FLORIDA STATE UNIVERSITY

RADIOACTIVE MATERIALS RADIATION SAFETY MANUAL

June 2025 Edition

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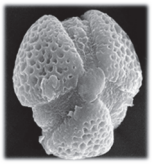
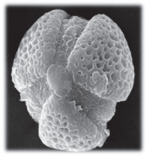


Cynopollen – scanning electron micrograph of pollen that resembles a radiation symbol; photo by D. L. Nickrent



CHAPTER 1 – ADMINISTRATIVE PROCEDURES

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1.0 FSU Radiation Safety Program

1.0.1 Introduction

Florida State University (FSU, the University) uses sources of ionizing and nonionizing radiation for a variety of educational and research applications. FSU maintains a comprehensive **radiation safety program (RSP)** to protect its employees, students, visitors, the public and the environment, from harmful effects of radiation. The program objective is to ensure that all work with radioactive material (RAM) and radiation-emitting machines is conducted in a safe manner.

The University is committed to meeting all applicable state and federal regulatory requirements, with emphasis on maintaining a strong safety and security culture and keeping doses from FSU radiation sources *as low as reasonably achievable* (ALARA).


STATE OF FLORIDA
DEPARTMENT OF HEALTH
BUREAU OF RADIATION CONTROL

RADIOACTIVE MATERIALS LICENSE

FLORIDA STATE UNIVERSITY
DEPARTMENT OF ENVIRONMENTAL HEALTH AND SAFETY

32-10

The **FSU Environmental Health & Safety (EHS) Dept.** holds multiple regulatory documents issued by the Florida Dept. of Health (FDOH). The most important is Florida Radioactive Materials License No. 32-10, an academic broad-scope license authorizing the University's research using radioactive materials. FSU also holds five radiation machine registrations that authorize educational, dental, industrial, and medical x-ray machines at the main campus and other university-controlled locations, plus the Fox Lab's tandem linear accelerator.

FSU's radiation safety program is led by the **Radiation Safety Officer (RSO)** and operates under the authority of the University's **Radiation Safety Committee (RSC)**. The program's objective is to ensure that all University activities comply with applicable federal and state radiation control regulations. Any use of ionizing radiation requires prior approval from the RSO and RSC.

The EHS Dept. provides a range of radiation safety services, including training of lab personnel, radioactive materials receipt and delivery; dosimetry and shielding; maintaining an inventory of the radioisotopes used on campus; contamination surveys; radioactive waste (radwaste) pickup and disposal; as well as guidance on safety and regulatory issues. For more information, contact the **Radiation Safety Office** at (850) 644-8802 or 644-9117.

1.0.2 RAM Radiation Safety Manual

This manual, which is available in hard copy and online at the EHS website, describes all program elements in place for ensuring the safe use of radioactive materials (RAM) at the University: facilities, equipment, personnel, and policies/procedures. This manual has been approved by the FSU RSC. There are additional radiation safety procedures and forms applicable to machine-produced radiation (x-ray machines and accelerators). To learn more about the program, visit the EHS Dept. at 1200 Carothers Hall, 1021 Atomic Way.

1.1 Regulatory Authorities and Regulations

1.1.1 Florida Department of Health (FDOH)

The FDOH regulates radioactive materials users in Florida. The University's academic broad scope radioactive materials license is issued by the FDOH Bureau of Radiation Control (BRC), Radioactive Materials Program in Tallahassee. The state's radiation control regulations are in Chapter 64E-5, Florida Administrative Code (FAC). The parts of that apply to the University's radioactive materials activities are listed below.

Chapter 64E-5, Fla. Admin. Code

Part I	General Provisions
Part III	Standards for Protection Against Radiation
Part V	X-rays in the Healing Arts
Part VII	Radiation Safety Requirements for Analytical X-ray Equipment
Part IX	Notices, Instructions and Reports to Workers; Inspections

Florida HEALTH
Bureau of Radiation Control

The FDOH BRC performs routine inspections of FSU facilities. The agency can issue citations, levy fines for violations, and may suspend or revoke FSU's license with due cause. A written report of inspection findings is provided, and any alleged violations may be disputed. If a denial is rejected, it may be appealed. Part IX provides additional information on the inspection process.

The University must also comply with U.S. Department of Transportation (DOT) hazardous materials regulations governing the shipment of radioactive materials, found in Title 49, Code of Federal Regulations (49 CFR). The federal hazardous materials transportation regulations are enforced by the USDOT, Federal Aviation Administration, and the FDOH BRC.

1.1.2 U.S. Nuclear Regulatory Commission (NRC)

The NRC is the lead federal agency governing radioactive materials in the United States. Florida, like most states, has an agreement with the NRC to assume regulatory oversight of radioactive materials located outside of federal facilities. The Agreement States are subject to NRC oversight and must maintain regulations that are compatible with their federal counterparts in Title 10, Code of Federal Regulations (10 CFR).

Note: Due to the FDOH BRC being headquartered in Tallahassee, NRC auditors routinely accompany state inspectors during FSU inspections.

1.2 Radioactive Materials Licensing Requirements

1.2.1 Licensing Hierarchy

FDOH licensing requirements are found in Part II of Chapter 64E-5, FAC. There is a three-tier hierarchy associated with licensing of radioactive materials: exempt, generally licensed, and specifically licensed.

Exempt sources are not subject to most regulatory controls due to their low activity or concentration, or because of the low risks associated with their use. Part II of the Florida rules describes exemptions for specified concentrations, quantities and items, such as smoke detectors and low activity calibration/reference sources. Note: FSU controls exempt sources on campus through permits and inventories.

Generally licensed sources are considered sufficiently hazardous to warrant limited controls of varying degrees depending on the source. Examples of "GL sources" include tritium exit signs, moderate-activity calibration/reference standards, static eliminators, *in vivo* and *in vitro* test kits, and low-activity gauges and other measuring devices. Some sources are distributed as GL sources even though their activity would otherwise make them exempt, so it's important to know the licensing status of any source possessed.

Some general licenses (GL) are issued without the filing of an application or the issuance of a licensing document. GL sources must be a designated responsible individual, they must be secured, and must be annually registered with the agency, which may include an annual fee for each GL source/device.

Specifically licensed sources are subject to strict controls. Authorization to possess "SL sources" requires applying for a license, establishing a radiation safety program, and describing appropriate facilities, equipment, procedures and qualified personnel.

License No. 32-10 authorizes FSU to use various SL radioactive materials for education, research and development uses. The specific license includes authorization for certain GL sources.

1.2.2 Components of FSU Radioactive Materials License

Possession and use of radioactive materials is limited to the locations and purposes authorized by the license (and FSU permit). FSU's license is divided into two sections: *Items* and *Conditions*. License Items 1 – 9 make up the first section. They are followed by the license conditions, which always begin with Condition 10. The number of conditions is based on the complexity of the license; FSU's license currently has 22 conditions.

License Items

Item No. and Title	Description
1. Name	Lists the legal name of the licensee.
2. Address	Lists the mailing address, which may differ from the physical address. If the two addresses are different, the physical address is listed in Condition 10; if the same, Condition 10 references the address listed in Item 2.
3. License No. and Amendment No.	Lists the number assigned to the license, which should be referenced in all correspondence The amendment number corresponds to license revisions.
4. Expiration Date	Lists the license expiration date. The license is valid for 5 years. A renewal application must be submitted at least 30 days prior to the expiration date.

1.2.2 Components of FSU Radioactive Materials License (continued)

License Items

Item No. and Title	Description
5. Category	Lists the license category: 3M(I); refer to sec. 64E-5.204, FAC.
6. Radioactive Material	Describes the type of radioactive material (element and mass number) the license authorizes for possession and use.
7. Form	Describes the form of radioactive material the license authorizes. For sealed sources, the source manufacturer name and model number are listed.
8. Possession Limit	Lists the maximum possession limits for radioactive sealed sources. A license may authorize a possession limit higher than the no. of sources possessed, but possession of more sources than authorized is a violation.
9. Use	Describes approved uses for the listed sources and devices.

License Conditions

License conditions describe requirements and limitations applicable to the radioactive materials authorized by the license. Additional requirements and conditions may be incorporated as appropriate to protect public health and the environment. If new authorizations are obtained, more license conditions may be added. FSU's license currently has conditions addressing the following:

- Authorized locations of use and storage
- Authorized user (AU) and RSO designations
- Radioactive material transfer limitations
- Radioactive material transportation requirements
- Radwaste shipment notification requirements
- Enforcement provisions
- Part III and IX provisions
- Leak testing and inventory requirements
- Generally licensed RAM requirements
- Licensee commitments

1.2.3 License Amendments

Radiological activities must be confined to the locations and purposes approved by the license and the FSU RSC. FSU's license allows the RSC to internally authorize new personnel and radiological projects within the restrictions imposed by the license. Prior to implementing any changes to licensed activities, a request to amend the license must be submitted to and approved by the FDOH BRC.

Examples of changes requiring a license amendment are new locations of use, policy/procedure changes, adding additional radioisotopes, and increasing possession limits. Changes that could increase radiation exposures require revision to the FSU public dose limits compliance study.

Amendment requests must reference the license number and be dated and signed by a certifying official – a person authorized to make legally binding statements on behalf of the University). Note: PIs are *not* certifying officials.

1.2.4 Vacating Premises

The PI must consult with the RSO at least 30 days before vacating or relinquishing possession or control of facilities listed in the license. The RSO must notify the FDOH BRC in writing no less than 30 days before vacating or relinquishing possession or control of facilities listed in the license. The notifications must describe the relocation of all radioactive material previously at the facility.

1.2.4 Vacating Premises (continued)

Documentation of transferred material may be required. A radiation survey of the facility may also be required as a condition for obtaining state approval for the facility's release for unrestricted use.

1.2.5 RSO Change

Per sec. 64E-5.213(7), FAC, the FDOH BRC must be notified in writing within 30 days after an RSO permanently discontinues performance of their duties. Notifications must include a license amendment request to approve the new RSO, with documentation of their qualifications.

1.2.6 License Renewals

The license is valid for 5-year periods. Provided a renewal application is received by FDOH 30 days prior to the expiration date, the existing terms and conditions are extended until the renewed license is issued. There are two approaches to the renewal process: a standard renewal, and an "attestation renewal." The standard renewal process requires submittal of a completed Form DH-1054 and a full description of all relevant facilities, equipment, procedures and personnel. In lieu of a complete application, an attestation renewal allows FSU to confirm that all commitments and procedures currently in place will continue to be followed. An attestation renewal is allowed every other renewal period and requires submittal of:

- A completed *License Renewal Attestation* form;
- A completed Form DH-1054, but without all of the supplemental information required for a full application (unless changes have been made since the last license amendment); and
- A completed "Designation of an Alternate Contact for the Licensee" form.

