addressed, experience at the University of Kansas (Lawrence Campus) indicates that contamination control and control over radioactive materials are the areas requiring special procedures and/or ALARA guidelines.

This chapter constitutes the written **ALARA Program** approved by the Radiation Safety Committee and mandated by state regulations. The ALARA Program commits all users of sources of ionizing radiation to the principle that all "unnecessary exposure" is to be avoided. Secondly, where potential or real exposures are unavoidable, every reasonable effort should be made to reduce the exposure. The Program applies to all Authorized Users of sources of ionizing radiation at the University of Kansas unless an amendment to a specific permit grants alternative means of satisfying equivalent control.

ALARA goals and levels of exposures or contamination requiring specific "action" are defined in this program. The latter are called **action levels** because they trigger the need for some specific response to the situation. Because references are made to these action levels throughout this chapter, the action levels are defined or stated first in Section 11.2 below.

The word **shall** is used for a required procedure. Failure to observe procedures and conditions introduced with a "shall" is "noncompliance" with permit conditions.

The word **should** is used for highly recommended, but not absolutely required, procedures and conditions.

11.1.2) Regulatory Limits

The limits for the exposure of Authorized Users, members of the general public, minors, and declared pregnant women are those specified in Part 4 of the Kansas **Radiation Protection Regulations** (Title 10, Code of Federal Regulations Part 20). These regulations also apply to exposure limits in unrestricted areas. Authorized Users are by definition occupationally exposed. The RSS will determine which Authorized Occupants (laboratory personnel) are included in the "occupationally exposed" category.

11.1.3) ALARA Goals

The goal of the ALARA program is to keep all individual Total Effective Dose Equivalents (TEDE) below 1 mSv (100 mrem) per year. No annual Shallow Dose Equivalent (SDE) should exceed 10 mSv (1000 mrem). No annual Lens of the Eye Dose Equivalent (LDE) should exceed 3 mSv (300 mrem). No Total Organ Dose Equivalent (TODE) should exceed 10 mSv (1000 mrem).

11.1.4) Achievement of Dose Equivalent Limits

Authorized Users shall:

11.1.4.1) Plan and conduct all activities so that the ALARA exposure limits specified in this chapter are not exceeded unless a Radiation Safety Committee-approved request (amendment to the permit) for a higher ALARA limit has been obtained. All approved ALARA limits shall be below the dose equivalent limits specified in the regulations.

11.1.4.2) Report to the Radiation Safety Service any accidental exposure that potentially is greater than the KU ALARA limits and cooperate with the RSS in the investigation of such an incident.

11.1.4.3) Plan and conduct activities such that the average weekly exposure does not lead to an exposure in excess of the annual ALARA limit unless a documented analysis shows that a higher exposure in a given week will be compensated by lower exposures in prior (preferable) or succeeding weeks.

11.1.4.4) Plan and conduct work so that the exposure of a declared pregnant woman does not exceed 300 μ Sv (30 mrem) in any given month during the declared phase of the pregnancy.

11.2) Action Levels

11.2.1) Radiation Exposures

11.2.1.1) Action Levels for Exposure

a.) Remedial Level (RL) for Exposure

Any measurable skin contamination requires decontamination and documentation in the survey records of the laboratory.

Note: Causes should always be determined when feasible even at the lowest levels of contamination and corrective action implemented.

b.) Investigation Level (IL) for Exposure

Any whole body personnel dosimeter report in excess of 30 mrem for x or gamma radiation in any one month and/or of 50 mrem energetic beta in any one month, requires an investigation by the RSS. See Section 11.7.

11.2.2) Control of Contamination

11.2.2.1) KU ALARA Goals in Contamination Control

a.) The primary goal in contamination control is to have no measurable contamination on any external surfaces that have the potential of being contacted by personnel- (outside surfaces of containers and equipment, floors, bench tops, secondary containers, etc.).

b.) Minimize contamination when the primary goal is not feasible.

c.) Remove contamination, even at low levels, whenever feasible and at the earliest possible time after detecting the contamination.

11.2.2.2) Action Levels in Contamination Control

a.) Remedial Levels (RL) of Contamination

Any removable contamination that exceeds one of the levels specified in Table 1 below requires prompt and documented decontamination. Fixed contamination shall not exceed 5 times the Table 1 levels.

Table 1 notwithstanding, decontamination shall always be attempted when a "wipe" is measured to exceed an activity of 220 dpm for a surface subject to the "unrestricted" ALARA limit. Contamination levels above those specified in Table 1 are not allowed unless special permission has been granted by the RSS.

Table 1 - Remedial Levels of Contamination
(Removable contamination)

Low Risk Beta or Emitters	X-Ray Emitters	Type of Radioactive Material*			
		Alpha Emitters		Beta or X-Ray	
		($\mu\text{Ci}/\text{cm}^2$)	(dpm/100cm ²)	($\mu\text{Ci}/\text{cm}^2$)	(dpm/100cm ²)
Type of Surface ($\mu\text{Ci}/\text{cm}^2$) (dpm/100cm ²)	($\mu\text{Ci}/\text{cm}^2$)	(dpm/100cm ²)	($\mu\text{Ci}/\text{cm}^2$)	(dpm/100cm ²)	
1. Unrestricted areas 2, 200	10 ⁻⁷	22	10 ⁻⁶	220	10 ⁻⁵
2. Restricted areas 22, 000	10 ⁻⁶	220	10 ⁻⁵	2, 200	10 ⁻⁴
3. Personal clothing 2, 200 worn outside restricted areas	10 ⁻⁷	22	10 ⁻⁶	200	10 ⁻⁵
4. Protective clothing 22, 000 worn only in restricted areas	10 ⁻⁶	220	10 ⁻⁵	2, 220	10 ⁻⁴
5. Skin 2, 000	10 ⁻⁶	220	10 ⁻⁶	220	10 ⁻⁵

* Beta or x-ray emitter values are applicable for all beta and x-ray emitters other than those considered low-risk. Low-risk nuclides include C-14, H-3, S-35, Tc-99m, and others whose beta energies are less than 0.2 MeV maximum, whose gamma- or x-ray emission is less than 0.1 R/h at 1 meter per curie, and whose permissible concentration in air (see 10 CFR Part 20, Appendix B, Table 1) is greater than 10⁻⁶ $\mu\text{Ci}/\text{ml}$. (Regulatory Guide 8.23, Radiation Safety Surveys at Medical Institutions)

Note: A **remedial level** of contamination is defined by the Federal Regulatory Guide 8.23 for restricted and unrestricted areas, equipment, and/or clothes. When a "remedial level" is discovered, prompt and documented decontamination shall be performed. Table 1 specifies those levels. Notice that these levels are not in cpm but in dpm. Appropriate efficiency corrections must be applied. These levels are defined in terms of removable activity (activity on wipes). [For example, a thin window (1-2 mg/cm²) GM meter typically might have an efficiency of 0.05 for C-14 and 0.2 for P-32. Liquid Scintillation Counters have higher efficiencies. The user needs to determine the efficiency.] The Safety Data Sheets provide nominal conversion factors from cpm to dpm for the most used instruments.

b.) Investigation Level (IL) for Contamination

Any contamination levels that exceed those specified in (I) or (II) below require an immediate investigation in which causes are determined, corrective actions designed to prevent recurrence are implemented, and reports are submitted to the RSS and the RSC.

Two different IL's are used. These levels are as follows:

I.) For clearly marked and labeled work areas covered with absorbent paper, contamination at more than 25 times the Table 1 "restricted" levels or 5 or more spots at 10 times the Table 1 levels requires implementation of an Investigation Level.

II.) For unmarked areas, including all floors, contamination at more than 10 times the Table 1 "unrestricted" levels requires implementation of an Investigation Level.

11.3) Control of Radiation Sources

11.3.1) Instruments Containing Radioactive Sources (Liquid Scintillation Counters and Gas Chromatographs with radioactive sources) and Radiation Generating Devices

The Authorized Laboratory Supervisor shall:

11.3.1.1) Ensure that the serial number(s) or some other unique identifying number has been registered with the RSS under the permit that governs the use of the instrument and/or radiation generating device.

11.3.1.2) Ensure that the permit specifies where the instrument and/or radiation generating device is located.

11.3.1.3) Ensure that a highly visible label with the following words shall remain attached to such an instrument and/or radiation generating device.

Notice: "Do not move without notifying the Radiation Safety Service."

11.3.1.4) Not transfer responsibility for the instrument and/or radiation generating device unless prior written authorization from RSS and the Committee has been obtained.

Note: These sources are covered together with all other sources of ionizing radiation under standard permit conditions.

