



Radiation Safety Manual

ORGANIZATION

The authorization, structure, personnel, and responsibilities of individuals for the radiation safety program for Southeastern Louisiana University at Hammond are described in this section. The names and telephone numbers of individuals currently involved in the program are listed at the front of this manual.

Authorization

Authorization for Southeastern Louisiana University to possess, store, and use radioactive materials is stipulated in an educational radioactive materials license issued by the Louisiana Radiation Protection Division of the Department of Environmental Quality, which has vested responsibility from the United States Nuclear Regulatory Commission within the State of Louisiana or a in special nuclear material license issued by the United States Nuclear Regulatory Commission. The educational license allows the University the use of radioactive materials for teaching and research through the operation of an internal radiation safety and control program. Copies of these licenses are available for inspection in Office of Environmental Health & Safety.

Authorizations for individual campus activities are contained in minutes of the SLU Radiation Safety Committee, in campus policy statements, and in approved individual campus radiation safety manuals. Special authorization for unusual circumstances may be required, and may supersede the contents of this manual.

Program Structure

The Chairman of the Radiation Safety Committee is administratively responsible for the radiation safety programs within the University, and reports to the University President. Direct responsibility for implementation of the radiation safety policies and directives are established by the Radiation Safety Committee.

The Radiation Safety Committee has the responsibilities for local supervision and control of radiation hazards and will direct the activities of the Radiation Safety Officer.

The SLU Radiation Safety Committee is composed of representatives from the College of Science and Technology.

Responsibilities and Authority

All persons involved with the handling, use, and storage of radioactive materials and radiation sources have the general responsibilities to:

- 1) Assure that University personnel, students, and visitors are not subject to undue radiation exposure;**
- 2) Assure that all federal and state regulations have full compliance;**
- 3) Assure that all University regulations and policies pertaining to radiation safety have full compliance;**
- 4) Assure that special project restrictions have full compliance;**
- 5) Assure that University insurance restrictions are met;**
- 6) Assure that local and state codes and ordinances have full compliance;**
- 7) Assure that the integrity and usefulness of University facilities are not compromised;**
- 8) Assure that maximum standards of good practice and safe handling are maintained.**

These general responsibilities apply to all individual users, technicians, students, and operating personnel.

Each person who handles radioactive materials or radiation sources must recognize that the ultimate success of a radiation safety program lies in responsible actions by individuals in their daily work.

The Radiation Safety Committee is charged with the responsibility and authority to control the use of radioactive materials and radiation sources on a local basis. The Radiation Safety Committee can expedite action on radiation safety matters because of its intimate knowledge of local situations, and because of its ability to convene quickly. An executive committee, consisting of the Radiation Safety Committee Chairman, the Radiation Safety Officer, and one other member chosen by the Committee, is empowered by the full Committee to act in emergency situations. The Radiation Safety Committee has advisory responsibilities for:

- 1) Assuring that user projects comply with license restrictions, University policies and regulations, and standards of good practice;**
- 2) Assuring that proposals for grants and contracts do not pose unacceptable radiological risks to individuals;**
- 3) Assuring that new construction and renovation of existing buildings meet standards of good practice for using or storing radioactive materials or radiation sources;**

- 4) **Assuring that University personnel involved in the control of radiation hazards, including users and their assistants, have appropriate training and experience; and**
- 5) **Reviewing the actions of the Radiation Safety Officer.**

The Radiation Safety Officer is appointed, by the Vice President for Administration and Finance to supervise the radiation safety program in all aspects, with the responsibility for proper control of radiation-related projects on the campus and at any other site under campus supervision or control. Approval of the Radiation Safety Officer is required for:

- 1) **All matters pertaining to the SLU radioactive material license and radiation-source registration;**
- 2) **All requisitions for purchase of radioactive materials and radiation producing equipment;**
- 3) **All user projects, including laboratory and teaching uses, research and development projects, and other activities with potential radiological hazards;**
- 4) **All contract and grant proposals involving radioactive materials or radiation sources;**
- 5) **All personnel who will directly use radioactive materials or radiation sources to assure that they are properly trained; and**
- 6) **All facilities, construction, outfitting, and renovation, including review and approval of construction plans, drawings and specifications involving radioactive material and radiation sources.**

The Radiation Safety Officer has the vested authority to act immediately in all matters pertaining to radiation safety for the purpose of assuring individual well-being and the integrity of University property. The Radiation Safety Officer may appeal directly to the Vice President for support in these actions, which are then subject to review by the Radiation Safety Committee.

