FIU | Operations and Safety

Environmental Health & Safety

# RADIATION SAFETY MANUAL

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## HANDLING INSTRUCTIONS AND APPROVAL

The Department of Environmental Health & Safety and the members of the Radiation Control Committee were primary contributors to this document. The following individuals and committees have prepared, contributed, and approved this version of the document:

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# STATEMENT OF POLICY ON FLORIDA INTERNATIONAL UNIVERSITY ENVIRONMENTAL HEALTH AND SAFETY

## GENERAL STATEMENT:

The University recognizes its responsibility to provide a safe environment for employees and all other members of the University community. Most accidents are avoidable. Accident prevention is fundamental to the interests of personal health and safety, and the protection of property belonging to the University or under its custody. The University also recognizes the need to maintain sensitivity to safety and health issues on the part of all persons at Florida International University, and for specialized training in safety procedures.

## POLICY:

It is the policy of the University to take all practical steps to eliminate or reduce exposure of all members of the University community to accidental injury or the conditions that would be injure their health.

## CONCURRENCE:

The University will adhere to the principles and intent of this policy statement. All practical measures will be taken to ensure the safety of the University community and the general public. The policies and procedures adopted by the University Radiation Protection Program will adhere to and be coordinated with the University's overall Environmental Health and Safety policy and Radiation Control Committee advisory decisions.

# FIU RADIATION PROTECTION PROGRAM (RPP)

## REGULATORY AUTHORITY – RADIOACTIVE MATERIALS AND MACHINES

All radioactive materials in use in Florida, with the following exceptions, are under the jurisdiction of the Florida Department of Health, Bureau of Radiation Control:

1. Radioactive materials used by or in the possession of federal government agencies.

2. Certain quantities of source material and special nuclear material.

The jurisdiction arises in the agreement entered into by the State of Florida and the United States Atomic Energy Commission effective 1 July 1964, in which the AEC transferred certain regulatory powers to the State under Section 274b of the Atomic Energy Act of 1954, as amended (73 Stat. 679).

In addition to the regulation of by-product material, the State assumed regulation over accelerator-produced radionuclides, naturally occurring radionuclides and required the registration of ionizing radiation producing devices.

Florida International University operates under a Broad Scope Radioactive Materials License 3669-1 issued by the Bureau of Radiation Control (BoRC) under the Florida Department of Health. This regulator will be cited numerous times in the manual and henceforth referred to simply as BoRC.

This license 3669-1 covers the procurement, use and disposal of radioactive material in accordance with the Florida Department of Health, Control of Radiation Hazards regulations as amended and revised on July 3, 1977, and subsequent communications from the State (current Revision 15 effective March 21, 2016). The license 3669-1 is renewed every five years (2015, 2020, and 2025).

The Federal Radiation Control for the Health and Safety Act of 1968 (Public Law 90-602) provides for the regulation and inspection of all types of electronic products capable of emitting ionizing or non-ionizing electromagnetic or particulate radiation or any sonic, infrasonic or ultrasonic wave. X-ray machines, television receivers and projectors, microwave ovens, lasers, ultraviolet lights, x-ray diffraction units, electron microscopes, x-ray microprobes, diathermy units, infrared heaters, ultrasonic cleaners, radar sets, and particle accelerators are examples of electronic products included in this control program.

FIU employees working with or near ionizing radiation sources must be an Authorized User (AU) of Radioactive Materials; Radioactive Sealed Sources; or Radiation Machines or working under an AU approved by the FIU Radiation Control Committee (RCC).

All AUs must follow all requirements of this FIU Radiation Safety Manual, FIU's Radiation Protection Plan (contained herein), safety protocols for the AU labs and facilities, and Florida Administrative Code (FAC) 64E-5 (Control of Radiation Hazards).

## PURPOSE AND REGULATORY REQUIREMENTS

The primary purpose of the FIU Radiation Protection Program is to ensure the safety of all personnel using radioactive materials and to ensure that sources of ionizing radiation will be procured, used and disposed of safely and in accordance with the Regulations of the State of Florida. Specifically, the Radiation Protection Program is applied to minimize unnecessary exposure to employees, students, and the general public, and help prevent exposure that exceeds limits in FAC 64E-5.

The University is required by Regulations to:

1. Establish an appropriate committee to determine relevant policies and procedures.
2. Appoint a radiation safety officer and a committee chairperson.
3. Maintain certain records.
4. Assure that safe procedures are followed.
5. Assure proper training, hazard signage, labeling, etc. for radiation areas.

This manual sets forth administrative and safety procedures, compliance programs, and policies approved by the University Administration and in accordance with the Radiation Protection Plan. This manual provides information intended to aid investigators working with ionizing radiation. The full cooperation of all individuals directly or indirectly associated with the use of radioactive materials or radiation machines is necessary to establish an effective radiation safety program. All policies, procedures and regulations as set forth in the manual must be strictly followed. Failure to comply shall result in revocation of authorization to use radioactive materials or radiation machines under the University license.

This manual is based upon the Florida Dept. of Health's Control of Radiation Hazard Regulations 64E-5 of the Florida Administrative Code (FAC) Revision 15, which became effective March 21, 2016. Nothing in this Manual should be construed to contradict FAC Chap. 64E-5. This manual contains information based upon Bureau of Radiation Control Guides (e.g., Regulatory Guide 1.40, June 2013) and best practices shared by the Radiation Safety Community of Practice.

### *Radiation Safety Manual Overview*

This radiation safety manual is a guide to those working with sources of ionizing radiation, specifically, all AUs and those working under them. It is intended to provide details on how to implement the FIU Radiation Protection Program (RPP) and all regulations, especially FAC 64E-5. Please advise the RSO if there is anything that is unclear between the RPP, the overall radiation safety manual, or FAC 64E-5. The FAC 64E-5 takes precedence.

To best guide those working with ionizing radiation at FIU, this manual has separate sections for the Authorized Users of radioactive materials, Authorized Users of radiation machines (devices), and Authorized Users of radioactive sealed sources. Everyone working with or close to radioactive materials or ionizing radiation sources must work under the supervision of individuals authorized by the Radiation Control Committee. An overview of the most important information is included in the chapters of this manual and more specialized, detailed information is contained in the appendices. Forms are described in general and links to their online locations are listed.

## RADIATION PROTECTION PROGRAM RESPONSIBILITIES

### *Senior Vice President of Research and Economic Development*

This position serves as the university's corporate officer and approves/signs all official documentation of the Radiation Safety Program including license applications and official communications with the regulator (BoRC). Currently, the Associate Vice President of the Office of Research and Economic Development (ORED) has been designated to serve as the Chair of the Radiation Control Committee and to have an active role in radiation safety at FIU.

### *Director of Environmental Health and Safety*

- Voting member of the RCC
- When required, acts as a liaison between the Radiation Control Committee, the RSO and the Vice President of Research.
- Responsible for coordinating among the various external and internal stakeholders of the FIU Radiation Protection Program.
- Reviews official documentation and communications that require VP's signature.
- Required to provide written notice of changes to the RSO assignment to the State regulatory authority (BoRC) within 30 days.

### *Radiation Safety Officer (RSO)*

- Oversees safety and control mechanisms related to the registration and inspection of radiation machines (devices), radioactive sealed sources, and radioactive materials.
- Revises the FIU Radiation Protection Plan (in this manual) with input from the regulator and approval from the RCC.
- Responsible for safety surveys, records, reports, violations and compliance with specific license conditions and other requirements of the Florida Department of Health (Chapter 64E-5 of the Florida Administrative Code (F.A.C.)).
- Approves all procedures that might conceivably involve radiation exposure and all changes in such procedures.
- Consults with any potential user of radiation devices or radioactive materials and advises them on the necessary radiation safety procedures and the development of rad safety protocols.
- Approves all purchases of radioactive materials, radioactive sealed sources and radiation machines at FIU. This is not approval for safe operation and use which the RSO provides after purchased materials are at FIU and all safety requirements are satisfied (e.g., protocols, PPE, signage, etc.)
- Performs routine radiation surveys and personnel monitoring as deemed necessary.
- Monitors operations that may be suspected of causing excessive radiation exposures or hazards.
- Reviews monthly doses received by radiation workers wearing dosimeters and notifies anyone with excessive radiation exposure.
- Provides an annual report on the exposure of all users of dosimeters, even those with no dose exposure.
- Oversees the Dosimetry Program to ensure compliance with regulations.
- Conducts quarterly inspections of labs using radioactive materials to verify compliance.
- Conducts semi-annual inspections of labs with radiation machines (devices) for compliance.
- Conducts semi-annual leak tests for general license sealed sources (>0.1 millicuries) and coordinates analysis by a qualified leak test vendor.
- Submits annual listing of all general license sealed sources at FIU as required.

- Ensures all license fees are paid by the required due dates.
- Performs monthly audit of the radiation waste storage area for compliance.
- Maintains records for audits; sealed source semi-annual leak tests; survey meter calibrations, radioactive material inventory; projects with planned exposures, semi-annual inventory of general license sources and check sources, dosimetry (lifetime records), rad waste pickup and disposal, and communications with BoRC.
- Coordinates RCC meetings.
- Coordinates the pickup and disposal of radioactive waste and sealed sources no longer needed.
- Submits annual ALARA and compliance reports to the RCC and VP of the Radiation Protection Program. This report includes audits completed, radioactive materials and sources inventory, and compliance program status updates.

### *Radiation Control Committee (RCC)*

The Radiation Control Committee (RCC), a Standing Committee at Florida International University (FIU) is the governing body for all aspects of radiation protection within the University, including all affiliated research, clinical, instructional and service units utilizing radiation sources in facilities owned or controlled by the University. The RCC shall ensure that all possession, use and disposition of radiation sources, including sealed sources in instruments and generally licensed radioactive materials, by University personnel at FIU comply with pertinent federal and state regulations and with the specific conditions of licenses issued to the University.

The RCC develops and promulgates policies, rules and procedures for the safe use of radiation sources. It has the authority to grant, deny, or withdraw permission for the use of radioactive materials or any other radiation sources within the University. The University intends that no use of radiation proceeds without the knowledge and approval of the Committee.

The RSO carries out the directives of the RCC. The RSO operates out of the Department of Environmental Health and Safety, which has broad responsibilities for all safety and occupational health programs on FIU campuses.

The RCC reports to the Vice President of Research, who is Chairperson of the RCC. The Vice President, Research may delegate administrative authority to Director, Environmental Health & Safety Department for matters related to the routine management of the Radiation Safety Program.

In its oversight role of the FIU Radiation Safety Program, the RCC is responsible for the following:

- Developing University policies, procedures, safety manuals, and criteria for training (and refresher training) and testing of each category of workers involved with radioactive materials, including ancillary staff, to ensure that the radiation safety program is implemented correctly according to accepted health physics practices. Ancillary staff refers to any support staff that provide service to areas where radioactive materials are used or stored, and includes housekeeping, maintenance, security, and receiving personnel.
- Reviewing emergency response plans, including any agreements with offsite emergency response agencies.
- Reviewing all proposals for radionuclide use and conditions of use, plans for all new buildings and modifications of existing structures where radioactive materials or radiation-producing devices are to be used, as proposed by the Radiation Safety Officer.

- Voting to approve, disapprove, or amend proposals.
- Ensuring that only qualified individuals are permitted to use radiation sources, or to supervise such use by others.
- Reviewing semi-annual reports from the RSO summarizing radiation surveys, lab inspections, occupational radiation dose for all personnel working with radioactive materials and other sources of ionizing radiation, any significant incidents, including spills, contamination, misadministration, etc.
- Conducting an annual audit of the radiation safety program that includes a review of documentation and performance required to comply with license conditions, Federal/State of Florida regulations, and Radiation Control Committee recommendations, and the ALARA program.
- Enforcing compliance with the program, including imposition of sanctions for noncompliance.
- Reviewing proposals for vendor services as may be required by license regulations, or commercial requirements.
- Making recommendations on risk management issues related to radiation safety.
- Delegating to the Radiation Safety Officer the authority to act for the RCC between meetings. His/her actions will be reported to the RCC for review at appropriate intervals.
- Recommending and implementing procedures for radioactive waste disposal.
- Providing advice to research groups, departments, and investigators.

### *RCC Membership*

The RCC is chaired by the VP of Research or their designee. The RSO and the Director of EH&S are voting members. Quorum to vote to set policy or approve items includes the VP, RSO and at least three other members.

Each department actively using radioactive materials shall be represented by at least one member. Qualified members shall include principal investigators and/or experienced professionals, proficient in the use and handling of radioactive materials, who are knowledgeable about regulatory compliance and University policy related to safe radioactive material use.

Nominations for appointment to the Radiation Control Committee shall be directed to the Vice President for Research or their designee via the RSO. The RCC will evaluate the nominations and will vote to approve/disapprove the members. The majority vote will prevail.

Unless a member is repeated violator of licensing requirements or leaves FIU, the member can continue to serve on the RCC.

To plan for temporary absences, each departmental committee member may designate an alternate. The designee may represent the absent member in all aspects of Committee participation and shall have the responsibility and authority to act on behalf of that member.

Members shall be expected to conduct themselves in a manner supportive of the policies, operations and initiatives of the RCC and in a manner that does not improperly interfere with the fulfillment of the responsibilities of the RCC.

### *RCC Meetings*

The RCC conducts the following activities at its meetings:

- Reviews records and reports from the RSO, ALARA program reports, results of regulator inspections/audits by RSO and State Bureau of Radiation Control (BoRC)
- Reviews and approves or disapproves authorizations as proposed by the RSO.
- Conducts reviews of compliance with regulations and FIU procedures, and authorizes enforcement, if deemed necessary.
- Recommends changes in policies and procedures, as appropriate.

Prior to each meeting the RSO prepare and distributes a meeting agenda to the members. The RSO shall maintain meetings minutes which will include the date of the meeting, the members present and absent to demonstrate that quorum was present, a summary of the discussions, recommendations and the results of votes. The RSO will also document the RCC's review of new users, uses, and program changes. Minutes will be distributed to members of the Committee. Additional copies may be distributed to others within the University as determined by the chairperson or EH&S Director.

## RADIATION PROTECTION PROGRAM COMPONENTS

### *ALARA (As Low As Reasonably Achievable) Program*

ALARA is a national philosophy of excellence regarding limiting radiation exposure to all who work with radioactive materials and other ionizing radiation sources. It's overall goal is to keep radiation exposure truly As Low As Reasonably Achievable by minimizing and reducing radiation exposure.

The ALARA philosophy encourages one to actively seek out methods of exposure reduction even if the current exposures are a small fraction of allowable exposures. ALARA means that if a simple change can significantly lower the already low exposure of a worker, then it must be implemented.

Examples of practices that can lower already low exposures:

- the use of tongs to handle sources with higher levels of penetrating radioactivity
- transferring a small amount from the primary source container to a secondary container and then transferring to multiple additional containers (greatly reducing hand exposure)
- Carrying a vial of radioactive material in a secondary container to increase the shielding of radiation-to-the hand
- Operational "Dry Runs" where operations involving ionizing radiation exposure are practiced completely but without the source materials to work out logistics and ultimately limit exposure time and maximize distance and shielding for personnel.
- Take time during audits discuss ideas to lower radiation exposure. Those working in the lab know best how to lower exposures and this is the perfect time to apply ALARA.

### *FIU's Commitment to ALARA*

Florida International University is committed to keep individual and collective doses as low as is reasonably achievable (ALARA). In accord with this commitment, FIU established an administrative organization for radiation safety and protection as discussed above with the RCC, RSO and the Office of Research. FIU has also established written policies, procedures, and instructions to foster the ALARA concept within our institution.

Appendix 1 shows the organization chart for management of FIU's Radiation Protection Program Plan, which describes functions of the Chairperson of the Radiation Control Committee, Radiation Control Committee (RCC) members, the Director of EH&S and the RSO.

The RCC reviews any modifications or changes as recommended by the RSO as a result of the annual review of the radiation safety program performed by the RSO. Modifications to operating and maintenance procedures and to equipment and facilities will be made if they will reduce exposures unless the cost, in our judgment, is considered to be unjustified. The RCC will be able to demonstrate, if necessary, that improvements have been sought, that modifications have been considered, and that they have been implemented when reasonable. If modifications have been recommended but not implemented, the RCC will be prepared to describe the reasons for not implementing them.

In addition to maintaining doses to individuals as low as is reasonably achievable, the sum of the doses received by all exposed individuals will also be maintained at the lowest practicable level.

### *Delegation of Authority*

(1) FIU Administration and the RCC delegate authority to the RSO for enforcement of the ALARA policy and program and review it every 6 months at semi-annual meetings of the RCC.

(2) FIU Administration and the RCC support the RSO to assert authority to shut down unsafe labs and facilities that are unsafe from radiological hazards. If implemented, the RSO would immediately notify the RCC who has ultimate responsibility and determination of keeping facilities closed and removing privileges for working with ionizing radiation sources from AUs and personnel.

Aus are required to consult with the RSO prior to using or purchasing radioactive materials or radiation machines, including new uses for existing sources of ionizing radiation. This is to ensure that exposure doses will be kept ALARA.

AUs are required to explain the ALARA concept and the need to maintain exposures ALARA to all supervised individuals.

AUs must ensure that supervised individuals who are subject to potential radiation exposure are trained and educated in good health physics practices and in maintaining exposures ALARA.

### *Termination or Changes in Projects involving Ionizing Radiation*

The RSO or EH&S Director have full authority to close or order evacuation from a laboratory or other facility where release, contamination, or other incident involving radioactive material is deemed to present a real hazard to persons who occupy that space. Such actions shall be taken upon prior consultation with the Vice President of Research or their designee.