1.2.7 Waivers and Variances

Per sec. 64E-5.102, FAC, the FDOH BRC may, upon application by FSU or by its own initiative, grant exemptions from or exceptions to regulatory requirements. The process for requesting a *waiver* (exemption) or *variance* (exception) is described in sec. 28-104.001 – .006, FAC and sec. 120.542, Fla. Statutes. The petition process is laborious, and a strong rationale must be provided for an approval to be granted, so such requests should be carefully considered before proceeding.

1.2.8 Regulatory Inspections

FDOH BRC staff conduct annual on-site inspections of FSU's licensed activities using radioactive materials, and if prompted by an allegation, a special inspection may be performed. Inspections may be announced or unannounced; their objective is to verify compliance and ensure that regulated activities are being conducted safely.

All components of the radiation safety program are subject to review: facilities, equipment, personnel qualifications, procedures, and records. Violations may result in fines or (worst case) license suspension/revocation. A written report of each inspection's findings is provided, and any alleged violations may be accepted or denied. If denied, a basis for the denial must be provided. If a denial is rejected, it may be appealed in accordance with state administrative procedures. If compliance is not achieved, escalated enforcement actions will be initiated, which may result in suspension or revocation of authorized activities.

While not a routine occurrence, FSU is also subject to unannounced inspections by the U.S. DOT and FAA to verify compliance with hazmat shipping regulations.

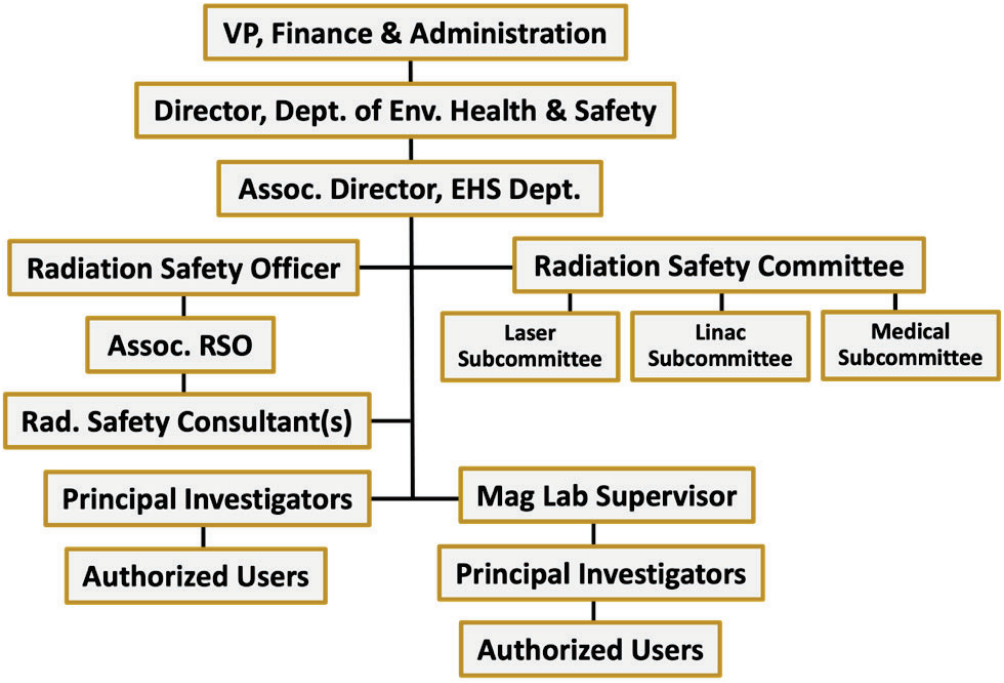
1.3 FSU Radiation Safety Program Administration

1.3.1 Radiation Safety Program Organization

The University's written radiation safety program (RSP) describes how FSU maintains safe radiological operations and compliance with regulatory requirements. The program's principal stakeholders are:

- **Radiation Safety Officer (RSO)**: leads the program, assisted by Radiation Safety Office and EHS staff.
- **Radiation Safety Committee (RSO members)**: provide program oversight.
- **Principal Investigators (PIs)**: FSU researchers designated as responsible for activities conducted under their radioactive materials research permits.
- **Authorized Users (AUs)**: individuals qualified to handle and store radioactive materials under the FSU license, by completing required training and testing.

FSU Radiation Safety Program Organization Chart



1.3.2 FSU Administration and the Environmental Health and Safety Department

The EHS Department operates under the University's Division of Finance and Administration, and the Vice President for Research is the principal representative of FSU senior management. The VP for Research serves on the FSU Radiation Safety Committee and provides oversight and budgetary control of the University's safety programs.

The EHS Dept. provides direct oversight of and support to the radiation safety program. The EHS executive director and associate executive director both serve on the RSC. EHS staff support the program when needed, under RSO supervision.

1.3.3 Radiation Safety Committee

The FSU Radiation Safety Committee (RSC) provides oversight and acts as an advising panel for the University's radiation safety program. The RSC establishes program policies and evaluates procedures, proposals, and records to ensure a safe work environment for students, faculty, staff, and the community.

The RSC's jurisdiction includes the FSU campus, remote FSU facilities and offshore research vessels. The Committee has overall responsibility of ensuring that the FSU radiation safety program complies with all internal and external rules and regulations, without placing undue burdens on any Principal Investigator (PI) or research program. Refer to Appendix B, the *FSU Radiation Safety Committee Charter* for a full description of the RSC organization and its subcommittees.

Radiation Safety Committee Duties

- Prepare for and attend scheduled meetings.
- Consult on membership appointments and approve selection of the RSO.
- Advise the RSO and RSC on technical matters and topics of expertise.
- Review and vote on any policy changes pertaining to the University's radiation safety program, broad scope license and/or radiation machine registrations.
- Review and approve annual radiation safety program audits and any other reports from the RSO.
- Revoke user privileges if the Committee perceives the situation to be warrant such action.
- Review and approve or disapprove the use of radioactive materials or ionizing or nonionizing radiation producing equipment under the University's jurisdiction.
- Prescribe special conditions as may be necessary, such as additional training and/or instructions, designated or limited areas of use, disposal methods, etc.
- Conduct periodic or discretionary reviews or evaluations of the radiation safety program.

1.3.4 Radiation Safety Officer

The University RSO is the individual delegated primary responsibility for administering FSU's radiation safety program, and is named in the license. Based in the EHS Dept., the RSO directs the Radiation Safety Office staff, and provides oversight and support to the PIs and AUs conducting radiological activities.

To accomplish their duties, the RSO and Radiation Safety Office staff are authorized to access all University facilities as needed.

The RSO position requires an individual with:

- Training and experience sufficient to control the hazards associated with the radiation sources possessed under the license, and to administer an academic radiation safety program;
- A level of competency at, or above that of authorized users;
- Knowledge, ability and responsibility to apply appropriate radiation protection principles and implement program requirements; and
- Thorough knowledge of regulations, facilities, equipment, procedures and personnel.

1.3.4 **Radiation Safety Officer** (continued)

The following are the duties and responsibilities of the RSO related to radioactive materials.

- Directs the FSU radiation safety program.
- Assesses potential radiation hazards and exposures and as necessary, develop and implement mitigating actions.
- Submits applications and related correspondence for the licensing requirements of the radiation safety program (the RSO is a certifying official for the radiation safety program, authorized to make legally binding statements on behalf of the University in matters relating to the license).
- Reviews receipts of radioactive materials to assure that the procurement of such materials is not in violation of the radioactive materials license, that the material and user have been approved by the FSU RSC and that suitable and secure storage and use areas exist.
- Reviews all plans for the proposed use of radioisotopes from the standpoint of radiation safety, outlines any additional requirements to the PI, and makes recommendations to the RSC.
- Assures that the monitoring, as required, and the opening of incoming shipments of radioactive materials is carried out properly and supervises the storage and delivery of such shipments.
- Ensures that the packaging of radioactive materials to be shipped from the University to other authorized recipients complies with packaging, shipping and labeling requirements.
- Ensures a physical inspection is made of each room or area where radioactive materials are used to assure that the proper radiation warning signs are posted, containers are labeled and ALARA principles are being adhered to.
- Assures the issuance and wearing of personnel monitoring devices when needed, their timely exchange, and the proper instructions on their use.
- Ensures routine wipe tests and surveys of storage and work areas in labs where radioactive materials are located. Surveys all areas where radiation hazards are suspected and any other special surveys that may be required.
- Determines exposure potential under actual or proposed working conditions and recommends time limits for personnel exposure and minimal working distances.
- Investigates radiation incidents (spills or other mishaps), supervises the decontamination of major spills, and reports such incidents to the Committee and to the State, as required.
- Arranges for the collection of radioactive waste for proper storage and disposal and supervises the management of such waste.
- Establishes proper calibration procedures for survey instruments that are currently in use or in a standby status and assures that qualified personnel perform these procedures in a timely manner. Also, arranges for prompt repair of survey instruments, as necessary.
- Ensures that all required health physics activities are conducted; e.g., leak tests, wipe tests, survey records, dose records, receipt records, inventory records, etc., and that records of such are properly maintained.

1.3.4 **Radiation Safety Officer** (continued)

- Submits an annual report to the FSU RSC describing the status of the radiation safety program, any non-compliance items found during recent audits and inspections, any unusual events or circumstances, any recommendations, and any unmet program needs.
- Develops and provides instruction for research personnel in proper radiation safety practices and procedures and ensures that all users have read and understand the policies and procedures applicable to their radiological activities.
- Possesses the authority to suspend any use of radiation that is judged to be a potentially serious radiation safety hazard or a flagrant violation of applicable rules.

The Radiation Safety Office may include an Associate RSO to assist with administration of the program, and other full- or part-time staff that are delegated various program tasks according to their qualifications.

1.3.5 Principal Investigators

Principal Investigators (PIs) are members of FSU researchers with appropriate radiation safety training and experience to obtain RSC approval for the designation. Lead and associate PIs are approved to work with radioactive materials under University-issued research permits.

Lead PIs must be experienced authorized users (AUs) of radioactive materials, and competent in directing the research described in their proposal. Lead PI duties and responsibilities include:

- Submitting a completed radioactive materials use permit application (see 1.5.1, below) describing their research proposal.
- Assure that the necessary funds are available to cover the costs of safely conducting the proposed radioactive experiments, the funding of personnel working under their permit, and ensuring they have the training and ability to safely conduct their assigned duties.
- Maintaining security, ordering, maintaining inventories and keeping disposal records of all radioactive materials authorized by the permit.
- Maintaining a current and complete permit description on file with the RSO.
- Observing all applicable safety policies, procedures, regulations and special permit conditions.
- Ensuring that all personnel who work with radioactive materials are listed on the proposal, have reviewed and are familiar with this manual, and have documentation of training as described in Chapter 2, included permit-specific training.
- Submitting a quarterly radioactive materials inventory report to the RSO. The reports must include the kind and amount of material on hand, receipts and disposals, and indicate the method(s) of disposal. Inventory forms are available on the EHS website.
- Notifying the RSO of any radioactive material shipments that are inadvertently shipped directly to their lab or are anticipated to be shipped directly to their lab or another location. The RSO must be notified of all shipments or transfers of radioactive material to and from the University.
- Immediately reporting to the RSO any incident involving radioactive materials.