ALARA PROGRAM

Policy

The Southeastern Louisiana University radiation safety program will be conducted in such a manner so that exposure to faculty, staff, students, the public and the environment will be maintained as low as reasonably achievable and that no radiation exposure will be received without societal benefit. This will be accomplished without impeding legitimate research, or realistic teaching objectives.

Implementation

The ALARA program will consist of establishing and enforcing the following procedures and practices:

Training
Personnel Monitoring
Site Monitoring
Delivery of Radioactive Material
Radioactive Materials Accountability
Waste Handling

PROCEDURES

Specific procedures required for the proper control of radioactive materials and radiation sources at SLU are described in this section. Questions concerning these procedures should be directed to the Radiation Safety Officer.

Grant and Contract Proposals

All proposals to outside agencies involving the use of radioactive materials or radiation sources must be routed through the Radiation Safety Committee. The Radiation Safety Committee may approve such applications. The originator of the proposal shall forward a copy of the proposal and approval form to the Radiation Safety Committee. The Radiation Safety Committee conducts reviews of proposals for their radiological safety content only.

User-Project Applications

Individuals who wish to use radiation sources or radioactive materials in research, development, teaching, or demonstration projects must obtain prior approval of the Radiation Safety Committee.

The date submitted, project title, user's department, and college and user's social security number must be completed. The user must supply information relative to training and work experience in the handling of radiation sources and radioactive materials of all personnel involved with the project. User qualifications must be commensurate with the planned use. If the application is from a user who has received prior approval on another project, the phrase "Qualifications on file in the Radiation Safety Office" may be inserted for convenience.

User-Project approvals are issued only to principal investigators (faculty) and group leaders. It is their responsibility to provide proof to the Radiation Safety Officer of radiation safety training for all persons involved with radiation related activities under their control.

The radionuclides or radiation sources required for the project must be specified in sufficient detail for radiological safety review. This listing includes radiation-producing equipment which requires separate registration by the Radiation Protection Division. For radionuclides, the total activity of each radionuclide that the user anticipates ordering at any one time and the total of each radionuclide the user expects to have on hand at any one time must be indicated.

Specific information must be supplied on all locations where radioactive materials or radiation sources are to be employed and/or stored during the course of the project. This information is required so that the Radiation Safety Officer can establish that the sites conform to the University's radioactive materials license. The Radiation Safety Officer is also required to inspect the specified locations to ascertain that the proposed use is consistent with license restrictions, federal and state regulations, and University rules and policies.

Expected approximate beginning and ending dates, if applicable for the project, should be indicated.

The user is to attach to the application form a project outline in which the specific details of the proposed use are described in sufficiently to permit review by the Radiation Safety Officer and Radiation Safety Committee. In general, this will involve operational details for radiological safety rather than details of experimental planning. Standard laboratory practice for handling radioactive materials can be assumed, but deviations from standard practice must be described. Waste-handling plans must also be described in detail.

Once the application is completed, it is to be transmitted to the Radiation Safety Officer for review. This review may include discussions with the applicant and site visits, with specific suggestions for revision of the application. It is the Radiation Safety Officer's responsibility to assure that the application meets all regulatory standards. Review of the applications by the Radiation Safety Officer is restricted to matters of radiological safety.

Training

The radiation safety officer will maintain a listing of all persons who have certified as trained in radiation safety commensurate with their exposure potential. Certification of training shall be one of the following:

- 1) Faculty by credentials submitted with the user project application.
- 2) By certifying in writing from the principal investigator that the person is trained in radiation safety.
- 3) By successful completion of a Nuclear Science course.
- 4) By attending a short course approved by the Radiation Safety Office and passing a test at the end of the course.

Radionuclide Orders

Radionuclides may only be ordered by approved users for a project. Orders for radioactive materials are placed just as any other materials or supplies are ordered.

Purchase approval by the Radiation Safety Office is required for any equipment containing radioactive sources, such as gas chromatographs equipped with electron capture detectors.

Delivery of Radioactive Materials

All radioactive materials arriving on the campus are to be delivered to the Radiation Safety Office. There are only three allowed exceptions to this requirement:

- 1) By prior approval of the Radiation Safety Officer, a user may be permitted to retrieve a very-short-lived (less than 24 hour half-life) radionuclide shipment directly from the carrier;
- 2) By prior approval of the Radiation Safety Officer large pieces of equipment containing radioactive materials may be delivered directly to the building where they are to be installed; and
- 3) By prior approval of the Radiation Safety Officer trivial quantities of radioactive material such as RIA kits may be delivered directly to the user.