11.3.1.5) Promptly notify RSS when the instrument and/or radiation generating device is no longer needed.

Note: Authorized Laboratories, sources of ionizing radiation, and radiation generating devices **shall not be abandoned** by an Authorized Laboratory Supervisor.

11.3.1.6) Not remove such instruments or radiation generating devices from the Equipment Inventory unless prior approval has been obtained from the RSS.

11.3.1.7) Specify the location of storage for instruments, spare radiation generating devices and/or X-ray tubes to be used in instruments in the permit application, and shall not change location without first notifying the RSS.

Authorized Users shall:

11.3.1.8) Use the radiation generating devices and/or sources of ionizing radiation only as specified in the applicable permit. This includes training requirements and procedures.

11.3.1.9) Not move a radiation generating device or source of ionizing radiation to another location without prior approval from RSS. This is for the purpose of ensuring that the radiation generating device or source of ionizing radiation will never become an "orphan," or that its location becomes unknown to the Radiation Safety Service.

11.3.1.10) Not remove the label specified in Section 11.3.1.3 above and/or "Caution Radioactive Materials" labels. Only RSS staff members are authorized to remove such labels subject to the restrictions placed upon them by the License.

11.3.1.11) Maintain the storage of spare radiation generating devices and/or spare X-ray tubes, (etc)., in a secured fashion so that unauthorized access is prevented.

Note: For Authorized Laboratory Supervisors who have only "sources" of the type addressed in this section (11.3.1), the only other applicable sections are 11.4 and 11.8 below.

11.3.2) Outdated Radioactive Sources

The Authorized Laboratory Supervisor shall:

11.3.2.1) Arrange for approved transfer and/or disposal of all radioactive sources in the inventory of the permit before leaving the university or terminating the permit.

11.3.2.2) Require an accounting by Authorized Users under their permit of all radioactive sources created by the users before such users leave the university. (This includes identification and labeling of containers with levels of activity and isotope.)

11.3.2.3) Properly and promptly transfer to RSS for disposal any sources for which no use is anticipated.

11.3.2.4) Place unused stock sources that have been on the inventory for more than five years and for which potential use has been justified in a secondary container that shall be sealed by the RSS and shall bear a label with these words: "Notice: Do not break seal or change location of this container without notifying the RSS." Sources will be placed in such containers at the time of the physical inventory. See Section 11.3.2.5 below.

11.3.2.5) Perform an annual physical inventory of all sources that are listed under the permit in cooperation with the RSS. (Stocks in containers specified in Section 11.3.2.4 above with unbroken seals are inventoried upon identification of the containers.)

Note: The conditions of Section 11.3.2 are agreed upon by the Authorized Laboratory Supervisor when responsibility for a permit and its conditions are accepted by signature of the acceptance letter.

11.4) Control of External Radiation Fields

11.4.1) Restrictions on External Gamma/X-ray Fields and Action Levels

The Authorized Laboratory Supervisor shall:

11.4.1.1) Ensure that the dose rate at the nearest occupiable unrestricted area where radioactive sources are stored or where x-ray producing machines are used is no greater than 2.0 μGy (0.20 mrem) in any one hour unless analysis by the RSS indicates that achievement of this level is not practical and an exemption is granted explicitly in the permit.

Note: If x-ray units are placed in a room with interlocks and no occupancy during exposures is possible, the nearest accessible surfaces are the exterior sides of the walls. However, for units that are operated inside occupied rooms, the above limit applies to the surface of the equipment itself.

11.4.1.2) Evaluate, plan and perform all activities under the permit with the intent of meeting the ALARA limits on exposure as specified in Section 11.2.

11.4.1.3) Notify the RSS immediately if there is any reason (measurement or calculation) to believe that the exposure of any individual exceeded the Investigation Level listed in 11.2.1 in any one month. Section 11.2.1.1.b establishes this as an Investigation Level, therefore:

- a.) Identify causes for the contamination
- b.) Establish Standard Operating Procedures designed to prevent recurrence of the contamination.
- c.) Cooperate with RSS in assessing the level of exposure.
- d.) Submit a report to the RSS and the Committee within two weeks of the incident.

11.4.2) External Beta Fields and Shallow Dose Exposures from Contamination

Authorized Users/Authorized Laboratory Supervisors should:

- 11.4.2.1) Use clear beta shields whenever high energy beta fields may be present.
- 11.4.2.2) Perform operations involving micro-curie amounts of a high energy beta emitter behind a beta shield.
- 11.4.2.3) Store beta-emitting sources so that betas will not penetrate to accessible areas, if this is readily achievable. The dose rate should not be more than 2.0 μGy (0.20 mrem) in any one hour.
- 11.4.2.4) Implement decontamination when measurable skin contamination is detected, implement corrective actions if feasible, and document initial and final activities with estimates of the duration of the contamination together with corrective actions.

Note: Measurements are to be made with instruments specified in the Safety Data Sheet for the radioactive source involved and under the conditions specified by the Safety Data Sheet (SDS). Safety Data Sheets provide specific radionuclide data on predicted and measured dose and dose rates, estimates of internal dose, and biological limits. Unless an RSS notation of a more accurate calibration factor is entered into the SDS, the calibration factor or conversion factor suggested in the SDS is to be used. If instruments specified in the general SDS are not available in the laboratory, the Authorized Laboratory Supervisor shall request an RSS calibration for the instruments that are to be used and these shall be noted in the laboratory-specific SDS.

11.4.2.5) Notify RSS immediately if the possibility exists that the exposure could exceed the Investigation Levels.

- a.) Identify causes for the contamination
- b.) Establish Standard Operating Procedures designed to prevent recurrence of the contamination.
- c.) Cooperate with RSS in assessing the level of exposure.
- d.) Submit a report to the RSS and the Committee within two weeks of the incident.

11.5) Contamination Control

11.5.1) Guidelines and Requirements

Note: In this section, action levels defined in Section 11.2 are used. Section 11.2 should be reviewed as needed.

Authorized Users shall:

11.5.1.1) Plan for and use procedures designed to prevent contamination.

11.5.1.2) Make reasonable attempts to remove any contamination found in unrestricted areas. **The goal is no measurable contamination.**

11.5.1.3) Use judgment in determining when decontamination may be deferred for a limited period of time provided that the contamination levels do not exceed the "Remedial Level."

Note: It always preferable to keep contamination levels in restricted areas at the "not measurable" levels, Dirty (many areas of contamination) areas are not acceptable.

11.5.1.4) Maintain floors in all areas below "Remedial Levels" for unrestricted areas.

Note: The only and "last resort" exception would be to establish a Class IV Laboratory with the approval of the Radiation Safety Service and declare the lab off limits for housekeeping and other personnel from facilities operations.

11.5.1.5) Maintain bench tops that are clearly marked and identified as restricted areas below "Remedial Levels" for restricted areas.

Note: Outside surfaces of equipment labeled and exclusively kept in such marked areas shall also be below "Remedial Levels" for restricted areas.

11.5.1.6) Maintain all unmarked and unreserved areas and equipment or clothes in such areas below "Remedial Levels" for unrestricted areas and/or equipment.

Note: However, every effort should be made to keep levels well below this - preferably non-measurable. Destructive decontamination shall be considered, if necessary.

11.5.1.7) Carefully survey laboratory coats and other items to be laundered before release to commercial laundries. The lab coats shall not be released if there is measurable contamination.

Note: The use of two lab coats is encouraged but not required.

Authorized Users/Authorized Laboratory Supervisors shall:

11.5.1.8) Immediately decontaminate, with the assistance of the RSS, any areas/materials that exceed the Investigation Level of Contamination. (See Section 11.2.2.2.b above)

11.5.1.9) Identify the causes and/or reasons for the contamination.

11.5.1.10) Establish changes in laboratory-specific standard operating procedures designed to prevent recurrence of such incidents, and ensure that all appropriate personnel are trained in those procedures.

11.5.1.11) Maintain written documentation as part of laboratory records.

The Authorized Laboratory Supervisor shall:

11.5.1.12) Report the incident to the RSS as soon as possible.

11.5.1.13) Provide a written report to the RSS and the Committee with review within two weeks of the incident.

11.6) Laboratory Surveys

11.6.1) Survey Frequency

Authorized Users should:

11.6.1.1) Survey floors and/or other areas that may have become contaminated at the end of the day or at the end of the experiment, whichever comes first.

Note: When surveys have been performed at the end of the experiment and no new experiments are performed, surveys do not need to be performed at the end of a day when new experiments were not performed.