Pending RSO/RSC approval, lead PIs may designate one or more qualified AUs as Associate PIs and delegate some of their permit responsibilities to them.

1.3.6 Authorized Users

Authorized users (AUs) have completed required training and testing to qualify them to work with either sealed or unsealed radioactive materials, or both. AUs are responsible for:

- Compliance with FSU policies and procedures, applicable regulatory requirements, plus the terms and conditions of the FSU license and the permit they operate under;
- Maintaining occupational and public radiation exposures ALARA (see 1.4, below);
- Communicating and coordinating with the RSO on radiation safety and regulatory issues; and
- Reporting any situation that appears to be unsafe or may lead to a violation of regulations, procedures or unnecessary exposure to radiation, including any radioisotope package received directly by the lab or elsewhere on campus (the Radiation Safety Office must process all radioactive materials shipments).

1.3.7 Radiation Safety Consultants

The University may contract with radiation safety consultants to provide technical and regulatory support to the program, perform specific assignments, or augment radiation safety staff. Consultants are vetted by the RSO and EHS executive director to ensure appropriate qualifications.

1.4 ALARA Policy

1.4.1 ALARA Philosophy

Part III of Chapter 64E-5, FAC establishes standards for protection against radiation hazards. FSU is required to use (to the extent practical) procedures and engineering controls based on sound principles to achieve occupational and public doses that are as low as reasonably achievable (ALARA). The basis for the ALARA philosophy is that even though occupational dose limits pose a very low risk of injury, unnecessary exposures should be avoided. The objective is to keep occupational and public radiation doses as far below regulatory limits as is reasonably achievable through good planning and practice, and by a management commitment to policies that deter departures from good practices.

1.4.2 Management Commitment

FSU management is committed to the ALARA philosophy of maintaining occupational and public radiation doses as low as reasonably achievable. The RSO has been delegated authority to ensure adherence to ALARA principles. Management will support them in instances where this authority must be asserted.

All reasonable modifications will be made to procedures, equipment and facilities to minimize internal and external exposures. Management is prepared to describe the reasons for not implementing any recommended modifications.

1.4.3 RSO ALARA Responsibilities

The RSO will emphasize the ALARA philosophy to radiation workers and instruct them on dose minimization techniques.

Exposure investigations. The RSO will conduct timely investigations of any exposures that appear to be unnecessary or excessive. If warranted, the RSO will take corrective actions to ensure that the exposures are halted and recurrence is prevented. A report of such investigations will be maintained.

1.4.3 RSO ALARA Responsibilities (continued)

Lab inspections. The RSO's objective is to perform or direct monthly inspections of labs using radioactive materials to ensure compliance and diligent application of ALARA principles. If not monthly, the inspections will be done at least quarterly. The labs are surveyed and where appropriate, wipe tested for contamination. If warranted, the RSO may implement corrective actions (e.g., additional training, repeat inspections, suspension of radiation work).

Annual program audits. At intervals not to exceed 12 months, the RSO conducts a formal review of the content and implementation of FSU RSP for radioactive materials, as required by 64E-5.303(3), FAC. The reviews include an evaluation of facilities, equipment, procedures, records, inspection findings and incidents. The objective is to determine if any modifications are needed. Audit findings are documented, reviewed by management, and signed and dated by the RSO and management representative.

1.4.4 PI and AU ALARA Responsibilities

PIs and AUs are responsible for consistently applying ALARA principles and good work practices during their research activities through strict adherence to FSU policies and procedures. They must take corrective actions to address any lapses, and report any issues, concerns and/or recommendations to the RSO. Everyone is expected to be proactive, promptly reporting any unsafe conditions and making suggestions for improving workplace safety. Monitored personnel are encouraged to review their dosimetry reports and track their occupational doses.

1.5 Radioactive Materials Use Permits

1.5.1 Permit Application Process

Authorization to use radioactive materials requires a research permit. The lead PI must submit a completed, signed Form EHS 10-1 – *Proposal to Use Radioactive Materials*, which must be approved by the RSO and RSC before the experiments begin. The RSO is available to assist with the proposal and if approved, will present the request to the RSC for evaluation and signature. Approval will be granted if the Committee agrees that the proposed use satisfactorily meets control and safety requirements, and the PI vetting reviews are satisfactory.

Proposal Reviews. Proposals are approved only when sufficient evidence is provided that the user is competent in performing all applicable phases of the proposed experiments. If after reviewing the proposal and supporting information, the RSO and RSC members have questions about the safety of the proposed use, they may require further details of the experiment, equipment and techniques, as well as information on the expertise of the researcher(s) before making a final determination.

Proposal reviews may require a personal interview with the lead PI for specific details on the research, or a commitment to conduct initial trial runs using non-radioactive materials.

Each proposal must include:

- The Lead PI's curriculum vitae (CV), that is no more than 5 years old, and includes practical experience working with radioactive materials
- List all additional PIs and AUs and describe their experience, training, and capabilities to safely conduct the proposed research.

1.5.2 Permit Amendments and Renewals

The PI must obtain a permit amendment approved by the RSO, before deviating from the radioisotopes, maximum activities, areas of use, or experiments described in the permit application and supporting documents. The RSO may approve minor changes in the proposal, including authorized activity increases of up to one millicurie. More significant changes to permit terms and conditions require RSC review and approval. Permits are issued for periods not to exceed 5 years, when the proposal application may be resubmitted for another RSO/RSC review.

1.6 Radiation Monitoring Program

1.6.1 Occupational Dose Limits

FSU must comply with occupational and public dose limits specified in Part III of Chapter 64E-5, FAC.

- **Adult radiation workers** are limited to an annual total effective dose equivalent (TEDE) of:
  - 5 rem (50 mSv) to the whole body;
  - 15 rem (150 mSv) to the lens of the eye; or
  - 50 rem (500 mSv) shallow dose to the skin or any extremity; and
  - Exposures must be maintained as low as reasonably achievable (ALARA)
- **Minors** are not allowed to exceed 10% of the adult limits.
- **Declared pregnant women** cannot exceed 500 mrem (0.5 mSv) during their pregnancy.
- **Members of the public** are not allowed to exceed:
  - 2 mrem (0.02 mSv) in any one hour;
  - 100 mrem (1 mSv) in one year; and
  - Exposures must be maintained as low as reasonably achievable (ALARA)

1.6.2 FSU ALARA Dose Limits

In keeping with ALARA principles, the RSC recommends that doses to radiation workers be limited to 10% of the above dose limits, adjusted to quarterly criteria. Any monitored individual exceeding a quarterly dose limit will be notified by the RSO so that the cause may be determined and any technique modifications are made to reduce their exposure.

- Whole body: 500 mrem (5 mSv); or
- Lens of the eye: 1.5 rem (15 mSv); or
- Shallow dose: 5 rem (50 mSv).

Regardless of the occupational dose limit in place for minors, it is FSU policy to not allow minors to work with any licensed sources of ionizing radiation.

1.6.3 Dose Limits for Declared Pregnant Workers

Due to the elevated risk associated with radiation exposure to an embryo/fetus, the occupational dose of a declared pregnant woman is limited to 500 mrem during the pregnancy. In addition, no more than 50 mrem should be received in any one month of a pregnancy. These limits apply only if a worker elects to follow them by formally declaring her pregnancy in accordance with this procedure.

1.6.3 Dose Limits for Declared Pregnant Workers (continued)

A declared pregnant woman is defined as a female worker who has voluntarily informed her supervisor in writing of her pregnancy and the estimated date of conception. If by the time the woman declares pregnancy, the dose to the embryo/fetus has exceeded 500 mrem or is within 50 mrem of 500 mrem, the University will be considered in compliance with the limit, provided the additional dose to the embryo/fetus does not exceed 50 mrem for the remainder of the pregnancy.

To initiate the process, a declared pregnant woman must submit a completed Form EHS 10-7, *Declaration of Pregnancy*, to the RSO and review, sign a copy of Form EHS 10-8, *Instructions for Declared Pregnant Workers*, and comply with the form's instructions. Declared pregnant women will not be removed from working with radiation sources unless requested in writing by the individual. The Lead PI must ensure that the employee wears her monitoring badge at waist level for the duration of the pregnancy.

Upon receipt of a Declaration of Pregnancy form, the RSO will verify that the employee has not requested removal from radiation work, ensure that the badge is worn properly, maintain records, and monitor compliance with the dose limit. Upon completion of the embryo/fetus monitoring, the RSO will issue a memo describing how these instructions were implemented and noting the doses reported for the worker's pregnancy. A copy of all relevant documentation will be maintained with the University's dosimetry files.

1.6.4 Dosimetry Information

If a determination is made that individuals working with radioactive materials are likely to receive exposures exceeding 10% of the annual occupational dose limits (i.e., for external doses, 500 mrem/year), they are signed personnel dosimetry – either whole body radiation monitoring badges or finger ring dosimeters, depending on the work.

FSU uses NVLAP-accredited badges for personnel monitoring that are processed at least quarterly, and quarterly dosimetry reports are issued. All monitoring data is maintained on file. When an individual is assigned a badge, their data is added to the database for the next monitoring period. Refer to Chapter 3 for personnel and area radiation monitoring procedures.

1.6.5 Records of Prior Occupational Dose

An individual's occupational dose history must be obtained prior to beginning work with radiation if the person is likely to receive exposures of 500 mrem/year or more (10% of the 5-rem annual limit). Years of monitoring data demonstrate that the majority of FSU radioactive material users receive doses well below the threshold, so dose histories are not required for most users.

In cases where a dose history is required, the RSO must determine the individual's occupational radiation dose received during the current year, and make a reasonable effort to obtain records indicating the individual's lifetime cumulative occupational dose. Dose histories should be documented on a *Cumulative Occupational Dose History* form (FDOH Form DH 1623, NRC Form 4 or equivalent), signed by the worker. The form should note any monitoring periods where dose data are unavailable. If a worker has no prior occupational dose, the form should be used to document it.

If the worker is unable to provide documentation of their dose history, one approach is to contact the dosimetry vendor(s) used by their past employer(s) and obtain the worker's dose data directly from the vendor. Such requests will likely require a written request from the monitored individual.

1.6.5 Records of Prior Occupational Dose (continued)

Alternately, reports of worker dose histories can be requested from previous employers by phone, fax or letter. If the authenticity of a transmitted report cannot be established, written verification of the dose data should be requested. If such efforts to obtain dose histories fail, the RSO may also seek assistance from the regulatory agency with jurisdiction in the location where the monitoring occurred.

