Radiation Safety Manual For Laboratories

Environmental Health and Safety
Florida Atlantic University
777 Glades Road CO69, Room 112
Boca Raton, FL 33431
Phone: 561-297-3129
Fax: 561-297-2210
Email: ehs@fau.edu
Web: www.fau.edu/ehs

November 2015

NOTICE: Copies of this publication can be obtained in an alternate format by contacting Environmental Health & Safety at ehs@fau.edu or 561-297-3129. This publication is available in standard print, Braille, or electronically for people with disabilities. Please allow at least 10 days to process this request.

This Page Left Blank

TABLE OF CONTENTS

This Page Left Blank

1 INTRODUCTION

The Radiation Safety Manual for Laboratories is an official guide to the safe use of radioactive material at Florida Atlantic University (FAU). It is prepared by the Department of Environmental Health & Safety (EH&S) to present information and procedures approved by the Radiation Safety Committee. These must be understood and practiced in order to ensure that all uses of radioactive materials are in compliance with applicable regulations and that any resultant exposures are ALARA or "As Low As Reasonably Achievable".

2 RADIATION SAFETY PROGRAM

FAU, in fulfillment of its commitment to personnel safety and regulatory compliance, has established specific administrative entities with the responsibility of controlling the use of radioactive materials on all University campuses. EH&S has overall responsibility for developing and administering all safety and health programs at FAU, including the Radiation Safety Program. The Radiation Safety Program is managed by the Radiation Safety Officer (RSO) who is a member of the EH&S staff and serves on the Radiation Safety Committee.

3 RADIATION SAFETY COMMITTEE

The Radiation Safety Committee (RSC) is established by the Provost as the authority for establishing and administering policies and procedures for the safe use of radioactive materials and radiation emanating equipment as set forth in the Florida Department of Health, Bureau of Radiation Control (BRC) state regulations, Chapter 64E-5 of Florida Administrative Code (F.A.C.). The RSC consists of at least five (5) members, a Chairperson, the RSO, a representative of management, and other members that represent the various types of uses of radiation at FAU. A quorum exists when more than half the members are physically present or attending a meeting by teleconference. The RSC has final authority over all radiation usage at FAU.

The RSC is also responsible for reviewing and approving license amendment requests. In March 2004, FAU was issued a Broad Scope Radioactive Materials License (#734-4) by the BRC. The latest license, issued in March 2014, expires on March 31, 2019. This type of license places greater responsibility on the RSC and the RSO to independently manage FAU's Radiation Safety Program.

Specific duties of the RSC:

1. Meets at least once a quarter and at any other time at the request of a committee member or the RSO to resolve emergency matters relating to radiation safety.
2. Reviews all proposals for the use of radioactive material and radiation emanating equipment.
3. Terminates any operation which is judged to cause unnecessary exposure to radiation or which is likely to result in exposures exceeding the maximum permissible limits of the State of Florida.
4. Reviews the Radiation Safety Program for the following:
    1. compliance surveys
    2. procurement, storage, use, and disposal of radioactive materials
    3. personnel dose records
    4. training
5. Ensures that the use of radioactive material is consistent with the ALARA philosophy.
6. Assists the RSO to ensure compliance with applicable State regulations and license conditions.

4 RADIATION SAFETY OFFICER

The Radiation Safety Officer (RSO) is responsible for the day-to-day administration and operation of the Radiation Safety Program at Florida Atlantic University. The RSO ensures that all activities involving radioactive materials are performed in accordance with approved policies and regulatory requirements. The RSO is authorized to terminate or require immediate changes to an operation if, in the RSO's judgment, that operation is in violation of FAU policies and regulatory requirements.

The RSO must ensure that each individual using radioactive material is qualified by training and experience, has the facilities to handle the materials safely, and proposes a use that is safe to all concerned. The RSC and the RSO review all proposals for the use of radioactive materials. The RSO is also responsible for the following:

1. General surveillance of all activities involving radioactive materials and ensuring compliance with the regulations of the State of Florida and conditions of the license.
2. Personnel monitoring, maintaining exposure records, notifying individuals of exposures approaching the maximum permissible amounts, and recommending appropriate remedial action. Bioassays are performed when appropriate.
3. Monitoring of all incoming and outgoing radioactive materials for contamination and other hazard conditions or regulatory compliance.
4. Performing leak tests on all sealed sources as per license conditions.
5. Maintaining an inventory of all radioactive materials.
6. Performing surveys of all laboratories using radioactive material, maintaining records of the surveys and informing the PI and individual users if contamination detected exceeds license conditions.
7. Supervising decontamination in accidents involving radioactive materials.
8. Consulting with any personnel on all aspects of radiation safety and proper procedures for use of radioactive materials.
9. Providing initial, refresher, ancillary, and specific training as necessary.

5 AUTHORIZATION TO USE RADIOACTIVE MATERIAL

The individual in charge of a project using radioactive materials is referred to as the "Principal Investigator." Any FAU staff or faculty member who wishes to become a Principal Investigator (PI) must submit an *Application to Use Radioactive Material Form*, RSO1, and a *Statement of Training and Experience Form*, RSO2, to the RSO. Personnel working under the supervision of a PI are designated as "Radiation Workers."

The PI is responsible for all activities under the scope of the authorization issued by the RSC. Basic safety duties may be assigned to experienced individual users but the primary responsibility rests with the PI who must be cognizant of the FAU guidelines for the use of radioactive material and must resolve any issues that may arise in the implementation of these guidelines. The PI must ensure that there are adequate resources (funds, personnel and space) to safely perform the research described in proposed radioactive material protocols. They are required to have training in the use of radioactive material although experience may be substituted for training at the discretion of the RSO and the RSC. The PI is also responsible for ensuring:

1. An up-to-date inventory of radioactive materials and radiation emanating devices are maintained and submitted to the RSO each quarter.
2. All uses of radioactive material or radiation emanating equipment must be evaluated (ALARA).
3. All individual users working on the project are properly authorized by the RSC, trained and supervised.
4. Compliance with all rules, regulations, and procedures for the purchase, use, storage, transfer, and shipment of radioactive materials or radiation emanating equipment.
5. All radioactive waste materials are properly prepared prior to collection by EH&S.

6. The RSO is notified of any changes in the storage or use of any radioactive materials or radiation emanating equipment before such change is performed.

5.1 Permit Amendments

All changes to existing permits must be requested by submitting to the RSO a *Radioactive Materials Authorization Amendment Request Form*, RSO5, outlining the changes. An amendment to the PI's authorization is required for changes of radionuclide, possession limit, place of use, protocol, and addition or deletion of individual users.

5.2 Permit Reviews

The RSO reviews the use of radioactive material under an issued permit every two years. The PI should also periodically review the use of radioactive material in the lab and notify the RSO of any necessary changes to the permit.

5.3 Permit Termination

The Principal Investigator should notify the RSO to terminate their permit if there will be an extended period of non-use, such as a couple of years. A PI who remains in an active status but does not work with materials must continue to complete all radiation safety requirements including weekly documentation of "no use" in laboratory survey records, weekly surveys in areas where source and/or waste material are stored in the laboratory, quarterly inventory of radioactive material, and completion of training and annual refresher training courses. If radioactive material is stored but not used for greater than one month, a survey must be performed at least once each calendar quarter.

5.4 Laboratory termination

The Principal Investigator must notify the RSO at least thirty days in advance of any plan to permanently discontinue the use of radioactive material or the use of an approved laboratory. The RSO will arrange a final close out survey of the area being vacated. Prior to termination, the PI must:

1. Notify the RSO to remove all radioactive material, including waste, from the lab and update inventory records. Each stock vial must have a final disposal date.
2. Perform and document final monitoring and decontaminate if necessary.
3. Remove all radiation labels from within the lab. The RSO will remove the door label after a final close out survey has been completed.
4. Transfer all laboratory records to the RSO, especially if terminating employment at FAU.

6 PROCUREMENT OR TRANSFER OF RADIOACTIVE MATERIAL

The acquisition of radioactive materials by purchase order, transfer, or gift requires prior approval from the RSO. All radioactive materials must be shipped to EH&S where they are monitored for contamination and entered into the inventory database before being delivered and signed for by the appropriate laboratory personnel. All shipments must be delivered to the applicable EH&S office:

Florida Atlantic University
Environmental Health and Safety
Campus Operations Building, #69, Room 112
777 Glades Road
Boca Raton, FL 33431

Florida Atlantic University
Environmental Health and Safety
FAU Research Facility MC-17
5353 Parkside Drive
Jupiter, FL 33458

Florida Atlantic University
Environmental Health and Safety
FAU Marine Science Bldg.
5775 North Old Dixie Highway
Fort Pierce, FL 34946

6.1 Procurement

A *Request for Radioactive Material Form*, RSO3, must be submitted to the RSO. The RSO authorizes the procurement of the material after verifying that the PI is approved to receive the type of material ordered and that the requested amount does not exceed the possession limit. A radiation safety approval number (RSS#) is issued if the order is approved. Each stock vial, sealed source, standard, marker, etc. is also issued a 6 digit RSS# by the RSO. Each individual order will have a unique approval and inventory number assigned to it. For example, if an order of 2 x 0.250 mCi of P-32 is requested, each 0.250 mCi stock vial would require its own approval and inventory number.