### *Appeals of RCC Decisions*

Any individual may submit a written appeal regarding action or decision of the RCC through the Vice President of Research or their designee. A copy of any appeal must be sent to the EH&S Director simultaneously.

# GUIDELINES FOR THE SAFE USE OF RADIOACTIVE MATERIALS

This section describes all aspects of safety and compliance including authorization, training, purchasing, storage and disposal; emergency procedures, spill control and clean up, bioassay, signage, labeling, recordkeeping, personal protective equipment, lab security, use of radioactive materials with plants, animals or humans, surveys with calibrated meters, swipe tests, and more.

Information on the safe use of radiation machines (e.g., x-ray devices), the safe use of sealed radioactive sources, the Dosimetry Program and the Detention Point System for Non-Compliance Actions will be covered in separate sections.

## GETTING STARTED WITH RADIACTIVE MATERIALS

Any individual interested in conducting activities involving radioactive materials must:

- Complete EH&S Radiation Safety PT1 (online) and PT2 (in-person)
- Be authorized by the RCC

### *Becoming an Authorized User*

The application procedure to become an authorized user is as follows. **NOTE:** A history of compliance issues or non-compliance could result in a delay or denial of request.

Submit the following information to the RSO:

1. Copy of current resume showing training and experience with radiation/radioactive materials
2. Copy of radiation training records
3. Contact information including telephone, mailing address and email
4. Project proposal that includes at minimum the following information:
    - Isotope to be used
    - Form of material – solid, liquid, gas or sealed source.
    - Quantity (activity) to be used
    - Location where radioactive materials will be used (including detailed floor plan)
    - Detailed procedure specifying exact use of radioactive materials
    - Detailed safety procedures
    - Acknowledgement of receipt and review of the Radiation Safety Manual
    - Acknowledgment of the Point System

The RSO will review application to assure that all required items are included and are in compliance with the Radiation Protection Program. The RSO will conduct preliminary inspection of the location where radioactive materials will be used, then forward the application to the RCC for review with recommendations.

The RCC may request the applicant to attend the meeting to provide any clarifications that may be required.

If the proposal is rejected, the RSO will forward RCC concerns and recommendations to the applicant. The applicant can then address these concerns and resubmit the updated application for review.

If the proposal is approved, the Vice President of Research/ or his/her designee authorizes the applicant through a communication via email.

**IMPORTANT! Radioactive materials cannot be ordered and used until the written authorization is received.**

### *New Proposal Review*

If you are an AU and you wish to start a new project and/or work at a different location, you must submit a proposal for the new project with the following information to the RSO:

- Isotope to be used
- Form of material – solid, liquid, gas or sealed source.
- Quantity (activity) to be used.
- Location where radioactive materials will be used (including detailed floor plan)
- Detailed procedure specifying the exact use of radioactive materials
- Detailed safety procedures
- Acknowledgement of receipt and review of the Radiation Safety Manual
- Acknowledgment of the Point System

The RSO will review the application to ensure that all the required items are included and are in compliance with the Radiation Protection Program, then forward it to the RCC for review with recommendations.

The RCC may request the applicant to attend the meeting to provide any clarifications that may be required.

If the proposal is rejected, the RSO will forward RCC concerns and recommendations to the applicant. The applicant can then address these concerns and resubmit the updated application for review.

If the proposal is approved, the Vice President of Research/ or his/her designee authorizes the applicant in writing.

**IMPORTANT! Please note that new radioactive materials cannot be ordered and used until the written authorization is received. For example, if you are authorized to use P-32 in a particular project and later decide to use S-35 in the same project, you must get approval for the use of S-35 before starting use.**

### *Approval for Use Radioactive Gases/Volatile Materials*

The RCC must first approve all rooms where radioactive gases are to be used or stored for the stated purpose. To start the approval process, submit the following items to the RSO:

- Copy of resume
- Copy of records for training in the use of radioactive materials
- Completed RC-1 form (can be downloaded from FIU EH&S web site). Give information about the training and experience with radioactive material and statement of agreement by the applicant to comply with regulations
- Proposal for the use of radioactive materials (gases) containing:
    1. What radioactive gases will be used?
    2. How much activity will be used?
    3. Where will these gases be used? (Please provide floor plan)
    4. Details of procedures for use
    5. Details of safety procedures

6. Details of security and access control
7. Details of enclosure (fume hood/glove boxes), exhaust, filtration, etc.

The RSO inspects the room and evaluates the consequence of release of the gas into the room based on the type of radioactive gas (inert or absorbed into system, external or internal exposure, type and energy of the radiation from the gas or its progeny), radioactivity, exhaust system/filtration, and potential for exposure of personnel in the room and in the adjacent areas. The RSO recommends engineering and administrative measures required, even a reduction in the quantity of radioactivity, to ensure that the exposures from the use or storage of gas to the radiation workers or members of the public (individuals who are not radiation workers) are ALARA.

After the identified safety concerns have been addressed the RSO forwards the request to the RCC for review and approval or disapproval with comments or recommendations.

The RCC approves the request or recommends changes/ improvements, and the AU will be notified via written confirmation. The AU is responsible for ensuring the room is used for the stated purpose after all requirements have been met.

### *Personnel Restrictions*

No person who is under 18 years of age may work in radiation areas or handle radioactive materials.

All students working with radioactive material will do so under the supervision of an AU. The user must be in the same building as the student and available to allow students to use radioactive materials under their supervision, but not necessarily in their physical presence. In no case will students be allowed to use radioactive materials when the AU (or another authorized user with whom prior arrangement has been made) is unavailable for direct supervision as described above.

All staff and students, both graduate and undergraduate, must complete the required Radiation Safety training (Part 1 and 2) upon assignment to a project laboratory where radioactive materials are used. Attendance must be on record with the RSO. Training will be conducted by the RSO, or RSO contracted, approved organizations as appropriate to the project, equipment and materials being handled. The individual attending the in-person training must successfully pass an exam before being approved to work with radioactive materials.

### *First Request to Procure Radioactive Materials*

For activities covered by the University license, first-time purchases or acquiring radioactive materials outside of the authorized use must be reviewed and approved by the RSO. For subsequent orders of authorized radionuclides, follow the procedures under “Ordering Radioactive Materials”.

### *Ordering Radioactive Materials*

**IMPORTANT!** Radioactive materials cannot be ordered without prior written approval from the RSO. Failure to follow the procedure below will result in a delay in the approval process.

- All requisitions for radioactive materials must clearly show that the item being ordered contains radioactive materials including the isotope, the activity and the form. Example:

  Radioactive Materials
  Isotope: P-32
  Form: Liquid

Activity: 500 microcuries

- The delivery address for all radioactive material is as follows:

  Environmental Health & Safety
  11200 SW 8th Street, Campus Support Complex 162
  Miami, FL 33199.

  **The Radiation Safety Officer may authorize delivery of short half-life (half-life < 3 days) directly to the authorize use lab. Contact the RSO for approval.**

- All requisitions shall be submitted to the RSO for approval via email before being sent to the Purchasing Department.

- The RSO will verify that the quantity of requested nuclide is authorized for the AU and does not exceed the inventory quota under the University License before sending an approval via email.

- If the RSO is unavailable, the Chairperson of the RCC/designee or the EH&S Directors is authorized to perform this function if an emergency purchase is required.

- All radioactive materials will be received by the RSO / Environmental Health and Safety office for monitoring, recordkeeping, and delivery.

- EH&S will retain copies of the requisition, purchase order and receiving report.

### *Damaged Packages*

Upon receipt, the RSO will check the package for damage and notify the AU. The RSO must notify the final delivery carrier and the BoRC by telephone when:

- Removable radioactive surface contamination exceeds the limits of 64E-5.1505(8) i.e., 22 dpm/$cm^2$ for alpha and 220 dpm.$cm^2$ for beta-gamma; on wipe 1/10 of these values;

**OR**

- External radiation levels exceed the limits of 64E-5.1505(9) i.e., 200 mR/h at any point on the external surface of the package, and 10 mR/h at 1 meter.

### *Purchases for Repeat Orders*

If the AU has already completed the initial order process, any repeat orders should be handled as follows:

- Submit all requisitions to the RSO for the radioactive materials requested.
- Maintain an accurate log of the receipt, use and disposal of all radioactive material in possession for at least three years.

### *Reporting*

All AUs holding or responsible for controlled radioactive materials, listed in the license or amendments to it, shall report the quantities and activity levels of materials in their possession to the RSO on a semi-annual basis. The user will perform such reporting on a semi-annual basis or at the request of the RSO. The report must identify the type of material held, the form in which it is being used, and the activity levels currently indicated or assayed.

## RADIOACTIVE MATERIAL WASTE REQUIREMENTS

Disposal of radioactive waste depends on several factors, e.g., type of radiation, energy, half-life, etc. This section will cover storage, handling, labeling, and disposal requirements.

Radioactive waste will be segregated according to type (dry or liquid) and half-life. Separate containers will be used for radioactive waste that fall into the short-lived category having a half-life of 120 days or less; and long half-life waste, having half- lives greater than 120 days. Disposal of short half-life waste will be in accordance with FAC 64E-5.328.

### *Dry Waste*

Special waste containers for radioactive waste disposal are to be available in all laboratories in which radionuclides are used. All radioactive material users should contact the Radiation Safety Officer regarding the type of dry waste containers recommended.

Dry wastes such as paper towels, disposable pipets, absorbent bench paper etc. will be packed in plastic bags. The amount of dry waste must be kept minimized. Always monitor waste and insure that only contaminated waste is stored as radioactive waste. Red bags labeled as radioactive material should not be used to store or pack any other material, or used for regular garbage.

Care should be exerted by laboratory managers to prevent any unauthorized use of specially marked bags and/or containers. It is particularly inappropriate to place radioactive waste in bio-hazard bags unless the waste is both radioactive and a biohazard.

### *Liquid Waste*

Small quantities of liquid waste which are soluble or dispersible in water may be discharged into the sewage system according to Florida Department of Health Regulations. Consult the Radiation Safety Officer for allowable quantities of various radionuclides that can be disposed of in this manner. Records must be maintained for these disposals.

**CAUTION! INCINERATION AND BURIAL OF RADIOACTIVE WASTES ARE NOT PERMITTED UNDER FLORIDA DEPARTMENT OF HEALTH REGULATIONS; EXCEPT ONLY C-14 AND H-3 DESCRIBED IN SECTION 64E-5.329, F.A.C., MAY BE INCINERATED PROVIDED THE CONCENTRATION IS BELOW 0.05 MICROCURIES PER GRA**M.

### *Short Half-life Waste*

Short-half-life wastes (120 days or less) will be stored for at least 10 half-lives and then surveyed to ensure background radiation levels before final disposal. The plastic bag or any other container used for disposal to a county or city landfill or any other location should not contain any radioactive labels or markings. Do not use biohazardous waste bags unless the waste has biological hazards other than radioactivity.

The short-lived waste must be labeled with the tags provided by the RSO. The following is the minimum information on the tag/label.

1. Year and I or II half of the year
2. Building and lab number
3. Solid or liquid

4. Running number of waste packages for the applicable half year
5. Radionuclide
6. Approximate radioactivity of the radionuclide
7. Dose rate (mR/h)

Example of a label for 0.1 milliCuries of solid P-32 package 1 waste to be picked up in January 2025 from Academic Health Center-1 lab 209, showing 10 mR/h

2025 (I)-AHC1:209-Solid001-P32-0.1 mCi-10 mR/h

The second waste package from the same lab, whether solid of liquid, will be labeled as Solid002 or liquid002 as below for 0.05 mCi activity showing 5 mR/h:

2025 (I)-AHC1:209-Liquid002-P32-0.05 mCi-5 mR/h

The labels must be affixed on two opposite sides of the package.

Short-half-life radioactive waste with hazardous components will be disposed of as hazardous waste according to RCRA regulations after being held for decay for a minimum of 10 half-lives and when the surface dose rate is indistinguishable from the background.

Short half-life radioactive waste that has biohazardous components will be disposed of as biohazardous waste after holding it for decay for a minimum of 10 half-lives and when the surface dose rate is indistinguishable from the background.

### *Caution Signs and Labels (Dry and Liquid Waste)*

Containers for such radioactive waste must be conspicuously posted with an appropriate radiation caution sign.

### *Radioactive Waste Storage and Disposal*

All radioactive material waste will be removed and transferred to the Radioactive Waste Storage Room located in AHC4 123A. This room shall remain locked at all times and will be off-limits to unauthorized personnel. Trained personnel from EH&S and RSO are the only authorized entry to the waste storage room. All waste must be disposed of through the RSO. To coordinate a pickup request, complete the Radiation Waste Pickup Request Form.

Short-half-life waste will be relocated to the waste storage room and disposed of when the 10 half-lives have transpired. The method of disposal will be determined, approved, and documented by the RSO.

The AU will maintain all records of radioactive waste released and must make them available for inspection by the RSO and BoRC.

Long-half-life waste must be relocated and stored in the radioactive storage room. The RSO will monitor the quantity of waste and determine when a shipment needs to be made. An approved outside vendor will be contracted to remove the waste.

The BoRC will be notified at least forty-eight (48) hours in advance of shipping low-level radioactive waste to a commercial treatment, storage, or disposal facility. The notification will be made by phone at (407) 297-2095 or by writing to the office of Radiation Control, Radioactive Materials Program, Department of Health and Rehabilitative Services, Post Office Box 15490, Orlando, Florida 32858.

If a waste is to be incinerated, the notification shall include the location and owner of the incinerator and a copy of the contract between FIU and the incineration company.

Specialized wastes, obtained from the US Department of Energy, will be returned to the originating site or disposed of following the appropriate sections of this document, and by direction of the RSO.

### *Radioactive Waste Shipment*

Long-lived radioactive materials will be packaged and transported following 64E-5.1501 and 64E-5.1502, F.A.C., and 49 CFR 171.15 by licensed and approved vendors. The following documents accompany the waste: shipping papers, container, and waste description, and emergency response information.

# GUIDELINES FOR SAFE USE OF RADIATION MACHINES

The RSO must approve the procurement, modification, transfer, relocation, or disposal of any device capable of producing potentially hazardous ionizing radiation. In this manual these devices will be referred to as Radiation Machines or Devices.

## REGISTRATION OF RADIATION MACHINES OR DEVICES

These radiation machines or devices must be registered with the Florida regulator, the Radiation Machines Section of the BoRC, by the RSO, who will inspect them periodically. The RSO will register the equipment with one of the current FIU JR licenses unless it is the first device at a new campus or remote location, in which case, a new JR license would be requested.

The RSO may waive registration and safety oversight for specific devices whose ionizing radiation is not generated directly but secondarily and whose levels of radiation exposure would be much less than that allowed to members of the public (e.g., some electron microscopes).

The following types of radiation machines and devices must be registered:

i. Medical and dental x-ray machines, including fluoroscopes;

ii. X-ray diffraction (XRD) devices;

iii. Mammography systems;

iv. Microscopes using beams of charged particles whose surface dose requires monitoring;

v. Static eliminators functioning by emitting ionizing radiation; and

vi. Any other equipment which may produce potentially hazardous levels of ionizing radiation.

Any person wanting to work with these radiation machines at FIU must either work under an AU of Radiation Machines or petition the RCC for approval as a new AU of Radiation Machines. The RSO and RCC will ascertain the qualifications, the type of machine, and how it will be used before approving the AU. The AU will create a Safe Operation and Maintenance Protocol for the RCC review and approval if deemed necessary.

The RSO and RCC will need the following information before approving the purchase and authority to operate a radiation machine:

- Equipment Description: type, make, model, PKV, PMA, and approximate date of installation. For particle accelerators or other "special apparatus" provide the pertinent information when the above specifications do not describe the equipment).
- Location of installation: building and room number.
- A person responsible for the operation of the machine.
- Person owning the machine or device (if not the AU) and their department or unit at FIU.
- Qualifications of persons (other than AU) for the safe operation of the machine or device.
- Summary of calibration information on the machine. For non-medical x-ray and devices, pertinent information on the radiation output.
- A copy of the summary of protection surveys performed on the device and a description of any personnel monitoring regularly performed are also needed.

# GUIDELINES FOR THE SAFE USE OF RADIOACTIVE SEALED SOURCES

The RSO must approve all purchases of sources of ionizing radiation, such as these sealed sources. These sealed sources fall into two categories: general license sources (>0.1 millicuries) and smaller sources such as microcurie-level check sources.

### *Approval and Registration with the BoRC*

Before purchasing ionizing radiation sources, the individual must be approved by the RCC as an Authorized User (AU), in this case, an Authorized User (AU) of Sealed Sources. Upon the arrival of the source(s) at FIU, the RSO must inspect the source(s) and approve the lab for its safe storage and use. The RSO and the AU review the requirements for its safe use and storage. These include:

- warning signs on the door and the cabinet or instrument holding the sealed source;
- a protocol for safe use (for sources with higher levels of radioactivity);
- The requirement that the source is in a locked lab and a locked cabinet or device when not being used and when no one is in the lab;
- a list of sources in the lab, inventoried twice each year by the RSO and/or the AU;
- a review of the requirement that the movement of any sealed source from or to a lab must be by the RSO; and
- The AU and all working with the source take the online Radiation Safety Training Part 1 and have in-person training with the AU.

Any radioactive sealed source with radioactivity greater than 0.1 millicuries is considered a General License sealed source (GLSS). The RSO is required to register these GLSSs with the BoRC regulator.

### *Inventory and Disposal*

All sealed sources must be inventoried by the RSO and the AUs twice a year. Annually, the AU and the RSO will review the need for all sealed sources. When sources are not used for three years or when they are of no further use to the AU, the RSO will take possession, store, and ultimately dispose of them.