If all reasonable efforts to obtain dose history records are unsuccessful, the worker may provide the RSO a written statement that documents the worker's estimated cumulative occupational radiation dose. Such statements must be signed and dated by the worker and the RSO.

If unable to obtain a complete record of a worker's current and prior accumulated occupational dose, the RSO must assume that for the current year, the allowable dose limit for the worker is reduced by 1.25 rem for each quarter that records are unavailable and the worker was engaged in activities that could have resulted in occupational radiation exposure.

1.6.6 Records of Individual Monitoring Results

Vendor dosimetry reports are equivalent to FDOH BRC Form DH-1622 and NRC Form 5, *Occupational Radiation Dose Record for a Monitoring Period*. The reports are reviewed by the RSO in a timely manner, so that any elevated doses are promptly identified and addressed.

When required to report an individual's radiation dose to the FDOH BRC, the report must be provided to the exposed individual no later than when the original is sent to the agency.

1.6.7 Annual Dose Reports

Individual reports describing the past year's monitoring results for each badged worker are issued annually. Each worker is issued a copy of their annual dose report if the worker requests a copy. The reports must list FSU as the employer, the name of the monitored worker, and the following statement: "This report is furnished to you under the provisions of the Florida Department of Health regulation entitled Chapter 64E-5, Control of Radiation Hazards. You should preserve this record for future reference." Vendor-generated reports may be used for this reporting requirement.

1.6.8 Termination Dose Reports

Within 30 days after the individual's final dose has been determined, or within 30 days from the time the worker requests the report, whichever is later, the monitored worker must be provided a written dose report summarizing the individual's occupational radiation dose history with FSU. The report must include the same information and statement required for annual radiation dose reports. Vendor-generated reports may be used.

Documentation (copy of completed form, preferably signed and dated by the terminated worker) showing that the reports have been furnished should be maintained. If workers with terminated monitoring are no longer present, the report should be mailed to their last known address, and a note should be retained that indicates that the report was mailed to the employee.

1.6.9 Lost/Damaged/Accidently Exposed Badges

In the event of a lost/damaged or accidently exposed monitoring badge, the worker may be provided a replacement badge for the remainder of the monitoring period. The replacement badge must be marked with the worker's name, initials or other form of ID, and the dose on the replacement badge must be added to the worker's dose total.

1.6.9 Lost/Damaged/Accidently Exposed Badges (continued)

The worker's dose for the period covered by the lost/damaged badge should be estimated based on available dosimetry data. The incident report (preferably signed and dated by the worker) should describe the methodology used to estimate the worker's dose. It should note that the estimated dose covering the time period in question was added to the worker's dose total. A supplemental dose report that documents the revised dose total should also be issued.

1.7 Radioactive Material Inventories

Each Lead PI must maintain an accurate inventory of the radioactive materials possessed under their permit. Inventory reports are due at least quarterly. The completed reports, or the information required to prepare them, should be received by the RSO within 10 working days following the end of each quarter. Serious delinquencies may result in punitive action by the Radiation Safety Committee. The RSO maintains a campus-wide inventory and may request an inventory verification at any time.

The RSO provides two radioactive material inventory forms: one for sealed sources and another for unsealed radioisotopes. The forms are for reporting the sources received, transferred and disposed of during the reporting period, plus the amount of each radionuclide "on hand" at the end of the period. Alternate methods of reporting equivalent information may also be used.

The decay formula is: $A = A_o \times e^{(-0.693t/T½)}$

Where: A = Activity now
A_o = Activity at some previous time
e = Base of natural logarithm
t = Elapsed time
T½ = Half-life of the radionuclide (must be in same time units as t)

1.8 Leak Testing Procedures

1.8.1 Leak Testing Requirements

Each sealed source containing licensed material must be tested for leakage at intervals not to exceed 6 months, with the following exceptions:

- Sealed sources containing only radioactive material as a gas or with a half-life of < 30 days;
- Sealed sources containing ≤ 100 uCi of beta or photon-emitters or ≤ 10 uCi of alpha-emitters;
- Sealed sources that are exempted or approved for different test intervals on their Sealed Source and Device Registry sheet; and
- Sealed sources listed on the FSU license as authorized for storage only. In such cases, the source must be leak tested before any use or transfer unless it has been tested within 6 months before the date of use or transfer. Records indicating the date a source is placed in storage, its latest leak test date and results, and storage location must be maintained.

Newly received sources without acceptable leak test documentation from the transferor shall not be put into use until tested. Sealed sources requiring leak testing at 6-month intervals are typically tested in March and September. Personnel authorized to perform leak tests are the RSO or persons designated by the RSO.

1.8.2 Leak Testing Procedure

- Sealed sources that have manufacturer-specific leak test instructions are tested in accordance with those instructions. In-house leak test samples are taken with an ethanol-moistened, absorbent, high wet-strength paper (except for certain applications where cotton swabs may be more effective). Tongs may be used to hold the source.
- Leak tests samples are taken from the source surface when practical, taking care not to damage it. Some sources (e.g. matrix types) may require the test sample to be taken from the source holder. Sealed sources permanently or semi-permanently mounted in certain devices may require taking the test sample at the nearest accessible point where contamination would be expected to accumulate.
- The leak test counting technique shall be in accordance with manufacturer instructions for the counting system employed.
- Records of the leak test results shall be kept in uCi units and maintained for at least 3 years.

Note: If a test reveals the presence of 0.005 uCi or more of removable contamination, the sealed source shall be immediately withdrawn from use and must be decontaminated and repaired, returned to the manufacturer, or disposed. A report must be filed within 5 days of the test with FDOH describing the equipment involved, the test results and the corrective action taken.

1.9 Records Retention Requirements

1.9.1 Records Requirements

Radiation safety program records are maintained in accordance with the retention intervals described below, as required by state and federal regulations. The records must be legible throughout the specified retention period. Records can be originals or reproduced copies (photocopy or scanned image). Copies of records required by Part III of Chapter 64E-5, FAC must be authenticated by authorized personnel. Records can be stored in electronic media capable of producing legible, accurate, and complete records during the required retention period. Letters, drawings, and specifications must include all pertinent information such as dates and signatures. The RSO is responsible for maintaining adequate safeguards against tampering and loss of records.

The below table lists the records pertaining to FSU's licensed activities, their retention intervals and regulatory references. The RSO may elect to retain records for longer than specified by the rule.

Document	Retention Interval	Reference
Current copy of Chapter 64E-5, FAC	Until termination of license	64E-5.901
Radioactive materials license (with all active amendments & supporting documents)	Until termination of license	64E-5.901
Provisions of radiation protection program	Until termination of license	64E-5.335(2)
Radiation Safety Committee meeting minutes	3 years after records are made	64E-5.335(1)(b)
Annual radiation safety program reviews	3 years after records are made	64E-5.335(2)
Radiation safety training & testing records	Until worker's termination or 5 years, whichever is greater	64E-5.1307(3)
USDOT hazmat employee training records	90 days from last day of	49 CFR 172.704(d)

1.9.2 **Records Retention Table** (continued)

Document	Retention Interval	Reference
Contamination control records	3 years after records are made	64E-5.337, .1319
Inventory records	3 years after records are made	64E-5.1304
Radioactive material receipt records	Until disposal is authorized	64E-5.103
Rad. material transfer & disposal records	Until termination of license	64E-5.340(2)
Personnel monitoring records (FDOH Form DH-1622 or equivalent)	Until termination of license	64E-5.331, .339(5)
Annual & termination dose records (FDOH Form DH-1622 or equivalent)	Until termination of license	64E-5.339(5)
Records demonstrating compliance with public dose limits	Until termination of license	64E-5.313(5)
Bioassay monitoring results	Until termination of license	64E-5.339(5)
Annual survey meter calibration records	3 years after records are made	64E-5.336(1)
Records of surveys/measurements used to determine external/internal doses or performed to evaluate radiation levels/hazards (e.g., area surveys, wipe test analysis reports)	3 years after the surveys/measurements were made	64E-5.336(1)
Records of surveys/measurements made to determine doses or rad. effluent releases	Until termination of license	64E-5.336(2)
Rad. material shipping papers	2 years after package shipment	49 CFR 172.201(e)
Records of Type A package test methods & results for each package used	1 year past last package shipment	64E-5.1502(2) 49 CFR 173.415(a)

CHAPTER 2 – RADIATION SAFETY TRAINING PROGRAM

2.0 Introduction

Only trained personnel are authorized to handle and use licensed radioactive materials at FSU – whether exempt, GL and/or SL sources – they are required to comply with state training requirements. There are two tiers of radiation safety training: awareness-level and authorized user/function-specific training, as described below. No one (faculty, staff, students or visitors) is allowed to work with or have unsupervised access to radioactive material until they complete appropriate radiation safety training. All training must be documented and maintained on file.

2.1 Initial Training

All individuals who will work with licensed radioactive materials must comply with training requirements specified in Parts IX and XIII of Chapter 64E-5. FAC.

- Radiation awareness-level training (instructions to workers) described in 64E-5.902, FAC; and
- Authorized User training described in 64E-5.1307, FAC.

2.1.1 Radiation Awareness-level Training

Before working with sources of ionizing radiation, all personnel must complete FSU's awareness-level radiation safety training, which addresses all topics required by subsec. 64E-5.902(1), FAC:

- Sources of ionizing radiation at FSU;
- Radiation health hazards, ways to minimize exposures, and information on protective devices;
- Provisions of the FSU license and applicable regulations and for the protection of personnel from exposures to radiation or rad. material;
- Responsibility to report unsafe conditions, violations and/or unnecessary radiation exposures;
- Instructions for responding to radiological incidents; and
- Radiation exposure reporting requirements.

Radiation awareness-level training consists of two components: 1) a computer-based training module (available on the EHS website), and 2) a practical training session provided by Radiation Safety Office staff.

2.1.2 Authorized User Training

Qualification as an authorized user (AU) of radioactive materials requires completion of function-specific training as specified in section 64E-5.1307, FAC. This includes practical training and testing to demonstrate competence. Individuals with documentation of training addressing all topics listed in sec. 64E-5.1307, FAC (listed below) are not required to complete FSU's AU training courses but must demonstrate competence on subject matter by scoring at least 70% on a test administered by the EHS Radiation Safety Office.

Training Topics for RAM Authorized Users

- Radiation safety fundamentals
- ALARA principles
- Radioactivity measurements
- Radiation detection instruments and proper use
- Biological effects of radiation
- Transportation of radioactive materials
- Operating and emergency (O&E) procedures

plus:

- Practical experience working with radioactive materials

Individuals lacking documentation of prior training and experience must complete one or both of the below FSU courses, as appropriate, which can be accessed from the EHS website.