6.2 Transfer of Radioactive Material between Authorized Users

Radioactive material in the possession of a PI may be transferred after approval by the RSO. A Radioactive Materials Transfer form (RSO4) must be completed and submitted to the RSO prior to transferring radioactive materials within FAU. All inventory records must be updated as necessary.

6.3 Transfer of Radioactive Material from FAU to Other Recipients

The transfer of radioactive material outside FAU requires prior approval from the RSO. The PI must complete and submit a *Transfer of Radioactive Material Form*, RSO4, to the RSO. This form must include the amount and the name of the material, along with the name of the RSO at the receiving institution. Authorization for the transfer is granted after verification by the RSO that the intended receiver is authorized to possess the radioactive material that is being transferred by receiving the institution's NRC or Agreement State license prior to shipment. The material must also be packaged and shipped in accordance with regulatory requirements.

7 TRAINING REQUIREMENTS

7.1 New Employee Training

Individuals who use radioactive material or frequent areas where radioactive material is used or stored must attend initial classroom radiation training. This training is offered monthly or on an as needed basis. All individuals wishing to attend radiation safety training should register to do so through EH&S.

7.2 Annual Refresher Training

Each calendar year, all persons who work in or frequent labs where radioactive material is used or stored must attend Annual Refresher Training. This training is available in a web-based format on the EH&S website.

8 POSTING AND LABELING

8.1 Posting Requirements

Each room approved for the use or storage of radioactive material must be posted at a minimum with a:

1. RSC2 Radioactive Material Use Authorization,
2. RSO14 Notice to Employees,
3. RSO15 Radioactive waste Disposal Guideline Poster, and
4. RSO16 Laboratory Rules and Emergency Procedures Poster

8.2 Labeling Requirements

1. Work Stations

1. When possible, radioactive material use should be restricted to a specific work area within the lab that is labeled with *CAUTION RADIOACTIVE MATERIALS*.

2. Surfaces and pieces of equipment located within a labeled work area should be considered contaminated until an appropriate survey determines otherwise.

2. Containers

Individual containers of radioactive material must be labeled with *CAUTION RADIOACTIVE MATERIALS.*

3. Equipment

Fume hoods, refrigerators, freezers, cabinets, centrifuges, pipettes, water baths, etc. used to store, process, or handle radioactive materials must be labeled with *CAUTION RADIOACTIVE MATERIALS.*

9 DOSE LIMITS

9.1 ALARA Policy

The acronym **ALARA, "As Low As Reasonably Achievable"**, means that persons using sources of ionizing radiation should make every reasonable effort to keep radiation exposures to individuals and releases of radioactive material to unrestricted areas as far below the regulatory limits as is practicable. The Administration of FAU fully supports the concept that all radiation doses should be ALARA. This implies that no dose is acceptable if it can be avoided or is without benefit.

Personnel shall constantly review their work habits and available safety equipment for adherence to the ALARA principle. The RSO will notify individuals when personnel exposures exceed ALARA levels. These exposures will be investigated and reviewed by the RSC. The RSO will investigate any individual's dose in excess of 125 mrem whole body or 1275 mrem to the extremities in any quarter.

9.2 Annual Occupational Dose for an adult Radiation Worker

Body Part	**Dose (rem/mrem)**
Whole Body (Head, Trunk, Upper Arms, and Thighs) Total Effective Dose Equivalent	5 / 5,000
Lens of the eye Eye Dose Equivalent	15 / 15,000
Skin or Extremity Shallow Dose Equivalent	50 / 50,000

9.3 Annual Occupational Dose for a Minor

The annual dose limit for a minor working in a restricted area is 10% of the dose for an adult radiation worker. This is 0.5 rem or 500 mrem for a whole body dose.

9.4 Annual Dose for the General Public

The annual dose limit for the general public is 0.1 rem or 100 mrem.

9.5 Annual Dose for an Embryo/Fetus and Declared Pregnant Worker

The dose to an embryo/fetus, as a result of an occupational exposure of its mother, shall not exceed 0.5 rem (500 mrem) during the entire period of gestation.

9.6 Annual Occupational Dose for a Declared Pregnant Worker

A woman who works in an area that is restricted for purposes of controlling radiation exposure, may, upon learning that she is pregnant, declare her pregnancy in writing to the RSO using a *Declaration of Pregnancy Form*, RSO13. Once the pregnancy is declared in writing, which includes the estimated date of conception, the stated limits above become effective.

9.7 Policy for Pregnant Workers

A pregnant employee is highly encouraged to voluntarily inform her employer, in writing, of her pregnancy and the estimated date of conception. The employee is encouraged to visit the RSO and receive information regarding concerns she may have about radiation exposure during pregnancy. Upon submission of a completed *Declaration of Pregnancy Form*, RSO13, the RSO will:

1. Evaluate the exposure history of the individual and her coworkers.
2. Provide information concerning risk and precautions.
3. Evaluate the working environment with respect to radiation exposure.
4. Make recommendations for reducing radiation exposure.
5. Monitor radiation exposure in accordance with State of Florida exposure limits.

9.8 Personnel Dosimetry

External exposure monitoring is required if an individual's occupational radiation exposure is likely to exceed 10% of the annual dose or 0.5 rem (500 mrem). Internal exposure monitoring is required if an individual is likely to receive in one year an intake in excess of 10% of the applicable Annual Limit of Intake (ALI) for ingestion and inhalation.

9.9 Internal Radiation Dose Limits

To determine the total annual dose of an individual, the radiation dose from the inhalation or ingestion of radioactive materials must also be considered. The State of Florida places limits on the amount of radioactive materials that a radiation worker can take into their body over the course of a working year. This is called the Annual Limit on Intake (ALI). These values have been calculated for several radionuclides and are listed in *Appendix A – ALI and DAC* of this manual.

If a radiation worker receives one ALI, the calculated radiation dose from that intake would be 5 rem. This dose is called the Effective Dose Equivalent (EDE). Regulations require that the total external and internal radiation dose to a worker not exceed 5 rem in one year. The sum of these doses is called the Total Effective Dose Equivalent (TEDE).

9.10 Thyroid Bioassays

Radioiodine activities requiring bioassay are shown below:

Bioassay Levels for ^{125}I		
Type of Operation	**Volatile or Dispersible**	**Bound to Non-volatile Agent**
Processes in open room on bench top	1 mCi	10 mCi
Processes in a fume hood with adequate face velocity and performance reliability	10 mCi	100 mCi
Processes in a glove box or mini-hood with charcoal filter	100 mCi	1000 mCi

Thyroid scans are performed on individuals performing radioiodinations or using radioiodine compounds in excess of 10% of the limits in the table above. The scan is performed before initiating the radioiodination or radioiodine protocol and then between 7 hours and 168 hours afterward. All radioiodinations are performed in a charcoal filtered hood and are monitored by EH&S.

9.11 Thyroid Uptake Limits

Weekly 600 nCi Investigation Level 120 nCi

9.12 Tritium Bioassays

Individuals involved in operations that use tritium in any form other than metallic foil, in quantities greater than those listed in the table below will have bioassays performed. Tritium bioassays are performed by urine sample analysis. Any individual working with quantities greater than those shown in the table below during a single operation shall provide a urine sample within one week after the exposure. An employee who, in one month, works with quantities exceeding those shown in the table below shall provide urine samples weekly during the exposure and once after the exposure ends.

Bioassay Levels for Tritium				
Process	**Tritiated Water or Tritiated Compounds**	**Tritium Gas in Sealed Vessels**	**Tritium Nucleotide Precursors**	**Tritiated Water with more than 10 kg of Inert Water or Other Substances**
In open room with possible escape of tritium	0.01 Ci	100 Ci	0.01 Ci	0.01 Ci/Kg
Within fume hood of adequate design	1 Ci	1000 Ci	0.01 Ci	0.1 Ci/Kg
Within a glove box	10 Ci	10,000 Ci	1 Ci	1 Ci/Kg

Internal exposures will be added to the individual's external dose in accordance with 64E-5.305.