11.6.1.2) Survey areas shortly after any high level operation, after any stock has been opened, or after any operation that is highly vulnerable with respect to inadvertent contamination (mixing, blending, centrifugation, etc).

Authorized Users shall:

11.6.1.3) Perform surveys as soon as possible whenever there is reason to believe that contamination has occurred.

11.6.1.4) Perform comprehensive documented surveys at the minimum frequency specified in this section as applicable. See Appendix IV-B to determine the level of laboratory.

a.) **In Class IV Laboratories** (High Level)

Comprehensive Surveys are required: 1) at the end of the day whenever a stock is handled; 2) before an area reserved for work with radioactive materials is returned to unrestricted (unmarked) status.

b.) **In Class III Laboratories** (Medium Level)

Comprehensive Surveys are required: 1) whenever a stock is handled so that a bioassay must be performed within a day or week; 2) before an area reserved for work with radioactive materials is returned to unrestricted (unmarked) status; 3) at least once a week of selected areas, including the floor, that could become contaminated.

c.) **In Class II Laboratories** (Low Level)

Comprehensive Surveys are required: 1) before an area reserved for work with radioactive materials is returned to unrestricted (unmarked) status; 2) at least biweekly of selected areas, including the floor, that could become contaminated.

d.) **In Class I Laboratories** (Very Low Level)

Comprehensive Surveys are required: 1) before an area reserved for work with radioactive materials is returned to unrestricted (unmarked) status; 2) at least monthly on selected areas, including the floor, that could become contaminated.

Note: **The following exception shall apply to all laboratory classes given above:**

During a period of time when radioactive materials are not being used, and materials are in storage only, area surveys do not need to be performed **if and only if** an extensive "close out" survey has been performed and recorded as such at the time usage was discontinued. Surveys are required during such a period if any accidents occur in the storage areas.

11.7) Actions Prompted by RSS Surveys/Reviews

11.7.1) Actions based upon RSS surveys

The RSS shall:

11.7.1.1) Immediately initiate corrective procedures. The RSS will provide the necessary assistance.

The Authorized User/Authorized Laboratory Supervisor shall:

11.7.1.2) Provide the necessary effort to achieve prompt corrective action. See Sections 11.5.1.8 to 11.5.11.

The RSS may:

11.7.1.3) Initiate the procedures described in Section 11.8 if a survey by the RSS finds contamination at Remedial Levels (Section 11.2.2.2.).

Note: Because the actual occurrence of contamination is assumed to be accidental it is not in itself deemed "noncompliance." However failure by the users to identify such contamination by appropriate surveying and/or to decontaminate to the extent required by this program could be noncompliance.

Therefore, if surveys performed by RSS were always after the completion of an experiment or after the end of a day's work, the discovery of contamination above the remedial level by them could indicate "noncompliance" in that laboratory. Because surveys by the RSS are performed during the day and may occur while experiments are still in progress, such findings will not automatically be deemed "noncompliance."

However, the frequency with which RSS finds such contamination should be low and the escalating actions specified in Section 11.8 below will be taken. Authorized Laboratory Supervisors should investigate causes for any contamination above remedial levels and should implement additional procedures designed to prevent recurrence if appropriate. High frequency of contamination will most likely result in mandatory changes in the procedures applicable under the relevant permit.

The RSS shall:

11.7.1.4) Implement the Non-compliance Procedures of Section 11.8 below when levels exceed the Investigation Level. (See Section 11.2.2.2.b.)

11.7.2) Actions by the RSS when Investigation Levels are Exceeded (whether reported by the laboratory or found with their own surveys)

The Radiation Safety Service shall:

11.7.2.1) Attempt to determine the reason for any exposure in excess of the levels specified in Section 11.2.1.2.b above and to help the laboratory institute procedural changes designed to prevent recurrence of such exposure if feasible under ALARA constraints.

Note: Exposures in excess of these levels are not "noncompliance" when reported by the laboratory but are action levels for triggering an analysis. They are "noncompliance" if found by the RSS.

11.7.2.2) Document their findings and include a summary in reports to the Committee.

11.8) Noncompliance Items and Undetected Remedial Level Contamination

A **violation** is a finding by the RSS of "noncompliance" with state and federal regulations, permit conditions, and/or required ALARA procedures and/or conditions. Regulations and conditions have varying degrees of safety, safeguards, or environmental significance.

Level A Noncompliance addresses violations that are more significant and are of considerable concern. Violations involving training, personnel protection, required surveys not performed or documented, and other procedures that would greatly affect the health and safety of individuals are examples of this level. Level A Noncompliance violations are more severe than Level B Noncompliance violations.

Level B Noncompliance addresses violations that are significant and are of concern. Examples are not correctly posting and labeling areas and/or equipment, eating or drinking in restricted areas, not performing the required surveys and/or inspections, leaving radioactive sources unsecured, working in unrestricted areas, not wearing personnel dosimeters, not preparing or maintaining the required record keeping, placing labeled equipment in unrestricted areas, etc. There may be incidents when these violations would be considered Level A Noncompliance depending upon the level of risk. Some violations are listed as Level A and Level B Noncompliance (for example, failure to perform and document surveys) to show that the severity of these violations depends upon the effects to health and safety.

Sanctioned actions for noncompliance could include immediate attention by the Authorized Laboratory, written corrections or written responses from the Authorized Supervisor, interview with RSO and/or Committee, increased RSS inspections, additional training requirements, increased assessments by the Authorized Users, suspended shipments of radioactive materials, established restrictions on Authorized User, decreased scope of permit, confiscated radioactive materials, or suspended or permanently terminated permit.

11.8.1) Level A Noncompliance Violations

The Radiation Safety Service shall:

11.8.1.1) Require individuals working with radioactive materials to immediately cease working if training has not been certified at the proper level.

11.8.1.2) Require individuals working with radioactive materials to immediately cease working if gloves and lab coats are not being used in a procedure that requires personnel protection.

11.8.1.3) Place ordering radioactive materials on a contingent status if the required documentation for surveys has not been completed by the Authorized Laboratory and has a significant impact on health and safety.

Note: Normally this precaution would be initiated only following the action of Section 11.8.2.3. Contingent implies that radioactive materials may be ordered upon completing the required survey.

11.8.1.4) Require individuals working with radioactive materials to immediately cease working if Level B Noncompliance violations have a significant impact on health and safety.

11.8.2) Level B Noncompliance Violations

11.8.2.1) First Violation or Undetected Remedial Level of Contamination

The Radiation Safety Service shall:

a.) Submit a letter to the Authorized Laboratory Supervisor identifying the details of the violation and explaining the required corrective action, and/or condition b. A verbal notice should also be given by the RSS.

b.) Note the violation on the RSS survey sheet in the "noncompliance" section.

11.8.2.2) Second Violation or Undetected Remedial Level of Contamination

The Radiation Safety Service shall:

a.) Send the Authorized Laboratory Supervisor a notice of violation.

b.) Send a copy to the Chair of the Committee.

11.8.2.3) Third Violation or Undetected Remedial Level of Contamination

The Radiation Safety Service shall:

- a.) Send a warning letter to the Authorized Laboratory Supervisor.
- b.) Send copies to the Chair of the Department and to the Chair of the Committee.

11.8.2.4) Fourth Violation or Undetected Remedial Level of Contamination

The Radiation Safety Service shall:

- a.) Request the Chair of the Committee to arrange for an interview between the Authorized Laboratory Supervisor and the Committee for the purpose of determining steps that need to be taken to prevent recurrence of the noncompliance.

Note 1: In the event of serious, health-threatening violations, the Radiation Safety Service may take appropriate action, including stopping work under a permit, until an interview with the Committee has been completed and it has made recommendations with respect to the safety issues.

Note 2: If the interval between violations is more than eighteen months, the sequence again begins with Section 11.8.1.

The Radiation Safety Committee shall:

- 11.8.2.5) Take necessary actions to address the problems and monitor the adequacy of those actions.

12) RADIATION SAFETY TRAINING

12.1) Requirements for Training

12.1.1) Any Unsupervised Occupant of a Controlled Room or a Controlled Area Shall Have Documented Training.

12.1.1.1) The Authorized Laboratory Supervisor shall ensure that all unsupervised individuals frequenting the Supervisor's Authorized Laboratory, except Housekeeping and Facilities Operations personnel, have the training required for the category applicable to that individual. The Authorized Laboratory Supervisor shall also ensure that provisions are made for briefing and escorting Visitors to the lab.

Note: The Authorized Laboratory Supervisor is encouraged to inquire whether the Housekeeping or FO personnel entering their laboratories have had the required training by RSS. The Authorized Laboratory Supervisor **shall ensure** that such personnel are not asked to handle or service any item or device that is restricted, that has not been surveyed, and/or that has a radioactive materials label, nor service any item in an area where ionizing radiation exists.