- Sealed Source User Radiation Safety Training
- Unsealed Source User Radiation Safety Training

2.1.3 Permit-specific Training

Each Lead PI is responsible for providing and documenting training specific to their permit's scope of research to all individuals (including students) working under their permit. This function-specific training must address:

- Permit authorizations
- Radioactive material use/storage area restrictions
- Location and procedures for radioactive material and radwaste storage and security
- Posting of required signs and notices
- Special handling techniques to minimize exposures
- Personal protective equipment
- Radioactive material accountability
- Walk-through review of lab protocols involving radioactive materials

All permit-specific training shall be documented and maintained on file by the permit holder. Training records must include:

- Department name
- Permit holder name
- Course title
- Date of training
- Content of training (outline, description)
- Instructor name
- Printed name of trainee(s)
- Signature or initials of trainee(s)

2.2 Refresher Training

While not a regulatory requirement, FSU may offer annual radiation safety training for its authorized users. The training should review the findings from the past year's annual radiation safety program review and recent state inspections. A question-and-answer session on the state of the program should be included. Refresher training records are maintained by the Radiation Safety Office and available upon request. Authorized users shall participate in refresher training when provided.

2.3 Radiation Safety Officer and Radiation Safety Staff Training

State regulations (subsec. 64E-5.1305(2), FAC) requires the FSU RSO to have sufficient training and experience to be a user of the radioactive materials authorized by the license.

Training must include practical experience in use of radioactive materials and knowledge of procedures, facilities and equipment. The RSO need not be an expert in the research covered by the program but must have sufficient training and experience to perform the duties required for the position. RSO qualifications should be a combination of formal education and relevant experience with the types and quantities of radiation sources possessed by FSU.

In addition to completing Authorized User training, FSU radiation safety staff receive instruction from the RSO regarding their responsibilities and supervised hands-on instruction on performance of program-related tasks, with emphasis on lab inspections, instrumentation, records and radwaste processing.

The RSO and any staff with job functions that impact radioactive materials shipments must complete U.S. Department of Transportation hazmat employee training (initial and 3-year refresher) specified in 49 CFR Part 172, Subpart H. Initial hazmat training must be completed within 90 days of beginning such activities (they can work under a qualified hazmat employee during that period). The training covers general awareness/familiarization, function specific, safety, and in-depth security awareness training. It is provided in-house or by qualified third instructors.

2.4 Instructions for Building Services and Maintenance Personnel

Building Services personnel must be informed of any radiation hazards present and the meaning of warning signs and labels. Radiation Safety personnel provide this training on an as-needed basis.

Maintenance personnel, who are required to work in laboratories where possible radiation hazards exist, must be informed of those hazards and be supervised when necessary. **The lead PI or their designee must notify the RSO before maintenance personnel start work on such projects, so that proper oversight, monitoring and personal protective equipment can be provided**. The following are examples of reportable projects:

- Changing filters in hoods or glove boxes where radioactive materials have been used.
- Working on drains of sinks that have been used for the disposal of radioactive materials.
- Working on potentially contaminated lab equipment.
- Machining parts that may be radioactive by induced activity, e.g., bombarded with neutrons.

2.5 Instructions for Ancillary Staff Training

FSU has radiation safety information available for people who may work in the vicinity of areas where radioactive materials are used or stored. Examples include custodians, clerical personnel, Facilities staff, Campus Police, and visitors. Information on the University's radiation sources and radiation safety program is available at the EHS website. The instructions cover:

- Hazards of radiation and radioactive materials
- Radiation warning signs and restricted areas
- Contacts in the event of a radiological incident

2.6 Training Records

The Radiation Safety Office maintains radiation safety records on the University's network, and in individual permit files. Lead PIs maintain radiation safety records for the personnel working under their permit.

Hazmat employee training records for Radiation Safety Office staff are maintained for the duration of each worker's employment, plus 90 days, and include the following information:

- The employee's name and date of most recent training completed;
- Description, copy, or location of training materials used;
- Name and address of the person providing the training; and
- Certification of hazmat employee training/testing as required by 49 CFR Part 172, Subpart H.

CHAPTER 3 – OPERATING PROCEDURES

Contents

3.0 Introduction

This chapter provides instructions for both Radiation Safety staff and the PIs/AUs working with radioactive materials. They must be followed diligently to ensure safe operations.

3.1 General Instructions

These procedures provide instructions for safely working with sealed and unsealed radioactive materials. Strict adherence to these instructions provides the greatest assurance of safe operations.

3.1.1 Personnel Responsibilities

Safe and compliant radiological operations are a shared responsibility. Each user must diligently and consistently adhere to the highest levels of professionalism to ensure workplace safety. Personnel should be familiar with the functions and limitations of their equipment, and must report to the Radiation Safety Office any equipment defects or other unsafe conditions.

3.1.2 Procedures and Manuals

A current copy of applicable FSU procedures and copies of any manufacturer operation/maintenance manuals of radiation-safety related equipment are kept available for reference by authorized users.

3.1.2 Prohibitions

Possession and use of radioactive materials is restricted to the specific sources authorized by the lab's radioactive materials use permit. Use of any radioactive material other than as specified in the permit is prohibited without written approval of the RSO.

Personnel are prohibited from opening sealed sources.

Modification, repair, or non-routine maintenance of any devices and related components containing radioactive material is prohibited without prior approval of the RSO.

3.1.3 Application of ALARA Principles

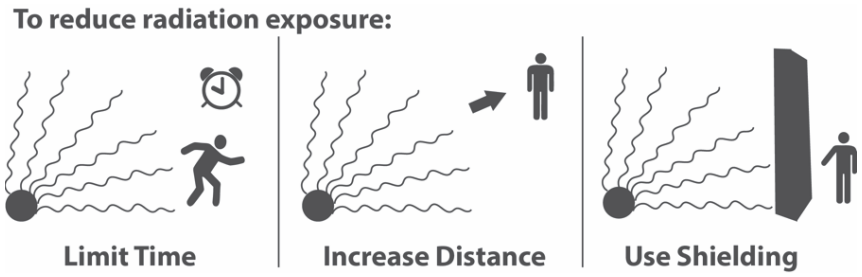
Controls are in place to minimize radiation exposure and contamination in areas where radioactive materials are used or stored. High standards of cleanliness and good housekeeping, proper supervision, and well-instructed personnel are keys to controlling radiation exposures and contamination. PIs are responsible for seeing that these conditions are met on a day-to-day basis in his/her lab – and each user is responsible for their actions.

3.1.3 Application of ALARA Principles (continued)

Radiation protection actions are implemented to ensure that the dose received by any individual does not exceed the maximum permissible limits and is as low as reasonably achievable or "ALARA".

This ALARA objective may be achieved by applying one, or a combination, of the following methods:

- **Time**: Limit the time spent in a radiation field to limit the exposure. For example, if a person entering an area where the radiation levels are 1000 mR/hr remains in the field for only 30 seconds, they would receive 8 mrem. The typical annual dose from background radiation is ~310 mrem/year; FSU's ALARA limit is **500 mrem/year**, and the maximum permissible whole-body dose is 5,000 mrem/year.
- **Distance**: Maximize the distance from a radiation source to minimize the exposure. The inverse square law states that radiation intensity from a point source varies inversely as the square of the distance from the source: "Double the distance, and quarter the intensity".
- **Shielding**: Most radioisotopes used at FSU are relatively easy to shield, particularly beta emitters. Utilize plastic or glass to shield energetic beta emitters. Lead shielding is generally used to shield x ray and gamma emitters. The RSO can assist with shielding needs.



- **Contamination Control**

  . The basic principles for control of radioactive contamination are listed below.

  - Minimize the amount of radioactivity being handled.
  - Make sure there is appropriate containment (normally at least two levels of containment are provided). Fume hoods and glove boxes are the most widely employed contamination control techniques because they are the least expensive and the most effective.
  - Follow procedures regarding protective clothing, washing, monitoring and decontamination.
  - Maintain a clean lab area to reduce the potential for spills and cross-contamination.

3.1.4 Personnel Protective Measures

- Eating, drinking and applying makeup are prohibited when working with radioactive material or with contaminated equipment; smoking is prohibited in all labs.
- Protective gloves and closed-toe shoes are required for work with powders or liquids.
- Surveying (when appropriate) and washing hands is required after working with loose material.
- Handling radioactive material should not be done with significant skin breaks (cuts or abrasions) that would permit entry of material or hinder effective decontamination by vigorous washing.
- Pipetting radioactive solutions by mouth is prohibited.

3.1.5 Lab Safety Procedures

- When working with radioactive material that may be dispersed into the air, such as; ashing, boiling, evaporating, or distilling, the work must be done in a fume hood. The airflow shall be no less than 100 linear feet per minute when averaged over the plane of the sash with the sash opened at least 18 inches. Work with fine particulate material must be done in a glove box. Any exceptions must be approved by the RSO and RSC.
- The extent of work areas and storage places for radioactive material within a lab are to be kept to a minimum. The material must be stored and secured as far as practical from other work areas and behind sufficient shielding, when needed.
- Tables and bench tops on which radioactive material is used shall be made of, or lined with, a nonporous and chemical resistant material. Such surfaces are to be covered with a disposable material such as absorbent plastic-backed paper. When working under conditions that a spill or incident would not be confined to a small area, the work shall be done over a tray, or other provisions should be made to minimize the extent of a contamination incident.
- Maintain a clean lab with minimal clutter on the radioactive workbench and in hoods. Each lab user must clean up his/her work area and apparatus, and properly dispose of or store radioactive material and radwaste.
- No person or object subject to radioactive contamination is to leave a lab without being monitored for radioactivity. Suitable monitoring techniques are required, such as using a G-M survey meter or conducting wipe tests. Consult with the RSO if instructions on proper monitoring techniques are needed.
- Point out careless practices and poor techniques of other users and explain proper procedures.
- Report items of noncompliance, persistent problems, or consistent lack of cooperation by users.
- Report contamination incidents to the RSO.

3.2 Security Measures for Radioactive Materials

Security of sources of ionizing radiation has always been important from a health and safety perspective. The potential for such sources to be used for malicious purposes makes it a priority, so it is imperative that every precaution is taken to prevent unauthorized access, loss, or theft.

Unless in secure storage, radiation sources must be under the control and surveillance of an authorized user. When not under direct supervision, they must be secured to prevent unauthorized access, preferably by at least two independent physical barriers. Storage areas must be kept posted and locked, with keys controlled by authorized personnel.

3.2.1 Sealed Sources

Sealed sources less than exempt quantities are not regulated, but when possessed on campus, are under the RSO's oversight and must be included in the inventory of radiation sources. Whenever 10 or more exempt sealed sources are stored or used in the same area, those sources and sealed sources greater than exempt quantities must be approved for use via a permit proposal. This includes sources in a generally licensed or exempt device (e.g.: gas chromatograph or liquid scintillation counter).