10 SURVEYS AND MONITORING

10.1 Laboratory Surveys

1. The laboratory must be surveyed for contamination after each use of radioactive material. At least one such survey must be recorded weekly. A Room Diagram and Survey Report Form, RSO7 may be used to document the monitoring results. Typical monitoring locations are:
    1. Areas of potential radioactive contamination such as bench tops, the floor, telephones, doorknobs, faucet handles, freezer/refrigerator handles and phones.
    2. Facilities and equipment such as liquid scintillation counters, centrifuges, pipettes, refrigerators, fume hoods and sinks.
    3. Equipment to be released for maintenance or disposal.
2. During weeks when radioactive material is used in limited areas within a laboratory, the survey may be limited to the applicable areas and "No RADIOACTIVE MATERIAL Use" recorded for other areas.
3. If radioactive material is stored but not used for greater than one month, a survey must be performed at least once each calendar quarter. This survey can consist of the following: Wipes on each radioactive materials storage refrigerator or freezer, wipes of the floor beneath each refrigerator or freezer, and a wipe on the floor near each radioactive waste storage area.

10.2 How To Monitor

Survey meters should be used in areas where only gamma emitters such as ^{125}I or energetic beta emitters such as ^{32}P are used.

10.2.1 Use of survey meters:

1. Prior to use, check that the instrument is functioning by performing a battery test, checking the background reading, and assuring that it responds to radiation.
2. Verify that the meter and probe are appropriately sensitive for the radionuclide being monitored. Use a low-energy gamma scintillation probe for ^{125}I; a pancake probe for energetic beta emitters like ^{32} P.
3. To perform a survey, move the meter/probe slowly about 6 inches per second over the surface to be monitored. Keep the face of the probe parallel to the surface, and as close as possible without contaminating the meter.
4. Do not use a meter in high background areas.

10.2.2 Performing a wipe test:

1. Put on gloves.
2. Drag the "wipe" over the surface to be tested applying moderate pressure and covering at least 100 cm^2.
3. Count the wipes in a liquid scintillation counter. Include one "blank" sample to verify that the background reading on the counter is consistent.
4. Dispose of wipes, vials, and gloves in accordance with EH&S waste disposal guidelines.

10.2.3 Records must include:

1. A diagram of the lab.
2. The date of the survey.
3. The initials/name of the person performing the survey.
4. The survey instrument used (not required for ^{3}H).
5. The background reading in counts per minute (cpm).
6. The survey results for each area in disintegrations per minute (dpm).

10.2.4 Positive Monitoring Results

1. Results exceeding 200 dpm/100 cm2 must be decontaminated.

2. Following decontamination, resurvey the area. Record resurvey results in survey records.
3. For personnel contamination or widespread contamination, contact the RSO immediately.

10.3 Instrument Characteristics

The following table lists the general types of radiation emitted by radionuclides approved for use at FAU. Typical detection efficiencies for commonly used survey probes are also listed.

Characteristic Radiation	Portable Survey Instrument	Laboratory Instrument
Low Energy Beta ^{3}H, ^{63}Ni	None Recommended	Liquid Scintillation Counter
Medium Energy Beta ^{14}C, ^{35}S, ^{45}Ca	Rate meter with end window or pancake GM detector	Liquid Scintillation Counter
High Energy Beta ^{32}P	Rate meter with end window or pancake GM detector	Liquid Scintillation Counter
Low Energy Gamma ^{125}I	Rate meter with thin NaI(Tl) scintillation probe	Gamma Counter with semiconductor or scintillation detector Liquid Scintillation Counter.
Medium - High Energy Gamma ^{51}Cr, ^{60}Co	Rate meter with thick NaI(Tl) scintillation probe or Energy Compensated GM	Gamma Counter with semiconductor or scintillation detector

10.4 Typical Detector Efficiencies And Sensitivities For Portable Survey Meters

Detector	Typical Efficiency	Detector	Sensitivity
End-Window GM	5% for ^{14}C 5% for ^{35}S 30% for ^{32}P	Energy Compensated GM	1,200 CPM per mR/hr
Pancake GM	10% for ^{14}C 10% for ^{35}S 50% for P^{32}	Gamma Scintillator	175,000 CPM per mR/hr
Low-Energy Gamma Scintillator	35% for ^{125}I		

10.5 Laboratory Counters

10.5.1 Liquid Scintillation Counters

Liquid scintillation counters should be calibrated annually using established standards of known activity. The counting efficiency for commonly used radionuclides should be known to calculate activity from counting data. The minimum detectable activity (MDA) of the counter for various radionuclides and counting times should also be calculated using the following:

MDA = [2.71 / T + 4.65 √ (R_B T)] / [(2.22x10^6) E]
Where: R_B = Background count rate, T = count time, E = counting efficiency of the counter

Scintillation counters often contain internal sealed sources. Contact the RSO before moving or disposing of a counter, so arrangements can be made for proper removal and disposal of the internal radiation source. Do not attempt to remove the source.

10.5.2 Gamma Counters

Gamma counters should be calibrated annually using established standards of known activity. The counting efficiency for commonly used radionuclides should be known to calculate activity from counting data. The minimum detectable activity (MDA) of the counter for various radionuclides and counting times should also be calculated.

11 Radiation Safety Audits

The EH&S staff perform audits on a quarterly basis to ensure that the use of radioactive material is being conducted in a safe manner and in accordance with regulatory requirements. These audits review the adequacy of facilities, training and competency of workers, availability of survey instruments, security of radioactive material, minimization of personnel exposure to radiation, and the required record keeping. All individuals working in the laboratory should be aware of the location of the radiation safety records and have them available for inspection by the radiation safety staff.
A written report of the audit is prepared by the RSO. The PI and individual users are informed of any deficiencies, violations or recommendations. The RSO issues a notice of violation if there is a violation of regulatory requirements or license conditions. The PI is required to respond to this notice of violation within thirty (30) days. Audit reports are continuously reviewed by the RSO and the RSC for efficiency and effectiveness in ensuring a safe working environment. Audit results are reported to the Radiation Safety Committee quarterly.

12 SECURITY

All radioactive material must be secured or under constant surveillance at all times. All radioactive material must be stored in a manner that prevents the possibility of unauthorized access or removal. For example, source vials of radioactive materials must be locked in a cabinet, refrigerator, or freezer and only the PI or individual users may access the keys. The radioactive material could be placed in a locked box in a refrigerator or cold room, only if the box cannot be removed from the refrigerator or room. Radioactive waste containers must also be secured.
There currently is no lower limit on the amount of radioactive material that must be secured. Laboratory areas must be controlled or secured if any radioactive materials are present. Lock all doors to the laboratory when radioactive material is unattended. Counting rooms must be secured if radioactive materials are present.

12.1 Reporting Of Loss Or Theft Of Radioactive Materials

The PI or individual user will immediately contact the RSO in case of actual or suspected loss or theft of radioactive material. An investigation must begin immediately to attempt to locate the material. The RSO will notify the State of Florida as required.

13 GENERAL RADIATION SAFETY REQUIREMENTS

The safe use of radioactive material depends on all individuals being aware of the potential hazards and the proper procedures to control those hazards. Prior to using radioactive materials in a laboratory, the following steps should be taken:

1. Become familiar with the radionuclide to be used, its characteristics, hazards, and appropriate handling techniques and storage requirements.
2. Develop written procedures for all experiments, including safety precautions.
3. Consult with Radiation Safety staff to determine the need for any shielding or ventilation requirements.
4. Designate a restricted area in which the experiment will be conducted.
5. Clearly post the area and clear out unnecessary equipment.
6. Perform a trial run of the experiment using non-radioactive materials to determine if the protocol is adequate.
7. Analyze the waste stream to prevent the production of mixed chemical/radioactive waste.
8. Maintain good housekeeping practices.

The following are the fundamental requirements for the safe use of radioactive materials in a research laboratory.

1. Use the principles of time, distance, and shielding, and contamination control to keep exposure to radiation As Low As is Reasonably Achievable (ALARA).
2. Eating, drinking, cell phone use, and applying cosmetics is prohibited in laboratory areas where radioactive materials are used or stored.
3. Work areas (such as bench tops, hoods, and countertops) must be covered with absorbent matting or the work must be conducted within trays to contain spills.
4. Plexiglas or other plastic shielding is required when strong beta emitting radionuclides (^{32}P) are used.
5. Lead bricks, foil, or lead impregnated plastic shielding may be required when gamma emitting radionuclides such as ^{125}I are used.
6. Disposable gloves and laboratory coats should be worn when handling radioactive materials.
7. Laboratories, rooms, animal facilities, or approved areas for use of radioactive materials must be posted with a *Caution Radioactive Materials* sign.
8. Each container or piece of equipment in which radioactive materials are used and/or stored must be labeled in accordance with the applicable requirements of Florida Control of Radiation Hazard Regulations, Chapter 64E-5 of Florida Administrative Code (F.A.C.).
9. Radioactive materials must be stored in labeled containers or storage areas and secured from unauthorized use or removal when not under surveillance by authorized individuals. This can be accomplished by ensuring that the laboratory room is locked when no individuals are present or by locking the refrigerator, freezer, or area at all times.
10. Radioactive waste storage containers in the laboratory must be labeled with a "*Caution Radioactive Materials*" sign. Liquid waste should be placed in plastic containers (or plastic coated glass containers for organics) that prevent leakage or breakage and should be placed in secondary containers to contain spills. Containers with liquid waste must be sealed or capped to prevent the release of volatile byproducts.

