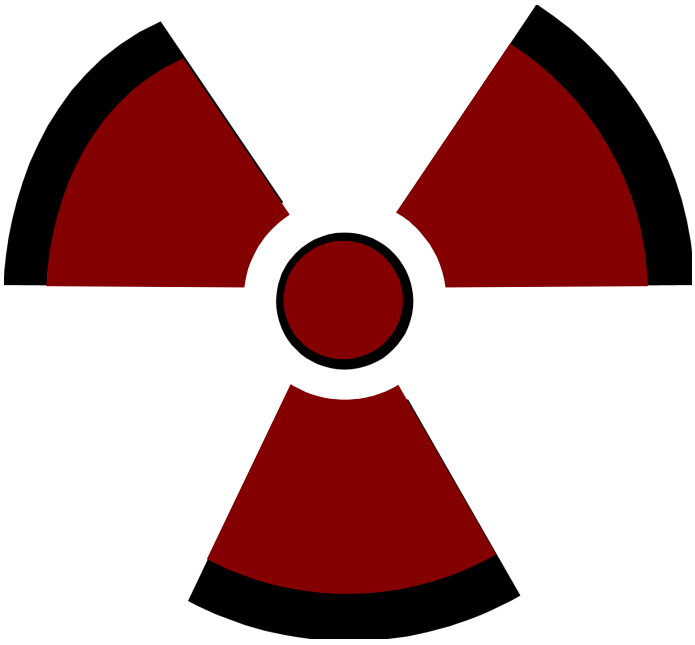
RADIOACTIVE MATERIALS

USE AND SAFETY MANUAL



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Revision History

Revision Number	Revision Date	Revised By	Description of Change
00	7/29/2019	Juliette Jones	Modification of Manual.
01	9/1/2022	Selvin McLean	Document review update to links and responsibilities. Position title update.

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INTRODUCTION

This manual establishes standards for protection against radiation hazards and sets forth the procedures and responsibilities established for safeguarding of personnel in the use of radioisotopes.

The Radiation Safety Committee (RSC) and Environmental Health and Safety (EHS) are responsible for all procurement of radioactive material at Florida Tech. The RSC and EHS are required to keep track of all radioactive materials (included sealed sources) no matter whether they are being used, stored, or disposed of as waste or in an animal carcass. They are also responsible for the health and safety of every individual within this institution.

It is the policy of Florida Tech to minimize the exposure of personnel and the public to radiation hazards, and to assure that occupational exposures to ionizing radiation are kept below the permissible limits established for employees (**A**s **L**ow **A**s **R**easonably **A**chievable or **ALARA** – see Appendix A-2 for policy).

State laws prescribe certain radiation protection procedures such as inventory, surveys, and personnel monitoring as well as require reporting of excessive radiation exposure and loss of radioactive material (Florida Department of Health 64E-5 F.A.C.). It is Florida Tech's policy to comply fully and promptly with these requirements.

1.0 General Responsibility and Instructions

1.1 A **Radiation Safety Committee (RSC)** has been designated by Florida Tech to provide necessary guidance and oversight of protocols involving radioactive materials and to ensure compliance with regulations pertaining to radioactive materials.

1.1.1 The RSC shall be responsible for ensuring radioactive materials protocols are in compliance with the Florida Department of Health (DOH), Control of Radiation Hazard Regulations, Chapter 64E-5.

1.1.2 The committee shall consist of faculty experienced in the use of radioactive materials and the **Radiation Safety Officer (RSO)**. See Appendix A-4 for the current RSC.

1.1.3 The committee will meet whenever there is a request for radioactive material use authorization by a new Principle Investigator or as requested by any member of the RSC.

1.1.4 The committee has final authority in approval of radioactive materials protocols at Florida Tech.

1.2 The RSO is responsible for the operational aspects of radiation safety to ensure compliance with RSC authorizations, Florida Department of Health (DOH), Control of Radiation Hazard Regulations, Chapter 64E-5, and any other applicable regulations.

1.2.1 The RSO reports to the department of **Environmental Health and Safety (EHS)**, which has final authority on enforcement of compliance with safety regulations at Florida Tech.

1.3 It is the responsibility of each potential Principle Investigator to report the use or planned use of radioactive materials to the RSC and to obtain the RSC's guidance on radiation protection.

1.4 All proposed uses of radioactive materials or plans to produce or obtain radioactive material shall be submitted to the RSC for prior approval.

1.5 Every individual authorized to enter radiation use areas have a responsibility to follow radiation protection guidelines. They should continuously consider the implications of their activities which could affect the safety of others and themselves. They should know when to consult the RSC, the RSO, and EHS, and they should seek their guidance early in protocol planning. Enthusiasm for their work should be tempered with an understanding and acceptance of their safety responsibilities.

1.6 All reports to the Florida Department of Health's Bureau of Radiation Control should be made through the RSO.

1.7 In the case of a radiation emergency, notify the RSO. For detailed instructions see the Appendix A-6.

1.8 Minors and pregnant women.

1.8.1 No individual under the age of 18 may handle or use radioactive material. Per 64E-5.310, minors who are present in labs that use or store radioactive materials shall be assigned a dosimeter film badge to verify that annual occupational exposures are 10 percent of the annual occupational dose limits specified for adults (per 64E-5.304).

1.8.2 Employees who wish to declare a pregnancy shall be assigned a fetal dosimeter to wear at waist level. Radiation exposure shall not exceed 50

mrem per month and 500 mrem during the gestational period as specified in 64E-5.311.

1.9 Research involving administration of radioactive materials to humans is prohibited at Florida Tech. Florida Tech's radioactive materials license does not allow radioactive materials protocols or procedures involving administration of radioisotopes to human subjects.

1.10 Handling of radioisotopes must be carried out by or under the supervision of those individuals designated as Principle Investigators by the Radiation Safety Committee and approved by Florida Department of Health Bureau of Radiation Control.

1.11 Any individual who wishes to work with radioisotopes as a Principle Investigator must fill out the Ionizing Radiation User Approval Request form (Appendix D-2) and submit it to the Radiation Safety Committee along with evidence of prior training and experience in handling isotopes.

1.12 All potential Principle Investigators must provide the RSO with a brief protocol stating the amount of isotope being used, the nature of the experiment, the safety procedures being used, and the names of potential authorized users directly involved in the protocol.

1.13 Any changes in personnel must be reported immediately to the Radiation Safety Officer.

1.14 Access to areas where radioactive materials are used or stored must be restricted. Labs where radioactive materials are used and stored must be locked and secured from unauthorized entry when unoccupied, even if only briefly.

1.15 All users must be familiar with the applicable sections of the Florida Department of Health (DOH), Control of Radiation Hazard Regulations, Chapter 64E-5. All local safety procedures are based upon these regulations.

2.0 Procedures for Obtaining Permission to Use Radioactive Materials

2.1 **Principle Investigators (PIs)** are the only personnel who can request to use radioisotopes and sealed sources. A PI is responsible for informing the RSO of their intended use of radioactive materials and radiation producing devices, providing lists of authorized users, designating "contact" people or themselves as the person responsible for inventory, survey, and waste logs, controlling access to restricted areas, maintaining postings required to restricted areas and storage locations, informing staff, faculty, or students of the "Declared Pregnancy Policy" and how to contact the RSO, enforce PPE and PMD (if required) use with authorized users, and purchase and maintain storage and survey equipment.

2.1.1 A PI is anyone who is a full-time employee of Florida Tech who will use or directly supervise the use of radioactive material in a lab.

2.1.2 To qualify as a PI, one must file documentation with the Ionizing Radiation User Approval Request from (Appendix D-2) with the RSO/RSC that states training and experience with radiation and radiation safety. This will be reviewed by the RSO and the Radiation Safety Committee.

2.1.3 After approval, PIs and their approved storage/usage locations are added to the radioactive materials license via amendment.

2.2 An **Authorized User** (or User) is an individual, either staff, faculty, or student, who is authorized to use radioactive materials or radiation producing devices. This includes PIs and radiation workers under the direct supervision of a PI. Authorized Users must have training in the handling of radioactive materials and radiation

safety. All Authorized Users are responsible for following **ALARA** principles, completing required training, wearing the correct PPE for a protocol, completing required surveys post-protocol, and reporting any contamination or incidents to the RSO.

2.3 A completed Radioactive Material Use Authorization form (Appendix D-1) must be submitted by the PI to the RSO in duplicate for each protocol requiring radioactive materials.

2.3.1 Protocols detailing how the isotope will be used, disposed of, and safety precautions/controls must accompany the Radioactive Material Use Authorization form (line 2).

2.3.2 Users listed in line 6 are all graduate students, technicians, and research associates who will be supervised by the PI in the use of radioisotopes on this project.

2.3.3 Submit the completed Radioactive Material Use Authorization form (Appendix D-3) for each user listed in line 6.

2.3.3.1 Initial radiation safety training and training in handling radioactive materials will be provided by the RSO and EHS for all Authorized Users. Users must verify that they have read and understood the Florida Tech Radioactive Materials Use and Safety Manual, applicable sections of the State of Florida, DOH, Control of Radiation Hazard Regulations 64E-5, and have completed the Introduction to Radiation Safety and Handling Radioactive Material's trainings. The Radiation Safety Committee has the responsibility for certifying that a prospective radioisotope user has adequate training and experience to safely use radioisotopes.

2.3.3.2 A Principle Investigator working with the Radiation Safety Officer may have protocol specific training in place for their users. This training must be documented and sent to the Radiation Safety Officer.

2.3.3.3 Satisfactory completion of a senior or graduate level radioisotope course taught at the Florida Tech may be substituted as initial training in the handling of radioisotopes. The radioisotope course must cover the basic principles of radiation and radioactivity, biological effects, detection of radiation, detection equipment, safe handling of radioisotopes, safety controls needed for working with radioisotopes, storage of radioisotopes, emergency and spill response, and proper disposal of radioisotopes.

2.3.3.4 Satisfactory completion of other radioisotope handling courses at institutions other than at Florida Tech may also satisfy the Radiation Safety Committee requirements for training provided that the coursework covers the required topics. Proof of this training as well as details of its scope must be sent to the RSO for approval.

2.3.3.5 All authorized users (including PIs and individuals who provided guidance such as the RSO/RSC) are required to take annual refresher training. Annual refresher training is available through the RSO our online via VIVID. The required courses are Introduction to Radiation Safety and Handling Radioactive Materials.

2.3.3.6 Individuals who work in RAM labs that will not work with or handle RAM are only required to have Introduction to Radiation Safety initially and annually.

2.4 Before any radioisotope project is started, all personnel associated with the project are required to become familiar with all the rules and regulations concerning the use of radioisotopes at the university. To this end, the PI must have a copy of the current Florida Tech Radioactive Materials Use and Safety Manual available to all users for reference. Users must also know how to access to regulations pertaining to radiation and radioactive materials (State of Florida, DOH, Control of Radiation Hazard Regulations 64E-5).

2.5 The RSO will review the completed application and will evaluate the proposed workspace including equipment and safety controls.

2.6 After evaluation, the RSO will submit application to the Radiation Safety Committee for final approval.

3.0 Procedures for Ordering Radioactive Materials

3.1 All requisitions for radioactive materials must be authorized by the RSO. This is necessary in order to ensure compliance with the allowed isotopes and quantities on our license.

3.2 Only the RSO can authorize procurement of radioactive materials which is not obtained via a purchase order, e.g. transfer from another institution. This must be done before the material is requested in order to ensure compliance with the allowed isotopes and quantities on our license.

3.3 Procurement staff are required to return all unauthorized purchase requisitions to the RSO. See memo to the Director of Purchasing (Appendix C-2).

4.0 Procedures for Receipt and Survey of Radioactive Materials Shipments

4.1 All incoming shipments of radioactive materials are routed through the Property Administration.

4.2 Property Administration staff are required to inform the RSO immediately of all radioactive shipments. Property Administration staff are not to handle radioactive shipments and to set them aside in a secure location until an individual trained in the proper receipt of radioactive materials packages picks them up. See memo to Property Administration (Appendix C-4).

4.3 The RSO or a properly trained member of EHS will conduct a metered survey of the external surface of the package within 3 hours of its arrival. Property Administration has been advised not to accept radioactive materials packages after normal work hours. If a radioactive materials package has been accepted after normal work hours, the RSO will conduct the survey within 3 hours of the beginning of the following workday.

4.3.1 Packages labeled with a Radioactive White I, Yellow II, or Yellow III label will be monitored for radioactive contamination unless the package contains only radioactive material in the form of a gas or in special form as defined in Chapter 64E-5 Part XV of the Florida Administrative Code.