12.1.1.2) An **Authorized Laboratory** includes the physical facilities and the associated Authorized Users/Occupants, and may consist of several Controlled Rooms and/or Controlled Areas.

a.) A **Controlled Room** is a **room** in which radioactive materials and/or radiation generating devices are being used or stored and which is included as part of an Authorized Laboratory under a permit.

b.) A **Controlled Area** is an **area** located outside a "Controlled Room" that is **temporarily** established in which radioactive materials are being handled or in which a radiation generating device is being used. The method for establishing the Controlled Area must be specified in an approved permit and a Controlled Area must be under the direct physical supervision of an Authorized User at all times to prevent entry by any unauthorized individuals. An example would be the use of a moisture gauge to determine moisture content at some location on campus.

12.1.2) Categories of Individuals Needing Training

12.1.2.1) Authorized Occupants in Authorized Laboratories

An **Authorized Occupant** is an unsupervised individual who is not working with radioactive materials or radiation generating equipment but who requires access to a Controlled Room or Controlled Area and has completed the documented training.

Note: An unsupervised individual as used in this Part means an individual who is not under the direct and continuous physical surveillance of an Authorized User who has the responsibility of ensuring that the individual will not receive radiation exposures or encounter radioactive contamination.

Authorized Occupants are

- a.) **Unsupervised Visitors** who require repeated entry into a Controlled Room. An example would be secretaries.
- b.) **Individuals** who have responsibilities that make frequent entry into a Controlled Room or regular occupancy of a Controlled Room mandatory but who do not use any radiation sources. Examples are lab managers and students.
- c.) **Non-laboratory Personnel** performing services in a Controlled Room. Examples are Housekeeping personnel and Maintenance personnel.

12.1.2.2) Authorized Users

An **Authorized User** is any individual who handles and/or uses radioactive materials or a radiation generating device who has the requisite documented training and experience and has been certified to have such training and experience by the RSS.

Note: No one at the University of Kansas (Lawrence Campus) may handle or use radioactive materials or radiation generating devices unless they he/she has documented "authorized users" training appropriate to the level of risk. See Section 12.3 below.

12.2) Training Requirements for Authorized Occupants

The Authorized Laboratory Supervisor shall ensure that the training specified in this section is completed before unsupervised visits and/or occupation of Controlled Rooms is permitted.

12.2.1) Training Requirements for Visitors of Controlled Rooms not under Direct Supervision (physical presence) of an Authorized User

12.2.1.1) The training shall include general safety training which comprises hazard recognition, hazard exposures, and hazard control measures.

12.2.1.2) The training shall include KU-specific training which comprises hazard assessment and work-site characterizations, hazard identification (labeling, posting, warning signs, and written authorizations), employee exposures and risks and/or cautions, protective measures, and emergency procedures.

12.2.1.3) The training may include more specific information regarding the particular concerns of hazard recognition, hazard exposures, and hazard control measures.

12.2.2) Actions of Unsupervised Visitors and the Authorized Laboratory Supervisor

Occasional Unsupervised Visitors to Authorized Laboratories shall:

12.2.2.1) Be given a copy of the training and the specific appended instructions, if any, for the specific Authorized Laboratory to be visited.

12.2.2.2) Read those instructions.

12.2.2.3) Sign the certified training documentation prior to unsupervised visits to the room.

12.2.2.4) Submit the form to the Authorized Laboratory Supervisor.

Note: With the signature of the certified training documentation, the visitor commits to follow the instructions and procedures of that form.

The Authorized Laboratory Supervisor shall:

12.2.2.5) Submit a copy of the form to the RSS.

12.2.3) Laboratory Occupants Regularly in a Controlled Room but not Using Radiation Sources

Laboratory Occupants shall:

12.2.3.1) Be given a copy of the training and the specific appended instructions, if any, for the specific Authorized Laboratory to be occupied.

12.2.3.2) Read those instructions.

12.2.3.3) Sign the certified training documentation and/or satisfactorily complete an "open material" examination concerning those instructions prior to unsupervised occupation of the room.

Note: With the signature the Authorized Occupant commits to following the instructions and procedures.

The Authorized Laboratory Supervisor shall:

12.2.3.4) Verify that the appropriate form has been signed and/or that the exam has been satisfactorily completed, sign the certified training documentation and submit a copy to the RSS.

Note: Housekeeping, Facilities Operation and Security personnel are trained by Environmental Health and Safety/RSS staff. See 12.2.4 below.

12.2.4) Personnel from Housekeeping, Facilities Operations, and Security with Unsupervised Activities in Controlled Rooms

Personnel from Housekeeping, Facilities Operations, and Security shall:

12.2.4.1) Complete the training provided by EHS/RSS before providing services in authorized laboratories.

Note 1: The instructions given shall be provided to such personnel at the time they are trained by RSS. This training shall be documented.

Note 2: Supervisors of Housekeeping, Facilities Operations and Security shall not give assignments to personnel that require entry into Authorized Laboratories until the training specified in this section has been completed and documented.

Note 3: Rooms posted as Level III or IV controlled rooms are not to be serviced by personnel listed in Section 12.2.4 without authorization by the Authorized Laboratory Supervisor. This includes verification that no contaminated areas or items will be encountered during the service.

The Radiation Safety Service shall:

12.2.4.2) Provide the training specified in Section 12.2.4.1 above and maintain the documentation for that training.

Authorized Laboratory Supervisors and Authorized Users shall:

12.2.4.3) Not permit Authorized Occupants who are not laboratory personnel to enter a Level III or IV Controlled Room until the Authorized Laboratory Supervisor has verified that no contaminated areas/equipment or radiation fields will be encountered by the Authorized Occupants and that they have been thoroughly instructed concerning any areas or items that are not to be approached or handled.

12.3) Training Requirements for Authorized Users

12.3.1) All individuals who handle or use radioactive sources or radiation generating devices shall be trained at the level commensurate with the risk. Appendix IV- C describes the maximum amounts of radioactive materials that a specific category of user may handle. Individuals shall be

12.3.1.1) Informed on the storage, transfer, or use of radioactive materials or radiation generating devices.

12.3.1.2) Instructed in the health protection problems associated with exposure to radioactive materials or radiation generating devices, in precautions or procedures to minimize exposure, and in the purposes and function of protective devices employed.

12.3.1.3) Instructed in, and required to observe, to the extent within the Authorized User's control, the applicable provisions of the regulations, license, and permit conditions for the protection of personnel from exposure to radioactive materials and/or radiation generating devices.

12.3.1.4) Instructed of their responsibility to report promptly to the RSS any condition that may lead to or cause a violation of the regulations, license, or permit conditions, or unnecessary exposure to radioactive materials and/or radiation devices.

12.3.1.5) Instructed in the appropriate response to warnings made in the event of an emergency that may involve exposure to radioactive materials and/or radiation generating devices.

12.3.1.6) Advised as to the radiation exposure reports that Authorized Users may request.

12.3.1.7) Instructed concerning prenatal radiation exposure and its risks to the embryo/fetus, and of the choice to declare pregnancy for female Authorized Users.

The Authorized Laboratory Supervisor shall:

12.3.1.8) Ensure that all individuals working within the Authorized Laboratory and who are handling and/or using radioactive sources or radiation generating devices have the documented training appropriate for the levels at which the individuals will be working.

Note: Individuals who have a need to begin working with radioactive materials quickly may qualify as Category F Authorized Users. See Section 12.3.7 below for the restrictions that apply and to Section 12.4 for the additional responsibilities of the Authorized Laboratory Supervisor under whom such individuals are working.

12.3.1.9) Ensure that a declared pregnant woman, a female Authorized User who has voluntarily informed her Authorized Laboratory Supervisor in writing of her pregnancy and conception date, has been informed of the risks associated with occupational exposures.

12.3.2) **Category A Training**

12.3.2.1) Required of:

a.) Users who will handle quantities exceeding the Category C limits in Appendix IV-C.

Examples are handling more than 1 mCi H-3 and 10 μ Ci of P-32.

12.3.2.2) Requirements for Certification as a Category A Authorized User

Individuals with no prior experience or training shall:

a.) Satisfactorily complete a written examination given by the Radiation Safety Service.

b.) Satisfactorily complete a one-day laboratory under the direction of the Radiation Safety Service staff or a 16-hour supervised on-the-job training session under an Authorized Laboratory Supervisor or an Authorized User approved by Radiation Safety Service staff as qualified to provide the training.