11. Laboratory glassware and other equipment used to work with radioactive materials must be labeled with a "Caution - Radioactive Materials" sticker and may not be removed from a laboratory or mixed with "clean" equipment until demonstrated to be free of contamination.

14 Radioactive Equipment Release

Once used for radioactive substances, equipment shall not be used for other work, or sent from the area to central cleaning facilities, repair shops, surplus, or returned to the source of supply, until demonstrated and recorded to be free of contamination. Prior to equipment release the following must be completed:

1. The equipment must be surveyed and decontaminated by a laboratory employee who is familiar with the materials that were used or stored in the equipment.
2. An Equipment Release Form, RSO17, must be completed and submitted to EH&S.
3. EH&S must conduct a contamination survey verifying the absence of radioactive contamination.

15 RADIOACTIVE SEALED SOURCE

1. Sealed sources containing 100 µCi or more of beta-gamma radioactive materials are leak tested at six (6) months intervals. Sealed sources containing 10 µCi or more of alpha emitting radioactive materials are leak tested at intervals not to exceed three (3) months. Sources containing hydrogen-3 (^{3}H) are exempt from testing. The test must be performed in accordance with the manufacturer's instructions.
2. Sealed sources must be inventoried at least every 12 months. Small check sources and calibration standards that are exempt from leak testing should be inventoried. Sealed source inventory reports are to be submitted to the RSO.

16 RADIOACTIVE WASTE PROCEDURES

16.1 Waste Pickup Requests

Waste pickups are requested by generators either by on-line submission, or by faxing a *Request for Waste Pick-Up Form*, RSO9, to EH&S. Once notified EH&S personnel will respond in a timely manner, usually within two working days.

16.2 Radioactive Waste Guidelines

When generating, handling, or storing radioactive waste the EH&S Radioactive Waste Guidelines must be followed. These are conspicuously posted by the laboratory waste holding area and are also available on the EH&S website.

All Principal Investigators are required to submit specific protocols along with the expected waste streams to the RSO prior to generating any radioactive waste. The generation of mixed waste is strictly forbidden unless the RSO has given written permission. Laboratories are not allowed to dispose of any radioactive material either by drain or decay in storage. Waste must always be placed in an approved containers with secondary containment which are both provided by EH&S. All containers must be labeled with a *Caution Radioactive Materials*, a Radioactive Waste Disposal Log, RSO11, and an EH&S waste tag.

16.2.1 Waste Segregation

Radioactive waste must be properly segregated. Isotopes are grouped into short, medium and long half lives.

Short	Half-life < 30 days	P-32, P-33, Cr-51
Medium	Half-life > 30 days but < 90 days	S-35, I-125
Long	Half-life > 90 days	H-3, C-14, Ca-45

16.3 Solid Waste

16.3.1 Generator Responsibilities

1. Generators are responsible for proper segregation, labeling, and storage of radioactive solid waste. Solid waste must be placed into approved waste containers and segregated by isotope half-life.
2. Solid waste containing Ca-45, P-32, S-35 and I-125 will be stored in separate waste containers. Solid waste containing H-3 and C-14 may be stored in the same waste container. Solid waste containing P-33 and Cr-51 may be stored in the same waste container.
3. Approved waste containers are available from EH&S and must be labeled with a "Caution Radioactive Materials" sticker and an EH&S waste tag. Waste tags must be completed and signed prior to removal by EH&S. All waste containers must also have a Radioactive Waste Log, RSO11, attached that includes the following information: Isotope, activity, Inventory #'s, date of disposal, and name or initials of person placing the waste into the container.
4. Solid waste containers must not contain any of the following:
   Lead, Liquid, Liquid Scintillation Vials, Sharps, Biohazardous Waste, Source Vials
5. Source vials to be disposed when empty or no longer wanted must be bagged and stored in the radioactive waste area of the laboratory. All source vials must be accompanied by a copy of the original RSO3.

16.4 Liquid Waste

16.4.1 Generator Responsibilities

1. Generators are responsible for proper segregation, labeling, and storage of radioactive liquid waste. Liquid waste must be segregated into two categories: Aqueous and Mixed.
2. Liquid waste must be collected in approved containers. EH&S will not collect liquids in flasks, beakers, tubes, or liquid scintillation vials.

16.4.1.1 Aqueous Liquid Waste

1. DRAIN AND SINK DISPOSAL IS NOT PERMITTED IN LABORATORIES
2. Aqueous liquid waste is liquid waste that is readily soluble or dispersible in water. This waste must be collected in an approved plastic carboy. All isotopes can be collected in the same liquid waste carboy. Approved carboys are available in various sizes from EH&S. Each carboy must be labeled with a *Caution Radioactive Materials* label and an EH&S waste tag. Waste tags must be completed and signed prior to removal by EH&S.
3. All waste containers must also have a Radioactive Waste Log, RSO11, attached that includes the following information: isotope, activity, Inventory #'s, date of disposal, and name or initials of person placing the waste into the container.

16.4.1.2 Mixed Liquid Waste

1. MIXED WASTE GENERATION IS NOT ALLOWED EXCEPT WHEN INCLUDED IN PI AUTHORIZATION. Mixed waste generation will require specialized waste procedures in the PI's authorization to use radioactive material.
2. Mixed waste is waste that is radioactive and contains another hazardous component such as a flammable, corrosive, toxic, or reactive substance.

3. Mixed waste containers must be tagged and labeled in the same manner as aqueous liquid waste containers. The chemical constituents must be recorded onto the waste tag and RSO11.
4. Consult the RSO if unsure whether or not generated waste is a mixed waste.

16.5 LIQUID SCINTILLATION VIAL WASTE

1. The use of LSC cocktail containing organic solvents will produce liquid mixed waste. MIXED WASTE GENERATION IS NOT ALLOWED EXCEPT WHEN INCLUDED IN PI AUTHORIZATION. Mixed waste generation will require specialized waste procedures in the PI's authorization to use radioactive material.
2. Biodegradable aqueous cocktails will be used in LSC vials. A list of approved LSC cocktails is available from EH&S.

16.5.1 Generator Responsibilities

1. Generators are responsible for proper segregation, labeling, and storage of radioactive liquid scintillation vial waste. Vials containing radioactive material liquid waste will be stored in appropriate waste containers.
2. LSC vials will be disposed with the caps firmly tightened on the vials.
3. Vial waste containing Ca-45, P-32, S-35 and I-125 will be stored in separate waste containers. Waste containing H-3 and C-14 may be stored in the same waste container. Waste containing P-33 and Cr-51 may be stored in the same waste container.
4. LSC vials used for counting wipe samples, and containing radioactive material, will be placed in the same appropriate waste containers as experiment vials.
5. If a wipe sample is background, the vial contents can be drain disposed, except for mixed waste. The vial can be disposed of as regular trash or re-used.
6. Empty LSC vials internally contaminated with radioactive material will be placed in original trays or in appropriate waste containers. All empty vials must be tightly capped to prevent leakage of any residual liquid. Each tray or bag must be labeled with a *Caution Radioactive Materials* label, an RSO11 and an EH&S waste tag with the following information: isotope, date, PI name, and estimated activity of vial when it was full.

16.6 BIOHAZARDOUS RADIOACTIVE WASTE

16.6.1 Generator Responsibilities

1. Generators are responsible for proper segregation, labeling, and storage of radioactive biohazardous waste. Sharps must be placed into approved plastic "sharps" containers and labeled as "radioactive". Animal carcasses must be double-bagged, labeled as "radioactive", and stored in an approved freezer until removed by EH&S. "Sharps" containers are available from EH&S.
2. AUTOCLAVING RADIOACTIVE BIOHAZARDOUS WASTE IS NOT ALLOWED EXCEPT WHEN INCLUDED IN THE PI'S AUTHORIZATION
3. All waste containers will be labeled with a *Caution Radioactive Materials* label and an EH&S waste tag. Waste tags must be completed and signed prior to removal by EH&S. All waste containers must also have a Radioactive Waste Log RSO11 attached that includes the following information: isotope, activity, Inventory #'s, date of disposal, and name or initials of person placing the waste into the container.
4. Biohazardous radioactive waste must be segregated by isotope half-life: Biohazardous radioactive waste containing Ca-45, P-32, S-35 and I-125 will be stored in separate waste containers. Waste containing H-3 and C-14 may be stored in the same waste container. Waste containing P-33 and Cr-51 may be stored in the same waste container.