3.2.2 Unsealed Sources

Licensed unsealed sources of radiation are only to be handled by qualified authorized users. They must be secured to prevent unauthorized access. To accomplish this, labs must be locked when users are not present, or stock radioactive materials must be secured within the lab by use of locked storage boxes, refrigerators or other security devices. Contact the RSO for information on lockboxes or radioactive material security.

3.3 Posting and Labeling Requirements

3.3.1 Workplace Postings

Copies of the below documents must be conspicuously posted to permit radiation workers to observe them on the way to or from areas where radiation sources are located. The documents must be replaced if they become outdated or illegible.

- Radiation emergency procedures (Chapter 4 of this manual)
- Radiation emergency contacts notification poster
- FDOH BRC "Notice to Employees" with a notation (see below)
- Enforcement correspondence: Any notice of violations, proposed imposition of administrative penalties or orders, and any FSU responses (posted within 5 working days of receipt and for at least 5 working days, or until corrective actions have been implemented, whichever is later)
- Other required documents:
  - Parts III and IX of Chapter 64E-5, FAC (state radiation control regulations)
  - Florida Radioactive Materials License No. 32-10
  - Operating procedures (this chapter)

Due to the impracticality of posting the regulations, license and operating procedures, a note is added to the "Notice to Employees" to indicate where those documents are available for review.

3.3.2 Radioactive Material Warnings

Areas where radioactive materials are used and/or stored must be clearly posted with signage bearing the radiation symbol and warning "Caution (or Danger), Radioactive Material(s)". The radiation symbols must be colored magenta or black on yellow backgrounds. Containers used to store radioactive materials must be labeled with the same warning, and when appropriate list the radioisotope, activity and activity measurement date. Contaminated equipment and surfaces must be identified as being radioactive. There are no size specifications, but warnings must be legible.

Sample radiation warning labels

Users should not remove radiation warning signs from lab or lab equipment. The RSO must test areas and equipment to ensure they are free of contamination before removing signs. Contact the RSO to request removal of postings, and for advice on posting and labeling requirements.

3.3.3 Radiation Areas and High Radiation Areas

Areas where radiation levels are > 5 mR/hr at 30 cm must be posted with "Caution – Radiation Area" signage with specification radiation symbols and colors.

Areas where radiation levels are > 5 mR/hr at 30 cm must be posted with "Caution (or Danger) – High Radiation Area" signage with specification radiation symbols and colors.

There are some exemptions to radioactive material labeling:

- Containers with RAM quantities < those listed in FL regulations: *RAM Requiring Labeling*
- Containers with RAM concentrations < specified in FL regulations
- Containers attended by an individual taking necessary safety precautions

Containers that are used temporarily during lab radioactivity work are not required to be so labeled, unless left unattended. Items left in a designated radioactive workplace will be assumed to be radioactive.

3.3.4 Additional Hazard Information

Additional information should be provided on or near required signs and labels to ensure personnel are aware of potential radiation exposures and measures to minimize exposures. Examples:

- Areas with unsealed materials present should post "No Eating, Drinking or Application of Cosmetics" warning signs.
- Entry doors to rad labs should be posted with radiation hazard icon and text to warn of the radioactive materials hazard.

3.4 Area and Personnel Monitoring Policies

3.4.1 Area Monitoring Policies

Area monitoring may be conducted on a case-by-case basis. If determined to be warranted, it will be specified in the permit. Area badges are useful for monitoring workspaces where researchers are unbadged. They may also be used to track ambient radiation levels and demonstrate compliance with dose limits. Records of area badging are maintained with personnel dosimetry records.

3.4.2 Personnel Monitoring Procedures

Personnel monitoring is required for individuals likely to receive doses exceeding 500 mrem/year. The majority of FSU radiation workers receive annual doses far below that threshold, so whole body badges are typically not issued. When issued, the following instructions apply:

- Do not allow an assigned device to be worn by any other person.
- Dosimeters are only to be worn during work-related activities, and are not to be removed from the workplace.
- All personnel assigned a whole-body personnel dosimeter must wear the badge in the position that will likely indicate the highest whole-body dose (e.g., between chest and waist level, outside of clothing).
- When not in use, badges should be stored in locations protected from adverse environmental conditions (excessive heat, light, moisture, chemicals or radiation sources)

3.4.2 Personnel Monitoring Procedures (continued)

Extremity (finger ring) dosimeters are typically issued if:

- The individual regularly handles millicurie amounts of energetic beta emitters (> 300 keV) or gamma/x-ray emitters (e.g., iodine-131);
- The PI or individual requests that a ring dosimeter be assigned, as long as the radiation source is detectable by the dosimeter; or
- The RSO feels that extremity monitoring is warranted.

Ring dosimeters must be worn on a finger with the sensitive portion of the dosimeter toward the palm of their hand; i.e., closest to the radiation source, so the finger doesn't shield the dosimeter from radiation. They must be worn under gloves when necessary to prevent contamination.

3.4.3 Personnel Monitoring Procedures

Personnel monitoring is required for individuals likely to receive doses exceeding 10% of the annual limit, so the threshold for whole body badging is 500 mrem/year. Years of monitoring data show that the majority of FSU radiation workers receive annual doses far below that threshold, so in most cases, whole body badges are not issued.

- Radiation workers issued any type of personnel monitoring device shall not allow their assigned device to be worn by any other person.
- Dosimeters are only to be worn during work-related activities, and are not to be removed from the workplace.
- All personnel assigned a whole-body personnel dosimeter must wear the badge in the position that will likely indicate the highest whole-body dose (e.g., between chest and waist level, outside of clothing).
- When not in use, badges should be stored in areas protected from radiation sources and adverse environmental conditions (excessive heat, light, moisture, or chemicals).

Ring dosimeters are typically issued if:

- The individual regularly handles millicurie amounts of energetic beta emitters (> 300 keV) or gamma/x-ray emitters;
- The PI or individual requests that a ring dosimeter be assigned, as long as the radiation source is detectable by the dosimeter; or
- The RSO feels that extremity monitoring is warranted.

- Extremity (ring) dosimeters must wear them on a finger with the sensitive portion of the dosimeter toward the palm of their hand; i.e., closest to the source of radiation, so that the finger does not shield the dosimeter from radiation.
- Ring dosimeters must be worn under gloves when necessary to prevent contamination.

Monitored personnel have a right to know their dose records, and FSU makes them available up upon request. Individual reports of annual doses are issued, as well as termination dose reports when badging is halted.

3.5 Radioactive Materials Inventory Procedures

Each Lead PI must maintain an accurate inventory of the radioactive materials possessed under their permit. Inventory reports are due quarterly. The completed reports, or the information required to prepare them, should be received by the RSO within 10 working days following the end of each quarter. Serious delinquencies may result in punitive action by the RSC. The Radiation Safety Office maintains a campus-wide inventory and may request an inventory verification at any time.

The RSO provides two radioactive material inventory forms – one for sealed sources and another for unsealed radioisotopes. The forms are for reporting the amounts of each radionuclide received, transferred and disposed of during the reporting period, plus the amount of each radionuclide "on hand" at the end of the reporting period. Alternate methods of reporting equivalent information may also be used. (e.g., spreadsheets).

The decay formula is as follows: $A = A_o \times e^{(-0.693t/T½)}$

Where: A = Activity now
A_o = Activity at some previous time
e = Base of natural logarithm
t = Elapsed time
T½ = Half-life of radionuclide (must use same time unit as t)

3.6 Radiological Laboratory Inspection Procedures

3.6.1 Rad Lab Staff Surveys

Physical measurements are necessary to ensure that exposures are kept low. Area surveys and direct surface contamination monitoring are simple and convenient methods. Area surveys identify ambient external radiation exposure rates, and wipes can detect the presence of removable contamination. A typical contamination monitor consists of a battery-operated ratemeter equipped with an external probe. All radiation surveys must be performed using an operable and calibrated instrument sensitive enough to detect the low activities required for contamination control.

Surface wipes are taken to test for the presence of removable contamination. Wipes should be initially checked in the lab with a portable probe and then counted with an LSC.

In addition to routine in-process and post-work surveys, lab personnel must perform additional surveys during procedures that may cause elevated contamination or exposure concerns.

The RSO should be contacted when any technical assistance is needed, such as during nonroutine decontamination procedures.

3.6.2 RSO Lab Inspections

Radiation Safety Office staff inspect all areas where radioactive materials are used or stored to ensure that its use is in accordance with the permit, license, and regulations. Inspection findings and recommended corrective actions are documented and reported to the Lead PI. If corrective actions are not taken, a meeting will be set up with the PI and lab personnel to discuss the findings. If the PI continues to act, a meeting with the RSC will be called on the matter. The RSO/RSC may suspend or revoke the PI's permit and impound their radioactive materials pending resolution. Individual violators may also be subject to civil and/or criminal penalties under applicable laws.

3.6.2 RSO Lab Inspections (continued)

Rad labs are surveyed by RSO staff at least monthly, and where appropriate, wipe tested for contamination. Survey intervals may be increased when:

- The lab has a recent history of being contaminated; e.g., contamination is found in the lab for several consecutive months, or contamination levels exceed 1,000 dpm per 100 cm^2.
- The lab has a high potential of being contaminated; e.g., frequent handling of solutions of multi-mCi amounts or the user is inexperienced and using multi-mCi amounts.
- The nature of a research project is unusual or inherently risky.
- The RSO has determined that it should be done, based on professional judgment.

3.6.3 Contamination Action Levels

Except for hoods, glove boxes and other enclosed areas not susceptible to the transfer of removable activity, the RSO will take action to have lab areas decontaminated if any wipe tests exceed 100 dpm beta/gamma or alpha activity averaged over 100 cm^2.

Any contamination exceeding this limit will be highlighted on the lab map and delivered to the Lead PI as soon as possible.

- Lab wipes that indicate levels of contamination 10 times the limit stated above are immediately made known to the PI and the areas are re-wiped within 7 working days.
- Lab wipes that indicate the presence of contamination 20 times the limit stated above (i.e., 2,000 dpm) are immediately made known to the PI and decontamination procedures are begun immediately. The RSO will provide technical assistance during any laboratory or personnel decontamination procedure, as necessary.

During lab surveys conducted by the RSO, any elevated radiation levels found that are not considered ALARA will be discussed with lab personnel and an attempt will be made to resolve the matter before leaving the lab.

3.6.4 Laboratory Surveillance by Wipe Criteria

- Disposable gloves should be worn by any person taking wipes where contamination is suspected.
- The wipe medium should consist of an absorbent paper measuring approximately 2.5 x 3.0 cm.
- All wipe papers should be moistened with ethanol just prior to being used.
- Each wipe should represent a surface area as close to 100 cm^2 as possible, but typically should be made in a random pattern over the general areas of interest.

3.6.5 Laboratory Surveillance with Portable Instruments

Survey in and around areas where the radioactive materials are stored and/or used. Labs that use only tritium are not surveyed (survey meters can’t detect low energy beta emitters. The RSO will provide technical assistance, as needed.