Individuals with training and experience at another institution shall:

- c.) Provide written documentation that should include the syllabus, course schedule, or course content of the training to the RSS.
- d.) Receive instructions in KU-specific procedures by the RSS.

Note: If condition c. does not meet the equivalent training requirements, conditions a. and/or b. shall be met as required by the RSO.

12.3.2.3) Subject matter upon which the written exam will be based.

- a.) Part I and II of the text by Benjamin S. Friesen, "Radiation Safety in the Use of Radioactive Materials," or equivalent material.

(Equivalent material is presented in *Radiation Protection: A Guide For Scientists and Physicians* by Jacob Shapiro, etc.)

Note: Completion of Biology 703, including its exam, satisfies the documented training requirement. Prospective users are encouraged either to audit or enroll in Biology 702 and 703 for the purpose of meeting this requirement. Users may choose the "self study" option.

12.3.3) **Category B Training**

12.3.3.1) Required of:

- a.) Users who will handle only **one kind** of radioisotope or specific types of emitter with prescribed conditions in quantities exceeding Appendix IV- C, Category C limits, but less than Category A limits.

Examples are handling more than 10 μCi but less than 500 μCi of P-32 or handling more than 1 mCi but less than 50 mCi of H-3.

- b.) Prospective Laboratory Supervisors who have had training and experience, but who do not satisfy the requirements for Category C and/ or Category A certification. Prospective Laboratory Supervisors may be certified to use ten times the quantities of Category B users.

12.3.3.2) Requirements for Certification as a Category B Authorized User

Individuals with no prior experience or training shall:

- a.) Satisfactorily complete a written examination given by the Radiation Safety Service.
- b.) Satisfactorily complete a one day laboratory under the direction of the Radiation Safety Service staff or a 16 hour supervised on-the-job training session under an Authorized Laboratory Supervisor or an Authorized User approved by Radiation Safety Service staff as qualified to provide the training.

Individuals with training and experience at another institutions shall:

- c.) Provide written documentation that should include the syllabus, course schedule or course content of the training to the Radiation Safety Service.
- d.) Receive instructions in KU specific procedures by the RSS.

Note 1: If condition c. does not meet the equivalent training requirements, conditions a. and/or b. shall be met as required by the RSO.

Note 2: If condition c. is not met by a Prospective Laboratory Supervisor, an "open material" exam may be completed to satisfy the equivalent training documentation.

12.3.3.3) Subject matter upon which the written exam will be based.

- a.) Relevant sections of Part I and II of the text by Benjamin S. Friesen, "Radiation Safety in the Use of Radioactive Materials" or equivalent material. The relevant sections are specified by RSS staff on the basis of the isotope to be used.

(Equivalent material is presented in *Radiation Protection: A Guide For Scientists and Physicians* by Jacob Shapiro, etc.)

Note: Prospective users are encouraged to audit relevant portions of Biology 702 and 703 for the purpose of meeting the documented training requirement and as preparation for the special examination given by RSS. Users may choose the "self study" option.

12.3.4) **Category C Training**

12.3.4.1) Required of:

- a.) Users who will handle no more than the quantities specified in Appendix IV-B, Category C.

Examples are handling no more than 1 mCi H-3, or 10 μ Ci P-32, or 100 μ Ci C-14.

12.3.4.2) Requirements for Certification as a Category C Authorized User

Individuals with no prior experience or training shall:

- a.) Satisfactorily complete a written examination given by the Radiation Safety Service.
- b.) Satisfactorily complete a one-day laboratory under the direction of the Radiation Safety Service staff or an 8-hour supervised on-the-job training session under an Authorized Laboratory Supervisor or an Authorized User approved by Radiation Safety Service staff as qualified to provide the training.

Individuals with training and experience at another institution shall:

- c.) Provide written documentation that should include the syllabus, course schedule, or course content of the training to the RSS.
- d.) Receive instructions in KU specific procedures by the RSO.

Note: If condition c does not meet the equivalent training requirements, conditions a. and/or b. shall be met as required by the RSO.

12.3.4.3) Subject matter upon which the written exam will be based.

- a.) Sections of Part I as described in the text by Benjamin S. Friesen, "Radiation Safety in the Use of Radioactive Materials," or equivalent material.

(Equivalent material is presented in in *Radiation Protection: A Guide For Scientists and Physicians* by Jacob Shapiro, etc.)

Note: Completion of Biology 702, including its exam, satisfies the documented training requirement. Prospective users are encouraged either to audit or enroll in Biology 702 for the purpose of meeting this requirement, but the "self study" option may be chosen.

12.3.5) **Category D Training**

12.3.5.1) Required of individuals who will be operating and using radiation generating devices. See Chapter 7 for types of units included in this designation. Examples are x-ray diffraction units, cabinet x-ray units, and diagnostic x-ray units.

12.3.5.2) Requirements for Certification as a Category D Authorized User

Individuals with no prior experience or training shall:

- a.) Satisfactorily complete a written examination given by the Radiation Safety Service.
- b.) Satisfactorily complete on-the-job training under an Authorized Laboratory Supervisor approved by the Radiation Safety Service staff as qualified to provide the training.

Individuals with training and experience at another institution shall:

- c.) Provide written documentation that should include the syllabus, course schedule, or course content of the training to the RSS.
- d.) Receive instructions in KU specific procedures by the RSO.

Note: If condition c does not meet the equivalent training requirements, conditions a. and/or b. shall be met as required by the RSO.

12.3.5.3) Subject matter upon which the written exam will be based.

- a.) The text by Benjamin S. Friesen, "Radiation Safety in the Use of X-ray Producing Machines," or equivalent material with unit specific material.

(Equivalent material is presented in in *Radiation Protection: A Guide For Scientists and Physicians* by Jacob Shapiro, etc.)

12.3.6) **Category E Training**

12.3.6.1) Required of individuals who will be operating and using moisture and/or density gauges that have radioactive sources in them.

12.3.6.2) Requirements for Certification as a Category E Authorized User

Individuals with no prior experience or training shall:

- a.) Satisfactorily complete a state-approved course by the manufacturer or a course conducted by the RSO.
- b.) Complete a brief orientation by the RSO to KU specific requirements if a manufacturer's course has been completed.

Individuals with training and experience at another institution shall:

- c.) Provide written documentation that should include a syllabus, course schedule, course content, or certificate of training to the RSS.
- d.) Receive instructions in KU specific procedures by the RSO.

Note: If condition c does not meet the equivalent training requirements, conditions a. and/or b. shall be met as required by the RSO.

12.3.6.3) Subject matter upon which the written exam will be based.

- a.) The text, "Radiation Safety in the Use of Moisture-Density Probes," or equivalent material with material that is specific to the unit.

12.3.7) Category F Training (Temporary Certification)

12.3.7.1) Required of:

- a.) Users who will not handle more than 0.1 of the levels specified for Category C Users in Appendix IV - B.

Examples are handling not more than 100 μCi H-3, or 1 μCi P-32, or 10 μCi C-14.

12.3.7.2) Restricted to:

- a.) Students in non-research laboratory courses
- b.) Laboratory assistants who need to begin work with radioisotopes very quickly and who are in the process of satisfying one of the other training requirements
- c.) Trainees who will be at the University for such a short period of time that completion of one of the permanent certifications is not an option and for whom Category F certification satisfies the training requirements for the levels of activity that will be used.

Note: The Category F certification is **temporary** for a duration of no more than one year and preferably less than that time. Under rare circumstances, Category F certification may be extended beyond one year if adequate justification for such an extension is provided by the Authorized Laboratory Supervisor 30 days before the expiration of the certificate.

12.3.7.3) Requirements for Certification as a Temporary Category F Authorized User

Individuals at Category F level shall:

- a.) Satisfactorily complete a written examination given by the Radiation Safety Service.
- b.) Receive hands-on-instruction in the use of safety practices by the Authorized Laboratory Supervisor.

12.3.7.4) Subject matter upon which the written exam will be based:

- a.) The text, "A Brief Introduction to Radiation Safety," or equivalent material.

12.4) Responsibilities of the Authorized Laboratory Supervisor for Category F Certification

12.4.1) Actions by the Authorized Laboratory Supervisor

The Authorized Laboratory Supervisor shall:

12.4.1.1) Carefully supervise the work of Category F users and shall not give such user independent responsibility for handling radioactive materials.

Note: Although constant surveillance is not required, absence from the room should not be frequent and should be of short duration.

12.4.1.2) Not require such an individual to maintain the records required by this manual.

Note: This does not imply that a Category F worker may not be asked to maintain records as a form of training but they will not be the official records. Official record keeping must be performed by someone with at least Category C training.