17 RADIATION EMERGENCIES

17.1 Emergency Procedures

Emergency procedures should be readily available to all personnel working with radioactive material. The primary consideration should be given to protection of personnel and containment of the radioactivity. Campus Police should be contacted for emergencies that occur after normal business hours.

17.2 Minor Spill Procedures

Spills or contamination involving < 100 uCi of non-volatile radioactive material are considered minor and may be cleaned up by lab personnel. However, at any time the RSO or radiation safety staff may be called for assistance.

1. Report the spill to the RSO immediately if you need assistance, if there is personnel contamination, or if the contamination is outside the licensed area.
2. Notify others in the area.
3. Prevent the spread of contamination by covering the spill with absorbent material and limiting access.
4. Clean up the spill using disposable gloves, lab coats, shoe covers and tongs as needed.
5. Proceed from the outermost edges of the contaminated area inwards, reducing systematically the area that is contaminated. Take care not to spread the contamination.
6. Put all contaminated objects into radioactive waste receptacles.
7. Normal cleaning agents are adequate. Keep cleaning supplies to the minimum needed to do the job.
8. Place contaminated cleaning supplies into a plastic bag and labeled waste container.
9. Following decontamination, survey all personnel and the area for removable contamination with a wipe test. If the floor was contaminated, be sure to monitor the bottom of shoes.
10. Continue decontamination until wipe test results are less than 200 dpm/100cm2.
11. Document results in laboratory notebook or records.

17.3 Major Spill Procedures

Spills or contamination involving > 100 uCi of non-volatile radioactive material, any amount of volatile radioactive material, and/or personnel contamination are considered to be major. The RSO or radiation safety staff must be notified immediately and decontamination should not be attempted without the assistance of the RSO.

1. Evacuate the room immediately, shutting doors and windows on the way out.
2. Notify the laboratory supervisor.
3. Immediately notify the RSO at 561 414 3224. If the RSO is not available contact EH&S at 561 297-3129.
4. Post *Keep Out* signs on all laboratory entrances to prevent access.
5. Assemble all persons near the lab entrance who were present in the laboratory during the spill.
6. Wait for assistance from the RSO before attempting to decontaminate the area.
7. Promptly report suspected inhalations, ingestions, or personnel contamination to the RSO.
8. Allow no one to return to work in the area unless approved by the RSO.

17.4 Fires, Explosions Or Major Emergencies

1. Notify all persons in the area to leave immediately.
2. Notify the fire department at # 911 and the RSO.
3. Attend to injured personnel first, then decontaminate.
4. Allow no one to return to work in the area unless approved by the RSO.

Annual Limits on Intake (ALI) and Derived Air Concentrations (DAC) for Occupational Exposure

Nuclide	Oral Ingestion	Inhalation	Inhalation
	ALI	ALI	DAC
	uCi	uCi	uCi/ml
^{3}H	8×10^{4}	8×10^{4}	2×10^{-5}
^{14}C	2×10^{3}	2×10^{3}	1×10^{-6}
^{32}P	6×10^{2}	9×10^{2}	4×10^{-7}
^{33}P	6×10^{3}	8×10^{3}	4×10^{-6}
^{35}S	1×10^{4}	2×10^{4}	7×10^{-6}
^{45}Ca	2×10^{3}	8×10^{2}	4×10^{-7}
^{51}Cr	6×10^{3}	1×10^{4}	5×10^{6}
^{65}Zn	4×10^{2}	3×10^{2}	1×10^{-7}
^{125}I	40	60	3×10^{-8}
	1×10^{2} (thyroid)	2×10^{2} (thyroid)	---
^{131}I	30	50	2×10^{-8}
	90 (thyroid)	2×10^{2} (thyroid)	---

The above values are limits which would result in exposure of an annual committed effective dose equivalent of 5.0 rem to an adult individual or an annual committed dose equivalent of 50 rem to an individual organ or tissue.

Calcium-45

Half-life: 163 days
Type of decay and Energy: Beta particle, 0.257 MeV (max)
Range in Air: 48 cm
Range in Water: 0.06 cm
Dose rate for typical quantities: No significant external exposure hazard.
Recommended Shielding: Plastic shield, any thickness, absorbs all beta particles.
Monitoring for contamination: GM detector, wipes counted by LSC.
Special Considerations: The low energy particles emitted from Ca-45 have a minimal penetration fraction for protective gloves or the outer layer of skin. Internal uptake is the primary concern since the critical organ is the bone. The annual limit on intake (ALI) is 2 mCi for oral ingestion or 800 µCi for inhalation.

Carbon-14

Half-life: 5730 years
Type of decay and Energy: Beta particle, 0.156 MeV (max)
Range in Air: 24 cm
Range in Water: 0.03 cm
Dose rate for typical quantities: No significant external exposure hazard.
Recommended Shielding: Plastic shield, any thickness, absorbs all beta particles.
Monitoring for contamination: GM detector, wipes counted in LSC.
Special Considerations: The low energy particles emitted from C-14 have a minimal penetration fraction for protective gloves or the outer layer of skin. Internal uptake is the primary concern since the critical organ is the bone for carbonates and body fat for many other compounds. The annual limit on intake (ALI) for compounds is 2 mCi for oral ingestion or for inhalation.

Cromium-51

Half-life: 27.7 days
Type of Decay: 0.32 MeV gamma (9.8%), 5 KeV X-ray (22%)
Dose rate for typical quantities: 160mR/hr at 1cm from 1mCi.
Recommended shielding: Lead shielding, 7mm thick.
Monitoring for contamination: Scintillation detector, wipes counted in LSC or gamma counter.
Special Considerations: Chromium-51 does not require any special precautions over and above those necessary for any radionuclide of these energies of emission. The GI tract is the critical organ for uptake. The annual limit on intake (ALI) is 40mCi for ingestion and 50mCi for inhalation.

Hydrogen-3

Half-life: 12.3 years
Type of decay and Energy: Beta particle, 0.019 MeV (max)
Range in Air: 0.6 cm
Range in Water: 0.0006 cm
Dose rate for typical quantities: No external exposure hazard.
Recommended Shielding: None required
Monitoring for contamination: Wipes counted in a LSC.
Special Considerations: The low energy particles emitted from H-3 cannot penetrate the outer dead layer of skin. Internal uptake is the primary concern since the critical organ is the whole body water. The annual limit on intake (ALI) is 80 mCi for oral ingestion or for inhalation.

Iodine-125

Half-life: 60 days
Type of decay and Energy: Gamma Rays, 35 KeV (7% of decays)
k-shell x-rays, 27-32 KeV (140% of decays)
Range in Air: 50 cm
Range in Water: 0.06 cm
Dose rate for typical quantities: 1.4 R per hour at 1 cm away from 1 mCi.
Recommended Shielding: Lead foil, 1mm thick, absorbs 99+% of photons.
Monitoring for contamination: Scintillation detector, wipes counted in LSC or gamma counter.
Special Considerations: Store NaI solutions at room temperature to minimize volatilization of compounds. Avoid acidic solutions. The thyroid is the critical organ for uptake. The annual limit on intake (ALI) for the thyroid is 40 µCI for oral ingestion or 60 µCi for inhalation.

Phosphorus-32

Half-life: 14.3 days
Type of decay and Energy: Beta particle, 1.709 MeV (max)
Range in Air: 790 cm
Range in Water: 0.8 cm
Dose rate for typical quantities: 26 R per hour at the mouth of an open 1 mCi vial in 1 ml of liquid.
Recommended Shielding: Plastic shield 1cm thick absorbs all beta particles.
Monitoring for contamination: GM detector, wipes counted in LSC.
Special Considerations: Do not use lead shielding for high energy particles. This produces x-rays that are harder to shield. The bone is the critical organ for uptake. The annual limit on intake (ALI) is 600 µCI for oral ingestion or 900 µCi for inhalation.

Phosphorus-33

Half-life: 25.4 days
Type of decay and Energy: Beta particle, 0.249 MeV (max)
Range in Air: 49 cm
Range in Water: 0.06 cm
Dose rate for typical quantities: No significant external exposure hazard.
Recommended Shielding: Plastic shield, any thickness, absorbs all particles.
Monitoring for contamination: GM detector, wipes counted in LSC.
Special Considerations: The bone is the critical organ for uptake. The annual limit on intake (ALI) is 6 mCi for oral ingestion or 8 mCi for inhalation.

Sulfur-35

Half-life: 87.4 days
Type of decay and Energy: Beta particle, 0.167 MeV (max)
Range in Air: 28 cm
Range in Water: 0.03 cm
Dose rate for typical quantities: No significant external exposure hazard.
Recommended Shielding: Plastic shield, any thickness, absorbs all beta particles.
Monitoring for contamination: GM detector, wipes counted in LSC.
Special Considerations: S-35 amino acids can decompose to volatile compounds during storage. Always open stock vials in an operating chemical fume hood. Incubation of S-35 methionine may release volatile compounds. The incubator may become contaminated.
The low energy particles emitted from S-35 have a minimal penetration fraction for protective gloves or the outer layer of skin. Internal uptake is the primary concern since the critical organ is the whole body. The annual limit on intake (ALI) for most compounds is 10 mCi for oral ingestion or 20 mCi for inhalation.