In all instances, the Radiation Safety Officer must be notified promptly upon arrival of the radioactive material so that proper inventory and receipt procedures can be completed.

All other radioactive materials must first be delivered to the Radiation Safety Office to ensure adequate inventory. Federal and state regulations require that the University be able to verify at any time the total quantities of radioactive materials on hand, and to be able to show an inspector the physical location of each individual shipment or prove that it

has been properly removed or shipped for disposal. Monitoring of packages before distributing them to individual users is required to prevent release of material from broken or otherwise contaminated containers, and to permit notification of excessive working radiation levels when the packages are handled.

After the inventory form and package monitoring have been completed, the individual who ordered the radioactive material will be notified, by telephone, or e-mail that the material is available for disbursement.

Receiving and Monitoring of Isotope Shipments

For the purpose of receiving and monitoring of isotope shipments, a "qualified" staff member shall be any person employed by the radiation safety office who is authorized by the radiation safety officer to inspect and log in radioactive packages unless prior permission is given by the radiation safety office.

All radioactive isotope packages are required to be received and inspected by a qualified staff member staff before release to the approved users. All shipments received by the SLU will be inspected for leakage, breakage, or defective packaging within three (3) hours of receipt. A qualified staff member will wear latex or plastic gloves and safety glasses at all times during inspection and opening of any package known or suspected to contain radioactive materials.

If the radioactive material is normal form, the innermost container which actually contains the isotope will be visually examined for breakage, visible leakage, or faulty packaging. If any irregularities in packaging are detected, the package will not be released from the radiation safety office.

Once it is determined that an isotope package is suitable for release, it will be logged in. The log in procedure checks approval status of the user, whether or not he or she is approved for usage of the specific isotope and activity, and assigns a unique serial number to the isotope shipment for tracking purposes. If the potential end user is not approved for a particular shipment for any reason, the shipment will be held at the radiation safety office until proper approval is obtained from the campus radiation safety officer. If the isotope shipment meets all of the requirements for release set out in this section, the assigned serial number will be inscribed on the innermost container which actually contains the radioactive material with indelible ink. In the case of a sealed source, a preprinted tag bearing the assigned serial number will be attached to the outer casing or housing of the sealed source. The shipment will be recorded on the master log sheet and the approved user notified that it is ready for pickup.

Additional information concerning each isotope kept on record includes purchase order number, date of receipt, reference date, physical and chemical form of the isotope, activity, volume or weight, specific concentration, manufacturer, and person who inspected the package. This information is printed out on the disbursement form which includes a copy for retention in the permanent files of the radiation safety office and a copy for the approved user.

Radionuclide Disbursement

Upon notification of the arrival of radioactive material, the user who originated the order may pick it up from the Radiation Safety Office or may send a trained member of his staff. At the time of transfer, the individual who receives the radionuclide must sign for receipt of the material.

Waste Handling Procedures

State and federal regulations and the University's radioactive materials license impose severe restrictions on waste-disposal methods.

For this reason, waste disposal is centralized through the Radiation Safety Office. Exceptions to this policy are specifically and individually considered.

- 1) Waste materials can be generally classified as:
- 2) Miscellaneous solid waste (glassware, paper towels, dissecting instruments, gloves, etc.);
- 3) Major aqueous-solution waste (reaction solutions, primary dilutions of stock solutions, residual stock solutions, etc.);
- 4) Minor aqueous waste solutions (third rinses from glassware, radioactively decayed solutions containing less than microcurie amounts of activity, etc.);
- 5) Major organic-waste solutions (see 3, above);
- 6) Minor organic-waste solutions (see 4, above, and liquid scintillation counting solutions);
- 7) Permanently contaminated equipment.

The only uncontrolled waste materials are minor aqueous waste solutions (item 4 above), which may be disposed of directly to the sanitary sewer system via laboratory sinks (disposal through toilets and washroom basins is not permitted).

Wastes in user laboratories shall be stored only in approved and appropriately labeled containers. NOTE: Any container which could be mistaken for a container for ordinary trash will not be approved. Waste shall be segregated by solid, aqueous liquid, and organic liquid. Radioisotopes with half-lives greater than 100 days may be combined provided no chemical hazard is created. Radioisotopes with shorter half-lives should be stored separately. Each container of waste shall have a label to indicate the isotope(s) total content in millicuries and for short lived material the date the material was placed in the container should be included.