All sources must be secured against loss or theft. The loss or theft of any radiation sources must be reported immediately to the RSO, which will then report it to the BoRC regulator.

### *GLSS Leak Testing and Inventory*

The RSO inventories these sources twice a year. Once a year, the RSO is required to send a written inventory to the BoRC. This officially notifies the BoRC of new GLSSs and sources that have been disposed of over the past year.

GL sealed sources are required to be leak tested semi-annually. The RSO uses this as another opportunity to confirm the locations of GLs and the AUs. After testing the sources, the RSO sends the kits to an approved vendor for processing and analysis. The results of the leak tests list information on the source tested, the date tested, and the level of radioactivity detected. Results must show that the radioactivity was less than 0.005 microcuries for no further action to occur.

### *New GLSS or Not Listed on the General License*

For sealed sources not listed on the general license, the RSO must be contacted regarding the procurement, trade-in, replenishment, transfer, relocation, or disposal of any instrument or device containing radioactive materials as a sealed source. An inventory should be filed for each sealed source. Sealed sources must be leak tested as outlined above.

## RADIATION SAFETY INSTRUMENTATION AND EQUIPMENT

The responsible investigator must ascertain that suitable survey instruments, personnel monitoring devices, and other equipment necessary to assure radiation safety are available for his/her facilities and that the equipment is in working condition.

### 1. Survey Instruments:

Calibrated survey instruments appropriate to the type and level of ionizing radiation used must be available to the investigator. Appropriate sensitive instrumentation must be available for nuclides that cannot be properly detected by a survey meter. Survey meters shall be calibrated annually, and records maintained.

## RADIATION DOSIMETRY PROGRAM

The RSO manages the personnel dosimetry program through Environmental Health & Safety (EH&S). EH&S shall maintain permanent records of dosimetry badge readings and radiation exposures measured by body badge and ring dosimeters. These dosimeters use technology based on Thermoluminescence (TL) and are often called TLDs.

Dosimeters must be worn by personnel as specified below and/or in such instances as deemed necessary by the RSO. EH&S also distributes monitoring badge reports of their annual and termination exposures to users.

### *Whole Body Badges*

Dosimetry body badges shall be worn when:

1. An individual enters or works in a radiation area where he/she may receive a dose in any calendar quarter over 25% of the maximum permissible exposure levels specified in section XI.
2. Working with any apparatus (such as x-ray machines, Klystron tubes, electron microscopes, etc.) capable of producing or emitting ionizing radiation, and as deemed necessary by the RSO.

### *Ring (Finger) Badges*

An additional dosimetry badge shall be worn in hazardous operations if the radiation safety officer and/or the university radiation control committee determine that the area or other types of monitors are not adequate.

### *Requesting a Dosimeter*

All dosimeters are obtained from EH&S. To get a new dosimeter, complete the Radiation Dosimeter Assignment and Cancellation Form. Requestors must upload current copies of the appropriate radiation safety training certificates to complete the request (Parts 1 and 2). Those working with X-ray devices will require the online X-ray device safety training. Those working with both X-ray devices and radioactive materials will require all three training certificates.

Dosimeters will be processed as frequently as recommended by the supplier. Body dosimeters are replaced quarterly, and the ring dosimeters are replaced monthly. Should the new dosimeters arrive late from the supplier, continue to wear the same dosimeter until the replacement dosimeter(s) is received. It takes up to a month for dosimeters to be requested from the supplier and the new ones to arrive, so plan accordingly.

EH&S is responsible for handling and processing dosimeters. If an overexposure is indicated or suspected, the AU must notify the RSO immediately.

EH&S will maintain permanent records of readings) for all personnel wearing dosimeters. Whenever an individual's dosimeter is lost or damaged, it should be reported to EH&S immediately to issue a new badge.

All personnel assigned dosimeters shall comply with the following:

1. Never use another worker's TLD.
2. Wear body dosimeters on the torso, at or above the waist and below the shoulder, and wear a ring dosimeter, if recommended by the RSO.
3. Store dosimeters in one location. Always keep them away from extreme environmental conditions, such as intense heat or light, which may affect their ability to record radiation exposure accurately.
4. Return dosimeters to EH&S promptly at the end of each use period (e.g., quarterly for whole body dosimeters and monthly for ring dosimeters) to ensure rapid processing.
5. Spare/visitor dosimeters assigned to new hires or contract employees can only be worn for the monitoring period and assigned imprinted with the worker's name and /or other form of identification. New badges, if required, will be ordered for the next monitoring period.

Individuals shall not start work before receipt of the appropriate dosimeters. Each AU is responsible for the dosimeters of the individuals under their supervision. The timely return of dosimeters is an essential part of the dosimetry program; non-compliance with this may result in detention points being assigned to the AU. If an AU accumulates too many points, suspension or cancellation of the privilege to use radioactive materials under the FIU Radioactive Materials license will follow.

### *Permissible Exposure*

The maximum permissible exposures (MPE) are specified by the Florida Division of Health Regulations as outlined in the Rules and Regulations for Control of Radiation Hazards.

Since radiation exposure is undesirable, all exposures must be **A**s **L**ow **A**s **R**easonably **A**chievable. The maximum permissible exposures for Florida International University are set forth below:

### Occupational Dose Limits for Adults:

A. The Annual limit, which is the more limiting of:

   i. The total effective dose equivalent is equal to 1 rem; or

   ii. The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye is equal to 12 rem.

B. The annual limit to the lens of the eye, to the skin, and to the extremities is:

   i. The lens dose equivalent of 3 rem, and

   ii. A shallow dose equivalent of 12 rem to the skin or to any extremity.

The total effective dose equivalent is the sum of the deep dose equivalent and the committed effective dose equivalent.

Deep Dose Equivalent, which applies to external whole-body exposure, means the dose equivalent at a tissue depth of 1 centimeter.

Committed Dose Equivalent means the dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50 years following the intake.

Committed Effective Dose Equivalent is the sum of products of weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues.

It is noted that these MPEs are significantly lower than those required by state law. These exposure levels are easily achievable, and this MPE level is an important facet of the FIU A.L.A.R.A. (As Low As Reasonably Achievable) Program.

### Occupational Dose Limits for Minors

The annual occupational dose limits for minors are 10 percent of the annual occupational dose limits specified above for adult workers.

### Dose Limits for Individual Members of the Public:

The total effective dose equivalent to individual public members from the licensed or registered operations shall not exceed 0.1 rem per year.

### Pregnant Workers

Declared pregnant workers will be required to observe the limits imposed by FAC 64E-5.311.

“Declared pregnant woman” means a woman who has voluntarily informed in writing of her pregnancy and the anticipated date of conception.

The exposure limits set by regulations for a declared pregnant woman (Appendix 18) are:

500 mrem during the entire pregnancy

50 mrem during any one month

### Maximum Permissible Exposures to Radioactive Material in the Air:

No staff member or student shall possess or use radionuclides in such a manner as to result in an individual being present in an area where the concentration of the radioactive material approaches the concentration in air allowed by the Florida Division of Health. The RSO should be contacted on any problems where the radionuclides to be used are not listed by the Florida Department of Health.

### Reporting Overexposures

In the event of a suspected overexposure of any personnel, the RSO must be notified immediately. In certain instances, the BoRC requires immediate notification of personnel exposures. The AU responsible for the area in which a radiation exposure is received by a person that is equal to or exceeds the maximum permissible exposure must follow the procedure outlined below:

- Provide the RSO with written details of the exposure.
- Describe the procedures that will be followed to prevent the recurrence of such an exposure.

## LABORATORY SURVEYING AND MONITORING

The AU has the responsibility to act as the laboratory's Radiation Safety Officer, to enforce these regulations, and to ensure that the laboratory personnel are properly informed about the hazards and uses of radioactive material.

Each investigator is responsible for making, or causing to be made, routine area surveys to assure the absence of contamination in his laboratory. Permanent records of these surveys will be maintained. A floor plan of each lab where radioactive materials have been or are being used will be drawn and areas marked where wipe tests or survey meter readings have been made. These records must be retained and made available for inspection.

The Radiation Control Officer, at his/her discretion or upon the request of an investigator, may periodically monitor a laboratory or experimental setup. The inspection will consist of a wipe-test and/or other forms of surface monitoring and a review of the user's records of compliance with regulations as outlined in this Radiation Control Plan. The authorized user will be notified of the impending inspection, and his/her presence will be required.

The Radiation Safety Officer will require that action be taken to decontaminate laboratory areas outside of hoods, dry boxes, and other enclosed areas not susceptible to transfer of activity if the revealed contamination from wipe tests exceeds the following limits:

- In **normal radioactive areas**
  20 DPM ALPHA/100 cm2
  100 DPM BETA-GAMMA/100 cm2

- In **hot labs**
  20 DPM ALPHA/100 cm2
  500 DPM BETA-GAMMA/100 cm2

**Normal radioactive areas** are defined as those within the captioned laboratories not ordinarily expected to be used for studies utilizing radioactive materials.

**Hot Labs** are designated with appropriate signs as radioactive handling areas.

All users will survey their laboratories at the end of each day when radioactive materials are received or used, and the results will be recorded on the same day, even if negative. These records will be maintained for DOH inspections.

Appendix 11 details the survey requirements. If contamination levels are higher than the action levels given above, the authorized user is responsible for undertaking decontamination for the area.

## SHIELDING OF STORED RADIOACTIVE MATERIALS

As a rule, when radioactive material is stored in a laboratory facility, it must be shielded so that the exposure rate at the shield's surface does not exceed 2.5 milliroentgens per hour.
.
Normally, gamma-emitting radionuclides are shielded in lead containers or behind lead bricks. Strong beta-emitting radionuclides should utilize plastic or glass containers or shields as a primary barrier. Lead may be used outside the plastic or glass container as a secondary barrier.

The storage area for radionuclides should preferably be in a hood or a remote area of the laboratory so that personnel in the laboratory or in the adjoining rooms or hallway will not be exposed.

The RSO will inspect each storage facility to determine compliance with regulations. If the materials require refrigerated storage, the dedicated refrigerator must be appropriately identified, labeled with the radiation symbol, and food storage prohibitions enforced. Such refrigerated storage must be within an approved laboratory or containment and secured by the RSO or AU.

# EMERGENCY PROCEDURES AND SPILL CONTROL FOR RADIOACTIVE MATERIALS

*In the event of an accident (spill, atmosphere contamination, overexposure, etc.), the Radiation Safety Officer (ext. 70489/72621) shall be notified immediately without such action causing excessive contamination spreading. If the radiation safety officer cannot be reached, utilize the emergency call list in this section and post it in the radiological labs. The University Public Safety X 76626 can be contacted for after-hours numbers. Decontamination procedures shall be the responsibility of the experimenter and/or his supervisor. They shall be carried out under the direction of the RSO or person(s) designated by him/her, and with the cognizance of the other University officials who may be responsible for the facility or laboratory.*

The following protective action guides are to serve as a basic philosophy for evacuation and implementation of the state radiological emergency plan resulting from a major radiological accident (based on EPA, Office of radiation programs recommendations of September 1974, and the state of Florida Radiological Emergency Plan, May 1975)

**1. General Public:** The limits of 64E-5.312 (1) (a) and (c) will apply. A survey following 64E-5.314 will be accomplished as required by RSO. TEDE is less than 0.1 rem, a projected dose from a licensed operation in a year. Deep dose equivalent in unrestricted areas is not to exceed 0.002 rem in one hour. Protective action may not be warranted where higher than normal risks could be anticipated from protective action.

2. **Emergency Workers:** Values as specified in 64E-5.309.

3. **Lifesaving Activities:** Values as specified in 64E-5.309.

Radioactive materials are usually handled using all recommended precautions and preventive measures. However, the possibility of an unplanned spill or contamination exists. If this serious problem is encountered, decontamination activities must be carried out as soon as possible, and every effort should be made to prevent the spread of contamination.

**First**- Isolate the area and notify the Radiation Safety Officer.

**Second**- Determine the extent and type of contamination. There can be two levels of contamination, high when activity is greater than 100 microcurie per liter volume or low when activity is less than 100 microcurie per liter volume. Follow the Radiological Emergency Plan for various types of emergencies. Ensure contamination on clothing, body parts, equipment, or building materials is within the limits.

### *Clothing*

Contaminated clothing should be monitored and separated into two categories:

1. Clothing exhibiting no detectable activity can be laundered according to ordinary laundry procedures.
2. Clothing exhibiting low-level or high-level contamination should be soaked in Versene or a similar chelating agent, thoroughly rinsed, monitored with the survey meter, and dried. If the activity is not reduced to a suitable level so that it gives a contact dose rate of 10 micro

R/h above background, the clothing should be handled as radioactive waste. The wash and rinse liquids may also require handling as radioactive waste.

3. See Supplementary procedures for clean-up of radioactive spills and decontamination posters.

### *Skin*

Wash approximately 2 minutes with mild pure soap in tepid water with a good lather, covering the affected area thoroughly. A soft brush may be used. Particular attention should be given to the nails and cuticles when the hands are contaminated. Avoid rough scrubbing. Repeat 2 or 3 times if necessary.

### *Decontamination of Surfaces and Building Materials*

RSO will declare the area as restricted entry, requiring rubber and respiratory protection. The area will be cordoned off and marked accordingly. There are three common types of contamination:

1. The radionuclide is in a small volume of liquid and dries after it reaches the surface.
2. The radionuclide is in a larger volume of liquid and is wiped off before it dries. The remainder then dries before it is cleaned.
3. The radionuclide is airborne and has become attached to dust or other particulates in the air before depositing on the surface.

Initial decontamination should be done by wiping the cloth with a chelating solution and dampening it. If airborne contamination is possible, all decontamination procedures must be carried out while wearing disposable gloves, protective footwear, and other appropriate protective measures, such as face masks. A proper survey should be made after each sweep to determine the level.

Wiping cloths, gloves, washing and rinsing solutions, etc., must be treated as radioactive waste until monitoring determines otherwise.
The area must be isolated until appropriate surveys demonstrate activities no higher than background. The Radiation Safety Officer must certify the area to contamination free.

## SUPPLEMENTARY PROCEDURES FOR CLEAN-UP OF RADIOACTIVE SPILLS

Radioactive materials are usually handled using all recommended precautions and preventive measures. However, the possibility of an unplanned spill or contamination exists. If this serious problem is encountered, decontamination activities must be carried out as soon as possible, and every effort should be made to prevent the spread of contamination.

First, determine the extent and type of contamination, low or high. A low-level contamination spill is defined as any spill involving less than 100 microcurie per liter volume, and high-level contamination is defined as any spill involving greater than 100 microcurie per liter volume.

Once the level of contamination is determined, immediately remove the spilled surface activity. The following procedure is believed to be more effective and less time-consuming, which is of great importance.

### *Clothing:*

Contaminated clothing should be monitored and separated into two categories:
1. Clothing exhibiting no detectable activity can be laundered according to ordinary laundry procedures.

2. Clothing exhibiting contamination should be soaked in Versene, monitored with the survey meter and dried. The clothing should be discarded if the activity is not reduced to a suitable level.

*Skin:*

1. Wash approximately 2 minutes with mild pure soap in tepid water with a good lather, covering the affected area thoroughly. A soft brush may be used. Particular attention should be given to the nails and cuticles when the hands are contaminated. Repeat 2 or 3 times if necessary.
2. For low-level activity contamination, spot clean contaminated skin areas using a 5% water solution of a solid mixture of 30% regular detergent, 65% Calgon, and 5% Carboxymethylcellulose. Avoid prolonged scrubbing of the contaminated area. Use the brush lightly to prevent scratching or eroding the skin. Rinse with tepid water.
3. If contamination is with a radioactive grease compound, Mechanic's waterless hand cleaning cream is more effective and less irritating.
4. If contamination persists, wash the skin with dilute HCl and then soap. Then rinse well with cold water.
5. For persistent contamination, a mixture of 8% carboxymethyl cellulose, 3% detergent, 1% Versene, and 88% water may be homogenized into a cream and rubbed into the skin for 3 to 5 minutes. Then, rinse thoroughly with warm water. This is generally used only as an extreme method because Versene often increases the radio element's absorption rate.

*Decontamination of Surfaces and Building Materials:*

There are three common types of contamination:

1. The radionuclide is in a small volume of liquid and dries after it reaches the surface.

2. The radionuclide is in a larger volume of liquid and is wiped off before dries. The remainder then dries before it is cleaned.

3. The radionuclide is airborne and has become attached to dust or other particulates in the air before depositing on the surface.

Initial decontamination should be done by wearing personal protective equipment and vacuuming or wiping with a damp wipe. If unsuccessful, try scrubbing with soap and water.

## Decontamination

Decontamination of anything utilized in the exclusion zone, interior to the laboratory or authorized area, and the contamination reduction areas (personnel and/or equipment) is an integral part of the system to contain and minimize the potential for the movement of contamination from on-site to off-site areas. Personnel decontamination is highly site-specific and will be determined with consideration for the following factors:

a. Types of on-site contaminants
b. Levels of contamination
c. Personal protection levels utilized, garments, and respiratory filtration apparatus
d. Work activities performed
e. Reason for leaving the site

Decontamination procedures will be performed on all equipment leaving the exclusion zone to prevent the off-site migration of contaminants. The on-site equipment will be decontaminated at the end of the project or between individual work operations, as specified in the site operations plan, or by direction of the RSO or authorized supervisory user. Additional efforts to limit the potential for environmental exposure will include the rinsing of the contaminated surfaces with decontamination solutions selected by the RSO, the collection and disposal of the waste water as hazardous waste (or in compliance with the specifications in the site operations plan), and the supervision of these activities by the RSO.