4.3.2 Packages labeled with Radioactive White I, Yellow II, or Yellow III will be monitored for radiation exposure levels unless the package contains quantities of radioactive material that are less than or equal to the A1 or A2 quantities as defined in Chapter 64E-5 Part XV of the Florida Administrative Code.

4.3.3 The RSO will immediately notify the carrier and the State of Florida DOH, Radioactive Materials Section if the radiation contamination exceeds the limits of 64E-5.1505(8) or the radiation level exceeds the limits of 64E-5.1505(9).

4.4 Radioactive materials packages with physical damage to them will be monitored for radioactive contamination regardless of labeling (i.e. UN2910, UN2911, White I, etc.).

4.5 The contents of the package are identified by radioisotope, activity, and the recipient PI. A packing slip included with the package should contain this information.

4.6 The package is opened and inspected for integrity of seal. Any pigs (containers for radioactive vials) and vials should be inspected for contamination with a wipe test/liquid scintillation counts (LSC).

4.7 The containers are replaced in the package and delivered to the individual user by the Radiation Safety Officer or their designee.

4.8 Each authorized user will be familiar with the appropriate method for receiving, storage, and safe opening of their radioisotope shipment.

4.9 All radioactive material, stocks, and compounds are stored in designated areas in such a manner as to prevent any radioactive or chemical hazard.

5.0 Receipt of Materials During Off-duty Hours

5.1 Common carriers (such as FedEx and UPS) are responsible for shipments not deliverable to the Florida Tech Property Administration after hours and will need to return for delivery during office hours.

5.2 Special air mail or air freight shipments are to be delivered directly to the RSO: the RSO will ensure integrity of shipment and perform regulatory surveys before delivering to storage locations. Air mail or air freight shipments which arrive after hours or during weekend cannot be delivered and is the responsibility of the common carrier.

6.0 General Safety Instructions for Laboratory Personnel While Working with Radioactive Materials

6.1 Only authorized personnel shall be permitted in radioisotope work areas where radioactive materials are actively used. Other personnel such as maintenance, housekeeping, and security are not allowed in these areas while radioactive materials are being used unless they are escorted and monitored. Visitor badges are available: please contact the RSO. Such personnel, however, are permitted unescorted provided no radioactive material is currently being used (i.e. radioisotopes are in secured storage and shielded if necessary) and they have authorization to enter the lab. Radioisotope work areas and storage locations must be secured from unrestricted access (i.e. doors to labs locked and closed when unattended, storage fridges locked and secured).

6.1.1 PMD's must be worn whenever handling high energy beta-emitters (200 eV or greater), gamma-emitting radioisotopes (i.e. P-32), or when transporting radioactive materials outside of its DOT approved packaging. PMDs are not required for low energy beta or alpha emitting radioisotopes (i.e. H3, C14).

6.1.2 Workers must only wear the PMD assigned to them.

6.1.3 PMDs must be handled with care and should not be exposed to high temperatures, moisture, or light. When not in use, they should be stored away from radioactive materials. Do not take PMDs home.

6.1.4 PMD records will be maintained the RSO for the lifetime of the institution. Authorized Users with exposure records at previous institutions should contact the RSO to retrieve these records from the institution (RSO Form 12 in Appendix D-13).

6.2 The PI shall be responsible for records of radioisotope use, noting time and radiation level of materials used by workers, any unusual happenings and the type(s) of radioisotopes in the operation.

6.3 Eating, drinking, smoking, food preparation, food storage or the application of cosmetics is not permitted in any area approved for use of unsealed or sealed radioactive material.

6.4 The use of any type of food or drink containers for storage of radioactive materials or presence of such containers in any area approved for use of unsealed or sealed radioactive materials is strictly prohibited.

6.5 At no time shall pipetting of any solution or any similar operation involving the use of mouth suction be permitted in any area approved for use of radioactive materials. Pipetting devices shall be used for all pipetting operations.

6.6 All operations involving radioactive materials shall be confined to a suitable hood or glove box if there is any possibility that the material could become airborne (e.g., dust, volatilization, gaseous, release, source rupture). Only use fume hoods and glove boxes authorized for radioactive use (if you need authorized equipment contact the RSO).

6.7 Personnel should not be permitted to work with RAM if there are any open cuts or abrasions on exposed areas of the body.

6.8 Personal Protective Equipment (PPE) must be used when there is any possibility of personal contamination: required PPE for usage of RAM are nitrile gloves, laboratory aprons or coats, and safety glasses.

6.9 All experiments using high energy beta emitters (i.e. P32) must be carried out behind plastic shields (Lucite or Plexiglass) using mechanical pipetting devices.

Lead should be used to shield gamma emissions, but lead should never directly shield beta emitters as it can cause x-rays to be emitted (bremsstrahlung).

6.10 Post-procedure monitoring of the hands, feet, and clothing will be performed when using high energy beta (200 eV or greater) or gamma-emitting radioactive materials and prior to leaving the use area. Such monitoring will be done with a GM type survey meter (Ludlum Model 3) equipped with a pancake type "frisker" probe (Ludlum Model 44-9).

6.10.1 Instructions for post-procedure personnel monitoring.

6.10.1.1 The probe is passed slowly and deliberately over the surface of hands, feet, and clothing to be surveyed with an approximate distance of 5 mm (3/16") between the surface and the probe window.

6.10.1.2 It is important not to touch the probe to the surface to avoid damaging the window or contaminating the probe. Special plastic films or a glove may be used on the pancake to help prevent pancake contamination.

6.11 Remove contaminated gloves after handling radioactive materials by pulling the gloves inside out (to keep contamination on the inside of the gloves). Dispose contaminated gloves in solid radioactive waste containers and wash your hands after each handling operation.

6.12 All working surfaces adjacent to all manipulations involving RAM shall be covered with an absorbent imperviously backed covering.

6.13 All manipulation shall be performed over an impervious —breakage resistant tray or container, lined with a disposable absorbent impervious backed covering. The

tray or container shall also be capable of containing the entire volume involved in the manipulation.

6.14 All equipment used in contaminated or activated laboratory areas shall be thoroughly surveyed before being removed from those areas.

6.15 It shall be the responsibility of the RSO to arrange for final disposal of all radioactive waste and to provide monitoring instruments, containers for disposal of radioactive waste, radiation tape, labels and warning signs.

6.16 Radioactive wastes should be stored only in posted labs, and they should be labeled with isotope, date of waste, activity at time of waste, and the "Caution: Radioactive Waste" signage with the radiation symbol. Contact the RSO for appropriate waste labels. Waste inventory records should be current and attached to waste containers or storage areas (RSO Form 8 in Appendix D-9).

6.16.1 Depending on activity, decay type, and energy, shielding may be required (Lucite or Plexiglass for high energy betas, and lead for gamma emitters). Keep containers closed when not in use and store in secondary containment (spill trays) to prevent contamination if the container is breached.

6.17 Waste containers should be separated by isotope/half-life. Do not mix long half-life and short half-life radioactive waste, as this increases cost for disposal. Avoid comingling different short half-life isotopes. Short half-life isotopes are defined at the institution as isotopes with half-lives less than 90 days.

6.18 Avoid using other hazardous materials (i.e. volatiles, flammables, corrosives) in radioactive materials use procedures whenever possible to decrease costs generated from disposal of mixed wastes. Segregate mixed waste from aqueous (and neutral pH) radioactive waste and label in accordance with both radioactive materials labeling requirements and the requirements for labeling hazardous waste.

6.19 Any experiment involving gaseous or easily volatile radioisotope must receive the advance approval of the RSO/RSC and amendment of our radioactive material license.

6.19.1 All such experiments must be carried out in fume hoods which are properly filtered and monitored.

6.19.2 Special Precautions for volatile RAM

6.19.2.1 All general safety precautions above apply (section 6.).

6.19.2.2 Wear nitrile gloves when handling volatile RAM (volatile RAM can deposit on hands). Double gloving may be necessary if wearing a ring PMD.

6.19.2.3 After each handling operation involving high energy beta (200 eV or greater) or gamma-emitting volatile RAM, check clothing, hands, floor, and bench tops outside the fume hood for contamination using a scintillation detector or a GM type survey meter equipped with a pancake type "frisker" probe.

6.19.2.4 Volatile wastes are to be stored in closed containers in ventilated compartments such as a fume hood or fume hood cabinet (behind Plexiglass, Lucite or lead-lined shielding as needed) until picked up by the RSO.

7.0 Instructions Concerning Movement of Radioactive Materials Between Rooms, Halls, and Corridors

7.1 The halls and corridors of Florida Tech are unrestricted areas. Radioisotopes should not be handled in those areas.

7.2 Transporting radioisotopes from one posted laboratory to another through unrestricted areas should only be done after the radioisotope is properly packaged to prevent contamination and shielded such that readings do not exceed 0.2mR/hour at 1 cm from the package.

7.3 All transfer of isotopes within labs under the supervision of one PI (from one posted lab to another) should be noted on inventory sheets.

7.4 Before transferring isotopes from one PI to another PI within Florida Tech, the RSO must be notified immediately in writing on the special transfer form (RSO Form 5 Appendix D-6). Do not complete this transfer until RSO approval has been received.

7.5 Before transferring to another institute outside of Florida Tech, the RSO must be notified immediately in writing (RSO Form 5 Appendix D-6). All transfers outside the institute must be approved by the RSO, and all shipments are to be done by the RSO. Do not attempt to ship yourself.

8.0 Storage and Labeling

8.1 All radioisotopes must be stored in glass or plastic bottles or vials placed in unbreakable containers large enough to catch any spills (in case of breakage).

8.2 Any refrigerator or freezer in a non-restricted area, such as hallways, must be locked and secured (so it cannot be removed by force), and readings outside the fridge should not exceed 0.2mR/hour at 1 cm from the refrigerator/freezer.

8.2.1 The RSO does not recommend using fridges/freezers in non-restricted areas, especially for storing H3 as H3 stored for long periods can contaminate ice/condensate. Ice/condensate in fridges/freezers where H3 is stored should be periodically examined via LSC for H3 contamination.

8.3 All refrigerators which contain isotopes are to be posted with a “Caution: Radioactive Materials” sign with the radiation symbol (trefoil) and the name and phone number of the Principle Investigator.

8.4 A list(s) must be posted on each refrigerator (RSO form 6 in Appendix D-7) noting the types, activities, and date of activities of the isotopes contained therein. Each Principle Investigator must keep an inventory of the amount isotopes in their possession and report the amount monthly to the RSO (RSO form 7 in Appendix D-8).

8.5 The RSO must be notified immediately whenever there is a discrepancy in the amount or number of radioactive materials in inventory (i.e. missing stocks, loss of inventory). Lost stocks must be reported by the RSO to the Florida DoH immediately.

8.5.1 Prevent loss/theft by keeping unauthorized individuals out of posted areas, by keeping labs/fridges/storage containers locked when unattended/not in use, and by notifying the RSO of any changes to authorized lab personnel. Report any suspicious activity to security.

8.6 Laboratories using radioisotopes must have the prescribed notices prominently posted. This includes the a “Caution: Radioactive Material" sign with the radiation symbol, the Form 3 “Notice to Employees,” and the Emergency Notice Poster with the 24-hour contact information of the RSO and Florida DOH affixed on all entrance doors. Access to posted labs is to be restricted to authorized users. Access to posted labs must be secured by lock or keycard access. Do not leave doors unlocked or propped open when unattended.

8.7 Each storage container (i.e. vial, radioactive waste container) must have the proper label affixed that displays a "Caution: Radioactive Material" sign with the radiation symbol; containers in use may use temporary tags.

9.0 Routine Area Survey and Monitoring Procedures

9.1 All authorized users that are likely to meet or exceed the occupational dose limits (as specified in 64E-5.315 F.A.C.) must wear Personal Monitoring Devices (PMDs). These are delivered to all authorized users at the beginning of each month by the RSO and are picked up at the end of the month for processing along with copies of monthly inventory sheets and protocol, post-protocol, and routine survey records.

9.2 A routine survey and monitoring schedule must be observed for all laboratories using unsealed radioisotopes (RAM).

9.2.1 The immediate work area where RAM have been used must be wipe tested for removable contamination. Isotopes that can be detected by survey meters (such as high energy beta emitters and gamma emitters) can instead be surveyed with a meter: if contamination is detected with a survey meter, a wipe test shall be conducted for removable contamination. Record results of daily meter surveys (if required) and wipe tests (form RSO-10 Appendix D-11).

9.2.2 Radiation surveys are required weekly for labs where RAM are in regular use to check for contamination, and surveys are required monthly for storage (no use or no current usage) locations of RAM (use form RSO-9 in Appendix D-10).