12.5) Responsibilities of the Radiation Safety Service

12.5.1) Actions by the Radiation Safety Service

The Radiation Safety Service shall:

12.5.1.1) Schedule and make available on a timely basis the training required by this chapter.

12.5.1.2) Maintain documentation of the training provided under the specifications of this chapter.

13) Standard Operating Procedures to be Applied in the Use of Sources of Ionizing Radiation

13.1) Classification of Procedures

Standard operating procedures for Authorized Laboratories are procedures designed, developed, and implemented to ensure the safe use of sources of ionizing radiation. These procedures attempt to promote habits and employ techniques that secure the achievement of ALARA.

These procedures may be universal for all Authorized Laboratories or very specific for particular manipulations and uses of sources of ionizing radiation. Therefore, licensed procedures, Committee-approved procedures, procedures adopted by the Laboratory Safety Committee, and laboratory-specific procedures could be required in any particular Authorized Laboratory.

Procedures for permit applications, permit renewals, procurement, training, ALARA considerations, exposure control and assessment, and laboratory limits and special design are specifically referenced in this Part. References to additional procedures and general practices are included in Sections 13.3 and 13.4.

13.1.1) **Licensed Procedures** have been approved by the Committee and have been incorporated into the Radioactive Materials License.

13.1.2) **Standard Permit Conditions** have been approved by the Committee and are stipulations that are binding to each permit that is approved by the Committee. These conditions are specific for uses of radioactive materials and/or radiation generating devices, and are automatically part of every permit.

13.1.3) **Guidance Documents** provide Authorized Users with procedures and/or instructions that have the potential to change quickly or that need to be revised routinely. These documents may be Committee approved.

13.1.4) **Laboratory General Procedures** are procedures identified in the Laboratory Safety Plan and that are applicable for a particular Authorized Laboratory.

13.1.5) **Laboratory-specific Procedures** are procedures that have been developed by the RSS and/or Authorized Laboratory Supervisor to address safety and health issues for an Authorized Laboratory.

13.2) Responsibilities Under the Procedures

13.2.1) Authorized Users and Authorized Occupants

Authorized Users and Authorized Occupants shall:

13.2.1.1) Comply with the applicable standard operating procedures identified in this plan and in the approved permit.

13.2.1.2) Inform the Authorized Laboratory Supervisor of procedures that will initiate and/or improve laboratory-specific procedures.

13.2.2) Authorized Laboratory Supervisors

Authorized Laboratory Supervisor shall:

13.2.2.1) Ensure that the applicable standard operating procedures are implemented and followed.

13.2.2.2) Develop and implement more specific operating procedures as necessary and/or obtain required permits and implement the requirements and conditions of the permit.

13.2.2.3) Ensure that the facilities and equipment required for compliance with the procedures are available and properly maintained for the Authorized Users.

13.2.3) Responsibilities of the Radiation Safety Service

The Radiation Safety Service shall:

13.2.3.1) Develop and/or recommend to the Committee operating procedures to satisfy the conditions of the license, requirements of the regulations and/or prudent practices.

13.2.3.2) Review the existing operating procedures and recommend, revise, and implement changes as necessary.

13.2.3.3) Provide assistance to Authorized Laboratory Supervisors in implementing specific procedures required under an approved permit.

13.2.3.4) Provide assistance to Authorized Laboratory Supervisors in developing and implementing more specific operating procedures as necessary.

13.3) Descriptions of Procedures

13.3.1) Proposed Facility Use Procedures

13.3.1.1) Specific facility use procedures are described in guidance documents that will be provided by the RSS. These procedures include use as classrooms, cold rooms, instrument rooms, temporary laboratories, authorized laboratories, and field studies.

13.3.1.2) A permit is required for each of these specific uses.

13.3.2) Posting and Labeling Procedures

13.3.2.1) Posting and labeling procedures are described in guidance documents that will be provided by the RSS. These procedures specify the requirements for lab entrance posting, specific hazard warnings, restricted area designations, equipment labeling, etc.

13.3.2.2) Consult the RSS for assistance with the posting and labeling requirements.

13.3.3) Wipe Survey Procedures

The Authorized Users should:

13.3.3.1) Check for removable contamination by performing wipe tests with a smooth, medium, porosity filter paper.

Note: To the extent specified in the Safety Data Sheets, "thin window" GM pancake probe & meter may be used as a **preliminary** survey for the location of contamination. Such a survey is **not a substitute** for performing wipes to determine the level of "removable" contamination.

13.3.3.2) Record the results of these tests in the survey log book in dpm/100 cm² or μ Ci/100 cm².

Note 1: The ALARA limits discussed in Section 11.2.2.2 above shall not be exceeded unless authorization for doing so has been obtained from the RSS and is addressed in the applicable permit. (This would require additional safety precautions.)

Note 2: Areas larger than 100 cm² may be tested with a single wipe. However, the actual dpm on any single wipe shall not be averaged over an area greater than 100 cm² because it would be possible that all of the activity on the wipe came from one small spot less than 100 cm² in area. If the dpm on any wipe exceeds the numerical limit given in Section 11.2.2.2., either decontamination shall be initiated or it shall be established by re-wipes that all such areas are below the limit. Remember that the goal is to have no measurable removable contamination. Decontamination should be attempted if measurable contamination is encountered.

Note 3: Enough wipes need to be made in places where contamination may have occurred (lab benches, floor in work area, door handles of storage facilities, hood aprons, etc.) to verify the absence of contamination. For beta emitters, the activity may be measured with a Liquid Scintillation Counter just as research results are measured. Gamma counters may be used for gamma emitters.

13.3.3.3) Directions for specific types of emitters:

- a.) For very low energy α emitters like ³H, the only practical means of monitoring is by wipes or smears counted in the LSC. GM survey meters cannot be used. The efficiency used for research samples may be used in determining the dpm.
- b.) For low-energy α emitters like ¹⁴C, "thin window" GM survey meters may be used to locate higher levels of contamination. Wipes counted in a LSC shall be used to determine the removable contamination.
- c.) For high-energy α emitters like ³²P, "thin window" GM survey meters may be used. Removable levels shall be determined with wipes. "Side window" GM meters may also be used but are not quite as sensitive.
- d.) For low-energy gamma and x-ray emitters like ¹²⁵I, normal GM survey meters cannot be used. (They might respond to very high fields that are far above those that would be permitted in the lab.) A low-energy gamma scintillation detector with a portable single-channel analyzer provides a very sensitive monitoring system and should be used.

e.) For average and high-energy gamma or x-ray emitters, a calibrated ion chamber is the instrument of choice for determining the external radiation field in mR/hr because of its energy independence. Because these instruments are not intended for rugged use and are quite expensive to maintain, GM survey meters may be used to detect and "estimate" gamma fields. They should be calibrated at the energy of the isotope to be detected. The instruments as described above are not used to determine dpm, which is needed for the records. Wipes counted in a gamma counter are required for documenting removable activity.

13.3.4) Laboratory Design

13.3.4.1) Laboratory design procedures are described in guidance documents that will be provided by the RSS. These procedures include the proper uses for poly-backed absorbent paper, secondary containment, segregation, etc.

13.3.4.2) Consult the RSS for assistance with the laboratory quality assurance procedures.

13.3.5) Quality Assurance Procedures

13.3.5.1) Quality assurance procedures are described in guidance documents that will be provided by the RSS. These procedures include the proper uses for survey instruments, liquid scintillation counters, fume hoods, etc.

13.3.5.2) Consult the RSS for assistance with the laboratory quality assurance procedures.

13.3.6) Personnel Dosimetry Procedures

13.3.6.1) Personnel dosimetry procedures and requirements are described in guidance documents that will be provided by the RSS. These procedures specify the guidelines for obtaining personnel dosimeters, qualifications that require the monitoring of Authorized Users, and requirements for care and use of personnel dosimeters.

13.3.6.2) Consult the RSS for assistance with the posting and labeling requirements.

13.3.7) Waste Management Procedures

13.3.7.1) Specific waste management procedures are described in guidance documents that will be provided by the RSS.

13.3.7.2) Records shall be maintained and kept as required by the RSS.

13.3.8) Emergency Response Procedures

13.3.8.1) Emergency response procedures are a part of each permit.

13.3.8.2) The RSS should be notified of any accident or emergency.

13.3.9) Record Keeping Procedures

13.3.9.1) Specific record-keeping procedures are described in guidance documents that will be provided by the RSS. Records are required for permit documentation, source use, inventory control, personnel dosimetry reports, laboratory surveys, waste records, training records, etc.