The Radiation Safety Office will schedule radioactive waste pickups at the generating

laboratories on a routine basis. By prior arrangement waste may be brought to the Radiation Safety Office. So that radioactive waste can be handled in a safe and efficient manner the follow is required of the generator:

- 1) Dry and liquid waste shall not to be mixed. If it is determined that waste has been mixed it will be returned to the generator for separation.**
- 2) Remove all radioactive labels from short half-life waste that is to be held for decay.**
- 3) Liquid waste is to be stored in containers provided by or approved by the Radiation Safety Office. Waste in unapproved containers will not be picked up. The generator will be required to transfer the waste to an approved container.**
- 4) Each box, bag, or container of radiation waste shall have affixed a fully completed radioactive waste tape.**

Waste will be disposed of in one of the following manners.

- 1) Shipment to Louisiana State University Radiation Safety Department for tritium and Carbon 14 waste. Cost of disposal will be borne by the generator.**
- 2) Held for decay: Solid, organic liquid, aqueous liquid radioactive waste and radioactive animal carcasses with half-lives of less than 100 days will generally be disposed in this manner. After holding for 10 half-lives, the material can be disposed of as ordinary waste. NOTE: Radiation labels shall be removed before placing this type waste into a radioactive waste container.**
- 3) Dumped to the sanitary sewer: Water soluble radioactive waste, i.e., aqueous liquids can be disposed of in the sanitary sewer. The concentration of the radioactive waste and total millicurie quantity disposed per year is governed by state regulations. NOTE: prior to disposing of radioactive waste in this manner the generator shall inform the Radiation Safety Office to assure that the concentration and annual quantity are not being exceeded.**
- 4) Designated as Hazardous Non-radioactive Waste: Organic scintillation medium containing 0.05 μ Ci of ^3H or ^{14}C or less per ml/gram of material may be disposed of as hazardous waste provided the applicable regulations for the chemicals are followed.**

Disposal of radioisotopes by any of these methods requires that traceable records of the amount of material disposed be kept. It is the user's responsibility to keep a record of the source number from which the waste was generated and the amount generated.

Transfer and Shipment of Radioactive Materials

Federal and state regulations restrict the transfer of radioactive materials, except in certain carefully specified situations, to persons holding valid radioactive materials licenses. A copy of the receiver's license must be provided to the Campus Radiation Safety Officer before the shipment or transfer can be authorized.

The Radiation Safety Office will assist in the transfer, including providing specific information on packaging and labeling packages for shipment, and advice on acceptable shipment methods and applicable regulations and restrictions. The department from which the shipment originates is expected to incur the cost of the transfer. Records of transfers are maintained in the Radiation Safety Office. When particularly hazardous shipments are received or sent, records of personnel exposures, shipping-cask smears, and other pertinent information are maintained in the Radiation Safety Office.

Storage of Radioactive Materials

Individual users are expected to keep on hand in their laboratories only those radioactive materials which they are actively using, or those which they feel must receive personal attention. The intent of this policy is to reduce as far as possible the number of places on the campus where the security of radiological materials might be jeopardized in emergencies such as fires or explosions.

All storage locations must be posted with approved radiation warning signs, which are available from the Radiation Safety Office. Storage of radioactive materials in locations where food or beverages are also stored is not permissible.

Radioactive Materials Accountability

The University is required by the terms of its radioactive materials license, and by state and federal regulations, to be able to account for all radioactive materials under its control. Records are maintained in the labs of receipts, disbursements, transfers, and ultimate disposals of radioactive materials, as described in preceding sections of this manual. Records in the labs must reflect known locations and known users.

Individual users must keep internal records of the radioactive materials they receive from the Radiation Safety Office, how they are used, what the current content of each individual bottle or vial is, and what material has been returned to the Radiation Safety Office. These records need not be highly formal or extremely detailed, but they must provide the necessary information when it is requested by the Radiation Safety Office. The Radiation Safety Office performs a physical inventory to verify records.

Exchange of radioactive material between approved users requires prior approval by the Radiation Safety Officer. Radioactive material may be used and stored only in rooms previously approved by the Radiation Safety Officer.

Registration of Machines Producing Ionizing Radiation

Regulations of the Louisiana Nuclear Energy Division require that all equipment that produces ionizing radiation must be registered with the Division, which then issues a certificate of registration to the owner of the equipment. The certificate must be posted on or near the machine. The Radiation Safety Office has the responsibility for submitting registration applications.