### *Decontamination Solutions*

Solution A: Solution containing 5% Sodium Carbonate ($Na_2CO_3$) and 5% Trisodium Phosphate ($Na_3PO_4$)

Solution B: Solution containing 10% Calcium Hypochlorite ($CaCl_2O_2$)

Solution C: Solution containing 5% Trisodium Phosphate ($Na_3PO_4$)
A good general-purpose rinse.

Solution D: A dilute solution of Hydrochloric acid (HCl) (Maintain pH of 3)

Solution E: A dilute solution of phosphate-free analytical quality detergent

The following Emergency response protocol will be laminated and posted as authorized by the RSO.

### *Special Response Protocol*

See Appendix 19 RADIOLOGICAL EMERGENCY PLAN

### *General Guidelines*

**In all cases of physical injury, even minor injuries, medical attention and hospitalization take precedence over contamination concerns. Contact FIU Police at 348-5911 (MMC/EC) or 919-5911 (BBC) to request medical assistance.**

Plan and equip your lab with spill response supplies such as paper towels, cleaning agent, extra waste bags and gloves. The five key steps to follow are:

**Stop ... working - get your thoughts together and don't panic**
**Presume ... everything is contaminated until proven otherwise**
**Inform …the RSO and others in the area about the spill**
**Localize ... the spilled material to contain the spill**
**Label ... or cordon off the area to limit access**

## FIU CONTACTS FOR RADIOLOGICAL EMERGENCIES

Radiation Safety Officer: **(305) 348-6625** or **(786)200-6220**
Alternate Radiation Safety Officer: **(305) 348-7882** or **(786)942-5833**
FIU Police: **(305)348-5911 or (305)919-5911**

## BIOASSAY

a. Biological samples, e.g., urine, feces, blood, tissue biopsies, and expired air, may be taken from all personnel working with heavy elements, millicurie quantities of tritium or other radionuclides, at intervals specified by the Radiation Safety Officer. Biological samples will also be taken from all personnel who have ingested or are suspected of ingested radioactive materials.

   Special tests for determining the presence of radioactive materials in the body are desirable for persons handling intermediate or high-level quantities of unconfined radioactive materials. The Radiation Safety Officer may order these tests.

b. Suspected Ingestion
   If you suspect that any personnel may have ingested any radioactive material, the following steps should be taken:
   - Immediately contact the RSO
   - The RSO will investigate the incident
   - If the RSO determines that a bioassay is required an outside consultant will be contracted to conduct the bioassay testing.

- Based on the test results, the RSO will determine what further actions should be taken.

### Iodine Bioassay

### Conditions under which Bioassay is Necessary

Routine bioassay is required when an individual handles unsealed quantities of radioactive iodine in open form that exceed those shown in the Table below. The amounts shown apply to both the quantity handled at any one time or integrated as the total amount of activity introduced into a process by an employee over any 3 months (65E-5, 1320(1), F.A.C.).

| **Iodine 125 or Iodine 131 activity handled in unsealed form making bioassay necessary** | | |
|---|---|---|
| **Types of Operation** | **Volatile or dispersible** | **Bound to nonvolatile agent** |
| Process in open room or bench with possible escape of Iodine from process vessels | 1 mCi | 1 mCi |
| Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability | 1 mCi | 10 mCi |
| Processed carried out within glove boxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage | 10 mCi | 100 mCi |

(a) A bioassay shall be taken within 72 hours of initial use of radioiodine and every 2 weeks thereafter. When radioiodine use is infrequent (less than every 2 weeks), a bioassay shall be taken within 10 days of the last day of use.

(b) If the thyroid burden at the time of measurement exceeds 0.12 microcurie (4.44 KBq) of iodine 125 or 0.04 microcurie (1.48 KBq) of iodine 131, the following actions shall be taken:

1. An investigation of the operations involved, including air and other facility surveys, shall be carried out to determine the cause(s);
2. Corrective actions that will eliminate or lower the potential for further exposures shall be implemented.
3. A repeat bioassay shall be taken within 2 weeks of the previous measurement and shall be evaluated within 24 hours after the measurement to confirm the presence of internal radioiodines; and
4. Notification reports must be provided as required by Rules 64E-5.345 and 64E-5.347, F.A.C., or as required by conditions of the license; and

(c) A record of each bioassay shall be maintained for inspection by the department in an auditable form for 3 years. It shall include the date of the bioassay, the name of the individual, and the thyroid burden at the time of the measurement.

All workers handling these activities of iodine 125/Iodine 131 or close to the process so that intake is possible should participate in the bioassay program.

**Procedure:**

- The bioassay procedure consists of thyroid scan using a scintillation probe- a NaI detector with a thin window attached to a rate meter or a scaler.
- Any instrument used to monitor an individual's thyroid as part of an Iodine bioassay program must be calibrated annually. In addition, the counting efficiency should be determined using a thyroid phantom and Iodine standard.

Whenever the thyroid at the time of measurement exceeds 0.12 microcurie (4.44 KBq) of iodine 125 or 0.04 microcurie (1.48 KBq) of iodine 131, the actions described above shall be taken.

**Tritium bioassay**

**Conditions Under Which Bioassay Is Necessary**

Routine bioassay is necessary when quantities of tritium processed by an individual at any one time or the total amount processed per month exceed those for the forms of tritium shown in the table below (65E-5, 1320(2), F.A.C.):

| Types of Operation | HTO and Other Tritiated Compounds (Including Nucleotide Precursors) | Tritium (HT or T ) Gas in Sealed Process Vessels |
|---|---|---|
| Process in open room or bench with possible escape of tritium from process vessel | 0.1 Ci | 100 Ci |
| Processes with possible escape of tritium carried out within a fume hood of adequate design, face velocity and performance reliability. | 1.0 Ci | 1000 Ci |
| Processes carried out with glove boxes that are ordinary closed but with possible release of tritium from process vessels and occasional exposure to contaminated box and box leakage | 10 Ci | 10,000 Ci |

(a) A bioassay shall be taken within 72 hours of initial use of tritium and every 2 weeks thereafter. When work with tritium is infrequent (less frequent than every 2 weeks), a bioassay shall be taken within 10 days of the last use.

(b) If the urinary tritium concentration exceeds five microcuries (185 KBq) per liter at the time of the measurement, the following actions shall be taken:

3. An investigation of the operations involved, including air and other facility surveys, shall be carried out to determine the cause(s).
4. Corrective actions that will eliminate or lower the potential for further exposures shall be implemented.
5. A repeat bioassay shall be taken within 1 week of the previous measurement and evaluated within 1 week after the measurement. Internal dose commitments shall be estimated using at least two bioassays and other survey data, including the probable times of intake of tritium, and
6. Notification reports must be provided as required by Rules 64E-5.345 and 64E-5.347, F.A.C., or as required by conditions of the license; and

(c) The department shall maintain an auditable record of each bioassay for 3 years, which shall include the date of the bioassay, the patient's name, and the urinary tritium concentration at the time of the measurement.

## Participation

All individuals involved in processing tritium under the conditions specified in the above table should participate in the bioassay program.

## Types Of Bioassay That Should Be Performed

1. Baseline (pre-employment or pre-operational)
   A baseline bioassay should be conducted no more than one month before the individual begins work with tritium in amounts that would require participation in the bioassay program.

2. Emergency
   If the initial sample or other data indicates a possible exposure high enough to warrant immediate medical attention, a complete and immediate follow-up should be conducted.

3. Post-Operational and Termination of Usage
   A bioassay should be performed within one month after the last possible exposure to tritium, such as when operations are being discontinued or when the individual is terminating activities with potential exposure.

4. Diagnostic
   A follow-up bioassay should be performed as soon as possible but within one week of any sample exceeding levels given as action points to confirm the initial results and, in the case of a single intake, allow an estimate of the effective half-life of the tritium in the body.

## Frequency Of Sampling

A bioassay sample of at least 50 ml of urine should be taken within 72 hours of an individual's entry into an area where operations require bioassay and then every month or more frequently thereafter, as long as the individual is working with tritium. When work with tritium is infrequent (less frequently than every month), bioassay should be performed within 10 days of the end of the work period during which tritium was handled.

## Action Points and Corresponding Actions

Monthly and Other Sampling

1. If urinary excretion rates exceed 5 µCi/L, but are less than 50 µCi/L, the following course of action should be taken:

   a) An investigation of the operations involved, including air and surface contamination monitoring, should be carried out to determine the causes of the exposure and evaluate the potential for further exposures or other individuals' possible involvement.

   b) Any reasonable corrective actions that the survey indicates may lower the potential for further exposures should be implemented.

   c) A repeat urine sample should be taken within one week of the previous sample and evaluated within a week after collection. Internal dose commitments should be estimated using at least these two urine sample evaluations and other survey data, including the probable times of tritium intake.

   d) Any evidence indicating that further work in the area might result in an individual receiving a dose commitment over the limits established in 64E-5.304 should serve as cause to remove the individual from work in this operation until the sources of exposure are discovered and corrected.

   e) Reports or notifications must be provided as required by 64E-5.344 and 64E-5.345 of Chapter 64E-5 or as required by the license conditions.

2. If urinary excretion rates exceed 50 µCi/L, the following course of action should be taken:

   a) Carry out all steps in item 1

   b) If the projected dose commitment exceeds levels for the whole body, as provided in 64E-5.304 of Chapter 64E-5, notify DOH appropriately.

   c) Refer the case to appropriate medical/health physics consultation for recommendations regarding immediate therapeutic procedures that may be carried out to accelerate tritium removal from the body and reduce the dose to as low as reasonably achievable.

   d) Carry out repeated sampling (24-hour urine collections) at approximately one-week intervals, at least until samples show an excretion rate less than 5 µCi/L. If long-term organic compartments of tritium that require evaluation are possible, continue sampling as long as necessary to ensure

that appreciable exposures to these other compartments do not go undetected and to provide estimates of total dose commitments.

Any individual working with tritium at Florida International University in any manner and in any amount may, if they wish, have a bioassay performed for their information by contacting the radiation safety office.

# TRANSFER OF RADIONUCLIDES, SEALED SOURCES AND RADIATION PRODUCING DEVICES

### *On-Campus Transfers*

Since approval for the use of ionizing radiation sources is given only for the original working area, radioactive materials and other sources of ionizing and non-ionizing radiation shall not be transferred without the approval of the Radiation Safety Officer.

### *Off-Campus Transfers*

If the proper legal agreement exists between two institutions and the receiving institution has a license permitting receipt of a particular radionuclide, a transfer may be made with the approval of the Radiation Safety Officers of both institutions. A radiation producing device may be transferred after both institutions' notification of and approval by the Radiation Safety Officers. The University Radiation Safety Officer is responsible for obtaining the necessary approval from the Bureau of Radiation Control.

### *Transporting Radioactive Materials*

This procedure is subject to audit by the Radiation Safety Officer (RSO). This procedure is for transporting an acceptable quantity of radioactive materials. Excepted quantity refers to a Class 7 (radioactive) material, which meets the following requirements:

- Its activity per package does not exceed the limits specified in Table 7 (49 CFR 173.425) or the authorized use limit, whichever is lower.
- The radiation level at any external surface point of the package does not exceed 0.5 mR/h
- The removable surface contamination on the external surface of the package does not exceed 2.2 dpm/cm$^2$ for alpha and 22 dpm/cm$^2$ for beta-gamma.

RSO or Alternate, do the following:

1. Check the integrity of the package, radioactive material, and radioactivity. Perform a survey that includes radiation dose measurement and a wipe check.
2. If the material will be delivered to a Principal Investigator (PI), contact the PI who has ordered the materials. Assure that he/she or a radiation worker will be available in the laboratory to receive the package.
3. Place the material in a radioactive material transport container. Make sure that the radioactive material package or the transport container used has enough packing material to withstand the shocks during transport. If the radioactive material is in liquid form, line the inside bottom of the container with enough vermiculite to absorb twice the quantity of liquid in packages.
4. Make sure the outside of the inner package bears the marking "radioactive".
5. Make sure that the package bears the following statement enclosed in or on the package: "The package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package- limited quantity of material, UN2910."
6. Place the transport container(s) in the EH&S vehicle. Secure the container(s) firmly so they do not move during transport.
7. Check the integrity of the package, deliver it to the user along with the "Radioactive Material Use Record" form, and obtain signatures on the radioactive material package log form for receipt (by the user) of the radioactive material and the use record form.

**8.** File the radioactive material package log form. Please see Appendix 10 for the **RADIOACTIVE MATERIAL USE RECORD**

## RADIOACTIVE PACKAGE LOG

| Isotope | Activity | Invoice # | P.O # | Date and time received | Shipped By | Addressee | Surface Scan Background (<50 mR/Hr)) | Delivery Date and time | Delivered to (Print Name) | Received Disposal Form Initial | Signature |
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## RADIATION CAUTION SIGNS

Each investigator is responsible for obtaining and posting proper warning signs in all areas where ionizing radiation is used. The investigator shall consult with the Radiation Safety Officer before placing any signs in operating facilities.

The philosophy of signage is to ensure that no person can unknowingly enter an area where radioactive material is stored or utilized. Therefore, appropriate signs should be prominently displayed:

a) At any entrance door to a room or laboratory where radioactivity is used or stored.

b) On any storage locker *(i.e.,* refrigerator, cabinet, etc.) that contains radioactive materials.

c) On the designated radioactive materials handling sink(s).

d) On the designated disposal containers.

e) On any other structure or area that meets the philosophical basis cited above. Consult the Radiation Safety Office for further clarification.

Other signs that prohibit smoking, eating, and drinking in the designated areas are also required. There should be signs that designate a portion of a room as a "hot lab" if that is the laboratory organization.

Signs must be posted as required. Appropriate signs will be available from the Radiation Safety Officer.

## RADIOISOTOPE FACILITIES

Because of the concern for radiation safety, sources of ionizing radiation are not to be used in any facility or area outside of those designated explicitly by the Radiation Control Safety Plan and Licensing materials.

The specified rooms and/or areas are on file with the license application. Any changes to these specifications will require approval from the Radiation Control Committee or an amendment to the license. The authorized users are expressly not authorized to transfer material from one facility to another without authorization from the Radiation Safety Office.

When radioactive materials are no longer being used at a location, it needs to be decommissioned. Contact the RSO to complete the required closeout survey and remove the room from the list of authorized locations.

Before any facility used for radioactive work is released for unrestricted use, a thorough survey will be conducted. The principal investigator will conduct the study and submit the report to the Radiation Safety Officer. The radiation safety officer/radiation consultant will then survey to confirm that the facility can be released. Regulatory Guide 1.86(NRC 1974), Termination of Operating Licenses for Nuclear Reactors, gives acceptable surface contamination levels criteria.

### Procedure for Using Radioactive Materials at Temporary Sites

1. The authorized user shall submit a proposal to RSO to use radioactive materials at a temporary site.
2. He/she shall be the authorized user for the radioactive material he/she plans to use.
3. The proposal shall describe details of the temporary site, its location, the method for containment of the radioactive material/spills, safety controls, access control to the site, and security of the radioactive material.
4. The RSO shall visit the site and ensure that the proposed safety and security measures are adequate and achievable.
5. The RSO will forward the proposal to RCC with his/her recommendations for approval/vote/comments.
6. The RSO will inform the user to resubmit the proposal with changes if the RCC recommends so.
7. After RCC approves the proposal, the RSO will ask the user to complete safety and security measures.
8. The RSO will approve the site for radioactive work after the user has complied with the safety and security requirements.
9. For radioactive work at any site belonging to an institution other than FIU, FIU shall reach an agreement with that institution for the use of the site, its safety, and security.

## INDIVIDUAL RESPONSIBILITY FOR RADIATION PROTECTION

Everyone who is designated as a user of or who has contact with any radioactive material and/or is an operator of a radiation-producing machine is responsible for:

a. Keeping his exposure to radiation as low as possible, and specifically below the Maximum Permissible Exposures, listed under Part XI of this Radiation Control Plan.

b. Wearing the prescribed monitoring equipment in radiation areas, such as dosimetry badges and pocket dosimeters.

c. Utilizing all appropriate protective measures such as:

1. Wearing protective clothing whenever contamination is possible.

2. Wearing gloves and respiratory protection devices where necessary.

3. Using pipette filling devices. Never pipette radioactive liquids by mouth.

4. Performing radioactive work within the confines of an exhaust hood or glove box unless previous examination has indicated the safety or working in the open.

d. Survey his hands, shoes, and body for radioactivity, and remove all loose contamination before leaving radiation areas.

e. Eliminating smoking or eating in areas where radioactive materials are present. Smoking is prohibited in FIU. Eating may be permitted in an office adjacent to such an area when it has been demonstrated that the office is free of contamination. Refrigerators will not be used jointly for food and radioactive materials.

f. Maintaining good personal hygiene.

1. Keep fingernails short and clean.

2. Do not work with radioactive materials if there is a break in the skin below the wrist.

3. Wash hands and arms thoroughly before handling any object to the mouth, nose, or eyes.

g. Checking the immediate areas of hoods, benches, etc., where radioactive materials are being used, at least once daily for contamination. Any contamination should be removed immediately. If such removal is impossible, the area shall be marked, and the radiation safety officer will be notified.

h. Keeping the area containing radioactive materials neat and clean. The work area should be free of equipment and materials not required for the immediate procedure.