9.2.2.1 High energy betas (P32) and gamma emitters should be surveyed with a calibrated meter with a GM pancake probe (the RSO supplies annually calibrated Ludlum Model 3 meters with Model 44-9 probes) in addition to wipe tests for removable contamination. Low energy betas (C14, H3) and alpha emitters must be surveyed by wipe test/scintillation

counter (a Beckman LS6500 in Room 202 of OLS has programmed rack cards for a wide window and specific isotopes (i.e. H3/C14/P32)).

9.2.3 A copy of laboratory surveys must be forwarded to the RSO at the end of each month for review. Copies should also be kept for auditing purposes. Survey records must be kept for three years.

9.2.4 All new laboratories using radioisotopes will be monitored by survey meter and wipe tests by the RSO at least once a month for three months.

9.2.5 The routine frequency survey period of every month in new laboratories will be changed to quarterly if after three months the following conditions are met:

9.2.5.1 No contamination levels are found either by the user or the RSO to equal or exceed 100 dpm/100 cm^2 for alpha emitters and 1000 dpm/100 cm^2 for any beta or gamma emitting radioisotope.

9.2.5.2 The working conditions during the three-month period, with respect to the potential for contamination, are representative of working conditions during the period in which the quarterly monitoring and survey will be employed, and there is no reasonable expectation that the criteria in 9.2.5.1 will be exceeded.

9.2.6 The RSO will survey monthly, any lab where contamination levels are exceeded, for 3 months after the contamination is found until the conditions in 9.2.5 are met or until authorization is revoked (per RSC recommendation).

9.3 The instructor of a laboratory in which radioisotopes are used as teaching aids is responsible for conducting an area survey/wipe immediately following the conclusion of each teaching session. Results of these surveys and wipes must be returned to the RSO (RSO form 10 Appendix D-11).

9.4 Radiation levels are to be kept **a**s **l**ow **a**s **r**easonably **a**chievable in all restricted and unrestricted areas (ALARA). All requirements of Part III section 64E-5.304 and 64E-5.312 F.A.C. shall be followed.

9.5 Every effort will be made to maintain radiation exposure in restricted areas, as low as reasonably achievable (ALARA). In keeping with ALARA, it is our intention that no individual in a restricted area will receive a whole-body dose of more than 125 mrems per calendar quarter (500 mrem annually).

9.5.1 Exposures greater than 125 mrems per calendar quarter but less than 325 mrems per calendar quarter will require consultative action by the RSO. The RSO, in consultation with the Principle Investigator, will review their radioactive use practices and take appropriate action to reduce the exposure below 125 mrems per calendar quarter. The RSO will prepare a report of their findings and actions taken to reduce the exposure for the RSC.

9.5.2 Exposures greater than 325 mrems per quarter constitute a major investigative action by the RSC. The RSO along with the RSC will investigate the practices and procedures which resulted in the over exposure to determine the necessary action required to reduce the exposure. The RSO will prepare a report of the RSC's findings and actions taken. Exposures greater than 325 mrems per quarter will be reported to Florida Department of Health Bureau of Radiation Control.

9.6 All records of surveys are kept in the office of the RSO. All surveys records must be retained for three years.

9.7 Radioactive materials and animal research:

9.7.1 Before starting any protocol involving radioisotopes and animals, the RSO, IACUC, and the RSC must be notified on the proper form, and authorization by all committees must be given before proceeding. All animal radioisotope experiments must be carried out in designated (i.e. posted and secured) radioisotope use areas only.

9.7.2 Each use supervisor is responsible for the cleaning of cages and trays. Waste is to be placed in radioactive waste containers that are provided and must be labeled accordingly. Considerations for waste storage must be considered (i.e. freezer storage for animal carcasses). Disposal of radioactive animal waste must be requested via the RSO (RSO form 4 Appendix D-5)

9.7.3 Animal carcasses containing 0.05 mCi or less of Tritium (H3) or Carbon 14 (C14) per gram averaged over the weight of the entire animal can be discarded without regard to its radioactivity.

9.7.4 See Appendix E-7 of this manual for information and guidelines concerning use of the animal facilities and animal care.

10.0 Sealed Sources

10.1 Sealed sources are encapsulated or plated radioactive materials that provide protection from contamination provided the encapsulation isn't broken or damaged. Examples of sealed sources include electron capture devices, static elimination strips, calibration sources, and spectroscopy sources.

10.2 The following procedures for sealed source usage must be followed:

10.2.1 Electron capture device sealed sources must not be removed from their container. Plated sources should not be excessively rubbed or handled. Tampering with the encapsulation of any sealed source is prohibited.

10.2.2 Keep sources locked in safes/drawers when not in use.

10.2.3 Keep a log of use including date, isotope, serial number if available, log out time, log in time, and name of user (RSO form 19 Appendix D-20).

10.2.4 All users of radioactive materials, including sealed source users, must be trained in radiation safety and use of radioactive sealed sources initially and annually. Sealed source only uses may either take the two trainings required of all RAM users (Introduction to Radiation Safety and Handling Radioactive Materials), or they may take the specialized Sealed Source User Training.

10.2.4.1 Users of unsealed sources must take Introduction to Radiation Safety and Handling Radioactive Materials: they cannot take the Sealed Source User Training as a substitute.

10.2.4.2 Faculty, staff, and students that work in labs with sealed sources (but do not handle them) or who have equipment containing static elimination strips only need Introduction to Radiation Safety initially and annually.

10.2.5 All licensed sealed sources must be inventoried annually, and the records are kept by the RSO for three years. A leak test must be performed by the RSO at least every 6 months on every sealed source except for:

10.2.5.1 Sealed sources containing only radioactive material with a half-life of less than 30 days;

10.2.5.2 Sealed sources containing only radioactive material as a gas;

10.2.5.3 Sealed sources containing 100 microcuries (3.7 MBq) or less of beta or photon-emitting material or 10 microcuries (370 kBq) or less of alpha-emitting material; or

10.2.5.4 Sealed sources that are listed on the radioactive materials license as being in storage only.

10.3 Leak test and inventory records are kept in the office of the RSO for three years.

10.4 Out of service sources will be maintained in storage at the Radiation Safety Office. Sources may not be put back into service without approval of the RSO and the subsequent amendment of the license to allow such use.

11.0 Bioassay Procedure for Hydrogen 3

11.1 Florida Tech recognizes its responsibilities to its employees in the area of radiation safety. As part of this concern, not only does Florida Tech provide routine film badge service, but also bioassay checks for airborne radioactive contamination, primarily Hydrogen 3 (H3).

11.2 All personnel handling 1 mCi or more of H3 in the form of nucleotides or nucleotide precursors is required to participate in the Florida Tech bioassay program.

11.3 The Radiation Safety Office must be informed in writing of anyone intending to use greater than 1 mCi of H3.

11.4 Hydrogen 3 (Tritium).

11.4.1 Urinalyses are required of personnel handling 1 mCi or more or H3 at any one time or total amount processed per month.

11.4.2 It is the responsibility of the Principle Investigator to see that the urinalysis is performed on personnel in his/her area as required.

11.4.3 The procedure for conducting the urinalysis for H3 are found in Appendix E-2.

11.4.4 The forms for reporting the results of the urinalysis to the RSO in the Appendix (RSO Form 11 in Appendix D-12)

12.0 Radioactive Waste Disposal

12.1 Radioactive waste is defined as any radioactive material that is not specifically provided for by regulation. Forms of waste are:

12.1.1 Solid waste -- Includes contaminated glassware, plastic ware, paper, gels, animal carcasses, plant tissue, disposable gloves, etc.

12.1.2 Liquid waste -- Includes glassware rinsing or any other water miscible radiochemical.

12.1.3 Scintillation material -- Includes the scintillation cocktail as well as the scintillation vial containing it.

12.2 The following radioactive material may be disposed of without regard to its radioactivity if:

12.2.1 0.05 microcurie (1.850 kBq) or less of hydrogen 3 or carbon 14 per gram of medium used for liquid scintillation counting, and

12.2.2 0.05 microcurie (1.850 kBq) or less of hydrogen 3 or carbon 14 per gram of animal tissue averaged over the weight of the entire animal tissue averaged over the weight of the entire animal; provided, however, tissue may not be disposed of under this section in the manner that would permit its use either as food for humans or as animal feed.

12.2.3 Records of disposal of material are kept in the office of the RSO (RSO-15) for the lifetime of the institute.

12.3 Radioactive waste is collected in plastic-lined primary containers, polyethylene bottles, vial boxes (scintillation waste), or steel shipping drums.

12.4 All radioactive waste disposals shall be authorized by the RSO.

12.5 All radioactive waste is picked up by the RSO or trained EHS staff member.

12.5.1 All waste containers of radioactive material must be properly labeled. Each container of radioactive waste must have a properly completed radioactive waste tag affixed to it. All information must be legible, in indelible ink, and include the isotope, date, estimated activity at date on label, and the PI's name. Please contact the RSO for proper labels

12.5.2 In addition to the radioactive waste label, please attach information to the container labeling any hazards in the waste. This is needed to determine whether waste can be disposed of by decay or sewer or if it also needs to be treated as hazardous waste.

12.5.2.1 Do not mix other hazardous waste with radioactive waste as this increases the cost of disposal. Please see Florida Tech's Chemical Hygiene Plan for information on avoiding mixed waste.

12.6 Radioactive wastes are disposed of in the following manner:

12.6.1 Decay -- If the radioactive material is short lived (less than 90 day half-life), it will be stored until the activity has decayed to acceptable levels (at least 10 half-lives). After a survey (GM meter/LSC) verifies the contents are decayed, the material will then be released by the RSC to be disposed of as conventional waste. Any radiation signs/labels shall be removed/destroyed before disposal in this manner.

12.6.2 Sewer disposal -- All radioactive material to be discharged into the sanitary sewer must be readily soluble or dispersible in water, neutral in pH, and will meet the requirements of 64E-5.330, State of Florida Bureau of Radiation Control, State of Florida Bureau of Radiation Control, ALIs, DACs, and Effluent Concentrations, June 2012, Table III, and City of Melbourne Prohibited Discharge Standards and Local Limits. See section 12.7 of this manual for more information on sewer disposal.

12.6.3 All long-lived radioactive liquid waste and liquid waste that cannot be discharged into the sewer will be solidified in Portland cement and disposed as solid waste. The waste will be monitored and packaged for shipment to an approved commercial site. See section 12.8 of this manual for more information on solid waste disposal.

12.6.4 All solid wastes are collected by the RSO and are disposed of as in section 12.8 of this manual.

12.7 Release of radioactive waste to the sanitary sewerage system.

12.7.1 All release of radioactive waste shall be authorized by the RSC and done only by the RSO.

12.7.2 All radioactive material to be discharged into the sanitary sewerage system must be readily soluble or dispersible in water: no non-aqueous wastes may be disposed of in the sewer.

12.7.3 All radioactive wastes may be disposed of to the sewer if the concentrations are not greater than the limit specified in 64E-5.330, State of Florida Bureau of Radiation Control, State of Florida Bureau of Radiation Control, ALIs, DACs, and Effluent Concentrations, June 2012, Table III, and are no longer radioactive per the requirements of the City of Melbourne Prohibited Discharge Standards and Local Limits. The only dilution that can be used is that which is immediately available to the individual project.

12.7.4 All liquid wastes shall be surveyed prior to disposal to verify that it is no longer radioactive.

12.7.5 Waste disposal records shall be maintained for each project.

12.7.6 All liquid radioactive waste, which cannot be disposed of into the sewer, shall be collected by the RSO for appropriate disposal.

12.8 Solid Waste Disposal.

12.8.1 Solid waste which does not meet the criteria established in section 12.2 of this manual will be picked up by Chem-Nuclear Systems for disposal at their Barnwell, SC site.

12.8.2 Solid wastes such as plant tissue, animal carcasses, and cage litter will be sealed in plastic bags and stored frozen until it can be removed by routine waste disposal.

12.8.3 Contaminated paper products, plastic, glass, foil, planchets, etc. shall be stored in plastic-lined, 55-gallon steel drums until quantities have accumulated to warrant the removal by the RSO.

12.8.4 All solid waste shall be picked up by the RSO. The solid radioactive waste containers shall be labeled to indicate the radioactive material(s) and corresponding activity(ies) in microcuries, the name of the use supervisor, and any other appropriate cautions or labels.

12.8.5 All solid waste shall be surveyed by the RSO before packaging for shipment to the approved site for burial.

12.8.6 Solid waste in which no radioactivity remains, as determined by measuring the radiation level at the surface of the container with a survey instrument set on its lowest setting with a result indistinguishable from background will be disposed of as conventional solid waste after all radioactive labels have been removed/destroyed.