Machine sources included under the registration requirement include diagnostic X-ray machines of all classes (e.g., field-portable, fluoroscopic, special-procedures, panoramic-dental, crystallogical, etc.), therapeutic X-ray machines of all classes (e.g., deep-therapy, superficial-therapy, supervoltage, etc.), industrial X-ray units, analytical instruments (e.g., diffraction, fluorescence, etc.), and accelerators (e.g., synchrotron, cyclotron, electron-therapy systems, etc.).

Although the Radiation Safety Office has the responsibility of completing registration forms, it is incumbent upon individuals initiating purchase of radiation producing equipment to notify the Radiation Safety Office of the arrival of such equipment. Such purchases must have been approved previously by the Radiation Safety Committee.

When an instrument is moved to a new location, or is transferred from the campus, the Radiation Safety Office must be notified to assure that records are current. Physical inventories of radiation producing equipment will be made on an annual basis. Movement of a radiation producing machine from one location to another requires prior authorization from the Radiation Safety Officer, which will be granted only after preliminary safety and shielding analyses have been completed.

New Facilities Approval

New buildings or renovated areas in old buildings in which radioactive materials or radiation sources are to be used must be approved by the Campus Radiation Safety Committee.

Radiation safety personnel should be involved as early as possible in the planning of new facilities. Proper design considerations can result in significant savings to the University by reducing initial costs and avoiding expensive corrective alterations later.

Personnel Monitoring

Every employee of the University and its consultants handling radioactive materials or using radiation sources of types and quantity such that it is possible to receive an exposure equal to or greater than 10% of the applicable radiation dose standard specified by the state of Louisiana and persons operating open beam analytical X-ray equipment shall be included in the radiation monitoring program. Long-term visitors, post-doctoral fellows and other such persons working with radiation as described above shall also be covered by the program. Other persons may be assigned to the personnel monitoring program at the discretion of the Principal Investigator and/or the Radiation Safety Officer. Records for

persons who are monitored, but who do not meet regulatory monitoring requirements will not necessarily be kept.

Students who are enrolled in courses involving the handling of radioactive material or use of radiation sources may be assigned to the radiation monitoring program. The decision to assign or not to assign will be a joint decision between the instructor and the Radiation Safety Officer. If a decision cannot be reached, the Radiation Safety Committee will make the determination.

When persons are assigned to the monitoring program they will be asked if they know or have been told that they had received an over exposure of radiation. If the answer is affirmative, the person will not be allowed to work with radiation until the past radiation exposure records have been obtained and evaluated. For other persons, prior exposure histories will not be obtained.

Good practice dictates, and state and federal laws require, that the University provide information to users that their radiation doses are within regulatory limits, and also that individuals be notified if their radiation doses exceed radiation protection guidelines.

The monitoring program includes, where applicable, personal body dosimeters, personal extremity dosimeters, rate sensitive area monitors, portable survey instruments, portable and fixed air sampling instruments, surface smears, and bioassay procedures. Personal dosimetry devices are available for detection of beta, X and gamma, and neutron radiations; supporting techniques allow assessment of alpha inhalation hazards. At the time of approval, the Radiation Safety Officer will determine the type monitoring techniques to be used for that project.

Excessive exposure detected on a personal dosimeter requires immediate notification of the wearer, initiation of any appropriate medical assistance, and a determination of the cause of the exposure. When necessary, The Radiation Protection Division and The United States Nuclear Regulatory Commission offices will be notified of the incident. These agencies can be of assistance in assuring the best available medical care, and also in procuring support personnel for facilities recovery. Anyone who suspects an overexposure should report this immediately to the Radiation Safety Officer, who can be reached at the telephone numbers listed at the front of this manual.

Records of individual radiation dose histories are maintained in the Radiation Safety Office. Individuals are encouraged to check their records. The Radiation Safety Office will respond to request for radiation exposure histories from employers after an individual leaves the campus.

Personnel Monitoring Program

All person handling radioactive materials or using radiation sources of types and quantity such that it is possible to receive an exposure equal to or greater than 10% of the applicable radiation dose standard specified by the state of Louisiana, is required to wear a dosimeter during their stay at the university. Such a person must come to the Radiation Safety Office to fill out and sign a request form for our records. If a person has been

exposed to radiation over the allowable limit prior to his coming to the university, then contact will be made with their previous employer to obtain a copy of that person's cumulative exposure history, to be used in closely monitoring that person's cumulative exposure while working here at the university.