- Since alpha emitters' progeny emit betas, gammas and/or characteristic x-rays, a G-M survey meter with a suitable detector may be used for gross alpha surveys; however, a properly calibrated alpha survey meter should be available, if needed.

3.6.5 Laboratory Surveillance with Portable Instruments (continued)

- A properly operating survey meter with a current calibration shall be used for surveys. Radiation Safety Office staff calibrate survey instruments at least annually and will arrange for prompt repair or replacement of inoperable or contaminated instruments.
- In addition to calibration, each instrument must be checked for an adequate battery charge, a visual condition check, and a radiation-response check using a radiation check source. Meters failing any check must be replaced.
- The instrument's audible switch should have "on" and "fast" response selected, if provided.
- A close distance must be maintained between the probe and the surface being surveyed, about 1 cm, while avoiding potential probe contamination from contact with the surface.
- While surveying, the detector must be moved slowly so that the instrument has time to respond.
- If elevated radiation levels are found, an attempt should be made to resolve the matter before leaving the lab.
- After the survey, the instrument should be turned off, including the "audible" switch, if independently powered.

3.6.6 Instructions for Self-Monitoring

- Anyone who enters a restricted area must monitor his or her hands and shoes before departing the lab and at the end of the workday.
- The survey meter's audible switch should be turned on, and "fast" response selected, if provided.
- Maintain a close distance (about one centimeter) between the probe and the surface being surveyed, while avoiding potential probe contamination from contact with the surface. Move the detector slowly so it will have time to respond.
- Check hands first, before handling the probe.
- Check bottom of shoes, moving the probe very slowly.
- If contamination is found, perform decontamination as necessary and re-monitor; if decon efforts are unsuccessful, immediately notify the RSO.
- After the survey, turn off the instrument to preserve the batteries.

3.7 Reuse of Contaminated Equipment

Containers, glassware and equipment that have become contaminated with radioactive materials, including items that have become radioactive from induced activity, must be labeled as "Radioactive" and cannot be returned to the University stock room or redistributed for general use without specific approval of the RSO.

- Contaminated items no longer needed in a program will generally be disposed of as solid radwaste or may be decontaminated and reused.
- Refrigerators, glove boxes and other costly lab equipment that once contained radioactive materials may be reused only after being checked and cleared by RSO and after removal of all radiation warning signs and labels. It is FSU policy that such refrigerator and freezer units shall not be sold to the public and should not be sent to FSU Surplus Property.

3.8 Radioactive Materials Shipping & Receiving Procedures

3.8.1 Ordering and Receipt of Radioactive Materials

Researchers seeking to obtain radioactive materials must coordinate their order with the University RSO. Possession limits are in place for each PI's permit. Radioactive materials cannot be procured if such materials and quantities, plus the materials and quantities on hand, exceed those authorized by the permit. Only the RSO is authorized to approve orders for radioactive material to ensure that the requested materials will not exceed possession limits specified in the university's license.

All incoming radioactive materials packages must be delivered to the EHS Dept.'s package receipt area. The RSO will verify their authorization and update the University's inventory. Each package is checked for integrity, monitored in accordance with Chapter 64E-5.327, FAC, and delivered to the appropriate lab. Form EHS 10-13 *Rad. Materials Receipt Report* is completed for each shipment.

3.8.2 Receipt of Radioactive Materials Packages

Radioactive material packages are delivered to the EHS Radiation Safety Office in Carothers Hall. Each package is inspected and surveyed prior to opening. If acceptable, the contents are verified and added to the University's inventory. RSO staff deliver the packages to the appropriate PI, whose name and location must match the PI's permit information. The steps listed below are taken for each package.

- Package shipping papers are retained (along with their respective package) and marked to note the applicable permit. Sealed source leak test certificates are also retained.
- The PI's permit is checked to verify that radioisotopes are authorized and within indicated maximum possession limits. To determine this, RSO staff checks the PI's inventory and correct for recent waste pickups, deliveries, and decay.
- The package information is recorded by RSO staff on Form EHS 10-12, *Radioactive Material Shipment Log*, and Form EHS 10-13, *Radioactive Material Receipt Report*.
- All packages are surveyed on contact by RSO staff and the highest mR/hr exposure rate is recorded in the "Contact mR/hr" space on the form. If the package is labeled Radioactive Yellow-II or -III, RSO staff also survey at one meter from the highest contact exposure point previously observed and compare it with the Transport Index (TI) on the label. If they are not reasonably comparable, RSO staff notifies the RSO, and verifies the reading with another meter. The RSO records the TI number and the 1-m mR/hr exposure rate in the spaces provided on the form.
- Unless the material is special form or a gas, packages labeled Radioactive White I, Radioactive Yellow-II or Radioactive Yellow-III are wipe tested for removable contamination by RSO staff. Packages showing signs of damage or leakage are also wipe tested.
- Package wipe procedure performed by RSO staff:
  - Randomly wipe all sides of the outer package, representing a total area of about 300 cm^2 using 1" x 1" filter paper.
  - Place the wipe in a liquid scintillation vial with at least 10 ml of counting fluid.
  - Count the vial promptly using the liquid scintillation counter.
  - If any wipe exceeds 100 dpm, wipe the package again to confirm the activity. If the results are verified, isolate the package. The RSO will hold the package pending further action.

3.8.2 Receipt of Radioactive Materials Packages (continued)

- Unless the package is going off-campus, remove the "radioactive" shipping labels and deface other references to the radioactive contents.
- Tape the associated paperwork to the package with a piece of "radioactive" tape.
- Those packages going off campus must remain intact and with their shipping papers until delivery to the off-campus PI is made. Once delivered, remove and deface the radioactive labels.
- Ensure that the delivery is documented and the appropriate individuals are notified of delivery.

3.8.3 Transfers to Other Facilities

Transfers of radioactive materials to other facilities must be coordinated with the RSO. Such shipments must be properly packaged, labeled and wipe tested, as necessary, and proper shipping papers must accompany them. The RSO must have a copy of the recipient's license demonstrating that the transfer is authorized and will generate a record of the transfer. Lab inventories must be updated after such transfers.

3.8.4 Transport Between Labs and Lab Relocations

When transporting radioactive materials, from one lab to another, a secondary container (Styrofoam, cardboard, rubber, or metal) must be used.

When radioactive solutions are transported, enough absorbent packing material must be used to ensure that all the liquid is absorbed in case of breakage or leakage.

University vehicles used to transport radioactive materials should be checked for contamination after use and if necessary, decontaminated. Use of private vehicles to transport radioactive material is prohibited.

Researchers relocating their labs must follow these instructions:

- Notify the RSO of the approximate planned date of the move/lab close-out, and the new lab location.
- Survey lab equipment for contamination and decontaminate as needed to eliminate removable contamination. Radiation Safety staff will perform confirmatory surveys to verify the equipment to be moved is free of contamination.
- Decontaminate lab work areas by the move date. Survey lab bench tops, fume hoods and storage areas and decontaminate as needed. The RSO will verify that the lab may be released for unrestricted use. Do not remove radiation hazard labels from equipment or lab space; Radiation Safety staff will remove any remaining radiation warnings and postings.
- Leave radwaste in the old lab location for removal by Radiation Safety. New waste containers will be delivered to the new lab location.
- Secure all materials in approved and labeled containers that will sufficiently contain and shield the radioactive contents. Contact the RSO for guidance.
- Only trained Authorized Users may move the radioactive materials.
- Do not move radioactive materials in personal vehicles, which is prohibited. If a transport vehicle is needed, contact the RSO.

3.8.4 Transport Between Labs and Lab Relocations (continued)

- Check shared areas for lab chemicals and equipment to be moved, disposed of and/or decontaminated; contact EH&S Chemical Safety at 644-7682 or 644-0971 for assistance.
- Any radioactive materials to be shipped off campus must be approved and processed by the RSO.

Warning: If a radioactive material package appears to be damaged or leaking, immediately notify the RSO. Don't move or handle the package. Leave the area and keep personnel at least 3 feet away from package.

3.9 Radioactive Waste Management and Disposal

Radioactive waste (radwaste) is not to be discarded by regular means of disposal. Specific rules, regulations, and guidelines must be followed for proper disposal of radwaste. Emphasis is placed on the segregation of different waste types according to radionuclide, half-life, chemical form, physical form, or combinations thereof. All radwaste disposals must be reflected on the inventory. When radwaste needs to be picked up, such as when waste containers are full, contact the Radiation Safety Office at 644-8802 (RSO) or 644-9117 (ARSO) or online (FSUID required). A radwaste pickup request form is available on the EHS website.

The following procedures and guidelines are to be used for radwaste disposal:

3.9.1 Liquid Waste

Sanitary Sewer Disposal of Aqueous, Readily Soluble, or Readily Dispersible Biological Material

- **Radiolabeled nucleotides in microcurie amounts:** Most aqueous liquid wastes and biodegradable scintillation cocktails can be discarded down designated sink drains, if disposal records are maintained. Such liquids must be aqueous, readily soluble in water, or readily dispersible biological material in water. Records of all sewer disposals must be indicated on a sewer disposal log and this log will be posted beside the disposal location. The chemical constituents of the radioactive waste must also be considered prior to sewer disposal. For assistance in determining which chemical forms are permissible for sewer disposal, contact the FSU Chemical Safety Section at 644 7682 or 644-6895.
- **Radiolabeled nucleotides in millicurie amounts:** Aqueous and readily dispersible biological material containing millicurie amounts of radiolabeled nucleotides shall be collected in five-gallon safety containers (or other suitable collection containers) provided by the RSO. Such waste should only be disposed of by the RSO.
- **Organic Solvent Waste:** Five-gallon safety containers are provided to each lab that generates radioactive organic liquid waste – usually xylene, benzene, or toluene-based scintillation fluid.
- **Exempt concentrations of tritium (H-3) and carbon-14:** Separate containers are provided for exempt concentrations of < 0.05 microcurie per gram of tritium or C-14.
- **Nonexempt concentrations and other radionuclides:** Additional containers will be provided by the RSO commensurate with the radionuclides used in a lab. All containers must be labeled as to which radionuclides should be discarded therein; strict compliance with these labels is essential. Before the container is 3/4 full, contact the RSO for pick up. Ensure that an accurate record is kept detailing the isotope, activity and hazardous chemical constituents for each container.

3.9.2 Solid Radioactive Waste

- **Sharps/Broken Glass:** Sharps contaminated with radionuclides should be placed into cardboard boxes or otherwise segregated from non-sharps and clearly identified, in order to prevent injury to personnel handling these wastes. Otherwise, segregation and disposal of this material is done exactly as it is for similar non-sharp radioactive wastes. Radioactive syringe needles and razor blades should be placed in a red plastic biohazard box and labelled with yellow 'Radioactive Material' tape.
- **Other Solid Waste:** Containers for discarding solid radwaste in the labs are provided by the RSS. Such waste shall be segregated by category; 90-day half-life, etc. If more than one waste category exists in a lab, the containers will be marked as to which radionuclides are to be placed into the specific containers. Compliance with such markings is essential.