12.8.7 Any solid waste suspected of being contaminated with Hydrogen 3 or Carbon 14 and does not qualify for disposal under section 12.2 of this manual is considered contaminated and is included with the radioactive solid waste for disposal.

12.9 Disposal of liquid scintillation materials.

12.9.1 Due to the hazards and disposal costs associated with toluene, it is not allowed at Florida Tech for use as a scintillation cocktail. Only biodegradable and environmentally safe cocktail is allowed. Contact the RSO for questions regarding what scintillation cocktail to use.

12.9.2 Keep vials separated by isotope whenever possible.

12.9.3 Scintillation vials should be capped and returned to their original trays for waste pick up. Please store them vertically.

12.9.4 Make sure that P-32 scintillation waste is properly shielded.

12.9.5 H-3 and C-14 Scintillation waste may be disposed of as non-radioactive waste if it meets the criteria in section 12.2 of this manual.

13.0 Emergency and Accident Procedures

13.1 The term "emergency" is taken to mean any incident resulting from the use or misuse of radioactive materials or a radiation producing device that would present a hazard to personnel or imperil equipment, facilities, or other experiments due to the spread of contamination or creation of hazardous radiation levels. Emergencies include (but are not limited to) theft or loss of radioactive materials, damage to RAM or sealed sources, spills, injuries to personnel, and fires.

13.1.1 Emergencies resulting from accidents of this nature may range from a minor spill of radioactivity, involving relatively no personnel hazards, to major radiation incidents involving extreme hazard and possible bodily injury. Because of the numerous complicating factors which may arise, and because of the wide range and variety of hazards, set rules of emergency procedures cannot be made to cover all possible situations. In any emergency, however, the primary concern shall always be the protection of personnel from radiation hazard. The secondary concern is the confinement of contamination or radiation to the local area of the accident to the extent that is possible. Quick, efficient action taken under the following guidelines should reduce any hazard to personnel and/or resultant area contamination.

13.1.2 The prompt evaluation of a radiological incident and immediate remedial action response is paramount in minimizing injury to personnel, minimizing loss of property, and for protection of the public health and safety. Call lists have been posted in all posted areas and with the security department. If a radiation incident or hazard is suspected, dial the numbers on the call list immediately for assistance.

13.2 All accidents.

13.2.1 The most experienced individual present shall determine the extent of the hazard and direct operation under the following guidelines until the arrival of the RSO. The posted call lists in all approved areas provide 24-hour emergency coverage.

13.2.2 Persons splashed with radioactive solution shall wash immediately with ample quantities of soap and water for no less than five minutes.

13.2.3 If possible collect wash and rinse in buckets or containers to prevent discharge of radioactive materials. Remember that safety of personnel comes first: do not avoid decontamination of a person with soap and water to avoid discharge of radioactive materials. Contain discharge to the extent possible to minimize spread of contamination from discharge.

13.2.4 The RSO shall be informed immediately of any inhalation or ingestion of radioactive material or any splashing of radioactive material on a person.

13.2.5 In the event of loss or theft of radioactive material, notify the RSO immediately. The RSO must report losses and thefts to the Florida Department of Health by telephone immediately and provide a written report per 64E-5.343 within 30 days.

13.2.6 Damage to radioactive materials should be reported to the RSO immediately. Do not handle RAM or sealed sources that have been suspected to be damaged until they have been assessed and approved by the RSO (i.e. tested for contamination or leak tested).

13.3 Minor accidents - Contamination levels below 1000 DPM/100 cm^2, exposure levels less than 2 mR/hr at 5 cm, or spills less than 2 L.

13.3.1 Notify all other persons in the room at once.

13.3.2 Survey all personnel in the area and change clothes as necessary.

13.3.3 Restrict access to the area to only the minimum number of persons needed to deal with the accident.

13.3.4 Contact the RSO to report the spill and to obtain assistance in removal of the contamination.

13.3.5 Limit contamination to as small an area as possible with absorbent material or coverings.

13.3.6 Wear protective gloves and remove contamination with appropriate materials.

13.3.7 Permit no one to resume work in the area until approval of the RSO is secured.

13.4 Major accidents - Contamination levels above 1000 DPM/100 cm^2, exposure levels greater than 2 mR/hr at 5 cm, spills greater than 2 L, or any contamination of personnel.

13.4.1 Notify all persons in the lab of the spill. If there is no immediate risk of contamination or exposure to personnel involved in the spill, call the RSO immediately. Otherwise use the following instructions to decontaminate personnel involved, as necessary, mitigate the spread of the spill, and have someone not involved with the spill contact the RSO immediately. Provide the location of the spill and a short explanation (i.e. isotope and activity spilled).

13.4.2 Limit the movement of persons involved in the spill to confine the spread of contamination. Persons not involved in the spill should vacate the room/area.

13.4.3 If there is no exposure risk to personnel, the use of absorbent materials to slow or prevent the flow of radioactive liquid into cracks, crevices or drains should be employed. If the spill is liquid, use gloves to right the original container and prevent further spill; otherwise use a stick or lever.

13.4.4 If the spill is on the skin, wash thoroughly with soap and water for not less than five minutes. Rinse thoroughly. Collect all discharge of rinse and wash as liquid radioactive waste: mitigate release into drains and sinks as much as possible.

13.4.5 If the spill is on clothing, remove outer or protective clothing at once and immediately survey skin under contaminated clothing. If skin is contaminated, treat as in 13.4.4. Place contaminated clothing in a plastic bag and set aside. Short half-life contaminated clothing will be held in storage by the RSO for decay. Long half-life contaminated clothing will be decontaminated by the RSO if removable. Otherwise, the clothing will have to be treated as solid radioactive waste.

13.4.6 Switch off all fans where possible.

13.4.7 Vacate the room and prohibit entrance to the contaminated area.

13.4.8 Decontaminate the area only after RSO arrival and assistance. The RSO will provide proper support personnel and equipment to decontaminate large spills.

13.4.9 Under no circumstances shall untrained persons attempt to examine or clean up the radioactive materials without the explicit directions of the RSO.

13.4.10 Continue monitoring of personnel involved in the clean-up operation to mitigate spread of contamination.

13.4.11 Permit no personnel to resume work in the area without the approval of the RSO.

13.5 Accident involving radioactive dust, mists, fumes, organic vapors and gases.

13.5.1 Notify all persons to vacate the room immediately.

13.5.2 Every attempt should be made to shut down ventilation systems if the contamination is airborne. Other areas of the building which may be contaminated shall also be vacated. In shutting down ventilation systems and closing of windows, doors, and vents, persons securing the above should where respiratory protection devices when possible. Doors and other openings should be sealed with masking tape from the outside, where possible.

13.5.3 Vacate the room.

13.5.4 Notify the RSO at once.

13.5.5 Check that all doors giving access to the room are closed. Post conspicuous warning guards to prevent accidental opening of doors.

13.5.6 Monitor all persons suspect of contamination. Proceed with decontamination of personnel if applicable.

13.5.7 Report at once to the RSO all known or suspected inhalations of radioactive materials.

13.5.8 Permit no one to enter without the approval of the RSO.

13.5.9 Decontamination of the area shall be done only as directed by the RSO.

13.5.10 Air survey of the area shall be performed before work can be resumed.

13.5.11 No person shall resume work in the area without approval of the RSO.

13.6 Injuries to personnel involving radioactive materials.

13.6.1 Flush minor wounds immediately under running water. Collect discharge to the extent possible.

13.6.2 Seek immediate medical treatment.

13.6.3 Report all personnel radiation accidents (wounds, overexposure, ingestion, and inhalation) to the RSO as soon as possible.

13.6.4 Submit a complete history of the accident and subsequent activity to the RSO.

13.6.5 No person involved in a radiation injury shall be permitted to return to work without the approval of the attending physician and the RSO.

13.7 Fires or other major emergencies.

13.7.1 Notify all persons in the room and building at once for evacuation.

13.7.2 If trained to do so, you may put out small fires by approved means if there is no immediate radiation hazard. Otherwise, evacuate the building but stay near where emergency personnel will arrive. All persons involved in the emergency should also report to this area to minimize any possible contamination.

13.7.3 If lives are in danger or a major fire is in progress, call emergency services (911) immediately after evacuating the building. Notify the university security officer and the RSO for all emergencies.

13.7.4 Ensure that firefighting or other emergency activities are governed by the restrictions of the RSO. Avoid tracking of contamination or passing of contaminated equipment into clean areas by emergency workers.

13.7.5 Monitor all persons involved in the emergency.

13.7.6 No persons shall resume work in the area without the approval of the RSO.

13.7.7 Since Florida Tech has no fire-fighting equipment, the university must rely on the Melbourne Fire Department for fire protection. The university's Security Department has a fire safety officer who is the liaison between the university and the Melbourne Fire Department. The university fire safety officer has been informed as to the location of areas of radioactive material and is updated to all changes in usage of

areas as they occur. The Melbourne Fire Department has been made aware of the locations and hazards associated with radioactive materials. The university Security Department immediately calls the RSO when any emergency is reported that might involve the radioisotope areas.

14.0 Decontamination Techniques

14.1 Decontamination techniques are needed for personnel and areas.

14.1.1 Damp wiping and mopping with water and detergent are the first steps. If the chemical characteristics of the contaminant are not known, detergent of neutral pH is preferable to soaps, which in some instances may cause fixation of certain nuclides rather than removal.

14.1.2 Complexing agents, e.g. citric acid or chelating agents (EDTA, DTPA) in combination with detergent or soap increases the cleaning efficiency; the action of chelating agents is accelerated by warming.

14.1.3 Occasionally, a weak hydrochloric or nitric acid wash may be of value. The procedure for decontamination is given below.

14.2 Preoperational.

14.2.1 Plan the decontamination operation thoroughly and obtain supplies.

14.2.2 Provide adequate protection for all personnel involved in decontamination and provide adequate replacement PPE.

14.2.3 Provide safe storage of all radioactive wastes and decontamination supplies.

14.3 Operational.

14.3.1 Always work toward the center of contamination.

14.3.2 Take care not to spread or track contamination to cleaner (lower activity) areas.

14.3.3 Monitor frequently and thoroughly.

14.3.4 Cover clean areas with plastic sheets, Kraft paper, or its equivalent.

14.4 Post-Operational.

14.4.1 Quarantine all used cleaning solutions and decontamination equipment until they can be monitored for contamination.

14.4.2 Contaminated cleaning solutions and decontamination equipment (such as used paper towels and rinse liquid) shall be disposed of only in radioactive waste containers.

15.0 Radiation Producing Devices

15.1 Florida Tech has radiation producing devices including X-ray diffractors (XRDs) and electron microscopes.

15.2 Contact the RSO when purchasing radiation producing devices. All devices must be registered with the State of Florida DOH.

15.3 New radiation producing devices may be assigned a PMD as an area monitor to verify that doses are under 100 mrem annually (the dose limit for the general public). If it is determined after a time (five years of exposures within limits) that

the device does not pose an exposure risk to the general public, the area monitor may be discontinued.

15.4 If machines are not functioning correctly or damaged contact the manufacturer for maintenance. Do not use until it is accessed.

15.5 Contact the RSO when disposing of a radiation producing device.

APPENDIX

Appendix A: ORGANIZATION AND GENERAL INFORMATION

ALARA POLICY

1) The ALARA Philosophy

Part III of Chapter 64E-5, Florida Administrative Code (FAC), establishes standards for protection against radiation hazards. Section 65E-5.303, FAC requires licensees to use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are **A**s **L**ow **A**s **R**easonably **A**chievable (**ALARA**). Management, the radiation safety officer (RSO) and all authorized users must participate in the establishment, implementation and operation of a radiation protection program that applies the **ALARA** philosophy of minimizing exposures to radiation.

The primary concept of the **ALARA** philosophy is that unnecessary exposure to radiation should be avoided even though current occupational exposure limits provide a very low risk of injury. The objective is to reduce occupational exposures (both individual and collective) as far below regulatory limits as is reasonably achievable by means of good radiation protection planning and practice.

2) MANAGEMENT COMMITMENT

We, the management of Florida Tech, are committed to the **ALARA** philosophy of maintaining occupational and public radiation doses as low as reasonably achievable.

a) It will be a management priority that all personnel working with radioactive material be made aware of our commitment to the **ALARA** philosophy and that they be instructed in the procedures to be used to keep their exposures as low as possible.
b) Management has delegated authority to our RSO to ensure adherence to **ALARA** principles. Management will support the RSO in instances where this authority must be asserted.
c) Management will make all reasonable modifications to procedures, equipment and facilities to reduce exposures, unless the cost is considered unjustified. We will be prepared to describe the reasons for not implementing modifications that have been recommended.