There are many different types of dosimeters available. Listed below are the most commonly used dosimeters:

- **K1, whole body dosimeter worn on a persons outside clothing for measuring deep and shallow doses for beta, gamma, and x-rays.**
- **U3, ring dosimeter which can be specified for the right or left hand. Used for measuring deep and shallow doses for beta, gamma, and x-rays.**
- **K8, whole body dosimeter worn underneath apron of those working with x-ray equipment. Used for measuring deep and shallow doses for beta, gamma, and x-rays. (This dosimeter can also be assigned as a secondary dosimeter for persons who will be working in another location other than the primary location they are assigned. This enables us to receive separate dosimeter readings for each location.)**
- **Z1, whole body dosimeter which includes dose readings to neutrons, in addition to the standard deep and shallow dose levels for beta, gamma, and x-rays.**
- **I1, whole body dosimeter which provides exclusive measurements for neutron dosages.**
- **X8, used as environmental control dosimeters for measuring deep and shallow doses for beta, gamma, and x-rays.**

Dosimeters are issued either on a temporary basis (good for one calendar quarter only), or on a quarterly basis (a renewal dosimeter is received at the beginning of each calendar quarter), or on a monthly basis. All new participants are issued a temporary dosimeter for the first quarter of their enrollment on the program. If any participant continues to work with radioactive materials longer than one quarter, they are placed on our permanent program to receive their dosimeter(s) routinely on a quarterly or monthly basis as indicated on their request form.

Each participant must return his or her dosimeter(s) within a specified number of days after their wear period, to receive an accurate reading with properly assigned control dosimeters. Each participant is notified at least 20 days in advance through campus mail as to when their dosimeter(s) are due to be returned to the Radiation Safety Office. If a person misses the deadline for returning his or her dosimeter(s), they are penalized with a late charge of \$10.00 for each dosimeter returned late. (Students working on semester class projects, with permission, are allowed to retain their dosimeters until the end of their class semester.)

After appropriate wear period, dosimeters are sent back to a NVLAP approved processor for reading. The RSO examines the recorded results upon receipt in order to

determine whether or not any control dose levels have occurred. Whole body dose that is found to be greater than or equal to 100 mrem, or if a ring dosimeter dose level is found to be greater than or equal to 1000 mrem within the time of one calendar quarter, it will be investigated. The results of the investigation along with any corrective actions will be documented.

Any person needing to be dropped from the dosimeter program must notify the Radiation Safety Office, and provide a letter requesting to be removed from the program for our files.

Currently, Southeastern Louisiana University has no dosimeters in use.

Site Monitoring

The Generator has the responsibility for monitoring all locations where radioactive materials and radiation sources are used or stored.

Site-monitoring checks include smears to establish removable contamination levels and where applicable portable-survey-meter measurements of radiation levels and surface contamination levels. Checks also include visual inspection of working conditions, observations of operating techniques, storage of waste, labeling of containers, posting of warning signs, radioisotope disbursement records, instrument calibration and discussions with site personnel to suggest improvements in radiation safety practices.

Because Radiation Safety Office personnel cannot be present for frequent monitoring in every laboratory, users are encouraged to monitor their own facilities on schedules tailored to their special needs. NOTE: The principal Investigator must see that contamination surveys are conducted at the end of each day when more than 0.5 mCi of a radionuclide is handled. Handling means any activity involving radioactive material. In other words if a person picks up a vial containing more than 0.5 mCi of radioactive material a laboratory survey is required. Records of laboratory monitoring by users must be maintained in the laboratories.

Leak Testing of Sealed Sources

Procedures:

- 1) All sealed beta sources greater than 100 uCi and all sealed alpha sources greater than 10 uCi are leaked tested upon arrival.
- 2) Sealed beta sources larger than 100 uCi, which are not stored under the direct control of the Radiation Safety Officer are leak tested at six-month intervals.
- 3) Sealed alpha sources larger than 10 uCi, which are not stored under the direct control of the Radiation Safety Officer are leak tested at three-month intervals.
- 4) At the time any sealed source is removed from storage, it is leak tested.

- 5) **Certain sources will be leak tested either more or less frequently at the stipulation of the Louisiana Radiation Protection Division (LARPD).**
- 6) **Analysis of leak tests will be by procedures and instrumentation documented to have a limit of detection of less than 0.005 uCi.**
- 7) **Records of sealed-source leak tests are maintained by the Radiation Safety Officer.**

Declared Pregnant Women

Once a woman has declared herself to be pregnant the allowable exposure for the remainder of the gestation period is effective dose equivalent limited to 0.5 rem. The regulatory definition of a declared pregnant woman is:

"A women who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception."