Keep or transport materials in appropriate containers, preferably double containers, to prevent breakage or spillage and ensure adequate shielding. Wherever practical, keep work surfaces covered with absorbent material, preferably stainless-steel trays or pans, to limit and collect spillage in case of accident.

i. Labeling and isolating radioactive waste and equipment, such as glassware, used for radioactive materials. Once equipment is used for radioactive substances, it shall not be used for other work or sent

from the area to cleaning facilities, repair shops, or surplus until it is demonstrated to be free of contamination.

j. Reporting accidental release, inhalation, ingestion, or injury involving radioactive materials to his supervisor and the Radiation Safety Officer, and carrying out their recommended corrective measures. The individual shall cooperate in all attempts to evaluate his exposure.

k. Carry out decontamination procedures when necessary and take steps to prevent any additional spread of contamination.

# GENERAL RADIATION SAFETY COMPLIANCE REQUIREMENTS

## TRAINING

The requirements of the training program, outlined below, are minimum qualification standards, and it is intended that all users should meet and exceed the requirements of this section.

1. All personnel entering radiation hazard areas are required to qualify for entry by:
    - Satisfying the restrictions as identified in Section VII of this manual.
    - Signing and understanding the briefing sheet for the activity they are to perform.
    - The authorized user will read such a briefing to the personnel, and signatures will be required as an acknowledgment of the safety principles to be observed and the individual's responsibility regarding the ALARA program. All workers will be familiarized with the location and content of notices posted in conformance with FAC 64E-5.323. All individuals engaged in licensed or registered activities will be instructed in the requirements and obligations of FAC 64E-5.903.
    - The authorized user will forward the originals of these documents to the RSO, who will maintain the records for five years. The user shall retain copies on hand for the personnel currently authorized to enter.

2. All named authorized users will be required to satisfy the State regarding their qualification for that status.

3. Users and the RSO must maintain their currency and familiarity with the devices and materials they are handling. The RSO will determine the level and extent of training needed for these activities, notwithstanding State regulatory direction.

4. Authorized User training per FAC 64E-5.1307 will be the standard for acceptance of new users who do not otherwise possess training or experience acceptable to the RSO and the State regulatory authority.

5. Hazardous Materials training for both radioactive and non-radioactive hazards will be required for users who may be exposed to such hazards during their work or as directed by the RSO. Such training may be obtained from commercial or Government programs and will be to the standards of 47CFR 172 or those acceptable to the RSO. Such training is also available on the FIU website.

6. FIU conducts training programs of the following types:

    - Online radiation safety training can be taken from any computer with an internet connection. This will serve as refresher training for the current authorized users (FAC 64E-5.1309) and radiation workers. Refresher training is required every three years.
    - All radiation workers must receive hands-on classroom training in addition to online training as part of their initial training. The classroom radiation training seminars are delivered, as required, usually two to four times per year.

    The topics covered in these trainings are:
        - Principles and fundamentals of radiation protection and safety practices- radiation and contamination, posting and labeling, Dose limits, control of exposures- ALARA

- Radioactivity measurement
- Use of radiation detection instruments and monitoring techniques, and radiation surveys
- Biological effects of radiation
- Transportation of radioactive materials
- Radioactive material ordering, inventory, forms and procedures, waste management, and emergency response

- Radiation Awareness Training. This is given to individuals who do not work with radioactive materials but may have to enter radiological labs to perform specific duties.

After any training, an examination is conducted. The minimum passing marks are 80%. Training certificates are issued to successful candidates, and records are maintained. Records are also maintained during the employment of individuals or for 5 years, whichever is greater.

## SECURITY, THEFT, AND LOSS

The potential for harm from willful misuse or accidental loss of radioactive materials is a serious concern that each authorized user must address. Regulatory agencies pay particular attention to this issue during inspections. In the event of a theft or loss, the investigator's security measures and record-keeping may come under intense regulatory and public scrutiny. Therefore, investigators should implement and maintain all reasonable precautions to control and secure their sources, even small ones, such as checking sources. The following are some guidelines that may be helpful:

- Sources of radiation shall be secured against unauthorized removal from the storage place. Check the integrity of physical barriers and security controls (e.g., locks, source safes, etc.). The sources must have a minimum of two independent locks between the device and the public when transported or stored.
- Lock laboratory doors when the laboratory is unattended.
- Keep stock materials in a designated storage location, preferably locked.
- Access control procedures must be implemented when using large quantities of radioactive materials.
- Establish a checkout procedure whereby persons authorized to use them sign out stock materials, record the use on inventory forms or other written documents, and sign the remaining stock back in immediately after the experiment.
- Implement "line-of-sight" rules for larger quantities or sources: if you are working where you can't see your stock material, put it away.

### *Response Procedures in Case of Lost or Stolen Materials*

- Contact the FIU Police to report the theft.
- Contact the RSO regarding any lost or stolen materials and provide a written statement regarding theft or loss.
- The RSO will inquire into the matter and inform the Bureau of Radiation Control if deemed necessary.

## ADMINISTRATION OF RADIOACTIVE MATERIALS IN ANIMALS OR PLANTS

Appendix 13 gives general guidelines for preparing specific procedures for administering animal radioactive materials. The researcher incorporates the required information in preparing their protocols for administering radioactive materials.

Appendix 14 gives a typical procedure for administering radioactive materials in plants.

# DETENTION POINT SYSTEM FOR NON-COMPLIANCE

To ensure that the University complies with the State Bureau of Radiation Control Regulations regarding radioactive materials, all authorized users must abide by the University's radiation protection program. The Authorized User Compliance Overview document that follows below lists 22 non-compliance issues for which an authorized user can accumulate points. With enough points, the right to work with radioactive materials or radiation machines is revoked.

## POINT ACCUMULATION AND USE REVOCATION

- When an authorized user accumulates 5 points, they will be notified of the points accumulated, with a copy to the department chair. The authorized user should post notice of violations in a visible location. Not posting notice of violation will be considered a violation.
- The authorized user will be given an opportunity to remove points by undergoing additional training.
- A maximum of 5 points accrued can be removed from additional training over a 3-year period. The remaining points stay on for 3 years. To remove any point, a written appeal must be submitted to the Vice President for Research or his/her designee (see section reinstating an authorized user).
- If an authorized user accumulates 10 points or more over an academic year (July 1 to June 30) and/or 20 points over three consecutive academic years his/her privilege to work with radioactive materials will be withdrawn within a week, via a memorandum with a copy to the Department Chair, EH&S Director, and the VP of Research (RCC Chairperson).

## AUTHORIZED USER REINSTATEMENT

An authorized user whose privileges to work with radioactive materials were withdrawn must:

- Acknowledge the receipt of notice from the Committee/ RSO on behalf of the Committee within 10 days of receipt.
- Post a copy of the notice at a visible location in his/her laboratory.
- Suspend work with radioactive materials within the time specified in the notice.
- May request the Director of Environmental Health & Safety to extend the date of suspension of work with radioactive materials to enable him/her to complete the work in progress.
- Submit a written Appeal to the Vice President for Research (or his/her designee) with a copy to the Director of EH&S and the RSO stating the corrective measures with completion dates that he/she plans to implement to prevent non-compliance recurrence and request for removing the points.
- The Vice President for Research (or his/her designee) in consultation with EH&S, decides whether to remove the points, if so how many for which years and responds to the authorized user with copy to the EH&S Director, the RSO and the department chair.

## CUSTODY OF RADIOACTIVE MATERIALS

Suppose privileges to work with radioactive materials of an authorized user are withdrawn and an appeal to reinstate is rejected by the Vice President (or his/her designee). In that case, the RSO will do the following:

- Inform the authorized user, the department chair, and the department Representative to the Committee of the decision.

- The department chair, RCC department representative, and RSO will discuss the appointment of an alternate authorized user in the department who will take custody of the radioactive materials. The RCC representative and the RSO will work together to ensure expedited training or authorization for the alternate user, if required.
- The alternate user will take control of all radioactive materials and comply with the approved procedures.

The Point System - Revision 1 implementation date was September 01, 2010, and it has not been significantly modified since.

## POINT SYSTEM ACKNOWLEDGMENT STATEMENT

- I hereby certify that I have submitted my request to become an authorized user of radioactive materials on FIU radioactive material license # 3669-1. I hereby certify that _____, the Radiation Safety Officer, has explained to me the importance of the point system.

- I hereby certify that I am an authorized user of radioactive materials on FIU radioactive material license # 3669-1. _____, the Radiation Control Committee member from my department of _____, and the Radiation Safety Officer have explained to me the importance of the point system.

I have received, read, and understood the significance of the point system, Revision 1. Failure to comply with the radiation program rules and regulations may result in my accumulating enough points and in the withdrawal of my privileges to work with radioactive materials.

Name: _____

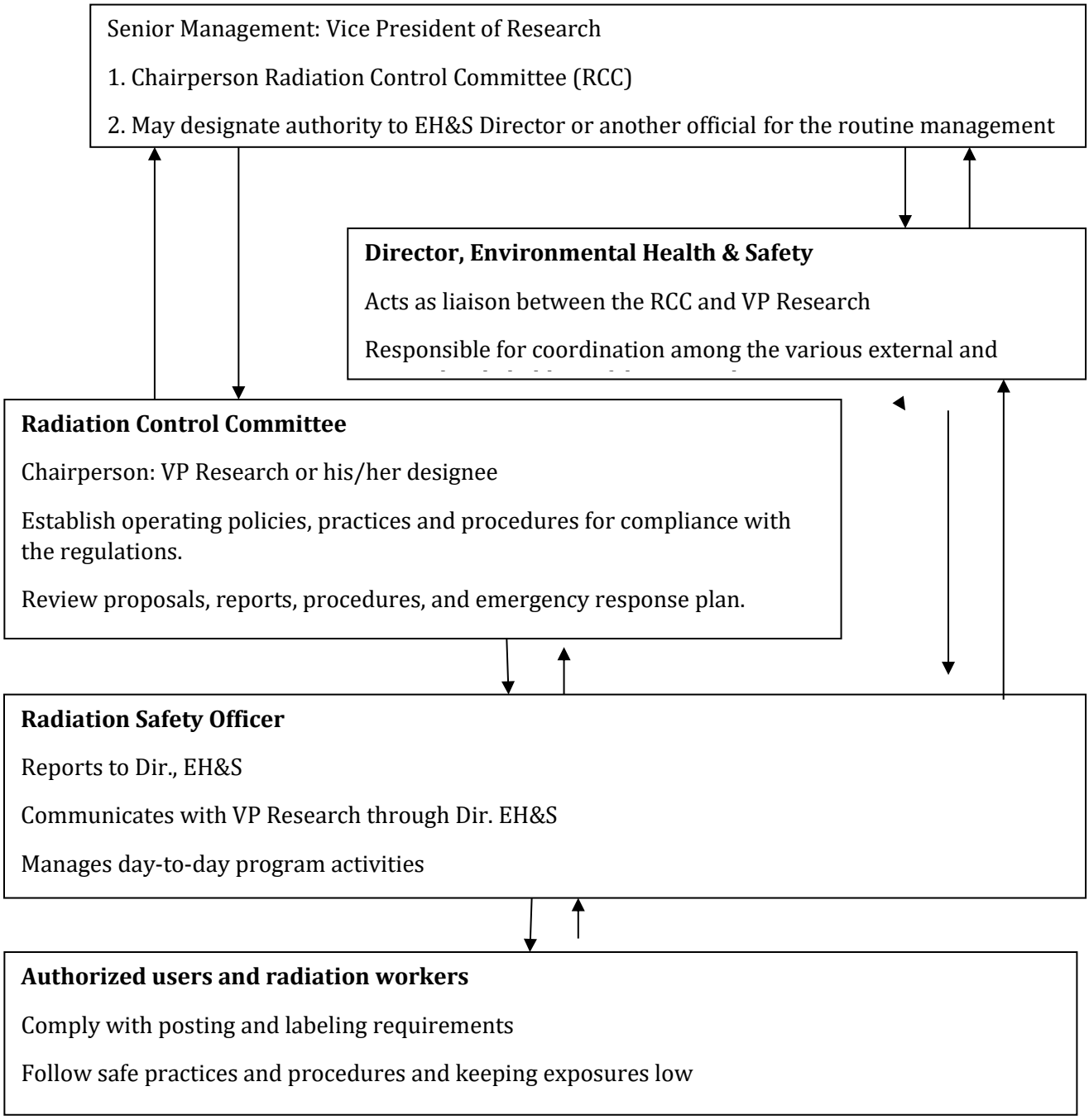
Signature _____ Date _____

This form will be sent to the EH&S Director and the RSO will be copied.

## AUTHORIZED USER NON-COMPLIANCE OVERVIEW TABLE

Refer to Appendix 15 in this manual.

## APPENDIX 1: ORGANIZATION CHART FOR MANAGEMENT OF RADIATION PROGRAM



## APPENDIX 2: APPLICATION FOR PURCHASE OF RADIATION X-RAY MACHINE

To: Radiation Safety Officer

Equipment Description_____

Model No.: _____Serial No: _____Supplier: _____
Maximum Voltage: _____KV Maximum Current: _____ mA
X-ray Equipment when energized:
Leakage radiation at 1 meter from the target: _____
Maximum exposure rate in accessible area: _____

1. Name of Principal Investigator: _____
   Department: _____
   Telephone: _____ Fax: _____Email: _____
   Emergency Contact number: _____
2. Place of use

BUILDING: _____ ROOM: _____ CAMPUS: _____

3. Purpose: o Use in current research
   o New research project (attach a detailed description of project)
4. Have P.I. and users received Radiation Safety Training? o YES o NO
   If Yes, When and Where: _____
   Is their training current? o YES o NO
   If No, have arrangements been made to complete training before start of use? Scheduled training date: _____

_____ _____
Signature of Principal Investigator Date

Approved By: _____ Date: _____
RSO or Authorized Representative

## APPENDIX 3: RADIOACTIVE MATERIAL USE RECORD

Department: _____ Authorized User: _____

Lab Location: _____ Date Received: _____ Purchase Order No.: _____

Isotope: _____ Activity: _____ Date Disposed: _____

Activity Disposed: _____ Disposal Method: _____

| Date (1) | Activity Used (2) | Volume Used (3) | Activity Remaining (4) | Volume Remaining (5) | How Used (6) | Disposal Activity SINK (7) | Disposal Activity Liquid (9) | Disposal Activity Solid (9) | Decay Corrected Activity Remaining (10) |
|---|---|---|---|---|---|---|---|---|---|
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Instructions for using this form

(1) Date: each time material from this package is used.
(2) Activity used: the activity used on the date indicated (may be multiple entries for a given date).
(3) Volume used: the volume used to obtain the required activity.
(4) Activity remaining: the activity remaining in the container, considering previous use.
(5) Volume remaining: the volume of the original material remaining.
(6) How used: e.g., IP rat, Sub cue mouse, In vitro, etc.
(7) SINK the total activity release into the sewer system (water soluble only).
(8) DRUM liquids within the drum must be kept in secondary containment, like vials, jugs, etc.. The drum must be lined with absorbent materials to absorb twice the liquid present.
(9) activity for disposal in a solid state
(10) DECAY activity in column 4 corrected for decay.

**Note: Failure to comply with Radiation Protection Program Regulations may result in the accumulation of points as per the Point System. At the time of final disposal, total all liquid activity in Column 8 and solid activity in Column 9 and correct for decay. This is the total liquid or solid activity disposed of as radioactive waste.**

When the radioactive material in the package has been completely used, please return this form to CSC 162. Maintain a copy for your records.

## APPENDIX 4: SURVEY REQUIREMENTS IN RADIOLOGICAL LABORATORY

| Item | Regulatory Requirements |
|---|---|
| Area Radiation Survey (Type and Frequency) | 1. Survey with a **radiation survey instrument** at the end of **each day of use or receipt** of all areas where radioactive materials are used or received.<br>2. **Weekly survey with a radiation survey instrument** of all areas where **radioactive materials or radioactive wastes are stored**.<br>3. **Weekly wipe survey** for removable contamination during weeks of use of all areas where **radioactive materials or wastes are routinely used or stored**.<br>4. **Wipe survey** for removable contamination at the end of each day of use of all areas where radioactive materials are routinely used if the radioactive materials **are not detectable with survey instruments.** For example, collecting wipes and counting for tritium in a liquid scintillation counter.<br><br>**In labs/areas where radioactive materials/wastes are stored a weekly survey, at a minimum, is required, even if the lab is kept locked, and there is only one authorized users/radiation worker whose absence from work place is documented.** An alternate AU for each lab is recommended who performs surveys during the absence of the AU. |
| Personal Monitoring | Monitoring for individuals for contamination prior to leaving the restricted area |
| Radiation Survey Report | The survey report shall be prepared and shall include:<br>• The date of the survey<br>• An annotated diagram of each area surveyed<br>• Background levels<br>• Measured dose rates (expressed in millirem per hour), and the removable contamination (expressed in cpm or dpm per 100 $cm^2$). The measured values shall be keyed to the diagram.<br>• The action levels (500 dpm per 100 $cm^2$ for beta and 20 dpm per 100 $cm^2$ for alpha contamination).<br>• The serial number, model number and manufacturer of the instrument.<br>• The initials of the person who performed the survey.<br><br>Records of personal and area surveys shall be retained for 3 years. |
| Air Flow Rate through Fume Hood | 80 to 120 linear feet per minute; measured semi-annually. |

## APPENDIX 5: SURVEY AND MONITORING PROCEDURES

**Survey with a Survey Meter**

The survey with a survey meter directly measures external radiation dose rates, enabling assessments for shielding needs and effectiveness. It is also the quickest and easiest (though not the most sensitive) method to assess surface contamination on objects such as lab coats, hands, floors, benches, etc. Compared to a wipe survey, a meter survey provides increased assurance that contamination "hot spots" will be detected and, unlike a wipe survey, it can detect total contamination (fixed + removable). A meter survey alone will not determine if contamination is removable.