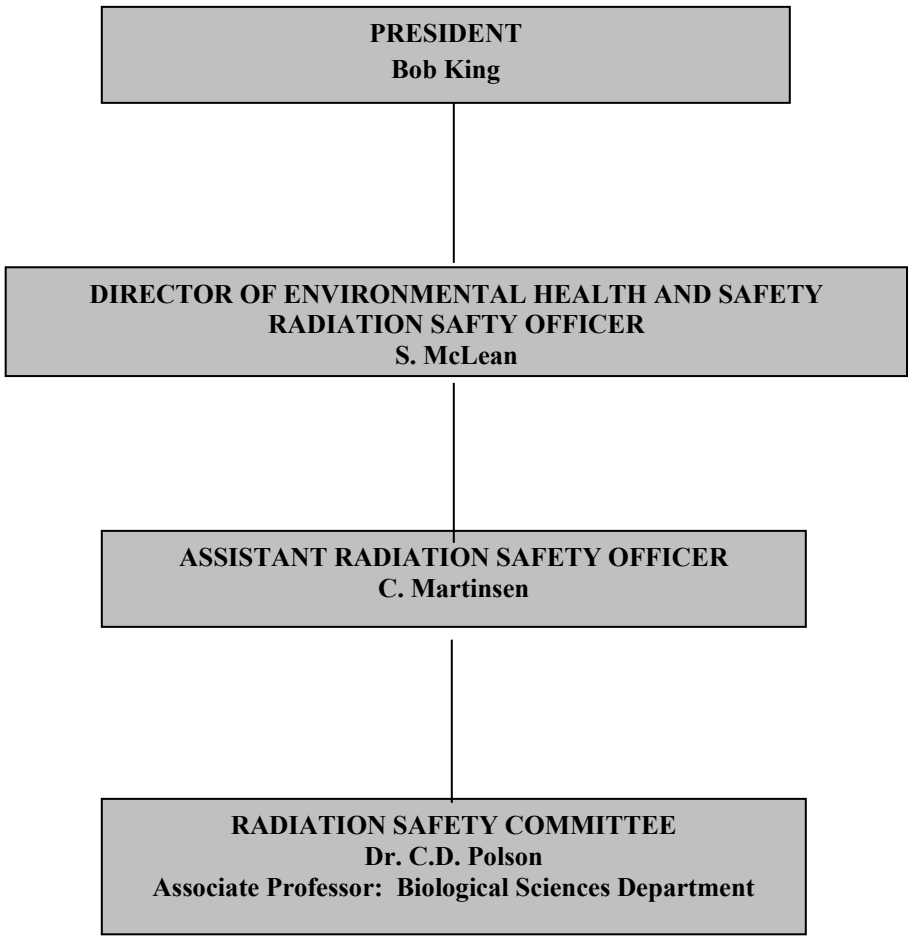
3) RADIATION SAFETY OFFICER COMMITMENT

a) The RSO will emphasize the **ALARA** philosophy to all personnel working with radioactive material and will instruct workers to review current procedures and propose changes to reduce exposure levels.
b) If personnel monitoring is conducted, the RSO will review dosimetry reports for all monitored personnel upon receipt (monthly for film badges or quarterly for TLDs) to determine if unnecessary exposures are being received. The RSO will sign and date each report reviewed. The RSO will investigate within 30 days the cause of any personnel exposure considered to be excessive. If warranted, the RSO will take corrective actions to ensure that unnecessary exposures are halted, and recurrence is prevented. A report of each investigation and the actions taken, if any, will be recorded and maintained for inspection purposes.
c) At least annually, the RSO will conduct a formal review of the radiation protection program's content and implementation, as required by subsection 64E-5.303(3), FAC. The review will include an evaluation of equipment, procedures, inspection findings, and any incidents. The RSO will assess trends in occupational exposures as an index of the program's success and to determine if any modifications to the program are needed. A summary of the results of each annual review, including a description of actions proposed and taken, if any, will be documented by the RSO, discussed with management, and signed and dated by both. A report on each audit will be maintained on file for 3 years from the date of review, in accordance with section 64E-5.335, FAC.

4) WORKER COMMITMENT

All personnel working with sources of radiation will adhere strictly to policies and procedures applicable to activities involving radiation sources and will apply **ALARA** principles and good work practices to minimize their occupational exposures. *Time, distance* and *shielding* will be used to keep exposures **ALARA**. When working with sources of radiation, minimize the time spent near the source, maximize the distance from the source, and make use of available radiation shielding. Workers must report to the RSO any conditions in the workplace that have the potential for causing unnecessary exposures.

Radiation Safety Organization



RADIATION SAFETY COMMITTEE

MEMBERS:

1. C.D. Polson, Associate Professor, Department of Biological Sciences
2. S. McLean, Director/Radiation Safety Officer, Department of Environmental Health and Safety
3. C. Martinsen, Assistant Radiation Safety Officer, Department of Environmental Health and Safety

EMERGENCY CALL LIST

	OFFICE	HOME
S McLean, RSO	x.8889/x7715	
C. Martinsen, ARSO	x.7562	
Dr. C.D. Polson	x.7480	
Security Office	x.8111	--------

SYLLABUS
RADIATION SAFETY TRAINING COURSE
(For new users of radioactive materials)
Florida Institute of Technology

Reading:
1) Florida Tech Radiation Safety Manual
2) Florida Department of Health – Control of Radiation Hazard Regulations – Part III

The course consists of two parts:
1) 4 hours of formal (classroom) training
2) 2 hours of laboratory training

In addition, a 50-question multiple choice exam will be given at the end of the classroom and laboratory training. A grade of 75% will be required to pass the course.

Topics in the formal training are:

1) What is radiation:
    a) Ionizing radiation
    b) Background radiation
    c) Biological effects of radiation
2) Characteristics of Commonly Used Radionuclide
    a) Mode of Decay
    b) Half-life
    c) Energy
    d) Range
    e) Shielding
    f) Handling and associated hazards
3) General Radiation Safety Practices
    a) How to limit exposure (time, distance, shielding); **ALARA** principle
    b) How to minimize contamination
    c) Personal Monitoring (film badges, etc.)
4) Survey for Radioactive Contamination
    a) How to use a survey instrument
    b) How to do a wipe test
    c) Decontamination guidelines
    d) What to do in case of a major spill
5) Management of Radioactive Material
    a) Instructions for ordering radioactive material
    b) How to keep an inventory of radioactive items
    c) How to record usage of radioactive material
    d) Where to put radioactive waste
    e) How to complete radioactive waste records
    f) How to dispose of radioactive waste
    g) Monthly records; what information is needed and how to fill out forms

Topics in the laboratory training sessions are:

I. Radiation Work Area
    a. How to set up work area, including waste containers
    b. Proper labeling of radioactive materials and containers
    c. Location of required posted material
    d. Location of Radiation Safety Manual
II. Personal Safety

a. Protective clothing
b. Likely areas of contamination
c. How to move samples safely within the work area
d. Demonstration of how to survey the work area for contamination
e. Five sites most likely to be contaminated
f. Demonstration of how to clean up the work are

Appendix B: FLOOR PLANS/FACILITY DESCRIPTION

LEGEND:

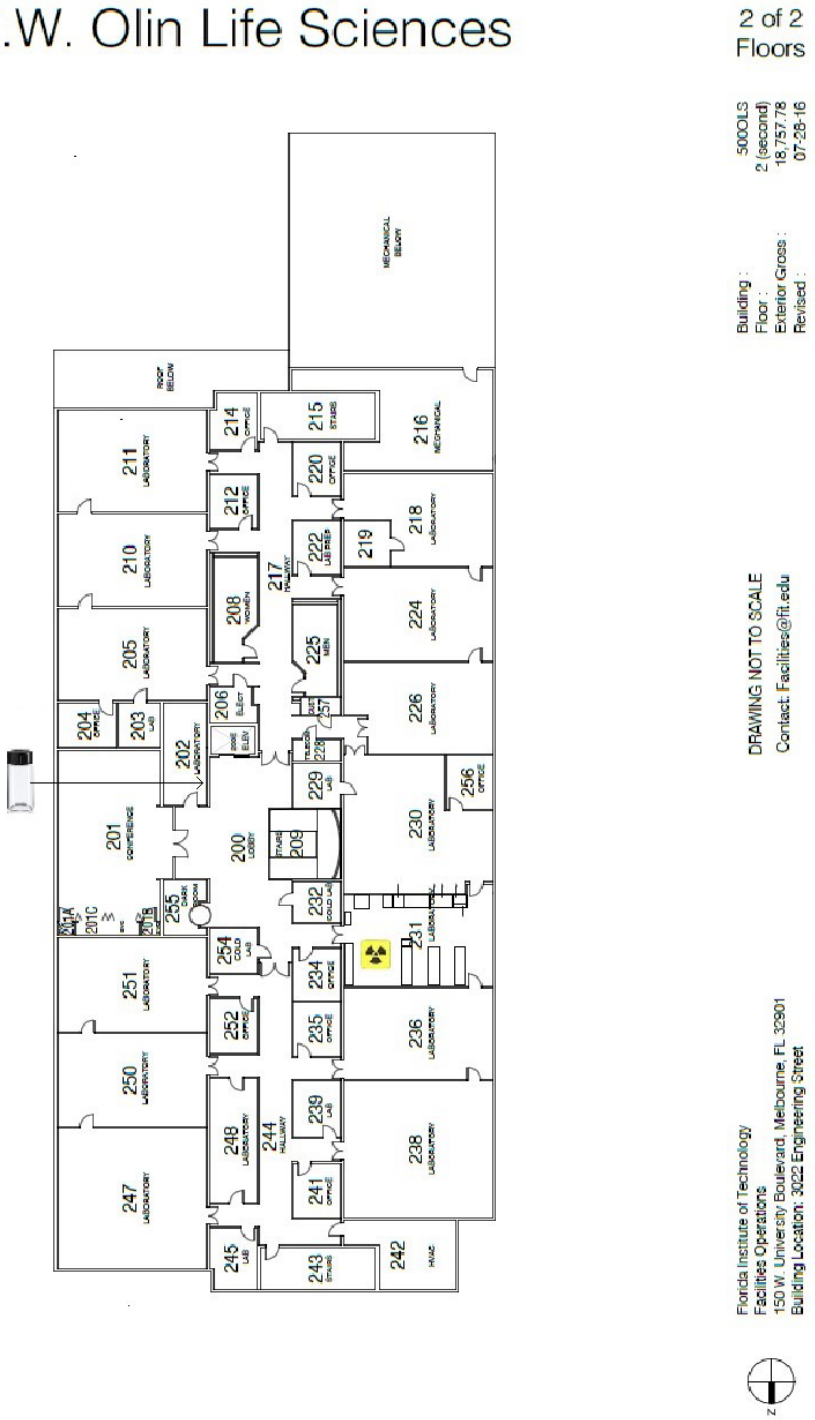
- storage/use of radioactive materials

- use of radioactive materials only

- storage of radioactive materials only

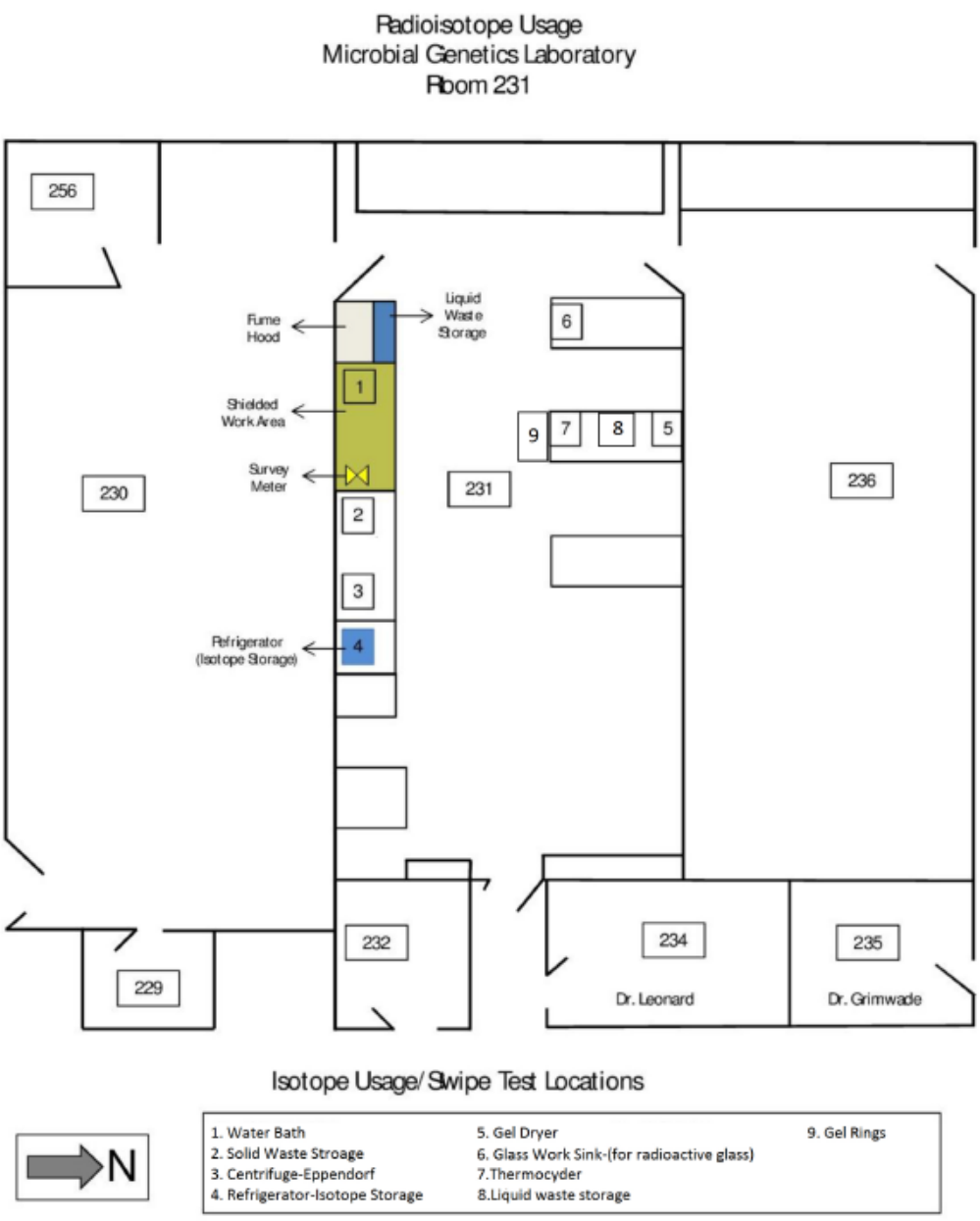
- scintillation counters only

F. W. Olin Life Science Second Floor



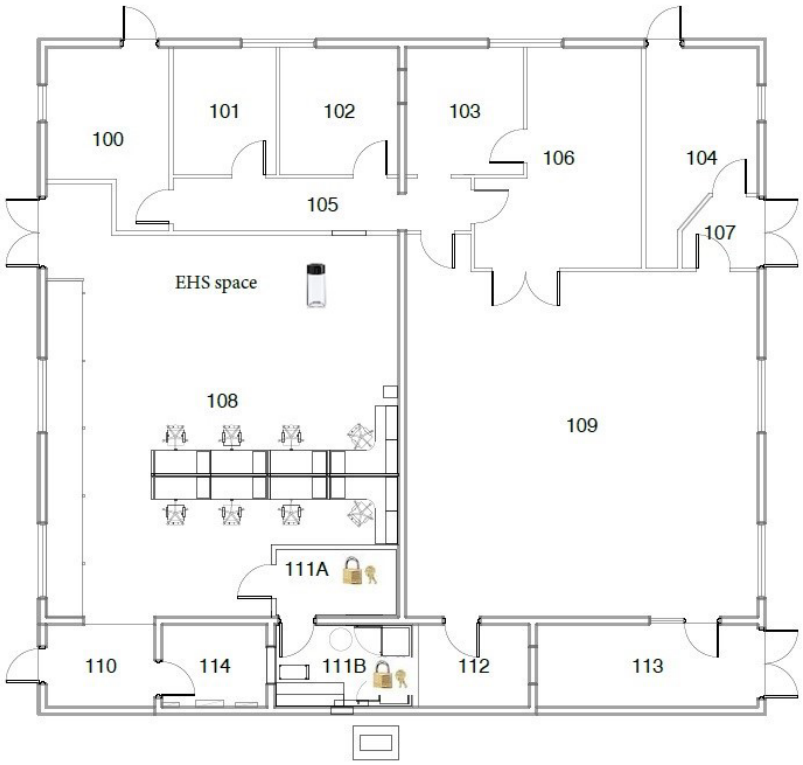
***Inactive Lab Status as of December 2019**

*Biosciences Radioactive Storage and Use Location



*Inactive Lab Status as of August 2019

QAD 407 – EHS Lab and Rad Storage Location



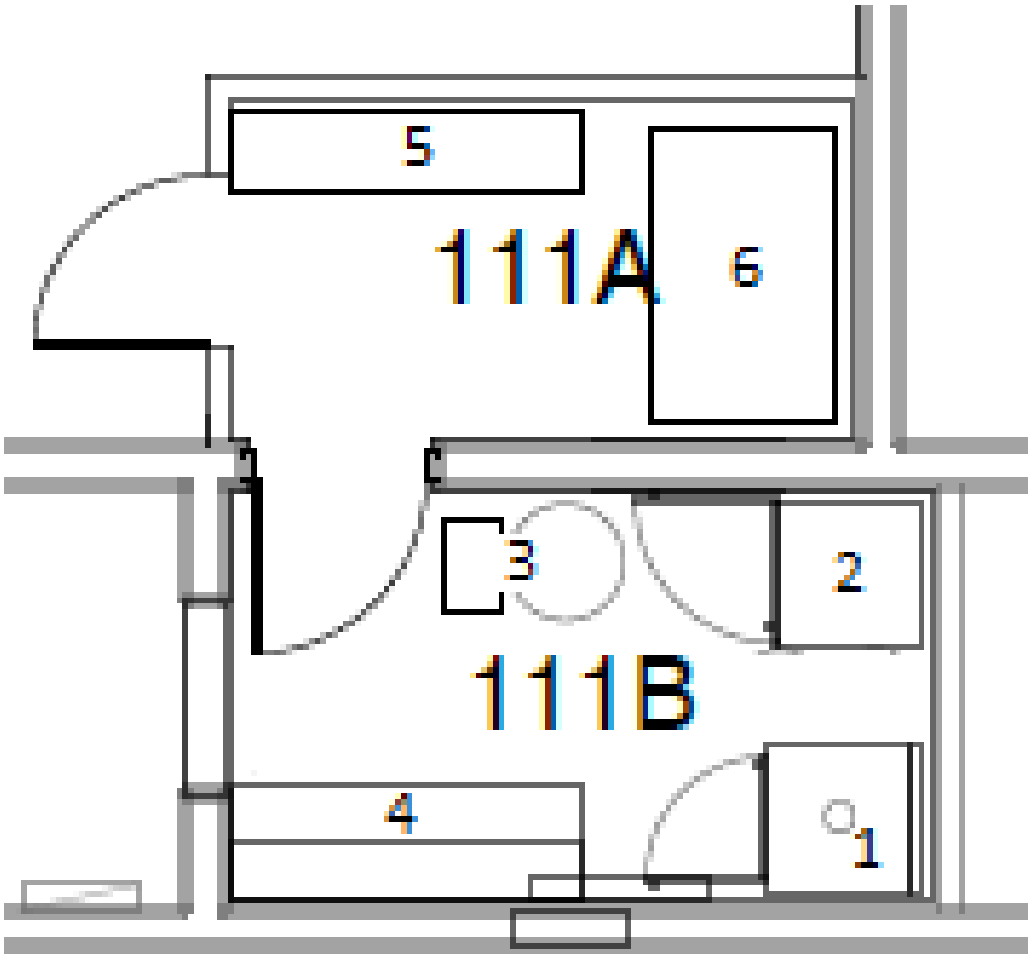
Florida Institute of Technology
Facilities Operations
150 W. University Boulevard, Melbourne, FL 32901
Building Location: 138 Aeronautics Drive

Building 407

Building :	407QAD
Floor :	1 (first)
Exterior Gross :	3,880.00
Revised :	08-01-16

1 of 1 Floors

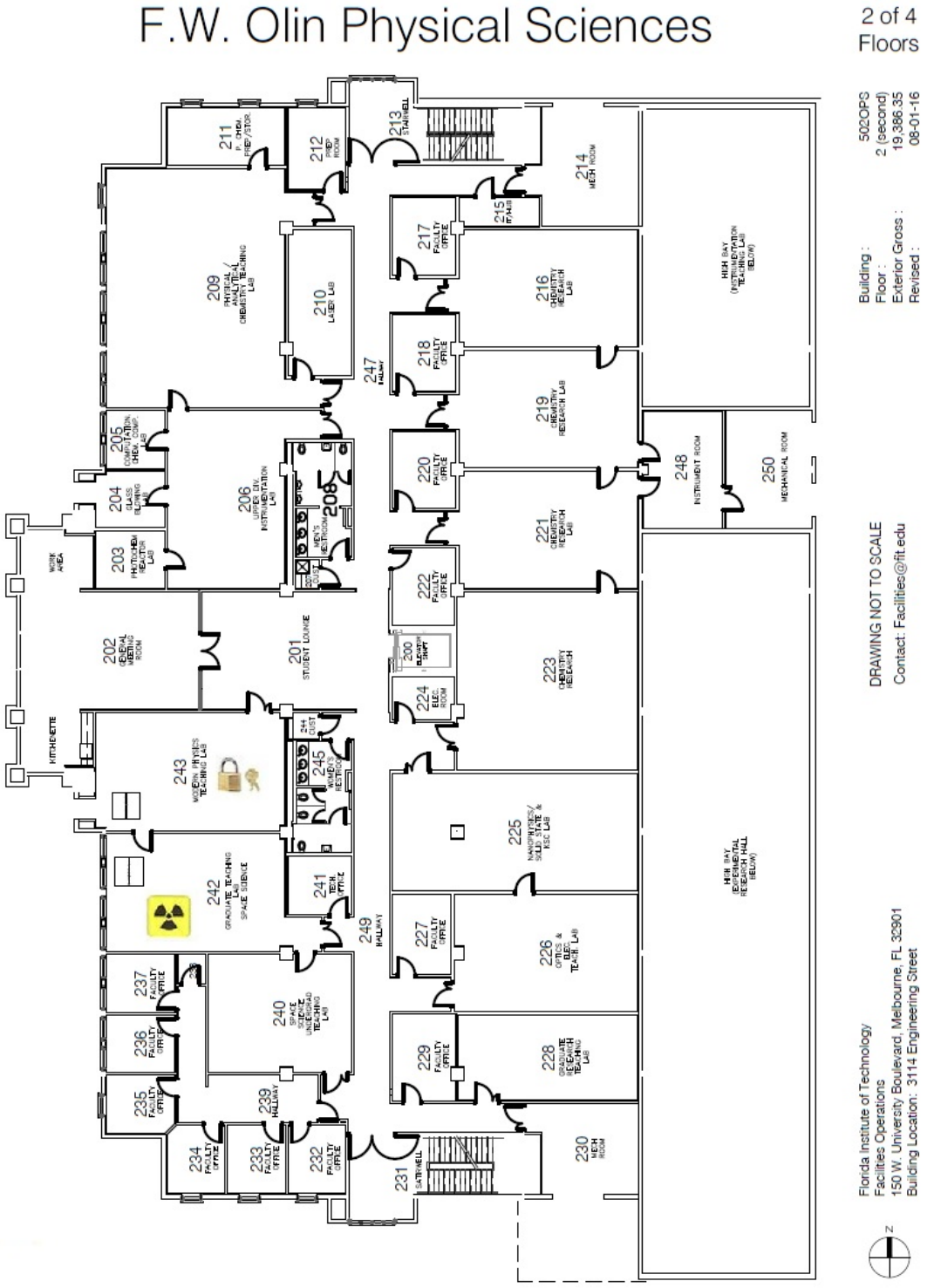
Radiation Safety Laboratory and Radioactive Storage Room