Practice

Guidelines, policies, and rules for the practice of radiation safety are presented in the following sections of this chapter.

General Rules for Radioactive Materials

- 1) **Eating, drinking, smoking, or applying of cosmetics is not permitted in areas where radioactive materials are used or stored.**
- 2) **Personnel monitoring devices (TLD badge, finger badge, wrist badge) prescribed for the area must be worn.**
- 3) **Protective clothing (gloves, laboratory smock, coveralls, respirator, shoe covers, etc.) prescribed for the area must be worn.**
- 4) **Proper containment (absorbent paper, trays, secondary liquid containers) required for the operations must be in place.**
- 5) **Fume hoods are to be used for all operations that potentially involve release of air-borne materials, including gases, volatile compounds, and dusts and aerosols (minimum air flow shall be 85 fpm).**
- 6) **Prescribed radiation detection equipment and calibrated survey instruments must be available and known to be working.**

- 7) **Work areas should be monitored when an operation is completed, or at the end of the work period.**
- 8) **Radioactive materials must be stored and shielded in the manner prescribed for the area, and secured to restrict unauthorized persons from using or removing the material.**
- 9) **All bottles, jars, boxes, and cabinets containing radioactive materials must be clearly labeled as to the radionuclide, quantity, and date, and initialed by the responsible person.**
- 10) **All entrances must be properly labeled with signs appropriate to the hazard, and posted with the names and telephone numbers of individuals to be contacted in emergencies.**
- 11) **Initial runs on new procedures should be made with nonradioactive materials or less than 10 microcurie amounts of radioisotopes.**
- 12) **Procedures should be designed to reduce to a minimum transfers from container to container, bench to bench, and room to room as a means of reducing spills.**
- 13) **Radiation levels in work areas should be determined before an operation is begun so that proper shielding and remote-handling equipment can be employed to reduce individual exposures.**
- 14) **Individuals unfamiliar with radiation hazards and emergency procedures must not be permitted to work with radioactive materials.**
- 15) **Pipetting by mouth in areas where radiation materials are being used is forbidden.**
- 16) **All equipment, glassware, and other contents of an area in which radioactive materials are being used, or have been used, should be considered as contaminated until properly monitored.**
- 17) **Any injury, no matter how slight, involving radioactive materials must be monitored to determine if the wound is contaminated.**

Signs, Notices and Labels

Regulations of the Radiation Protection Division and University regulations require that signs be posted to inform the public of the existence of a hazard in areas where radioactive materials and radiation sources are used and stored. Posted signs must comply with federal regulations, which are in agreement with international symbols for recognition of hazards. These signs are printed with magenta ink on a yellow background, and bear the word "caution" at the top, the standardized three-bladed "propeller" symbol for radiation in the center, and a descriptive prescribed phrase

denoting the magnitude of the hazard at the bottom.

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

- 1) Principal user
- 2) Alternate person knowledgeable of the specific area (if possible)
- 3) Radiation Safety Officer Emergency notices will be supplied by the Radiation Safety Office, which should be informed promptly of any changes.

DECONTAMINATION

Introduction

Although Radiation Safety Office personnel are available to assist in decontamination operations, it is standard policy of the nuclear industry that the person who is responsible for contamination has the obligation to assume primary responsibility for decontamination. Immediate reaction to a contamination situation frequently can prevent serious side-spread problems. In any situation involving contamination the first concerns are to determine its extent and to minimize the spread of radioactive materials. This is accomplished in four steps:

- 1) Monitor to determine the extent of contamination.
- 2) Isolate the contaminated area.
- 3) Institute anti-contamination procedures to minimize the spread of contamination.
- 4) Establish of a "hot line" to control contamination spread during team operations.

Spread of Contamination

Contamination may be transported or spread to other areas. Radioactivity may be spread via wind or liquid-borne surface runoff from the site. Contamination can be spread by:

- 1) Resuspension of radioactive particulates that have settled on surfaces because of the movement of personnel and equipment in a contaminated area.
- 2) Transfer to the shoes, clothing, or skin of personnel and transport to uncontaminated areas.

- 3) Release of contaminated equipment to uncontaminated areas. The ease with which contamination is spread depends upon physical factors (porosity of surface, chemical bonding, electrostatic forces, and physical form of the contaminant), meteorological factors, and the effectiveness of contamination control.