Performing the Survey with the Survey Meter

1. Check the meter for proper operation.
   a. Check the batteries using the self-check function of the meter.
   b. Check detector response by exposing the probe to a radiation source. An intermittent response indicates a damaged probe cable. If no response is observed, the meter is nonfunctional.
   **c. With audio "on" determine that the background count rate is normal (20 - 50 cpm). Zero background indicates that the meter is nonfunctional. A high background suggests contamination of the probe or a meter malfunction.**
   d. Background reading must be taken in each room to be surveyed.
   e. Preferably use an open-end window count rate meter (cpm) rather than mR/h for survey for contamination check.

If found to be nonfunctional, immediately label with an "Out of Service" label and contact the Radiation Safety Officer (305-348-6625) or phone Environmental Health & Safety (305-348-2621) for further instruction.

2. Survey all authorized areas according to the floor plan. For maximum sensitivity, hold the probe no more than 1 centimeter from the surface, move the probe slowly (not faster than one probe width per second), and check for increased count rates.

3. Background count rates will vary by a factor of 2. A reading exceeds background when the count rate exceeds twice the background count rate.

4. Mark areas of suspected contamination (use a grease pencil, a non-permanent marker, tape, etc.). Include the marked areas when performing the wipe survey.

5. Determine the counting efficiency of the detection system for the type and energy of radiation being measured.

**Tips:**

- $^{3}H$ is the exception for which no ordinary survey meter probe will respond; reliance is placed on thorough wipe surveys and liquid scintillation counting.

- Choose the appropriate probe:

  - Use a thin window GM probe for beta-emitting radionuclides except 3H. The lower detection limit is about 1000 dpm for $^{14}C$ and $^{35}S$ and about 200 dpm for $^{32}P$.

- Use a thin crystal NaI (Tl) probe for low-energy gamma (10 - 100 keV) emitters. The lower detection limit for 125I is about 200 dpm. GM probes are inadequate, as the lower detection limit is higher by a factor of more than 10.

- A thin window GM probe is used for high-energy gamma (>100 keV) emitters, accompanied by beta radiation.

- Use a thick NaI probe for high-energy gamma (>100 keV) emitters without beta radiation.

- The minimum detection activity limit can be lower when the sample is counted longer in scaler mode (not rate mode).

- Meters must be calibrated for each authorized radioisotope.

  - Be sure not to move the probe too quickly over surfaces. This will obstruct finding contamination.

  - Determine the counting efficiency of the instrument by using a calibration standard.

- Convert cpm to dpm by dividing cpm by the fractional counting efficiency of the instrument.

- Convert dpm to dpm/ 100 $cm^2$ by dividing the obtained dpm by the area of the open-end window and multiplying it by 100.

**Wipe Survey**

The wipe survey is the most sensitive method for determining the amount of removable contamination. It is the only method for distinguishing removable contamination from fixed contamination. To perform the wipe survey, follow the instructions below:

1. Collect wipe samples

   a. Use a paper filter disk about 4 cm in diameter. It may be moistened with distilled water, ethanol, or a "decontamination" solution. A dry filter is acceptable but less sensitive.
   b. Wipe areas designated by the lab's survey system and any area marked during the meter survey.
   c. Wipe some additional non-use areas, including areas of frequent contact, such as door knobs, sink handles, light switches, telephones, etc.
   d. Wipe an area of approximately 100 $cm^2$.
   e. Specify in the record any area(s) wiped that/are not indicated on the floor plan.

2. Prepare samples

   a. Beta emitters
      1. Using tweezers, place the filter disk wiped side up on the bottom of a 20 ml counting vial.
      2. Add 20 ml of liquid scintillation counter (LSC) cocktail.
      3. Mark the cap with wipe identification.
      4. Repeat steps (1) - (3) for each sample taken.

5. Prepare a control sample using a clean filter and following steps (1) - (3). The control provides the background count rate.

b. Gamma emitters

1. Using tweezers, place the filter disk into a gamma counting vial.
2. Mark vial with wipe identification.
3. Repeat steps (1) and (2) for each sample taken.
4. Prepare a control sample using a clean filter and following steps (1) and (2). The control provides the background count rate.

3. Count samples

Wipes for surveys shall be counted with the most sensitive instrument available. This is usually a liquid scintillation counter (LSC) for beta radiation emitters and a gamma counter (GC) for gamma radiation emitters (with no associated betas).

When the survey is for beta and gamma, count the filter first in the gamma counter and then in the LSC.
a. Liquid Scintillation Counter

**ALL BETA EMITTERS**

- Count the samples, a control, and a standard(s) for at least two (2) minutes each.
- Results of less than two (2) times background are considered negative. Counts greater than or equal to two (2) times background is considered positive.
- Recount the sample(s) with positive results for verification. Some positive results could be the result of extraneous luminescence.

**Tips:**

- Factors, such as chemiluminescence and static, can cause false-positive results.
- A moist filter improves the survey sensitivity, transferring more activity. If a decontamination solution is used, allow chemiluminescence to dissipate by storing samples in the dark for at least 2 hours before counting.
- Using a larger filter or a mini vial causes the filter to either fold in on itself or attach itself to the side of the vial. This reduces the counting efficiency, especially for the lower energy beta emitters.
- Dissolvable filters are acceptable.

Counting filters spotted with a known radioisotope activity in use may determine LSC counting efficiency.

## APPENDIX:6 SAMPLE RADIATION SURVEY USING RATE METER

**Survey and wipe records for _____**

*Location*

Principal Investigator: _____
Background Level: _____
Survey Meter – Serial # _____; Model #: _____
Meter Manufacturer: _____
Fractional Counting Efficiency: f
Probe Area (A $cm^2$)
Scintillation Counter # (If used): _____

| ACTION LEVELS |
|---|
| 20 DPM Alpha/100$CM^2$ |
| 500 DPM Beta &Gamma/100 $CM^2$ |

**Daily Survey/Wipe on Days of Use:**

| Date | Location Surveyed | Count rate (CPM) | DPM/100 | Name | Initials |
|---|---|---|---|---|---|
| | | | C*100/f/A | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Weekly Survey if Radioactive Materials Not Being Used:**

| Date | Location Surveyed | Count rate (C cpm) | Count rate (C cpm) | Name | Initials |
|---|---|---|---|---|---|
| | | | C*100/f/A | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Weekly Wipes: (Measured Using Survey Meter or Scintillation Counter)** Areas Wiped 100 $cm^2$

| Count rate (C cpm) | Count rate (C cpm) | Name | Initials |
|---|---|---|---|
| | C/f | | |

## APPENDIX 7: SAMPLE RADIATION SURVEY USING SCALER

### RADIATION SURVEY: OU 108

| | ALPHA | | | | | BETA | | | | GAMMA | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Type and Location** | **Count Time (min)** | **Gross Total Counts** | **Avg. (cpm)** | **Net (cpm)** | **Dpm/ 100 cm2** | **Gross Total Counts** | **Avg. (cpm)** | **Net (cpm)** | **dpm/ 100 cm2** | **Location** | **R/h** |
| **Bkg** | 10 | 72 | 7.2 | | | 477 | 47.7 | | | | |
| **Wipe** 1 | 6 | 36 | 6 | 0 | 0 | 241 | 41.7 | 0 | 0 | 4 | 6 |
| 2 | 6 | 47 | 7.83 | 0.63 | 1.86 | 270 | 45 | 0 | 0 | 5 | 8 |
| 3 | 6 | 43 | 7.17 | 0 | 0 | 304 | 50.6 | 2.97 | 5.98 | 6 | 10 |
| **Air Sample** | 10 | 73 | 7.3 | 0.1 | | 500 | 50 | 2.3 | | | |

| Air Activity | | | | | | ALPHA | BETA |
|---|---|---|---|---|---|---|---|
| **Pump Model** | **Pump Sr. No.** | **Flow rate (lpm)** | **Sample Time (min)** | | **Volume (mL)** | **µCi/mL** | **µCi/mL** |
| CF-901 | 8601 | 132 | 180 | | 23760000 | 5.5 E-14 | 8.70E-13 |

| | **Counter model** | **Counter Sr. No.** | **Meter Model** | **Sr. No.** | **% Efficiency** | **Action Level** |
|---|---|---|---|---|---|---|
| Alpha | 43-10 | PR 144969 | 2241-3 | 142291 | 34.05 | 20 dpm/ 100 cm2 |
| Beta | 43-10-4 | PR 144761 | 2241-3 | 1E+05 | 49.59 | 500 dpm/ 100 cm2 |
| Gamma | 44-2 | PR 172188 | 2241-3 | 2E+05 | | 1000 R/h |

Surveyor Name: Signature: Date

# APPENDIX 8: WASTE SHIPMENT

**1. Shipping paper**

The shipping paper shows:

Organization managing transportation and Emergency contact
Name and address/phone # of the consignee (Agency to whom the material is shipped)
Name, number of the carrier, vehicle number, route
The materials being shipped are radioactive
Hazard Classification 7 (radioactive)
Not otherwise specified or surface-contaminated objects
Identification number (Applicable to waste, e.g., UN 2982, UN 2912, UN 2913)
Name of the radionuclide
Physical form: solid or liquid
Chemical form: oxide
Details of the contents of each package are to be on a separate sheet
Radionuclides, Radioactivity in both SI and conventional units, volume weight
Radioactive labels: White-1 < 0.5 mR/h on contact
Radioactive label: Yellow- II ≤ 50 mR/h on contact, dose rate at 1 meter in mrem/hour (Transport index) ≤ 1.
Type of shipment: Exclusive use shipment (yes/No)
(All shipments may not be for exclusive use)
Total number of pieces and weight
24-hour Emergency phone #
Remark: Applicable DOT Emergency Response Guides #

Name, address, signature of shipper, and date of shipment
(Applicable name and address will be entered in the shipping paper)

Name, signature of carrier, and date of shipment

**2. Containers and Waste Description**

This form gives details of each package-
Container identification (Box and #, or Drum and #, or Aq and # )
Container description
Volume/ Weight
Surface radiation level
Surface contamination
Physical description
Chemical description
Individual radionuclides and activity, total container activity
Waste classification: Class A, B, or C, Stable/unstable.
Total: number of packages, volume, weight, activity, special nuclear materials (and activity), e.g., H-3, C-14, Tc-99, I-129, source materials and their activity

**3. Emergency Response Information (Sample) in Shipping Paper**

1. PROPER SHIPPING NAME AND HAZARD

Radioactive materials, n.o.s., 7, Hazard Class UN 2982 (Emergency Response Guidebook Guide # 163).

Radioactive materials, Low Specific Activity, n.o.s., 7, Hazard Class UN 2912, LSA-II (Emergency Response Guidebook Guide # 162).

Radioactive materials, Surface contaminated object, 7, Hazard Class UN 2913, SCO-II (Emergency Response Guidebook Guide # 162).

2. IMMEDIATE HAZARD TO LIFE
   None. Low radiation exposure, low radioactivity. Radiation presents minimal risk to the lives of persons during transportation.

3. RISK OF FIRE OR EXPLOSION:
   None. Radioactivity does not change flammability or other properties of the materials. Some of the materials may burn, but none of them ignites readily.

4. IMMEDIATE PRECAUTIONS:
   Keep unnecessary people away, isolate the hazard area, and deny entry. Uninjured persons or equipment with suspected contamination should be detained or isolated. Deny clean-up unless instructions are received from the Radiation Authority. Notify CHEMTREC of the accident conditions shown below.

5. EMERGENCY FIRE MEASURES:
   Positive pressure self-contained breathing (SCBA) and structural firefighters' protective clothing provide adequate protection. Maintain surveillance until Radiation Authorities arrive.

6. HANDLING FIRE MEASURES:
   Do not touch damaged packages or spilled material. For small liquid spills, Cover with sand, earth, or non-combustible absorbent material. Do not attempt clean-up operations. Maintain the area until the Radiation Authorities arrive.

7. FIRST AID:
   The public emergency number 911 should be used as ordinarily prescribed. Ambulance and hospital personnel should be informed about possible low-level radioactive contamination or other radiological conditions. First aid treatment should be used according to the nature of the injury.

**The priority for rescue, life-saving, first aid, and fire control is higher** than the priority for measuring radiation fields.

8. EMERGENCY NUMBERS:
   Florida International University, Environmental Health & Safety, Radiation Safety Office
   11200 SW 8th Street CSC 162 Miami, FL 33199
   Phone: (305) 348-6625 (regular business hours 8:00 am to 5:00 pm)
   24 HOUR (786)200-6220 (cell)
   CHEMTREC 24 HOUR: (800) 424-9300

The testing methods and results of each of Type A packages will be maintained on files at the FIU permanent facility.

## APPENDIX 9: PROCEDURES FOR A PREGNANT WOMAN TO DECLARE PREGNANCY

1. The pregnant woman worker completes the “pregnancy declaration by a pregnant woman worker” form and submits it to her supervisor. After the stated officials sign the notification, it is recorded by both the supervisor and RSO.

2. The RSO brings to the supervisor's attention the dose limits of the embryo or fetus under section 64E-5.311 (500 mrem during the entire pregnancy from occupational exposure and 50 mrem in any month). The dose to the embryo or fetus is taken as the sum of the deep dose equivalent to the declared pregnant woman and the dose to the embryo or fetus from radionuclides in the embryo or fetus and radionuclides in the declared pregnant woman.

3. Each declared pregnant worker shall wear a radiation dose monitor at the waist level to estimate the fetal deep dose equivalent.

4. Each declared pregnant worker whose duties require protective clothing shall also wear a radiation dose monitor outside the protective clothing to estimate dose to the worker, and the standard occupational limits will apply.

5. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing, completing and submitting “WITHDRAWING A PREGNANCY DECLARATION” form (or is no longer pregnant).

| PREGNANCY DECLARATION BY A PREGNANT WOMAN WORKER | | |
|---|---|---|
| TO BE COMPLETED BY THE WORKER | | |
| Worker Name | Badge Number | Panther ID Number |
| Date/Time | Work phone number | |
| Job Title | Employer/Supervisor's Name | |
| Work Place | | |

DECLARATION

For the purpose of lowering the dose received by my embryo/fetus, I voluntarily declare that l am pregnant. I realize that my job assignment or responsibilities may change due to work restrictions imposed to ensure that the embryo/fetus radiological dose is maintained within limits specified in FAC 64E-5.311. I will cooperate with any supplemental radiological monitoring and dose evaluations that may be required to ensure compliance with FAC 64E-5. The work restrictions may also apply during the entire gestation time or until I make a formal withdrawal of my pregnancy declaration. I understand that submitting this pregnancy Declaration Form will in no way affect my pay, benefits, seniority, or potential for promotion.

| | |
|---|---|
| Estimated conception date | Estimated delivery date |
| Worker Signature | Date |

| TO BE COMPLETED BY FIU SUPERVISOR | | |
|---|---|---|
| Receipt verified by: | | Date: |
| Notification made: | Signature | Date |
| RSO | | |
| Department Head/Program Manager | | |
| Worker's Supervisor | | |

**WITHDRAWING A PREGNANCY DECLARATION**

| TO BE COMPLETED BY THE WORKER | | |
|---|---|---|
| Worker Name | Badge Number | Social Security Number |
| Date/Time | Work phone number | |
| Job Title | Employer/Supervisor's Name | |
| Work Place | | |
| I am voluntarily withdrawing my previous declaration of pregnancy that was executed on date _____. I understand that, as a result of signing and submitting this form, any work restrictions that have been imposed as a result of the previously submitted Pregnancy Declaration Form will be lifted. | | |
| Worker Signature | | Date: |
| TO BE COMPLETED BY FIU SUPERVISOR | | |
| Receipt verified by: | Signature: | Date: |
| Notification made: | Signature: | Date: |
| RSO | Signature: | Date: |
| Department Head/Program Manager | Signature: | Date: |
| Worker's Supervisor | Signature: | Date: |

# APPENDIX 10: ANNUAL LIMITS ON INTAKE (ALI) AND DERIVED AIR CONCENTRATIONS (DAC) OF RADIONUCLIDES FOR OCCUPATIONAL EXPOSURE; EFFLUENT CONCENTRATIONS; CONCENTRATIONS FOR RELEASE TO SANITARY SEWERAGE

"Annual limit on intake" (ALI) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by Reference Man that would result in a committed effective dose equivalent of 5 rem (0.05 sievert) or a committed dose equivalent of 50 rem (0.5 sievert) to any individual organ or tissue. For each radionuclide, Table I (State of Florida Bureau of Radiation Control ALIs, DACs, and Effluent Concentrations, July 1993, (FAC 64E-5)) indicates the chemical form that is to be used for selecting the appropriate ALI or DAC value. The ALIs and DACs for inhalation are given for an aerosol with an activity medial aerodynamic diameter (AMAD) of 1 µm, micron, and for three classes (D, W, Y) of radioactive material, which refer to their retention (approximately days, weeks or years) in the pulmonary region of the lung. This classification applies to a range of clearance half-times for D of less than 10 days, W from 10 to 100 days, and Y greater than 100 days. Table II provides concentration limits for airborne and liquid effluents released to the general environment. Table III includes concentration limits for discharges to sanitary sewerage.

"Derived air concentration" (DAC) means the concentration of a given radionuclide in air which, if breathed by Reference Man for a working year of 2,000 hours under conditions of light work, results in an intake of one ALI. For purposes of these rules, the condition of light work is an inhalation rate of 1.2 cubic meters of air per hour for 2,000 hours in a year. DAC values are given in the State of Florida Bureau of Radiation Control ALIs, DACs, and Effluent Concentrations, July 1993, Table I, Column 3.