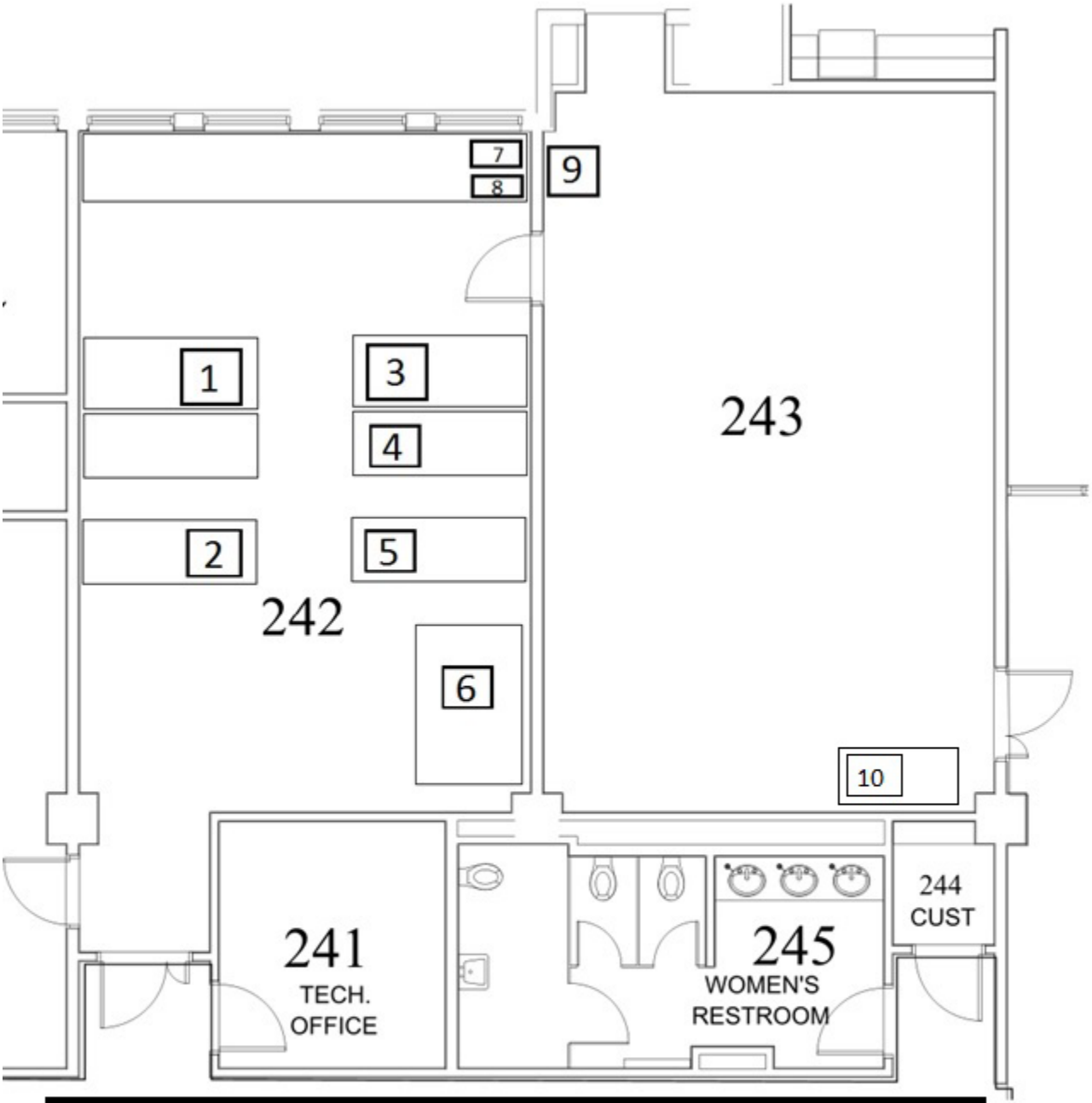
Building 407: rooms 111A and 111B

1. **Lead Lined Storage Safe**
2. **Refrigerator/Freezer**
3. **Storage Containers (rad waste and sealed sources)**
4. **Benchtop (out of service survey meters)**
5. **Benchtop (in service survey meters)**
6. **LSC Machine**

F.W. Olin Physical Science, Second Floor

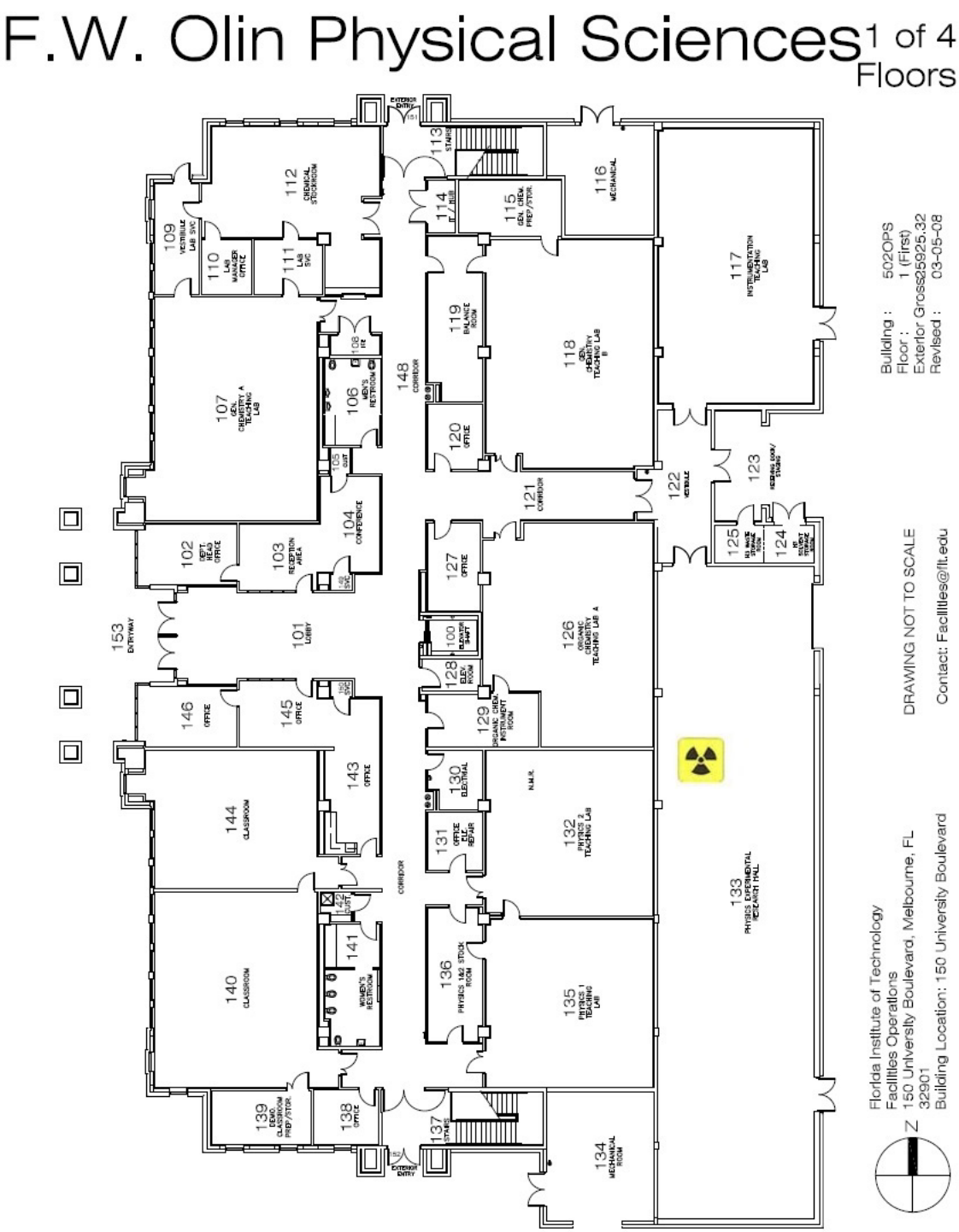


Room 242 & 243 Advanced Physics Laboratory

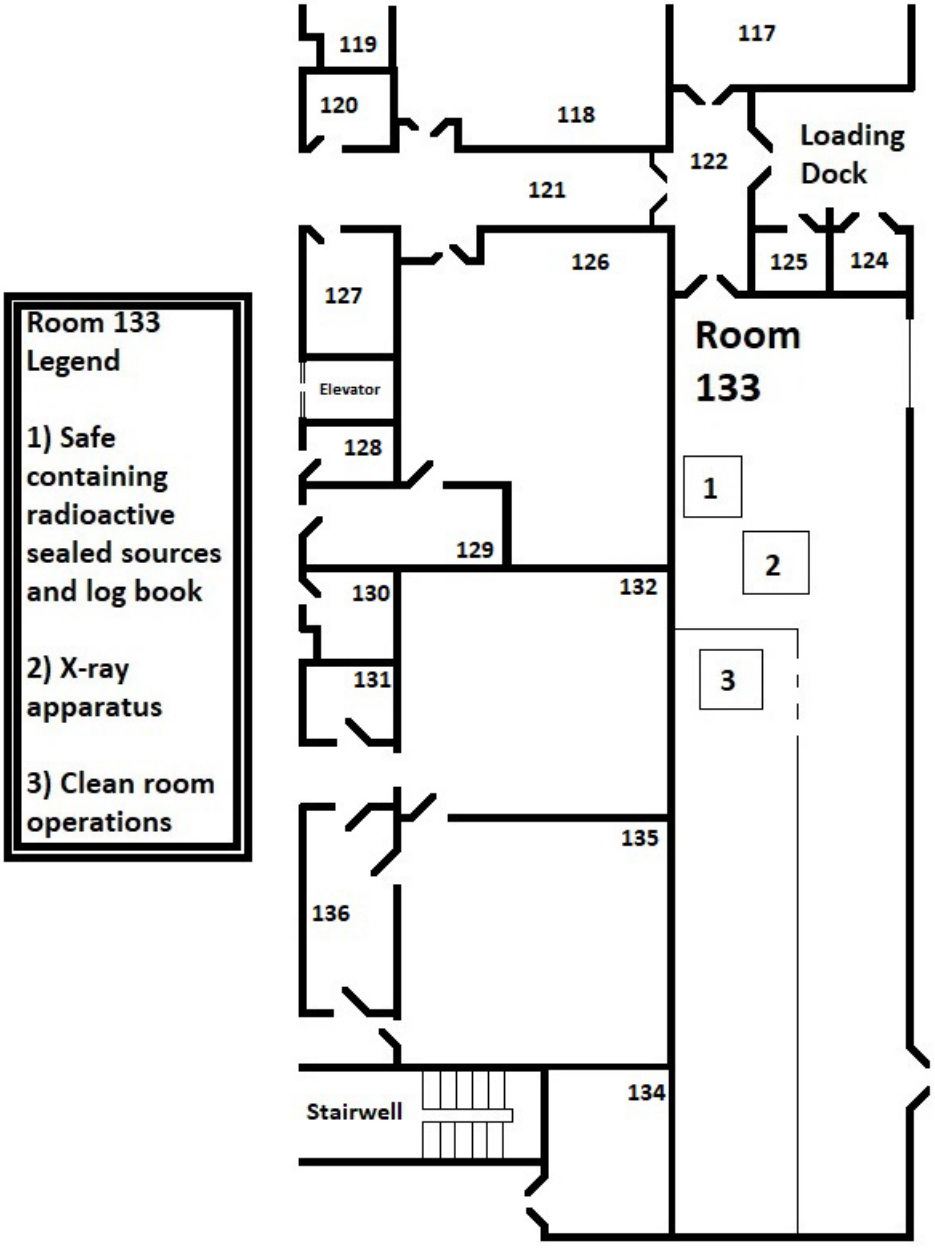


1) High resolution x-ray spectroscopy exp.
2) Electronic signal experiment
3) Energy loss experiment
4) Alpha spectroscopy
5) SiPM experiment
6) Arduino
7) Licensed sources
8) Generally licensed sources
9) Generally licensed sources
10) Storage (registered x-ray tube)