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

1. Principle Investigator Information

Name:	University ID Number:
Department:	Bldg/Office Number:
Office Phone:	Emergency Phone:
Email address:	Fax:

2. Radioactive Material

Isotope	**Physical Form** (solid/liquid/gas)	**Chemical Compound**	**Maximum Quantity Used per experiment** (mCi)	**Maximum Quantity Possessed Include Waste** (mCi)

3. Use and Storage Locations

Bldg/Room #	**Room type (Use, Storage, Counting, etc.)**

4. Radiation Detection Equipment

Equipment Type	**Manufacturer**	**Model**	**Serial Number**

5. Protocol

Attach a protocol describing the intended use of the radioactive material.

6. Signature

I commit to abide by FAU policies and procedures as set forth in the FAU Radiation Safety Manuals.

Signature:	Date

RSO1 Page 1 1/28/2014

7. Application Instructions

1. Section 1: Complete PI information. Include all requested information.
2. Section 2: List all radioactive material to be used. List each isotope, form, compound, activity to be used per experiment and total activity to be possessed. Include activity in waste in total activity.
3. Section 3: List the building and room number of all use and storage locations. Include counting and common areas.
4. Section 4: List the radiation detection instruments that will be used during experiments to monitor radiation levels and perform contamination surveys.
5. Section 5: Attach a protocol describing how radioactive material will be used and the purpose of the use. The protocol must contain the following information:
   1. A general description of the research plan.
   2. How radioactive material will be ordered, used and stored, including radioactive waste. An estimate of the amount of radioactive material to be ordered, used and stored.
   3. A description of how radioactive material will be secured during use or storage when not under direct surveillance of an authorized user.
   4. Any significant use or storage hazards such as fume hood necessity or fire hazard.
   5. A description of personal protective equipment (PPE) to be used such as gloves, coats and safety glasses.
   6. A description of area or individual monitoring to be used. Attach copies of Form RSO10, Request for Dosimetry, for individuals that will need monitoring. Attach copies of Form RSO8, Exposure History Request Form, for individuals that have previously been provided personal radiation monitoring (whole body or extremity badges).
   7. A description of shielding (lead, plastic, etc.). for use, storage and waste locations.
   8. A separate diagram of each room or location where radioactive will be used or stored. Include the location of hoods, work benches, refrigerators, freezers, doors and wastes. Form RSO7, Area Survey Report, may be used to provide location diagrams.
   9. A description of radiation level and contamination surveys to be conducted.
   10. A description of where records will be maintained for receipt, use and disposal of radioactive material, and for radiation level and contamination surveys.
   11. List all individuals who will use radioactive material or conduct contamination and radiation level surveys. Include which radioactive material and what activity each individual will use.
   12. Attach Form RSO2, Statements of Training and Experience, for all individuals that will use radioactive material or conduct contamination and radiation level surveys. FAU Radiation Safety Training is required for all individuals that will use radioactive material or conduct contamination and radiation level surveys. Training information is available on the web at www.fau.edu/ehs, http://www.fau.edu/facilities/ehs/training/index.php or contact the RSO by phone at 561.297.3129.
   13. Attach copies of licenses or certifications for individuals who will use radioactive material on humans.
   14. Attach Division of Research Approval for use of radioactive material on humans.
6. Section 6: Sign and date the application. Signing indicates consent to follow FAU policies and procedures when possessing or using radioactive materials.

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

To be completed by all individuals who will be working with radioactive materials.

1. Name

Name:	Department:	Phone:
Classification (*Faculty, Technician, Student, etc.*):	Radioactive Material to be used:	Principal Investigator:

2. Training

Type of Training	Where Trained	Dates and Duration of Training	On the Job?	Formal Course?
A. Principals and practices of radiation protection, ALARA and Shielding			Yes☐ No☐	Yes ☐ No ☐
B. Radioactivity measurement, standardization, monitoring techniques and instruments			Yes☐ No☐	Yes☐ No☐
C. Mathematics, calculations and measurement of radioactivity			Yes☐ No☐	Yes☐ No☐
D. Biological effects of different types of radiation and dosimetry			Yes☐ No☐	Yes☐ No☐

3. Radioisotope Handling Experience

Isotope	Maximum Amount	Where Experience was Gained	Dates and Duration of Experience	Types of Use

Have radiation exposure records been maintained for you at another institution? ☐ YES ☐ NO

4. Signature

I commit to abide by FAU policies and procedures as set forth in the FAU Radiation Safety Manuals.

Signature:	Date

If additional space is needed, use the back of this sheet or attach additional sheets.

RSO2 1/27/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

Please Attach a Separate Copy of this Form for Each Isotope Requested

1. PI Order Information

Principal Investigator/User:			**Date:**	**Date Requested By:**
Bldg:	**Room #:**	**Email:**	**Phone:**	**Fax:**
Radionuclide:		**Chemical Compound:**		**Activity:**
Physical Form:		**Supplier:**	**Catalog #:**	**P.O.#:**
RSS#:		**Date:**	**Approved By:**	

2. EHS Receipt Information

Transportation Label: ☐ None ☐ White ☐ Yellow-II		**Trans. Index:**	**Condition:** ☐ OK ☐ Damaged/Wet
Radiation Level:			**Wipe Test Result:**
Survey Meter Model:		**Serial #**	**Counter:**
Inventory#:	**Reference Date:**		**Lot #:**
Survey performed by:			**Date surveyed:**
Delivered to:			**Date:**

3. PI Use Log/Disposal Information

Date	Amount used	Amount Remaining	Amount to Waste	Initials

When remaining activity in source vial is 0, place vial in bag, attach completed RSO3. Call for disposal at 561.297.1052

RSO3 1/27/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

☐ Within FAU

☐ Outside FAU*

From:

Principal Investigator:	Department:	Date:

To:

Name:	Department:
Address:	City:
State:	Zip:
Telephone No.	License No:

Isotope:	Activity: (uCi/mCi)	Compound:	Form: (solid/liquid/gas)

Shipping Instructions :(*circle one*)

As is	Keep Frozen	Refrigerate	Prevent Freezing
Ship Date:	Carrier:	Packing Method:	
Remarks:			

**Radioactive materials shall not be transferred to or from a FAU facility or outside organization without prior approval from the Radiation Safety Officer. A copy of the NRC/Agreement State License must be received by the RSO prior to the transfer of radioactive material to an outside organization.*

RSO4 1/27/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

1. Principle Investigator Information

Name:	University ID Number:
Department:	Bldg/Office Number:
Office Phone:	Emergency Phone:
Email address:	Fax:

2. Add or Remove Radioactive Material From Authorization

Add or Remove	**Isotope**	**Physical Form** (solid/liquid /gas)	**Chemical Compound**	**Maximum Quantity Used per experiment** (mCi)	**Maximum Quantity Possessed Include Waste** (mCi)

3. Add or Remove Use and Storage Locations

Add or Remove	**Bldg/Room #**	**Room type (Use, Storage, Counting, etc.)**

4. Add or Remove Radiation Detection Equipment

Add or Remove	**Equipment Type**	**Manufacturer**	**Model**	**Serial Number**

5. Add or Remove Authorized Radiation Workers

Add or Remove	**Name**	**Isotope**	**Activity**	**Dosimetry**

5. *Principle Investigator Leave of Absence or Sabbatical*

Leave Dates	Transferred Authorized Users	Temporary Principle Investigator	Signature	Date

6. Protocol

Attach a protocol describing changes to radioactive material use.

7. Signature

I commit to abide by FAU policies and procedures as set forth in the FAU Radiation Safety Manuals.