## Table II "Effluent Concentrations"

The columns in Table II, captioned "Effluents," "Air," and "Water," apply to the assessment and control of dose to the public, particularly in the implementation of the provisions of 64E-5.312. The concentration values given in Columns 1 and 2 of Table
II are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over a year, would produce a total effective dose equivalent of 0.05 rem (0.5 millisievert). Consideration of non-stochastic limits has not been included in deriving the air and water effluent concentration limits because non-stochastic effects are presumed not to occur at or below the dose levels established for individual members of the public.

For radionuclides, where the non-stochastic limit was governing the deriving of the occupational DAC, the stochastic ALI was used to derive the corresponding airborne effluent limit in Table II. The air concentration values listed in Table II, Column 1, were derived by one of two methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by $2.4 \times 10^9$, relating the inhalation ALI to the DAC, as explained above, and then divided by a factor of 300. The factor 300 includes the following components: a factor of 50 to relate to the five rem (0.05 sievert) annual occupational dose limit of 0.1 rem limit for members of the public; and a factor of 3 to adjust for the difference in exposure time and the inhalation rate for a worker and that for members of the public; and a factor of 2 to change the occupational values, derived for adults, so that they apply to other age groups.

For those radionuclides for which submersion, external dose, is limiting, the occupational DAC in Table I, Column 3 was divided by 219. The factor 219 is composed of a factor of 50, as described above, and a

factor of 4.38 relating occupational exposure for 2,000 hours per year to full-time exposure (8,760 hours per year). Note that an additional factor of 2 for age consideration is not warranted in the submersion case. The water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by $7.3 \times 10^7$. The factor of $7.3 \times 10^7$ (ml) includes the following components: the factor of 50 and 2 described above, and a factor of $7.3 \times 10^5$ (ml), which is the annual water intake of "Reference Man". Note 2 provides groupings of radionuclides that apply to unknown mixtures of radionuclides. These groupings, including occupational inhalation ALIs and DACs, air and water effluent concentrations, and releases to sewer, require demonstrating that the most limiting radionuclides in successive classes are absent. The limit for the unknown mixture is defined when the presence of one of the listed radionuclides cannot be excluded as being present either from knowledge of the radionuclide composition of the source or from actual measurements.

### Table III "Release to Sewers"

The monthly average concentrations for release to sanitary sewerage apply to the provisions in 64E-5.330. The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by $7.3 \times 10^6$ (ml).

The factor of $7.3 \times 10^6$ (ml) is composed of a factor of $7.3 \times 10^5$ (ml), the annual water intake by "Reference Man," and a factor of 10, such that the concentrations, if the sewage released by the licensee were the only source of water ingested by a "Reference Man" during a year, would result in a committed effective dose equivalent of 0.5 rem (5 millisievert).

**Please see pages 1-62, 64E-5 Florida Administrative Code ATT. 1 -- ALIs, DACs & Effluent Concentration.**

## APPENDIX 11: RADIOLOGICAL EMERGENCY PLAN

### Introduction

Florida Administrative Code (64E-5.219 Emergency Planning) requires each application to possess radioactive materials in unsealed form, on foils or plated sources, or sealed in glass more than the quantities in 64E-5.220, must contain either: (a) An evaluation showing that the maximum dose to a person off-site due to a release of radioactive materials would not exceed 1 rem (10 mSv) effective dose equivalent or 5 rem (50 mSv) to the thyroid; or (b) An emergency plan for responding to a release of radioactive material. Florida International University (FIU) does not possess nor intends to possess radioactive materials exceeding 64E-5.220. FIU has established maximum exposure limits for its occupational workers that are lower than the state limits, and the actual exposures are significantly lower. FIU has embarked up on a Radiological Emergency Plan to protect its employees, students and public adequately, and to keep their internal and external radiological exposures as low as reasonably achievable.

### Purpose

The purpose of this Radiation Emergency Plan is to identify potential conditions that may result in the release of radioactive materials and to plan for actions that must be initiated to protect the FIU community and the public from exposures to radiation.

### Types of Radiological Emergencies:

Radiation emergency can be on-site, affecting personnel and property of the facility where emergency conditions may exist, or off-site, involving the public outside the campus. Since FIU is licensed to possess only an extremely small quantity of source and special nuclear materials, a nuclear criticality accident cannot occur in FIU. Further, because FIU is authorized to have a limited quantity of radioactive materials, the release of significant quantities of radioactive materials that affect the public is not envisioned. Given below are conditions that may result in a radiological emergency:

1. Spills of radioactive materials during the transfer of solutions from containers, malfunctioning equipment, and loss of integrity of a containment, such as a glove box or fume hood.
2. Incidents Involving Radioactive Dusts, Mists, Fumes, Organic Vapors, and Gases.
3. Radioactive Material Escape to Public Domain.
4. Accident during Transportation of Radioactive Materials or Wastes.
5. Fires, Explosions, or Major Emergencies in Radiological Laboratories
6. Fatal or critical accidents or injuries occurring on University premises accompanied by personal radiological contamination of employees, students or visitors.
7. Natural disasters, including storms, floods, hurricanes, or tornadoes, can affect radiological laboratories and, hence, impair barrier and containment integrity.

### Responsibilities of the Head of the Department

- Establish written procedures to handle emergencies ranging from a minor spill to a major accident that may require intervention by University emergency response personnel. These procedures should include provisions for immediate response, after-hours notification, handling of each type of emergency, equipment, and the appropriate roles of users of radioactive materials and the staff. Except for minor spills or releases of radioactivity that can be controlled

and cleaned up by the user, individual users should clearly understand their limitations in an emergency, with step-by-step instructions and clear direction of whom to contact.
- Provide workers with radiation safety training and training to respond to radiation emergencies. Ensure only authorized persons enter the radioactive use laboratories.
- Designate lead persons, such as principal investigators, departmental safety persons who maintain liaison with department of Environmental Health & Safety.
- Conspicuously post the name and telephone number of persons to be contacted in an emergency, including those of the radiation safety officer (RSO) or alternate person(s) in areas of use, so that it is readily available to workers in case of emergencies.
- Provide copies of emergency procedures to all users. Post a current copy in each laboratory or area where radioactive material is used.
- Make an emergency response kit available.
- Place emergency spill kits strategically in well-marked locations for all authorized users and the radiation safety staff.
- Designate persons responsible for inspecting all equipment periodically for proper operation and replenishment, as necessary.
- Provide the spill kit and appropriate survey instruments, including batteries (for survey meters).

**Responsibilities of the Principal Investigator**

- Ensure that you and the people working with you are trained to respond in radiation emergencies.
- Ensure you and the people working with you know where the emergency response kit is.
- Ensure the name and telephone number of persons to be contacted in an emergency, including those of the radiation safety officer (RSO) or an alternate person(s), are conspicuously posted at the laboratory's entrance so that they are readily available to workers in case of emergencies.
- Ensure radioactive laboratories are kept locked.
- Ensure the security of all radioactive materials, including those in instruments.
- Maintain inventory of all radioactive materials.

**Responsibilities of the Public Safety Department (MMC: 305 348 5911; BBC: 305 919 5911)**

- Assess the nature and extent of the emergency situation or threats to the University and alert the Director of Emergency Management and the departments with the capability to respond.
- Coordinate with the various service agencies, such as EH&S, Fire Department Facilities Operations, Health Care & Wellness Center, and EMC.
- Collect and transmit relevant information throughout the various phases of an emergency to emergency-response agencies.
- Control access to university premises, preservation of law and order, and campus security.
- Perform building lockdown procedures as scheduled.
- Provide intelligence information on campus conditions to the Director of Emergency Management.

**Types of Emergencies and Response**

1. **Spills of radioactive materials during the transfer of solutions from containers, malfunctioning equipment, and loss of integrity of a containment, such as a glove box or fume hood**.

The decision to implement a major spill procedure instead of a minor spill procedure depends on many incident-specific variables, such as the number of individuals affected, other hazards present, the likelihood of spread of contamination, the types of surfaces contaminated, and the radiotoxicity of the spilled material.

### 1.1 Minor Spills of Liquids (< 100 microcurie of short-half (<120 days) radionuclides, volume < 1 liter) and Solids (< 1 microcurie)

- Instructions to Workers
  - Notify persons in the immediate area that a spill has occurred.
  - Ask someone to promptly report the incident to the Radiation Safety Officer (RSO).
  - Do not allow anyone to leave the contaminated area without first being monitored to ensure his/her safety.
  - Wash hands first if they are contaminated as a result of the accident.
  - Put on disposable gloves to prevent contamination of the hands.
  - Cover the spill with absorbent paper. (If solids are spilled, dampen the paper.) This will prevent the spread of contamination.
  - Carefully fold the absorbent paper with the clean side out and place it in a plastic bag for transfer to a radioactive waste container. Put contaminated gloves and any other contaminated disposable material in the bag.
  - Clean the spill from the periphery and work inward.
  - Be careful not to track contamination out of the spill area
  - Survey the area with an appropriate low-range radiation detector survey meter or other appropriate technique. Check the area around the spill for contamination.
  - Mark off the contaminated area with chalk, marker, rope, etc., and restrict traffic.
  - After cleaning the spill start decontamination. Start at the periphery of the contaminated area and work inward, systematically reducing the contaminated area.
  - Use a survey meter or wipe tests to monitor the effectiveness of the decontamination procedure.
  - Check hands, clothing, and shoes for contamination. Check persons in the lab for contamination.
  - Allow no one to return to work in the area unless the RSO approves.
  - Follow the instructions of the RSO and/or the RSO's staff (e.g., investigation of root cause, decontamination techniques, surveys, provision of bioassay samples, requested documentation).
- Responsibility of RSO
  - Follow up on the decontamination activities and document the results.
  - Survey and clear the area if the contamination is within the limits; otherwise, advise further decontamination.
  - As appropriate, determine the cause and corrective actions needed. Document the incident along with the contacts of the persons involved. If there is a potential for internal contamination, consider bioassays.

### 1.2 Major Spills of Liquids and Solids

- Instructions to Workers
  - Notify persons in the immediate area that a spill has occurred.

- Ask someone to promptly report the incident to the Radiation Safety Officer (RSO).
- Do not allow anyone to leave the contaminated area without first being monitored to ensure his/her safety.
- Wash hands first if they are contaminated as a result of the accident.
- Put on disposable gloves to prevent contamination of the hands.
- If the material can potentially become airborne, cover your nose and mouth with a kerchief or dust mask to prevent inhalation exposures.
- Prevent the spread of contamination by covering the spill with absorbent paper (the paper should be dampened if solids are spilled), but do not attempt to clean it up. Also, limit the movement of all personnel who may be contaminated.
- Shield the source only if it can be done without further contamination or a significant increase in radiation exposure.
- Request facility management/facility operations to turn off fans, ventilators or air conditioners that supply air to other areas. Direct exhaust ventilation should be left on.
- If appropriate, survey all persons not involved in the spill and vacate the room.
- Close the room and lock or otherwise secure the area to prevent entry. Post a sign in the room warning anyone trying to enter that a spill of radioactive material has occurred.
- Allow no one to return to work in the area unless the RSO approves.
- Decontaminate contaminated personnel by removing contaminated clothing, flushing contaminated skin with lukewarm water, and washing with a mild soap.
- Check Personal Monitoring devices (TLDs) are free from contamination. Seal in contaminated TLDs in a plastic bag.
- Follow instructions of the RSO and/or the RSO's staff for spill clean-up and area decontamination, surveys, bioassay samples, etc.
- Cooperate with the RSO and/or the RSO's staff to investigate the root cause and needed documentation and data.

- Responsibility of RSO
  - Guide decontamination. If the decontamination of personnel is not fully successful, consider inducing perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.
  - Guide spill control and decontamination so that normal activities can resume in the area as soon as possible.
  - Take charge of contaminated TLDs. Note down their IDs. These will record high doses. Decontaminate TLDs if possible. Send these for urgent processing.
  - Document the information about contamination, location, and the results of personal, equipment, and area decontamination and radiation surveys.
  - Collect nasal swabs and count to check for potential inhalation exposures.
  - Determine cause and needed corrective actions; consider need for bioassays, if licensed material is suspected ingested, inhaled, or absorbed through or injected under the skin.
  - Notify the Director of EH&S and the Radiation Control Committee.
  - Notify the State Bureau of Radiation Control, if necessary.

### 2. Incidents Involving Radioactive Dusts, Mists, Fumes, Organic Vapors, and Gases

- Instructions to Workers
  - Notify all personnel to vacate the room immediately. Vacate the room. Seal the area, if possible.

- Request facility management/facility operations to turn off fans, ventilators, or air conditioners that supply air to other areas. Direct exhaust ventilation should be left on.
- Notify the RSO immediately.
- Survey all persons who could have possibly been contaminated.
- Decontaminate as directed by the RSO.
- Isolate the adjacent corridor against traffic and spectators.
- Promptly report suspected inhalations and ingestions of licensed material to the RSO.
- Decontaminate the area only when advised and/or supervised by the RSO.
- Allow no one to return to work in the area unless the RSO approves.
- Cooperate with the RSO and/or the RSO's staff (e.g., investigate root cause, provision of requested bioassay samples).
- Follow the instructions of the RSO and/or the RSO's staff (e.g., decontamination techniques, surveys, provision and collection of bioassay samples, requested documentation).

- Responsibility of RSO
  - Familiarize yourself with the incident and assess the likely consequences, such as contamination of personnel, equipment, and areas.
  - Perform air sample surveys in the area. These are needed to determine the magnitude of the airborne releases and potential inhalation by workers. These are also required before permitting resumption of work with licensed materials.
  - Supervise decontamination activities.
  - Collect nasal swabs and count to check for potential inhalation exposures.
  - Document the information about the incident. Determine the cause.
  - Determine the corrective actions needed. If licensed material is suspected of being ingested, inhaled, absorbed through, or injected under the skin, consider the need for bioassays/whole body count. Document the incident.
  - Notify the Director of EH&S and the Radiation Control Committee.
  - Notify the State Bureau of Radiation Control, if necessary.

### 3. Radioactive Material Escapes to Public Domain

All persons (including FIU personnel) who are not occupationally employed to work with radioactive materials or equipment producing radiation are considered members of the public. Radiation dose limits applicable to members of the public regulate such persons. All areas outside the radiological laboratories are considered public domain.

Radioactive material may find its way to the public domain under following conditions:

3.1 Major breach of the integrity of the container of radioactive materials, containment structure or process piping, and spreading of the spill to areas outside the radiological laboratory.

3.2 Falling of radioactive waste container or radioisotope from the vehicle while transported from one building to another.

3.3 Theft of a radioactive material from a facility or an instrument and intentionally left in a strategic place, exposing personnel to radiation.

### 3.1 Major breach of the integrity of the container of radioactive materials and that of the containment structure or the process piping and spreading of the spill to areas outside the radiological laboratory

- Instructions to Workers

- Notify persons in the immediate area that a spill has occurred.
- Ask someone to promptly report the incident to the Radiation Safety Officer (RSO).
- Do not allow anyone to leave the contaminated area without first being monitored to ensure his/her safety.
- Wash hands first if they are contaminated as a result of the accident.
- Put on disposable gloves to prevent contamination of the hands.
- Cordon off the area and label the cordon “Radioactive Material Stay Away”.
- Use a dust mask/respirator if the spill is major or has dry powder.
- Prevent the spread of contamination by covering the spill with absorbent paper.
- Carefully fold the absorbent paper with the clean side out and place it in a plastic bag for transfer to a radioactive waste container. Put contaminated gloves and any other contaminated disposable material in the bag.
- Scoop the contaminated soil and collect it in a bag.
- After cleaning the spill start decontamination. Start at the periphery of the contaminated area and work inward, reducing systematically the contaminated area. Remove more soil, if needed.
- Use a survey meter or wipe tests to monitor the effectiveness of the decontamination procedure.
- Check hands, clothing, and shoes for contamination.
- Follow the instructions of the RSO and/or the RSO’s staff (e.g., investigation of root cause, decontamination techniques, surveys, provision of bioassay samples, requested documentation).

- Responsibility of RSO
  - Follow up on the decontamination activities and document the results. Ensure that the area is free from contamination.
  - Survey and clear the area if it is contamination-free; otherwise, advise further decontamination.
  - As appropriate, determine the cause and corrective actions needed.
  - Consider bioassays if there is a potential for internal contamination.

### 3.2 Falling of radioactive waste container or radioisotope from the vehicle while being transported from one building to another

All materials will be carried in the University vehicle according to radiation safety procedures for transporting radioactive materials. These materials will be secured in the vehicle so that they do not move or fall off. Further, they will be placed in a secondary container. If the radioactive material container happens to fall from the vehicle and breaks so that its contents are spilled out, follow the instructions in section 3.1. The RSO assumes the duties of both worker and RSO.

### 3.3 Theft of a radioactive material from a facility or an instrument and intentionally left in a strategic place, exposing personnel to radiation

The best way to prevent loss of materials is by 1) keeping the radiological laboratories locked all times, 2) issuing laboratories keys only to the authorized users, 3) maintaining access control record (name, time in, time out, purpose) of the persons, 4) installing sensitive radiation monitoring instruments at the laboratory exit, keeping ‘on’ and hooking the radiation alarm to the department’s office, and 5) installing surveillance cameras. Because the quantities of radioactive materials in use or likely to be used soon are small, steps 4) and 5) are not warranted. Radioactive material theft may be prevented if steps 1 to 3 are followed. It is also essential to perform periodic surveys and leak tests.