Monitoring

Monitoring determines the extent of contamination, the effectiveness of contamination control, and the need for further decontamination efforts. The monitoring of personnel for contamination of clothing and skin surfaces is pertinent to contamination control. Ground surveys should be conducted to define the degree of contamination. Two methods of plotting the data, a radial plot or a grid plot, have been used. Typical documentation information includes:

- 1) Survey date and time.
- 2) Location.
- 3) Identification of instruments used, including serial number.
- 4) Specific location of measurements (a sketch or drawing may be useful).
- 5) Contamination levels measured.
- 6) Identification of individual taking the survey. Equipment surveys will be taken in counts per minute (cpm); however, the instrument efficiency must be known so that the reading can be converted to disintegrations per minute (dpm).

Types of Contamination

Surface contamination may be classified as either fixed or removable. Fixed contamination is measured by passing a suitable detector over the surface of interest as close as possible without actually touching it. Removable contamination is estimated by wiping the surface and measuring the activity on the wipe. Analysis of wipe samples are usually accomplished in a laboratory.

Isolation of the Contaminated Area

The boundaries of the contaminated area should be marked to prevent inadvertent entry. Ideally, the barrier line should be placed so that radiation levels are at or near normal background for the location inside of the barrier line. The area delineated should be large enough to allow for unforeseen conditions such as wind spread or water runoff. It is better to delineate an area that is too large than one that is too small.

Anti-Contamination Procedures

It is difficult to protect equipment from contamination because of size and use. However, through proper selection and control, this problem can be reduced. Only a minimum of equipment should be used. The equipment selected must be clean to reduce contamination pickup and to reduce decontamination problems.

Certain equipment such as beta-gamma meters and probes can be enclosed in plastic bags to reduce the spread of contamination. However, alpha-survey instrument probes must be left uncovered.

The "hot line" is an arbitrarily established control line separating the contaminated area from the contamination-free area and is generally situated upwind from the contaminated area. All personnel and equipment entering and leaving the contaminated area are channeled through the hot line. The requirements for entering should also be posted. In addition, step off pads and containers for disposal of protective clothing and trash should be set up. No individual, materials, or equipment should be allowed to leave the contaminated area until monitored and decontaminated.

The area adjacent to the hot line is designated the stepoff pad (SOP) and serves as a boundary zone between contaminated and uncontaminated areas. It is considered to possibly contain some low-level contamination. Hence, the SOP is often covered with plastic sheeting to facilitate its decontamination.

The procedure for leaving the contaminated area is as follows:

- 1) **While in contaminated area:**
 - Remove protective clothing except shoe covers and gloves.
 - Discard clothing and trash into appropriate barrels.

- 2) **Stepping onto SOP:**
 - Remove one shoe cover and place foot on SOP.
 - Repeat for other shoe cover. To prevent spraying the SOP with contamination, the bottom of the foot should be pointed toward the contaminated area when removing shoe cover.
 - Discard shoe covers in appropriate barrel.
 - Remove respirator.
 - Remove gloves and discard in appropriate barrels.

- 3) **While in clean area:**
 - Perform personnel contamination survey.
 - Don street clothes.

Personnel Decontamination

If a person is suspected of being contaminated, remove their clothing and place in a plastic bag. Mark radioactive and do not discard. Shower thoroughly with water and a liberal amount of soap.

Special instructions for decontamination of various parts of the body are:

- 1) Skin - Use a soft bristle brush vigorously but lightly so as not to abrade the skin. Particular attention should be paid to cleaning around and under finger nails, between the fingers, at the back of the fingers, and the palms.**
- 2) Hair - Scrub the hair vigorously using a liberal amount of soap. Particular care should be taken to prevent suds and water from entering the eyes, ears, nose, or mouth. Several washes and rinses should be applied before drying the hair.**
- 3) After decontamination, individuals should be monitored again. Repeat decontamination procedures if required. If the person still shows contamination, seek medical advice. The basic ground rule is not to abrade or puncture the skin.**

Decontamination of Equipment

A key decision must be made to either decontaminate an object or to treat it as radioactive waste. Decontamination might generate a greater volume of radioactive materials (wash water, towels, etc.) than the object itself. Samples of the wash water should be assayed to help determine if it can be released to the environment or if it must be contained for disposal as radioactive waste. Monitoring of the objects determines the extent of decontamination required. Perhaps only limited areas require cleaning. Dry vacuuming may be very effective as an initial step. Care should be taken that wet techniques do not soak contaminants into porous surfaces.

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