3.9.3 Mixed Waste

Mixing radioactive material with other hazardous material is strongly discouraged. If this is unavoidable, the following criteria applies:

- Mixed waste containing radionuclides with a half-life of $\leq$ 90 days will be held for decay-in-storage and disposed of in accordance with hazmat disposal requirements.
- Mixed waste containing radionuclides with a half-life of > 90 days must be kept separate from all other mixed waste. Disposal of such waste is difficult and expensive, so the RSO must be notified prior to the generation of long-lived, mixed waste.

CHAPTER 4 – EMERGENCY PROCEDURES

4.0 Radiological Spill Response

4.0.1 Major Spill Incidents

For spills of millicurie amounts of a short-lived radioisotope, microcurie or greater amounts of a long-lived radioisotope, spill in an uncontrolled area, or a bodily injury, contact the Radiation Safety Office during normal business hours (8 am to 5 pm weekdays) at 644-8802 (RSO) or 644-9117 (Assoc. RSO).

To obtain emergency medical care, follow the procedures described in *Workers' Compensation*. After normal working hours, weekends or holidays, call the FSU Police at 644-1234, 911, or use an emergency telephone. At a minimum, provide:

- Your name;
- The building and your specific location, and
- The estimated seriousness of incident/injury.

Stay on the line until all necessary information has been provided. If you call FSU Police, they will notify the EHS Dept. and appropriate emergency response personnel.

If the RSO can't be reached, other Radiation Safety Office personnel or EHS staff must be notified.

4.0.2 Contamination/Exposure Control for Localized, Non-volatile Liquid Spills

Minor Incidents – defined as a spill of microcurie amounts of radioactivity and no personal injury. Spills of a few microcuries with no personnel contamination or damaged equipment do not require reporting to the RSO. Lab personnel should be able to decontaminate and monitor minor spills. Any time the required reporting of an incident is questionable, call the RSO for guidance. When liquid radioactive material is spilled, specific action must be taken. Listed below, in order of priority, are steps to be taken in handling a minor spill:

- Request help from lab workers, if available.
- Make a quick evaluation of the extent of the airborne potential –
  - If there is potential for an airborne problem, shut off the air handling system and leave the immediate area; keep involved personnel in the general area, prevent the entry of non-essential personnel, and contact the RSO.
  - If there is no airborne potential, proceed to monitor personnel and the area to establish the extent of the contamination. If the radiation levels in the area exceed 2 mR/hour, shield the source or leave the area.

4.0.2 Localized, Non-volatile Liquid Spills (continued)

Minor Incidents (continued)

- Control the area. Avoid the spread of contamination. If your shoes are contaminated and you must leave the area, go to the outer perimeter of the contaminated area and remove your shoes, rope off the area, and post signs warning of the radiation incident. Avoid leaving the area unattended or unlocked.
- Notify the RSO. Provide general details and the incident location. Maintain control of the area.
- Decontaminate the workers involved under the supervision of RSO, if possible. Skin should be immediately decontaminated, and contaminated clothing should be promptly removed. Skin and clothing contamination should be reported to the RSO so a dose determination can be made. Decontamination supplies and waste containers are provided by the RSO.
- Decontamination of the area should begin as soon as possible, but only after personal injuries are taken care of. The decontamination procedure for a spill is to start at the perimeter (the least concentrated area), absorbing the radioactive liquid while working toward the center of the spill area (the most concentrated area). After the major portion of the liquid is absorbed, further decontaminate the area using a decontamination agent. Continue to verify contamination areas with using detection equipment (G-M meter). Repeated decontamination efforts of the area will be performed until wipe tests (counted by Radiation Safety personnel) indicate the activity to be within the permissible limits.
- Assist in preparing a final report by later giving detailed information of the incident to the RSO.

4.0.3 Contamination/Exposure Control for Powdered, Volatile Liquid or Gaseous Spills

- Refer to the emergency response procedures for chemical emergencies, exposures, and spills.
- Turn off ignition sources and air handling equipment, if possible.
- Evacuate the area immediately.
- Assemble personnel immediately outside the room and instruct them to stay in one location, to prevent the spread of contamination.
- Close and lock the room doors to prevent re-entry.
- Attempt to seal accessible lab entries to prevent escape of airborne activity to outside areas.

4.1 Care of the Injured

4.1.1 Emergency Care

- Immediately call 911. Report the incident to a supervisor and obtain additional assistance as soon as is possible.
- Apply any necessary first aid, using caution not to further aggravate the injury. Do not totally disregard radioactive contamination, but it should be secondary to caring for the injured person; the contamination can be dealt with later.
- Stay with the accident victim until emergency personnel arrive and advise them as to the extent of the injury, the victim's condition, the existence of the contamination, and, if known, the type and extent of the contamination and the type and extent of the contamination, if known.

4.1.1 Emergency Care (continued)

- Accompany the victim to the hospital, if possible, and take along a G-M survey meter whenever radioactive contamination is suspected (other than tritium).
- The victim or supervisor must initiate the FSU injury report as soon as they are able after the emergency actions have been taken using the procedures described in *Workers' Compensation*.

4.1.2 Non-emergency Care

To obtain follow-up or non-emergency treatment, refer to the FSU injury reporting procedures described in *Workers' Compensation* and in the *Lab Accident Response flow chart*. Contact the Radiation Safety Office for assistance at 644-8802 or 644-9117.

4.2 Incident and Notification Requirements

Sections 64E-5.343 – .349, FAC describe reporting requirements for radiological incidents or events. When the seriousness of an incident requires a notification or report, the RSO will make the official notifications and reports, and will notify the RSC members and the FSU Office of General Counsel.

4.2.1 Reports of Stolen, Lost or Missing Radiation Sources

Telephone Reports

Stolen, lost or missing radioactive material must be reported by phone to the FDOH BRC (407/297-2095) immediately after its occurrence becomes known.

Written Reports

Telephone reports of stolen, lost or radioactive material must be followed by a written report to the FDOH BRC within 30 days after making the phone report. The reports must include the information specified below.

- Description of the radioactive material (isotope, activity and form)
- Description of the circumstances under which the loss or theft occurred
- Statement of disposition or probable disposition of the source
- Exposures of individuals, the circumstances, and possible doses received
- Actions taken or planned to recover the source, and corrective/preventive measures

4.2.2 Incident Notifications

Reports may be made by phone or fax. The names of individuals that have received radiation exposures must be stated in a separate and detachable portion of the report. Individuals' social security numbers and birth dates should be excluded.

Immediate Notification. Required for any event that **might have caused** or threatens to cause any of the following: a dose of 25 rem or more, an eye dose of 75 rem or more, or a skin, extremity or total organ dose of 250 rad.

Notify the FDOH BRC as soon as possible, but not later than 4 hours after the discovery of an event, such as a fire, explosion, or toxic gas release, that prevents immediate protective actions necessary to avoid exposure to radiation that could exceed regulatory limits or to avoid releases of radioactive material that could exceed regulatory limits.

4.2.2 Incident Notifications (continued)

24 Hour Notification. Required for any event that **might have caused** or threatens to cause any of the following: an individual to receive in 24 hours a dose greater than 5 rem, an eye dose greater than 15 rem, or a skin, extremity or total organ dose greater than 50 rem.

Notify the FDOH BRC within 24 hours of discovery of:

- An unplanned contamination event that requires access to the contaminated area to be restricted for more than 24 hours;
- An event in which equipment is disabled or fails to function as designed when the equipment is required by rule or license condition to prevent exposures exceeding regulatory limits or to mitigate the consequences of an accident, the equipment is required to be available and operable when it is disabled or fails to function, and no redundant equipment is available and operable to perform the required safety function;
- An event that requires unplanned medical treatment at a medical facility of an individual with radioactive contamination on the individual's clothing or body; or
- An unplanned fire or explosion damaging radioactive materials or the device, container or equipment containing radioactive material when the damage affects the integrity of the source(s) or container(s).

4.2.3 Information Requirements for Immediate/24-Hour Notifications

Make reports to the FDOH BRC of events requiring immediate or 24-hour notification as described above by phone, and if available at the time of notification, include the following information:

- The caller's name and call-back phone number;
- A description of the event, including location, date and time;
- The radioisotopes, quantities and chemical/physical forms involved; and
- Any personnel radiation exposure data available.

4.2.4 Reportable Events

Events requiring immediate or 24-hr. notification require a written report to be submitted within 30 days after learning of the event's occurrence. The following occurrences are also reportable events and require submittal of written reports within 30 days:

- Dose exceeding the occupational dose limits for adults (total dose > 5 rem, organ dose > 50 rem, lens dose > 15 rem, or shallow dose > 50 rem);
- Dose exceeding the occupational dose limits for minors (total dose > 500 mrem, organ dose > 5 rem, lens dose > 1.5 rem, or shallow dose > 5 rem);
- Dose exceeding limit for an embryo or fetus of a declared pregnant woman (500 mrem);
- Dose exceeding public dose limits (2 mrem in any 1 hour or 100 mrem in one year); or
- Radiation levels greater than 20 mrem/hr in unrestricted areas.

4.2.4 **Reportable Events** (continued)

Reports must describe the extent of exposure of individuals, including (as appropriate):

- Estimates of each individual's dose;
- The levels of radiation and activities of radioactive material involved;
- The causes of the elevated exposures or dose rates; and
- The corrective steps taken or planned to prevent recurrence, including a schedule for achieving conformance with applicable limits, ALARA constraints, and license conditions.

Include for each overexposed individual, the person's name, social security number, and date of birth. For events involving an embryo/fetus, this information applies to the declared pregnant woman. Reports should be prepared so that the information on exposed individuals is stated in a separate and detachable portion of the report. When submitting a report, also provide a copy to the exposed individual(s), no later than when submitting it to the state, in accordance with the provisions of Part IX of Chapter 64E-5, FAC (i.e., include this statement: "This report is furnished to you under the provisions of the Florida Department of Health regulation entitled Chapter 64E-5, Control of Radiation Hazards. You should preserve this record for future reference. ").

4.2.5 Reports of Leaking/Contaminated Sources

Immediately notify the FDOH BRC upon learning of any leaking or contaminated sealed source. A follow up written report must be submitted within 5 days and identify the equipment involved, the test results and the corrective action taken.

4.2.6 Reports of High Radiation Levels on RAM Packages

Immediately notify the FDOH BRC and the final delivery carrier by phone or fax upon learning of external radiation levels exceeding 200 mrem/hr at any exterior surface, or 10 mrem/hr at one meter from any exterior surface of an incoming package containing radioactive material. These limits are in 49 CFR 173.441, which is referenced in subsections 64E-5.1505(9) and 64E-5.327(5), FAC.