Signature:	Date

8. *Radioactive Materials Authorization Amendment Request Instructions*

1. Section 1**:** Complete PI information. Include all requested information.
2. Section 2**:** List radioactive material to be added or removed. List each added isotope, form, compound, activity per experiment and total activity to be possessed. Include activity in waste in total activity. For removed isotope list currently possessed activity including waste in total activity. Request a waste pickup for all radioactive material to be deauthorized.
3. Section 3: List the building and room number of all use and storage locations to be added or removed. Include counting and common areas.
4. Section 4**:** List added or removed radiation detection instruments.
5. Section 5: List added or removed authorized radiation workers. Indicate isotope, activity to be used and if dosimetry is needed**.** Attach copies of Form RSO10, Request for Dosimetry, for individuals that will need monitoring**.** Attach copies of Form RSO8, Exposure History Request Form, for individuals that have previously been provided personal radiation monitoring (whole body or extremity badges).
6. Section 6: When a Principle Investigator takes a leave of absence or goes on sabbatical another PI must temporarily manage the radiation safety program. The temporary PI must be authorized to do so. Complete the requested information: dates of the leave, names of authorized workers to be assigned to the temporary PI, name of the temporary PIs, signature of the temporary PIs, and the signature date. More than one temporary PI may be utilized.
7. Section 7: Sign and date the amendment request. Signing indicates consent to follow FAU policies and procedures when possessing or using radioactive materials.
8. Attach a protocol describing changes to radioactive material use. The protocol must contain the following information:
9. A general description of the research plan and how the added radioactive material will change the previously authorized protocols. See Form RSO1, Application to Use Radioactive Material, section 7, item 5 for guidance on what information needs to be included to address use changes.
    - **A.** An activity estimate of the added radioactive material to be ordered, used and stored, including waste.
    - **B.** Attach Form RSO2, Statements of Training and Experience, for all individuals that will use the added radioactive material or conduct contamination and radiation level surveys. FAU Radiation Safety Training is required for all individuals that will use radioactive material or conduct contamination and radiation level surveys. Training information is available on the web at www.fau.edu/ehs, http://www.fau.edu/facilities/ehs/training/index.php or contact the RSO by phone at 561.297.3129.
    - **C.** Equipment decommission or disposal for removed radioactive material.

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

1. Principle Investigator Information

Name:	University ID Number:
Department:	Bldg/Office Number:
Office Phone:	Emergency Phone:
Email address:	Fax:

2. Sealed Source List

Manufacturer	Model	Serial #	Isotope	Activity (mCi)	Location (Bldg/room)	Date Received

3. Signatures

PI / Authorized User:	Date

RSO:	Date

RSO6 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

Building:	**Room:**
PI:	**Radionuclides:**

Diagram

Survey

#	Location (Wipe results attached)	Meter Survey (cpm or mR/hr)
1	**Background**	
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		

Meter MN:
Meter SN:
Calibration Date:
Background (cpm-mR/h):
Surveyor:
Survey Date:

Comments:

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

1. *Former Employer Information*

Contact Name:		
Employer:		
Department:		
Street Address:		
City:	State:	Zip:

2. Monitored Employee

Name:		
Address:		
City:	State:	Zip:
Phone:	Email:	
Employee ID #:		
Department:		
Employment Dates:		

3. *Exposure History Request*

To whom It Concerns:
Please send a copy of my Occupational Radiation Exposure History to the Florida Atlantic University Radiation Safety Officer. Thank you for your prompt attention to this matter. If needed I may be contacted using the above information.

Signature:	Date:

4. *Radiation Safety Officer*

Leanne Cobb, RSO
Email: cobbl@fau.edu
Phone: 561.297.2385, Cell 561.414.3224

Florida Atlantic University
EH&S RSO CO69-112
777 Glades Road
Boca Raton, FL 33431

RSO8 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

1. Principle Investigator

Principle Investigator:	Building:	Room:
Requestor Name:	Signature:	Date:

2. Radioactive Waste

NOTE: If an isotope is in solution, please indicate the solvent and solute components and concentrations. Also, avoid generating "mixed waste" (radioactivity in EPA regulated hazardous waste) since it is difficult to comply with the time frame for disposal as required by Federal and State regulations.

Isotope:	Solution/Composition:	Activity: (uCi or mCi)	☐ Liquid ☐ Solid ☐ LSV	Volume/Weight:	Container Type
Isotope:	Solution/Composition:	Activity: (uCi or mCi)	☐ Liquid ☐ Solid ☐ LSV	Volume/Weight	Container Type
Isotope:	Solution/Composition:	Activity: (uCi or mCi)	☐ Liquid ☐ Solid ☐ LSV	Volume/Weight	Container Type
Isotope:	Solution/Composition:	Activity: (uCi or mCi)	☐ Liquid ☐ Solid ☐ LSV	Volume/Weight	Container Type
Isotope:	Solution/Composition:	Activity: (uCi or mCi)	☐ Liquid ☐ Solid ☐ LSV	Volume/Weight	Container Type
Isotope:	Solution/Composition:	Activity: (uCi or mCi)	☐ Liquid ☐ Solid ☐ LSV	Volume/Weight	Container Type
Isotope:	Solution/Composition:	Activity: (uCi or mCi)	☐ Liquid ☐ Solid ☐ LSV	Volume/Weight	Container Type

3. Special Handling Precautions:

RSO9 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

1. Principle Investigator Information

Name:	University ID Number:
Department:	Bldg/Office Number:
Office Phone:	Emergency Phone:
Email address:	Fax:

2. Signature

3. Information for Authorized User Needing Dosimetry

Name:	Department:	
Phone:	Office Building:	Office Number:
Employee ID No:	Email:	
Date of Birth:	Male ☐	Female ☐
Radionuclides to be used:		

4. Monitor Needed

Whole Body ☐	
Ring ☐	Size: S ☐ M ☐ L ☐
Fetal Monitor ☐	
Area Monitor ☐	Number requested:

RSO10 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

Date	Isotope	INV#/RSS#	Activity (µCi)	Disposer Initials

RSO11 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

I, _____, declare my occupational radiation exposure
(Print Name)

for the period _____ to _____
(Beginning Date) (Ending Date)

to be _____ millirem.
(Number)

Z –

_____ _____ _____
(Employee ID Number) (Birthday) (Gender)

_____ _____
(Signature) (Date)

RSO12 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

I, _____, hereby declare I am pregnant.
Print Name

The estimated date of conception is _____.
Date

I understand that my occupational radiation dose during my entire pregnancy will not be allowed to exceed 0.5 rem (500 mrem), unless that dose has already been exceeded between the time of conception and submitting this letter. I also understand that meeting the lower dose limit may require a change in job or job responsibilities during my pregnancy.

If I find out that I am not pregnant, or if my pregnancy is terminated, I will promptly inform you that my pregnancy has ended.

_____ _____
Signature Date

_____ _____
RSO Signature Date

RSO13 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

FLORIDA DEPARTMENT OF HEALTH

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION;

NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS
POSTING REQUIREMENT

THIS NOTICE MUST BE POSTED IN PLACES THAT PERMIT EMPLOYEES IN A RESTRICTED AREA TO SEE A COPY ON THE WAY TO OR FROM THEIR PLACE OF EMPLOYMENT.

The Department of Health has established standards for protection against radiation hazards in Chapter 64E-5, Florida Administrative Code.

YOUR EMPLOYER IS REQUIRED TO:

- Post or provide you a copy of the Department of Health rules and operating procedures that apply to your work and explain them to you.
- Apply the rules to work involving radiation sources.
- Post or provide you any Notice of Violation involving radiological working conditions, proposed civil penalties, and orders.

YOU ARE REQUIRED TO:

- Become familiar with the rules and the operating procedures that apply to your work.
- Observe the requirements to protect yourself and your co-workers.

WHAT IS IN THESE RULES:

- Limits on exposure to radiation and radioactive material in restricted and unrestricted areas
- Actions to take after accidental exposure
- Personnel monitoring, surveys, and equipment
- Caution signs, labels, and safety interlocks
- Exposure records and reports
- Options for workers about Department of Health inspections
- Related matters

REPORTS ON RADIATION EXPOSURE

Your employer must give you a written report if you receive an exposure above the limits in the rules or in the license. The maximum limits for exposure to employees are in Part III of the rules. However, your employer should keep your radiation exposure as low as reasonably achievable.

If you work where personnel monitoring is required:

- Your employer must give you a written annual report of your radiation exposures.
- Your employer must give you a written report of your radiation exposures when you terminate employment.

INSPECTIONS

Representatives of the Department of Health inspect all licensed and registered activities. Any worker or worker representative who believes that there is a violation of Chapter 404, Florida Statutes; Chapter 64E-5, Florida Administrative Code; or the terms of the employer's license or registration can request an inspection by contacting the Bureau of Radiation Control, Bin C21, 4052 Bald Cypress Way, Tallahassee, FL 32399-1741 (850) 245-4266. The request must state specific reasons for the inspection. During inspections, Department of Health inspectors can confer privately with workers and any worker can bring to the attention of the inspectors any past or present condition that they believe contributed to or caused any violation.

Copies of Chapter 64E-5, F.A.C., the license or registration, operating procedures, any notice of violation about working conditions, penalty orders issued, and responses can be examined at:

FAU Environmental Health and Safety
777 Glades Rd, Bld CO 69 Rm 112
Boca Raton, FL 33431
phone 561-297-3129, fax 561-297-2210
ehs@fau.edu, www.fau.edu/ehs.