13.3.9.2) Records shall be maintained and kept as required by the RSS.

13.4) General Summary of Safety Practices

This list provides standard safety practices that are requirements for working with radioactive materials, and that promote the necessary habits to work safely with radioactive materials.

13.4.1) The University of Kansas is committed to the goal of keeping collective and individual radiation exposures *as low as reasonably achievable (ALARA)*. This goal serves as the overall controlling aim of radiation safety to plan and to conduct work with radioactive materials so that exposures will be kept as low as reasonably achievable.

13.4.2) The Authorized Laboratory Supervisor is responsible for the safe use of radioactive materials for all those who work in the laboratory. This includes ensuring that all users of radioactive materials have received the applicable training certification and that all laboratory users/occupants have been appropriately instructed.

13.4.3) All users of radioactive materials shall receive training and instructions commensurate with the potential radiological health protection problems in the restricted areas.

13.4.4) All radioactive materials are to be ordered through the Radiation Safety Service. The transfer of all radioactive sources/samples between laboratories is to be approved by the RSS. All off-campus shipments to/from research laboratories or other university laboratories (co-projects) are to be coordinated with the Radiation Safety Service.

13.4.5) **Gloves and lab coats shall be required for all work with radioactive materials.**

13.4.6) Gloves and lab coats worn while handling radioactive materials should be removed and surveyed upon leaving the area. Working areas should be monitored/surveyed for contamination after experimental operations have been carried out. Record survey results even if the readings are background. Comprehensive surveys are required at a specified frequency- (monthly, biweekly, or weekly).

13.4.7) Personnel exposure monitoring will be recommended by the Radiation Safety Service if appropriate for the particular isotopes that are used. All users of P-32 should obtain personnel dosimeters prior to handling radioactive materials. A TLD ring should be obtained prior to handling more than 5 mCi of P-32 or I-125.

13.4.8) All operations should be planned to limit actual or potential spread of radioactive material. Dry runs and accident evaluations should be made prior to using radioactive tracers in the experiment.

13.4.9) The radioactive material labels on an original shipping container are required to be removed or defaced before the container is discarded.

13.4.10) Areas for work should be chosen with respect to ease of decontamination in case of an accident. Work areas should also be segregated from high-traffic areas.

13.4.11) All work areas should be defined by trays and/or absorbent paper and with "caution, radioactive material" tape. Easily removable "temporary areas" of absorbent paper should be placed over more "permanent areas" of absorbent paper. This design facilitates ease of decontamination.

13.4.12) Trash containers for regular trash should not be located near restricted work areas.

13.4.13) Users of radioactive materials should not work alone. Another individual should be within hearing distance to provide assistance in case of an accident.

13.4.14) All equipment used in radioisotope work areas should be labeled and kept segregated from unrestricted equipment. **All equipment used for radioactive materials should be labeled.** Do not use labels requiring wetting.

13.4.15) Hands should be washed upon completing a procedure and/or leaving a work area for radioactive materials.

13.4.16) Solutions shall not be pipetted by mouth in a radioisotope laboratory.

13.4.17) Eating food, drinking beverages, smoking, applying cosmetics and using handkerchiefs other than disposable ones are not permitted in designated work areas.

13.4.18) All radioactive materials and contaminated equipment shall be appropriately secured against unauthorized use.

13.4.19) All radioactive waste that is generated must be transferred to the RSS for proper disposal. Only tertiary rinses of glassware may be released to the sanitary sewer in the laboratory. Dilution is not a true means of disposal.

13.4.20) Any accident involving internal or external exposure to radiation or involving uncontrolled release of radioactive materials should be reported immediately to the Radiation Safety Service.

13.4.21) Workers who have worn personnel monitoring devices may request a radiation exposure report at any time from the Radiation Safety Service. Routine reports are issued monthly.

13.4.22) Users of radioactive materials are responsible for reporting promptly to the Radiation Safety Service any condition that may lead to or cause a violation of the regulations or license conditions or unnecessary exposure to radiation or to radioactive material.

13.4.23) Any significant change in the level of activity, the procedures, or the type of activity utilized requires prior approval by the Committee on Radiation Safety.

13.4.24) These procedures and activities are governed by the Kansas Radiation Protection Regulations, Title 10 Code of Federal Regulation Part 20, 10CFR19, the Radiation Safety Plan, and the Radioactive Materials License. These documents are available in the offices of the RSS.

IV: Appendix A

QUANTITIES OF RADIOACTIVE MATERIALS
FOR A LOW LEVEL PERMIT

<u>Radioactive Material</u>	<u>Micro-curies</u>	<u>Radioactive Material</u>	<u>Micro-curies</u>
Antimony 122 (Sb 122)	100	Fluorine 18 (F 18)	1000
Antimony (Sb 124)	10	Gadolinium 153 (Gd 153)	10
Antimony 125 (Sb 125)	10	Gadolinium 159 (Gd 159)	100
Arsenic 73 (As 73)	100	Gallium 72 (Ga 72)	10
Arsenic 74 (As 74)	10	Germanium 71 (Ge 71)	100
Arsenic 76 (As 76)	10	Gold 198 (Au 198)	100
Arsenic 77 (As 77)	100	Gold 199 (Au 199)	100
Barium 131 (Ba 131)	10	Hafnium 181 (Hf 181)	10
Barium 140 (Ba 140)	10	Holmium 166 (Ho 166)	100
Bismuth 210 (Bi 210)	1	Hydrogen 3 (H 3)	1000
Bromine 82 (Br 82)	10	Indium 113m (In 113m)	100
Cadmium 109 (Cd 109)	10	Indium 114m (In 114m)	10
Cadmium 115m (Cd 115m)	10	Indium 115m (In 115m)	100
Cadmium 115 (Cd 115)	100	Indium 115 (In 115)	10
Calcium 45 (Ca 45)	10	Iodine 125 (I 125)	1
Calcium 47 (Ca 47)	10	Iodine 126 (I 126)	1
Carbon 14 (C 14)	100	Iodine 129 (I 129)	0.1
Cerium 141 (Ce 141)	100	Iodine 131 (I 131)	1
Cerium 143 (Ce 143)	100	Iodine 132 (I 132)	10
Cerium 144 (Ce 144)	1	Iodine 133 (I 133)	1
Cesium 131 (Cs 131)	1,000	Iodine 134 (I 134)	10
Cesium 134m (Cs 134m)	100	Iodine 135 (I 135)	10
Cesium 134 (Cs 134)	1	Iridium 192 (Ir 192)	10
Cesium 135 (Cs 135)	10	Iridium 194 (Ir 194)	100
Cesium 136 (Cs 136)	10	Iron 55 (Fe 55)	100
Cesium 137 (Cs 137)	10	Iron 59 (Fe 59)	10
Chlorine 36 (Cl 36)	10	Krypton 85 (Kr 85)	100
Chlorine 38 (Cl 38)	10	Krypton 87 (Kr 87)	10
Chromium 51 (Cr 51)	1000	Lanthanum 140 (La 140)	10
Cobalt 58m (Co 58m)	10	Lutetium 177 (Lu 177)	100
Cobalt 58 (Co 58)	10	Manganese 52 (Mn 52)	10
Cobalt 60 (Co 60)	1	Manganese 54 (Mn 54)	10
Copper 64 (Cu 64)	100	Manganese 56 (Mn 56)	10
Dysprosium 165 (Dy 165)	10	Mercury 197m (Hg 197m)	100
Dysprosium 166 (Dy 166)	100	Mercury 197 (Hg 197)	100
Erbium 169 (Er 169)	100	Mercury 203 (Hg 203)	10
Erbium 171 (Er 171)	100	Molybdenum 99 (Mo 99)	100
Europium 152 (Eu 152) 13 yr	1	Neodymium 147 (Nd 147)	100
Europium 152 (Eu 152) 9.2 hr	100	Neodymium 149 (Nd 149)	100
Europium 154 (Eu 154)	1	Nickel 59 (Ni 59)	100
Europium 155 (Eu 155)	10	Nickel 63 (Ni 63)	10

IV Appendix A (cont.)