## 4. Accident during Transportation of Radioactive Materials or Wastes

Radioactive materials purchased by various authorized users are first received in the Radiation Safety Office. The University Radiation Safety Officer (RSO) delivers these materials to the authorized users in the University vehicle. The RSO also picks up radioactive wastes from different facilities and brings to the University Radioactive Waste Storage Facility (AHC-4/123A). During the transportation, an accident may take place, resulting in an integrity breach of the container of radioactive material or of the waste, resulting in spill of the radioactive waste material, contamination of the university vehicle, university, or public road, and contamination of vehicles/personnel involved in the accident, if precautions are not taken. The accident may also cause bodily injury to the RSO or other persons. The quantity of radioactive materials transported in FIU is minimal. Radioisotopes are delivered in their original packaging after being placed in secondary containment with vermiculite to absorb any standing liquid. The quantity of waste generated and shipped is negligible and will be contained in the vermiculite if spill occurs in an accident. Medical attention and hospitalization shall take precedence over decontamination concerns in case of physical injury. The RSO shall provide guidance to prevent the spread of contamination without sacrificing medical attention.

## 5. Fires, Explosions, or Major Emergencies in Radiological Laboratories

### 5.1 Minor Fires

Instructions to Workers

- Notify all persons present to vacate the area and have one individual immediately call the Public Safety department at 75911 and RSO (x 70489).
- Immediately attempt to put out the fire by approved methods (e.g., fire extinguisher) if other fire or radiation hazards are absent. If you attempt to fight a minor fire, do not do so alone; get help, and never allow the fire to block your path of exit from the area or the building. Never compromise your safety to control a fire.
- To use a Fire Extinguisher
  - **P**ull the pin
  - **A**im the extinguisher nozzle at the base of the flames
  - **S**queeze the handle while holding the fire extinguisher upright
  - **S**weep the extinguisher nozzle from side to side, covering the fuel with the extinguishing agent.
- Once the fire is out, isolate the area to prevent the spread of possible contamination.
- Survey all persons involved in combating the fire for possible contamination.
- Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water, then washing with a mild soap.
- In consultation with the RSO, determine a plan of decontamination and the types of protective devices and survey equipment necessary to decontaminate the area.
- Allow no one to return to work in the area unless the RSO approves.
- Follow the instructions of the RSO and/or the RSO's staff (e.g., investigation of root cause decontamination techniques, surveys, provision of bioassay samples, requested documentation).

- Responsibility of RSO
- Supervise decontamination activities.
- If personnel decontamination was not fully successful, consider inducing perspiration by covering the area with plastic. Then, wash the affected area again to remove any contamination released by the perspiration.

- Consult with fire safety officials to assure that there are no other possibilities of another fire starting.
- Determine the cause and needed corrective actions; consider the need for bioassays if licensed material is suspected of being ingested, inhaled, absorbed through, or injected under the skin.
- Document the incident.
- Notify the Director of EH&S and the Radiation Control Committee.
- Notify the State Bureau of Radiation Control, if necessary.

### 5.2 Major Fires, Explosions, or Major Emergencies

- Instructions to Workers
  - Notify all persons in the area to leave immediately.
  - Notify the Public Safety department at 75911.
  - Notify the RSO and other facility safety personnel and EH&S safety personnel (x2621, x76971), if hazardous materials are handled in the area.
  - Provide information about the radioactive materials to public safety personnel, where the radioactive materials are currently being stored or being used, and the best possible entrance route to the radiation area, as well as any precautions to avoid exposure or risk of creating radioactive contamination by use of high-pressure water, etc. Also, provide information on whether the materials involved in the fire could be radioactive and/or hazardous, as well as the precautions to be taken.
  - Cooperate with the RSO and/or the RSO's staff (e.g., investigate root cause, provision of requested bioassay samples).
  - Allow no one to return to work in the area unless the RSO approves.
  - Follow the instructions of the RSO and/or the RSO's staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).
- Responsibility of RSO
  - Coordinate activities with the facility's safety personnel and with public safety personnel.
  - Consult with the firefighting personnel and set up a controlled area where the firefighters can be surveyed for contamination of their protective clothing and equipment after extinguishing the fire.
  - Once the fire is extinguished, advise that no body should enter potentially contaminated areas or areas where radioactive and/hazardous materials may be present until a thorough evaluation and survey are performed by RSO and Haz Mat Unit to determine the extent of the damage to the materials and areas.
  - Perform thorough contamination surveys of the firefighters and their equipment, and supervise decontamination, if there is contamination on persons or equipment.
  - Collect air samples and count for radioactivity.
  - Collect nasal swabs from persons and count the samples to check for potential inhalation exposures.
  - If licensed material is suspected of being ingested, inhaled, absorbed through, or injected under the skin, consider bioassays. Document the incident.
  - Collect names and phone numbers of all persons involved in or helped in the fire incident.
  - Document incident.
  - Notify the Director of EH&S and the Radiation Control Committee.
  - Notify the State Bureau of Radiation Control, if necessary.

### Fatal or critical accidents or injuries occurring on University premises accompanied by personal radiological contamination of employees, students or visitors

- Instructions to Workers
  - To request medical assistance, contact Public Safety at x75911 (305-348-5911). In all cases of physical injury, medical attention and hospitalization take precedence over contamination concerns.
  - Evacuate personnel and, if possible, segregate them. Determine medical status of involved personnel.
  - Remove all personnel dosimeters and/or TLD badges from exposed personnel. Read dosimeters and record the reading. Send dosimeters and TLD badges immediately to a safe area.
  - Notify the Emergency Director, who will then activate the emergency plan.
  - Notify Radiation Safety Officer.
- Responsibilities RSO
  - Evaluate situation and personnel (or assist, as applicable) in regard to:
    - Personnel medical status
    - Current environmental status
    - Extent of contamination
    - Nature and level of radiation exposure (external, internal)
  - Close off the radiation area.
  - Request facility management/facility operations to turn off fans, ventilators, or air conditioners that supply air to other areas. Direct exhaust ventilation should be left on.
  - Save all clothing samples, blood, urine, stool, and vomitus. Label with name, date, and time.
  - Send TLDs for emergency processing.
  - If medical condition permits, perform preliminary decontamination before releasing patients to hospitals.
  - If possible, use portable battery-operated tape recorders to collect and store information and obtain a complete history of the accident. It is often difficult to record all of the events, opinions, and statements in an emergency. The taped records can be typed later, thus providing a more complete history of the accident.
  - If available, use a video camera. It will be an excellent method of showing what happened. If a video camera is unavailable, suitable still photographs will be helpful.
  - Collect names and phone numbers of all persons involved in or helped in the fire incident.
  - Notify the Director of EH&S and the Radiation Control Committee.
  - Notify the State Bureau of Radiation Control, if necessary.

**Natural disasters, including storms, floods, hurricanes, or tornadoes, can affect radiological laboratories and, hence, impair barrier and containment integrity.**

Storms, floods, hurricanes, and tornadoes can cause extensive property damage. Damage to the structure (ceiling, walls, etc.), accompanied by damage to the containment (fume hood, glove box) and radioactive material container, may expose the radioactive material. This may lead to spillage of the material into the fume hood or glove box. The spill may spread to the lab floor and other areas. If the lab is flooded, it may also be mixed with rainwater.

- Instructions to Workers
  - Secure the radioactive material prior to the occurrence of an event. Provide soft packing surrounded by a shield so that the container is not breached when a heavy structure falls on the source vial or the source container.

- If the spill does occur, notify persons in the area, if anyone is around. It is essential to retrieve the material in as short a time as possible and comply with instructions regarding the natural disaster emergency.
- Notify the public safety.
- Report the incident promptly to the Radiation Safety Officer (RSO) and Director of Emergency Management (DEM). Follow the instructions of the DEM.
- Request facility management to shut off fans, ventilators, or air conditioners that circulate air to other areas. Direct exhaust ventilation should be left on.
- Put on disposable gloves to prevent contamination of the hands.
- Survey the area with an appropriate low-range radiation detector survey meter or other appropriate technique. Also, check the area around the spill for contamination.
- Try to retrieve the source with mechanical tools, such as long tongs, small pumps without exposing hands to radiation.
- Follow the spill procedures if the situation permits.
- Prevent the spread of contamination by covering the spill with absorbent paper.
- Carefully fold the absorbent paper with the clean side out and place it in a plastic bag for transfer to a radioactive waste container. Put contaminated gloves and any other contaminated disposable material in the bag.
- Clean the spill from the periphery and work inward.
- Check the persons for contamination.
- Decontaminate the area, only if the situation permits
- Use a survey meter or wipe tests to monitor the effectiveness of the decontamination procedure.
- Check hands, clothing, and shoes for contamination.
- Allow no one to return to work in the area unless approved by the RSO.

- Responsibilities of RSO
  - Follow up on the decontamination activities and document the results.
  - Document the incident along with the contacts of the persons involved.
  - If the situation permits, survey and clear the area if the contamination is within the limits; otherwise, advise further decontamination.
  - As appropriate, determine cause and corrective actions needed. Consider bioassays if there is a potential for internal contamination.

## APPENDIX 12: ADMINISTRATION OF RADIOACTIVE MATERIALS IN ANIMALS

### Procedures for the Use of Radioactive Materials in Animals

### General:

Any area to be used for radioactive materials must first be approved by the University Radiation Control Committee.

1. To use radioactive materials in animals, authorized users must submit to the Radiation Safety Officer the precautions and procedures to be used in handling and caring for animals for approval by the Radiation Control Committee. Approval is coordinated with the Institutional Animal Care and Use Committee (IACUC). The following information must be included:

    - A description of the area where the animal will be housed during the procedure.
    - Procedures for injecting radioactive material into animals: Describe procedures for restraining animals during injection and the method for containing any radioactive material lost during injection. For small animals, a tray lined with absorbent material should be used. For large animals, some other method may be required.
    - Cage: What type of cage will be used? A disposable polystyrene cage is recommended to avoid the spread of contamination.
    - Describe the number of animals that will be studied at any one time. The radionuclide and the maximum activity to be injected into each animal, the maximum activity used in any single day, and the maximum activity in the lab at once. After each experiment, the room must be carefully surveyed for radioactive contamination.
    - Labeling of cages: The label must include the type of radionuclide, quantity of material injected per animal, date of injection, and the name of the Authorized User. Cage labeling is essential for animals that are not euthanized within a few minutes after injection.
    - Monitoring and decontamination of cages: Describe how the monitoring/decontamination of the animals, cages, and lab will be performed. If animal cages are to be returned to the Animal Care Facility after use, describe procedures for decontaminating and monitoring cages. The Authorized User must maintain records of radiation levels and wipe tests. Disposable cages are recommended. These can be packed and disposed of. There will be no need for decontamination.
    - Segregation of the animals injected with radioactive materials from other animals: Are long-term retention studies being conducted? If so, detailed labeling of cages and animals is essential.
    - Disposal of animal excreta: Describe the methods to be used for disposal.
      Surgical Instrument Decontamination: Describe how surgical instruments and other non-disposable devices or materials used during the experiment will be decontaminated. They must be surveyed for residual contamination before storage. They must be labeled with the isotope, date, estimated activity, and Authorized User.

2. Instructions for animal handlers: Describe the indoctrination that will be provided by the authorized user of handlers who may come into contact with animals injected with radioactive materials. This should include dose levels, time limitations, and special handling requirements that you specify for your animals and/or their excreta. In general, once injected with radioactive material, animals should be housed in the experimental laboratory properly designated for animal and radioactive material use. They are not to be returned to the central animal care

facilities without specific approval of the Radiation Safety Officer and the Director of the Animal Care Center.

a. All hands-on care of animals containing radioactive material must be provided by the laboratory research personnel performing the research. The researchers must have training in the general use of radioactive materials by the Environmental Health and Safety Department (EH&S) and specific training related to radioactive animal care by the laboratory's radioactive materials supervisor. This training must include specific instructions requiring the laboratory staff to:

    i. Perform all feeding and cleaning of animals;
    ii. Perform regular contamination surveys to prevent the spread of contamination and to ensure that radiation levels are maintained as low as reasonably achievable.
    iii. Clean and decontaminate cages and facilities.
    iv. Packaging and handling all animals, animal wastes, carcasses, and other wastes.
    v. Contact EH&S to perform free-release surveys to allow the reuse of equipment.
    vi. Contact EH&S before disposal of waste.
    vii. Any bite or scratch from animals injected with radioactive materials must be immediately reported to EH&S due to the potential for internal contamination.
    viii. Animal Disposal: After euthanasia, animals that have been injected with radioactive materials must be stored in a freezer that is designated and marked for radioactive material use. Animals must be double bagged and labeled with the isotope, date, estimated activity, and name of the Authorized User. Animals should be stored until radioactivity decays to background level before disposal with biological waste, or disposed of under the direction of the Radiation Safety Officer.

# APPENDIX 13: ADMINISTRATION OF RADIOACTIVE MATERIALS IN PLANTS

## Plant Uptake Studies

### General:

- All plant studies will follow procedures approved by the FIU Greenhouse Use Committee.
- All procedures requiring radioactive materials will follow guidelines approved by the Radiation Safety Committee.
- All areas where radioactive materials are handled will first be approved by the University Radiation Control Committee.
- Adequate provisions will be made for safety and security in areas where radioactive materials are used.

### Procedure:

- Plants will be grown in a laboratory growth chamber or FIU's Greenhouse facility.
- Soil will be inoculated with the appropriate radioactive chemical at the desired concentrations.
- Seeds or seedlings will be planted in potted soil, and regular watering will be carried out.
- Plants will be harvested, and roots and shoots will be separated and transported to the laboratory. Soil will also be transported to the laboratory. The labs have restricted access and are approved for using radioactive materials.
- Shoots and roots will be dried in an oven at 80 °C for three days. Samples will be ground for solvent extractions of parent and metabolic products and analyzed by thin-layer chromatography, followed by autoradiography.
- Soil samples will be extracted for radioactive parent compounds and metabolites using selective solvents. The extracts will be rotary-evaporated to 0.5 mL. The concentrated extracts will be spotted on thin-layer chromatography, followed by autoradiography.
- To minimize the risk of contamination, all surfaces on which work will be done and all surfaces on which the soil and plants will be placed will be covered with absorbent pads. All personnel will wear disposable gloves, lab coats, and shoe covers. All personnel will wear applicable whole-body personal radiation dosimetry badges.
- Following the analysis, the waste will be picked up by a radiation safety officer and stored in a radioactive waste storage area prior to disposal through a contractor.
  The maximum activity to be used on any single day is 5 mCi. After each experiment, the room will be carefully surveyed for radioactive contamination. If contamination is detected, established decontamination procedures will apply.

## APPENDIX 14: POINTS FOR NON-COMPLIANCES AND RECURRENCE OF NON-COMPLIANCES

| | On Due Date | 30 Days After Due Date | 90 Days After Due Date | 1 Time Violation | 2 Times Violation | 3 Times Violation | Total Points for the Violation Category |
|---|---|---|---|---|---|---|---|
| 1. Radiation training not attended | | | | 5 | 8 | 10 | |
| 2. Refresher training not attended | | 1 | 2 | | | | |
| 3. Failure to wear appropriate protective dress (lab coat, shoes covering feet, etc.) | | | | 1 | 3 | 5 | |
| 4. Not wearing TLD while working with radioactive materials | | | | 1 | 3 | 5 | |
| 5. TLD/(exposure acknowledgment receipt) not returned | 1 | 2 | 4 | | | | |
| 6. Survey meter not calibrated/repaired | 1 | | 2 | | | | |
| 7. Signage/posting missing/inadequate/misused | | | | 1 | 2 | 3 | |
| 8. Unauthorized persons working with radioactive materials (RAM) | | | | 5 | 8 | 10 | |
| 9. Radiation survey not performed/incomplete | | | | 2 | 4 | 6 | |
| 10. Incomplete inventory of RAM | | | | 2 | 4 | 6 | |
| 11. Incomplete inventory of generally licensed materials | | | | 2 | 4 | 6 | |
| 12. Evidence of eating/drinking, including candy wrapper in garbage container | | | | 3 | 6 | 10 | |
| 13. RAM procurement procedure not followed | | | | 1 | 5 | 8 | |
| 14. Radioactive waste not stored/labeled properly | | | | 2 | 3 | 4 | |
| 15. Incident (e.g., > 10 μCi contamination on surface other than work areas like table top, hood. Example – contamination on floor) not reported RSO | | | | 3 | 6 | 10 | |
| 16. Rad lab relocation to unauthorized area | | | | Automatic suspension | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17. Rad lab relocation to authorized area without RSO consent | | | | 5 | Automatic suspension | | |
| 18. Rad lab relocation to authorized area without decontaminating previous lab | | | | 5 | Automatic suspension | | |
| 19. Lab security inadequate/lab left unlocked and unattended | | | | 5 | 8 | | |
| 20. Warning letter not posted (for a minimum of 5 working days, or until action correcting the violation has been completed, whichever is later). | 1 | | | | | | |
| 21. An authorized user must designate an alternate who will perform his/her duties in his/her absence | 1 | 3 | 5 | | | | |
| 22. Schedule inspection of the lab | 2 | 4 | 6 ** | | | | |

* List not exhaustive. Other instances of non-compliance can exist.
** Automatic suspension if radioactive materials/ wastes are used/ stored and inspection is not performed in 6 months

## APPENDIX 15: THE RESPIRATORY PROTECTION PROGRAM STANDARD 29 CFR 1910.134

Adhering to work procedures established by your department and the Respiratory Protection Standard (The Standard) can control occupational exposure to diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors (called contaminants).

Refer to the EH&S Respiratory Protection Program for more information on responsibilities and your role as an employee who may be potentially exposed to airborne contaminants.