Chapter 64E-5, F.A.C., is also found at:
http://www.doh.state.fl.us/Environment/radiation/regs.htm

RSO14 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

1. General Information

Radioactive waste containers are furnished by EH&S and include: Solid/LSC vials—5 gal step cans & plastic bags; Aqueous liquids—plastic carboys (1—5 gal sizes); Sharps —plastic "sharps" containers. All radioactive waste must be properly packaged, labeled, and stored in the proper radioactive waste storage area of your lab. Label each container with an EH&S waste tag, an estimated activity for each isotope and a RSO11 log form, which should be updated as material is added to the container. Contact EH&S, 561-297-3129, for a waste pickup or if you have any questions regarding these rules.

2. Solid Waste

1. **Segregate isotopes by Half Life:**
   a. 3H and 14C have >90 day ½ life and should be placed in the same step can.
   b. 33P & 51Cr have similar ½ lives & should be placed in the same step can.
   c. 32P, 35S, 45Ca & 125I must be placed in their own separate step can.

2. **Solid Waste** must not contain any of the following items:
Liquid, Liquid Scintillation Vials, Lead, Sharps, or Biohazardous material

3. **Source Vials:** When empty or no longer used bag source vials with a copy of the applicable RSO3 form and placed in the radioactive waste storage area of your laboratory.

3. Aqueous Liquid Waste - Not Mixed Waste

1. **All isotopes** can be placed in the same aqueous liquid waste carboy.

2. **NO SINK DISPOSAL** all liquid waste must be analyzed, recorded, and processed by EH&S.

3. **RINSES** First rinses or washings of glassware or equipment used to handle isotopes must be placed into the aqueous liquid waste carboy. Second and third rinses, when proven to be at background level, can be placed down the drain.

4. Mixed Liquid Waste

1. Mixed waste is waste that is radioactive and contains another hazardous component such as a flammable, corrosive, toxic, or reactive substance

2. MIXED WASTE GENERATION IS NOT ALLOWED EXCEPT WHEN INCLUDED IN PI AUTHORIZATION. Mixed waste requires specialized waste procedures in the PI's authorization.

3. The chemical constituents must be recorded onto the waste tag and RSO11.

4. Consult the RSO if unsure whether or not generated waste is a mixed waste.

5. Liquid Scintillation Waste

1. LSC vials containing radioactive liquid must be segregated by isotope.
   a. Vials containing H-3 and C-14 may be stored in the same waste container.
   b. Vials containing P-33 and Cr-51 may be stored in the same waste container.
   c. Ca-45, P-32, S-35 and I-125 must be stored separately.

2. Vial caps must be securely tightened to prevent spills.

3. LSC vials used for counting wipe samples, and containing radioactive material, will be placed in the same appropriate waste containers as experiment vials.

4. If a wipe sample is background, the vial contents can be drain disposed, except for mixed waste. The vial can be disposed of as regular trash or re-used.

5. Empty LSC vials contaminated with radioactive material will be placed in original trays or in appropriate waste containers. All empty vials must be tightly capped to prevent leakage of any residual liquid. Each tray or bag must be labeled with a "Caution Radioactive Materials" sticker and an EH&S waste tag.

6. Biological Radioactive Waste

1. **Radioactive solid waste that contains biohazardous material** must be stored in a separate waste container provided by EH&S. This container must be labeled as "**Radioactive**" and "**Biohazardous**".

2. **Sharps** must be placed in a plastic "sharps" container and labeled as "**Radioactive**" and "Biohazardous."

3. **Animal carcasses** must be double-bagged, labeled as "**Radioactive**", and stored in an approved freezer until removed by EH&S.

4. **DO NOT AUTOCLAVE** biological/radioactive waste unless approved to do so by EH&S.

5. **Segregate by isotope half life** as listed above in the Solid Waste Section 2.

RSO15 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

Radioactive Material Laboratory Rules

1. Smoking, eating, or drinking shall not be permitted in radionuclide laboratories.
2. Food or food containers shall not be permitted in the laboratory and refrigerators shall not be used for storage of food and radioactive materials.
3. Radionuclide work areas shall be clearly designated and should, to the extent possible, be isolated from the rest of the laboratory. The work area shall be within a hood if the radioactive material to be used is in a volatile form.
4. All work surfaces shall be covered with absorbent paper which should be changed regularly to prevent the buildup of contamination.
5. Work involving relatively large volumes or activities of liquid radioactive material should be performed in a spill tray lined with absorbent paper.
6. Protective clothing shall be worn when working with radioactive materials. This includes laboratory coats, gloves, and safety glasses (when working with liquids which could be hazardous to the eyes).
7. Dosimeters shall be worn when working with quantities of radionuclides which emit penetrating radiations.
8. Mouth pipetting shall not be permitted in radionuclide laboratories.
9. Cell Phones shall not be permitted in radionuclide laboratories.
10. All containers of radioactive materials and items suspected or known to be contaminated shall be properly labeled (i.e., with tape or tag bearing the radiation logo and the word “radioactive’).
11. All contaminated waste items shall be placed in a container specifically designated for radioactive waste. Sharp items such as needles or razor blades shall be placed in a leak and puncture resistant container, labeled with the appropriate biohazard and radioactive labels.
12. A radiation survey shall be performed at the end of each procedure involving radioactive materials. All items found to be contaminated shall be placed either in the radioactive waste container or a designated area. Any personnel or items found to be contaminated shall be decontaminated as soon as possible or properly labeled. EH&S shall be notified immediately if personnel or other extensive contamination is found within the laboratory.
13. A record of the types and quantities of radionuclides possessed by each principal investigator shall be maintained.

Radioactive materials shall be protected from unauthorized removal or access at all times

Radioactive Material Emergency Procedures

Minor Spills

Incidents involving the release or spillage of less than 100 micro curies of a radionuclide in a nonvolatile form can generally be regarded as minor. In such cases:

1. **Inform** all other persons in the room at once.
2. **Clear** the room of all nonessential personnel.
3. **Call EH&S** if you feel that you cannot safely respond. If you determine that you are capable, respond as follows:
4. **Confine** the spill immediately.
   - **Liquids:** Use absorbent paper to pick up the spill. Decontaminate the area and survey. Containerize the waste and label and contact EH&S for disposal.
   - **Solids:** Solid Compounds. Take care not to spread contamination. Use wet paper towels to avoid spreading. Decontaminate the area and survey. Containerize and label and contact EH&S for disposal.
5. **Notify** Environmental Health and Safety. Phone 297-3129.

Major Spills

Incidents which occur outside the hood and involve the release of more than 100 micro curies of a radionuclide in a nonvolatile form, or the release of any amount of a radionuclide in a volatile form, should be considered “major.” In such cases:

1. **Evacuate** the room immediately shutting doors and windows on the way out.
2. **Notify** the laboratory supervisor.
3. **Notify** Environmental Health and Safety. Phone: 297-3129.
4. **Post** the laboratory door with a “Keep Out” sign.
5. **Assemble** those persons who were present in laboratory near the laboratory entrance.
6. **Wait** for assistance. Do Not track radioactive material around building.

RSO16 1/30/2014

Environmental Health and Safety: Phone: 561 297 3129 Fax: 561 297 2210 Email: ehs@fau.edu Web: www.fau.edu/ehs

Prior to offering scientific equipment for disposal, transfer, maintenance, or surplus, the Equipment Release Form must be completed and submitted to EH&S. This form must be completed by a laboratory employee who is familiar with the hazardous materials that were used or stored in the equipment. When preparing the equipment for release the following items must be completed:

1. Remove all hazardous chemical, biological, and radiological agents and hold for EH&S final release survey.
2. Decontaminate all accessible surfaces that were potentially contaminated and hold waste for disposal.
3. Document radiological surveys showing radiation levels are < 200 DPM/100cm2 and attach survey results to this form.
4. Notify EH&S if the equipment contains any of the following: Pump oil, refrigerants, asbestos, fluorescent tubes or other mercury containing lamps, radioactive sources, x-ray tubes, batteries (excluding alkaline), mercury (including switches), lead, or any other hazardous materials.
5. Complete the RSO17 and submit to EH&S. If you need assistance or have any questions please contact EH&S at 297-3129.

Principle Investigator:	**Phone:**
Person Requesting Release:	**Phone:**
Department:	
Description, Model, Serial #, FAU Barcode of Equipment:	
Building and Room Number To Be Removed From:	
Signature:	**Date:**

With the exception of hazardous materials inherent in the construction of this equipment:
(Yes/No)_____ All hazardous materials used or stored in this equipment have been removed, and
(Yes/No)_____ All surfaces potentially contaminated with hazardous materials have been decontaminated.

Decontamination Information

Chemical Agent	Decontamination Method

Biological Agent	Decontamination Method

Radiological Agent	Decontamination Method

Other Known or Suspected Hazard Not Removed	Decontamination Method Needed

EHS Signature:_____ Date:_____

RSO17 1/30/2014