<u>Radioactive Material</u>	<u>Micro-curies</u>	<u>Radioactive Material</u>	<u>Micro-curies</u>
Nickel 65 (Ni 65)	100	Strontium 89 (Sr 89)	1
Niobium 93m (Nb 93m)	10	Strontium 91 (Sr 91)	10
Niobium 95 (Nb 95)	10	Strontium 92 (Sr 92)	10
Niobium 97 (Nb 97)	10	Sulphur 35 (S 35)	100
Osmium 185 (Os 185)	10	Tantalum 182 (Ta 182)	10
Osmium 191m (Os 191m)	100	Technetium 96 (Tc 96)	10
Osmium 191 (Os 191)	100	Technetium 97m (Tc 97m)	100
Osmium 193 (Os 193)	100	Technetium 97 (Tc 97)	100
Palladium 103 (Pd 103)	100	Technetium 99m (Tc 99m)	100
Palladium 109 (Pd 109)	100	Technetium 99 (Tc 99)	10
Phosphorus 32 (P 32)	10	Tellurium 125m (Te 125m)	10
Platinum 191 (Pt 191)	100	Tellurium 127m (Te 127m)	10
Platinum 193m (Pt 193m)	100	Tellurium 127 (Te 127)	100
Platinum 193 (Pt 193)	100	Tellurium 129m (Te 129m)	10
Platinum 197m (Pt 197m)	100	Tellurium 129 (Te 129)	100
Platinum 197 (Pt 197)	100	Tellurium 131m (Te 131m)	10
Polonium 210 (Po 210)	0.1	Tellurium 132 (Te 132)	10
Potassium 42 (K 42)	10	Terbium 160 (Tb 160)	10
Praseodymium 142 (Pr 142)	100	Thallium 200 (Tl 200)	100
Praseodymium 143 (Pr 143)	100	Thallium 201 (Tl 201)	100
Promethium 147 (Pm 147)	10	Thallium 202 (Tl 202)	100
Promethium 149 (Pm 149)	10	Thallium 204 (Tl 204)	10
Rhenium 186 (Re 186)	100	Thulium 170 (Tm 170)	10
Rhenium 188 (Re 188)	100	Thulium 171 (Tm 171)	10
Rhodium 103m (Rh 103m)	100	Tin 113 (Sn 113)	10
Rhodium 105 (Rh 105)	100	Tin 125 (Sn 125)	10
Rubidium 86 (Rb 86)	10	Tungsten 181 (W 181)	10
Rubidium 87 (Rb 87)	10	Tungsten 185 (W 185)	10
Ruthenium 97 (Ru 97)	100	Tungsten 187 (W 187)	100
Ruthenium 103 (Ru 103)	10	Vanadium 48 (V 48)	10
Ruthenium 105 (Ru 105)	10	Xenon 131m (Xe 131m)	1000
Ruthenium 106 (Ru 106)	1	Xenon 133 (Xe 133)	100
Samarium 151 (Sm 151)	10	Xenon 135 (Xe 135)	100
Samarium 153 (Sm 153)	100	Ytterbium 175 (Yb 175)	100
Scandium 46 (Sc 46)	10	Yttrium 90 (Y 90)	10
Scandium 47 (Sc 47)	100	Yttrium 91 (Y 91)	10
Scandium 48 (Sc 48)	10	Yttrium 92 (Y 92)	100
Selenium 75 (Se 75)	10	Yttrium 93 (Y 93)	100
Silicon 31 (Si 31)	100	Zinc 65 (Zn 65)	10
Silver 105 (Ag 105)	10	Zinc 69m (Zn 69m)	100
Silver 110m (Ag 110m)	1	Zinc 69 (Zn 69)	1000
Silver 111 (Ag 111)	100	Zirconium 93 (Zr 93)	10
Sodium 24 (Na 24)	10	Zirconium 95 (Zr 95)	10
Strontium 85 (Sr 85)	10	Zirconium 97 (Zr 97)	10

Any radioactive material not listed above other than alpha emitting radioactive material0.1

IV Appendix B

RADIOISOTOPE LABORATORY DESIGN AND SPECIAL PROCEDURES

All guidelines for the safe handling of unsealed radioactive materials indicate that certain special laboratory design features and special procedures may be necessary. The type of material to be handled, the activity of the material, and the type of operation determine which of these special features and procedures are necessary. The chart on the following page may be used as a general guideline for laboratory design. The list of radioactive materials is intended to be representative rather than comprehensive. For materials not listed, consult the Radiation Safety Service.

When a combination of radioactive materials is involved, the limit for the combination should be derived as follows: Determine for each radioactive isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all of the radioactive isotopes in the combination may not exceed "1" (i.e., unity).

Example: If a "Type II" laboratory contains as stock 100 mCi of H³ and 5 mCi of I¹²⁵, it may not contain more than 5 mCi of C¹⁴. This limit was determined as follows:

$$\frac{100\text{mCi H}^3}{250 \text{ mCi}} + \frac{5 \text{ mCi I}^{125}}{10 \text{ mCi}} + \frac{5 \text{ mCi C}^{14}}{50 \text{ mCi}} = 1$$

The denominator in each of the ratios listed above was obtained from Column III, "Low Level Lab (Type II)" for each radioactive isotope present in the laboratory. The same type of calculation is applicable to the limits for a combination of materials in one experimental vessel (Column I) or to be handled at any one time (Column II).

IV Appendix B (cont.)

Isotope	Very Low Level Lab (Type I)			Low Level Lab (Type II)			Medium Level Lab (Type III)		
	I	II	III	I	II	III	I	II	III
H-3	250 uCi	2.5 mCi	25 mCi	2.5 mCi	25 mCi	250 mCi	250 mCi	2.5 Ci	25 Ci
C-14									
S-35	50 uCi	500 uCi	5 mCi	500 uCi	5 mCi	50 mCi	50 mCi	500 mCi	5 Ci
Cr-51									
P-32									
Ca-45	10 uCi	100 uCi	1 mCi	100 uCi	1 mCi	10 mCi	10 mCi	100 mCi	1 Ci
Fe-59									
Na-22									
Mn-54									
Co-60									
I-125	1 uCi	10 uCi	100 uCi	10 uCi	100 uCi	1 mCi	1 mCi	10 mCi	100 mCi
I-131									
Cs-137									
Sr-90									
Po-210	0.1 uCi	1 uCi	10 uCi	1 uCi	10 uCi	100 uCi	100 uCi	1 mCi	10 mCi
Ra-226									

- I. Maximum activity to be contained in any one experimental vessel.
- II. Maximum activity to be handled at any one time (liquid stock container, etc.).
- III. Maximum activity present in the laboratory at any one time.

IV Appendix B (cont.)

SUMMARY OF SPECIAL DESIGN DETAILS

	Very Low Level (Type I) -----	Low Level (Type II) -----	Medium Level (Type III) -----
Floor	-	Non-absorbent	Non-absorbent, no cracks
Walls	-	Painted	Smooth, non-absorbent
Benchtops	-	Non-absorbent or sealed	Non-absorbent
Sink	-	Non-absorbent, not slab construction. Foot, knee or elbow operated faucets.	Non-absorbent, not slab construction. Foot, knee, or elbow-operated faucets.
Ventilation	-	No recirculated air to building supply.	No recirculated air to building supply.
Drain lines	-	-	Special drain connection.
Hood (if needed)	Any	100 lfm face velocity	High efficiency design, 125-150 lfm face velocity. Individual ducting.
Other	Closed system for dry, dusty operations. Confine work to areas lined with absorbent paper.	Closed system for dry, dusty operations. Confine work to areas lined with absorbent paper.	Integral shielded storage if indicated. Closed system for dry, dusty operations. Confine work to areas lined with absorbent paper.

IV Appendix C

LIMITS FOR CATEGORIES A, B, C, and F CERTIFICATIONS

Isotope	User Category		
	C*	B*	A*
	Maximum Amount to be Handled		
H-3	1 mCi	50 mCi	
Cr-51	1 mCi	50 mCi	
C-14	100 uCi	5 mCi	
S-35	100 uCi	5 mCi	
P-33	100 uCi	5 mCi	
Ca-45	100 uCi	5 mCi	The limits will be specified by the permit.
P-32	10 uCi	500 uCi	
Co-60	1 uCi	50 uCi	
I-125	1 uCi	50 uCi	
T-131	1 uCi	50 uCi	

Category F users are limited to 0.1 of the limits for Category C. For radioisotopes not listed, consult the Radiation Safety Service.

* The numbers in column C and B above are to be multiplied by the modifying factor. The following factors may be applied after consultation with the Radiation Safety Service for specific permits.

Modifying Factor*	Procedure
x 10	<u>Very simple wet operations (simple withdrawal of a sample from a stock solution).</u>
x 1	Normal chemical operations
x 0.1	Complex wet operations with risk of spills
x 0.1	Simple dry operations
x 0.01	Dry and dusty operations

The following modifying factors are applied to all user limits.

Organic Molecules	Limit is 1/3 of that specified above.
DNA Analogues	Limit is 1/10 of that specified above.