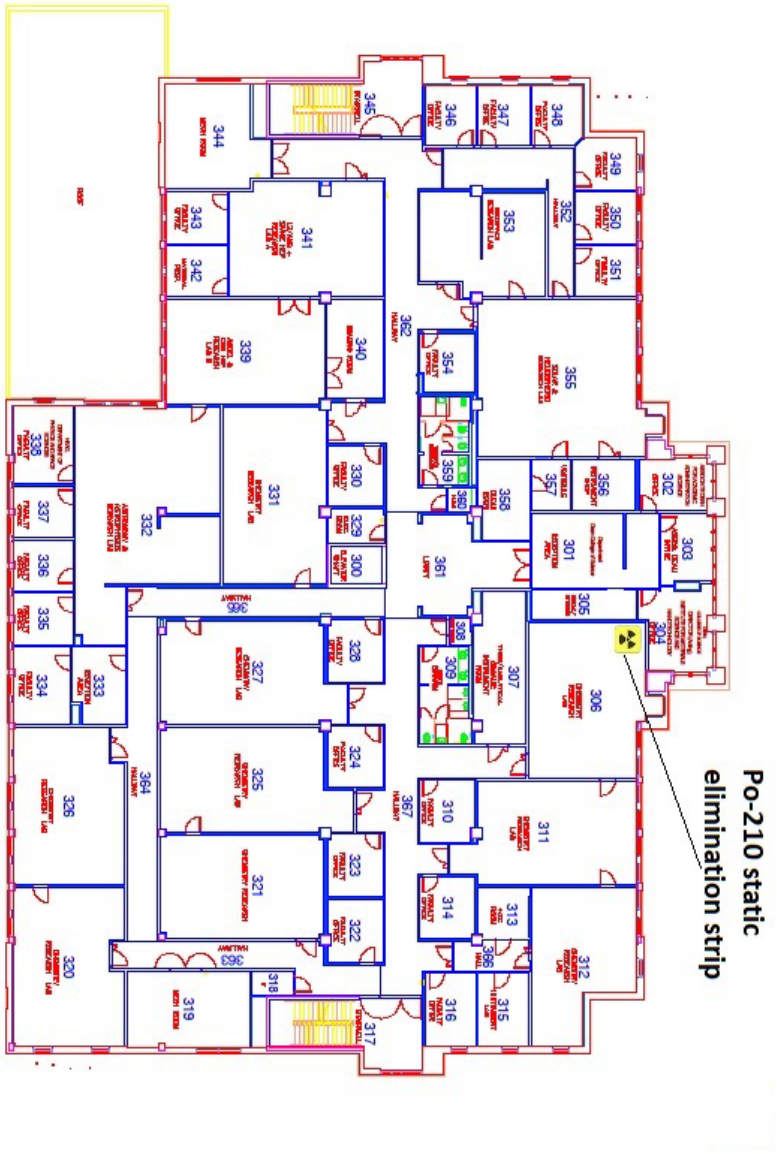
F. W. Olin Physical Science, First Floor



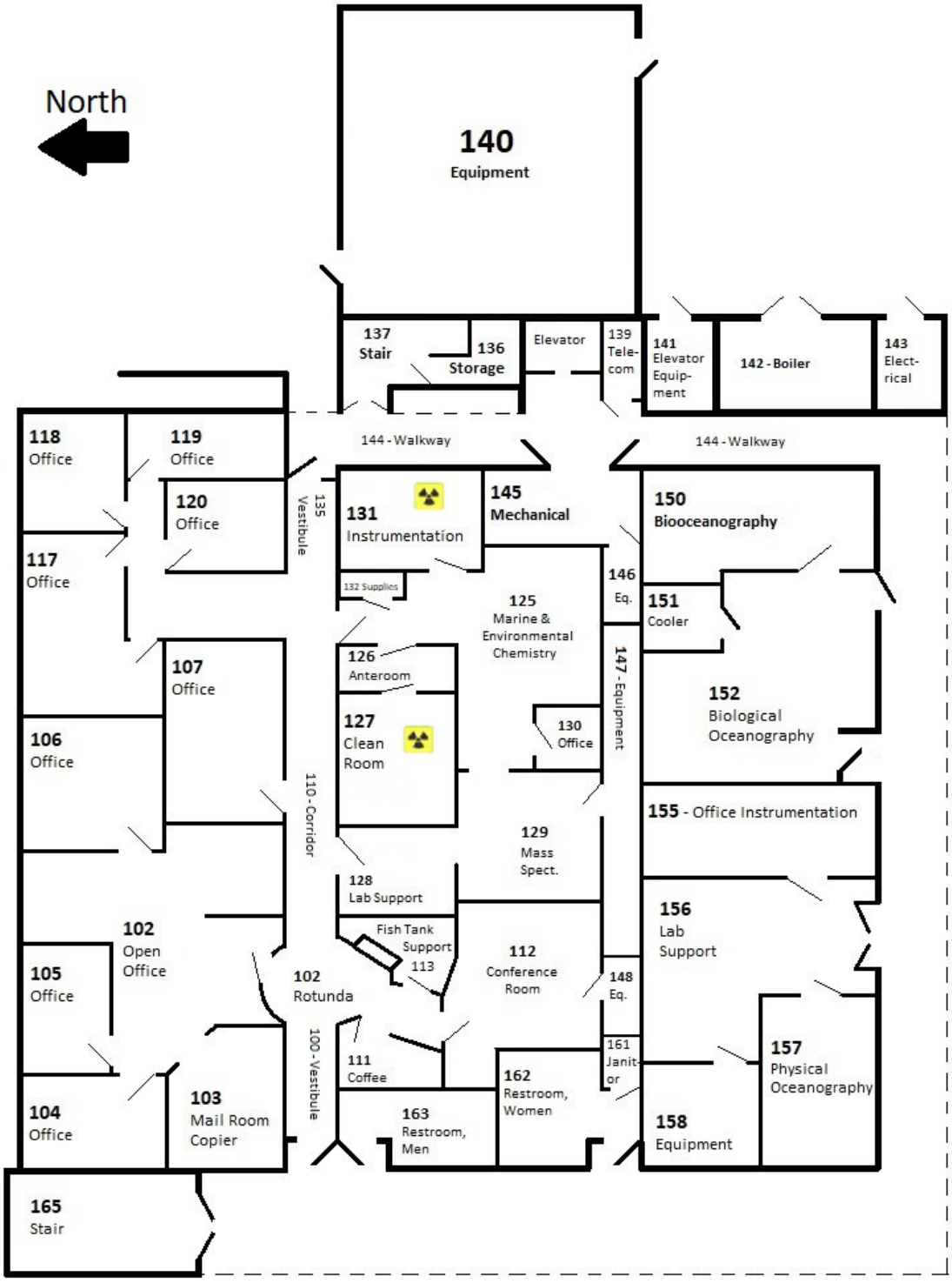
Room 133 Physics High Energy Research Laboratory



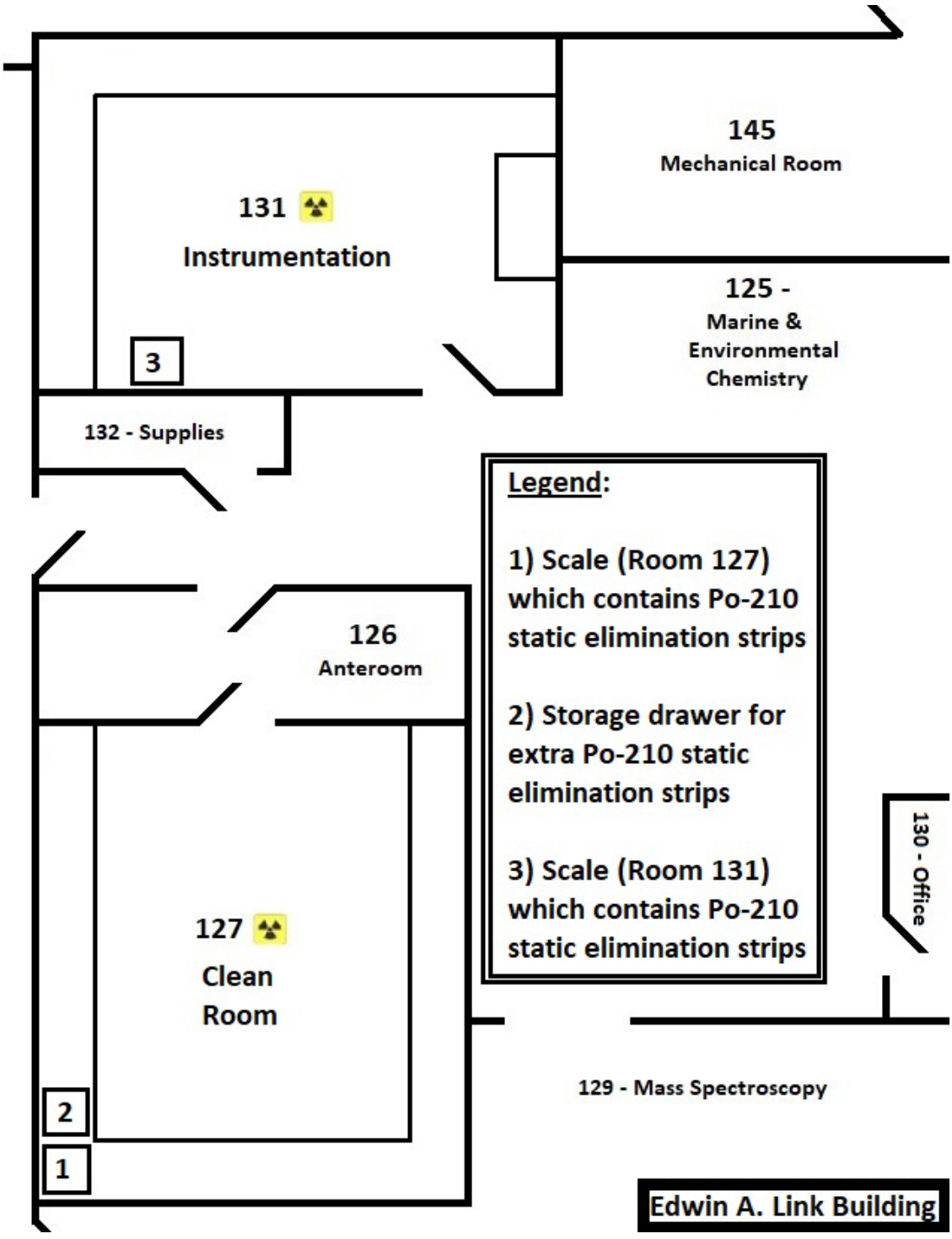
F. W. Olin Physical Science, Third Floor



Edwin A. Link Building, First Floor



Edwin A. Link Building, Rooms 131 and 127



Appendix C: MEMORANDA

TO:

Memo

To: Lee Karnbach, Director of Purchasing

From: Juliette Jones - RSO

CC: Selvin McLean, Director of EHS

Date: April 28, 2021

Re: Purchasing Authorization for Radioactive Materials

In the process of renewing our Radioactive Materials Program, I would like to take this opportunity to review some of our rules and regulations concerning the ordering of radioactive materials. The following information is provided to assist you in identifying radioactive materials on a purchase requisition and to aid in your determining the authorization of the request.

1) Vendors from whom radioactive materials are purchased:

   a) Perkin Elmer Life & Analytical Sciences (Vendor #:900244916)

   b) Eckert & Ziegler Isotope Products

   c) Spectrum Techniques

   d) NRD, LLC.

   e) Fisher Scientific

   f) Cambridge Isotope Laboratories

   g) VWR

   h) Mirion Technologies

   i) MP Biomedicals

   j) Sigma-Aldrich

2) Packages containing radioactive materials can be identified by:

   a) UN2910 – Label for Exempt Quantities of Radioactive Materials (most common)

   b) UN2911 – Label for Exempt Quantities of Radioactive Equipment (such as static elimination strips from NRD, LLC.)

   c) Radioactive Labels - White I, Yellow II, or Yellow III (White I is the most common after UN2910 and UN2911, Yellow II and Yellow III are unlikely to be ordered at Florida Tech)

3) Radioactive materials can be identified on the packing slip by:

a) Symbol designation – usually a capital letter preceded by a number, e.g. 14-C, 3-H, 32-P, 35-S

b) Sometimes the number will come after the letter, e.g. C-14, H-3, P-32, S-25

c) Quantity designation – the Curie (Ci) is the standard unit for radioactive materials, e.g. 30 μCi, 20 mCi, etc.

4) The following is a list of authorized radioactive material users:

   J. Grimwade, PhD, D. Carroll, PhD, A.C. Leonard, PhD, C.D. Polson, PhD, M. Hohlmann, Ph.D, F. Yumiceva, PhD, and G. Rybicki, PhD.

   No other university personnel are permitted to use or possess licensed radioactive material.

5) No one is permitted to purchase radioactive materials without my authorization. If you receive a requisition that you identify as one for the purchase of radioactive materials and it does not come from me, please put a hold on the requisition and forward it to me. Under no circumstances can anyone in your office phone in or place an order for radioactive materials unless you have a verbal confirmation from me.

6) Occasionally, someone may try to order radioactive materials from a vendor not on the list or fail to use the letter-number combination to identify the isotope; in this case you may not recognize it as a radioactive material. However, vendors of non-generally licensed radioactive materials orders will require our radioactive materials license before accepting orders. If you ever get an inquiry from a vendor as to what our radioactive materials license number is, tell them that you do not have that information and contact me.

Please pass this information along to all purchasing personnel.

If you have any questions as to whether anything is radioactive or not, please give me a call at ext. 8889.

Thank you

Memo

To: John Cady, Property Administration

From: Juliette Jones - RSO

CC: Selvin McLean

Date: April 28, 2021

Re: Receipt of Radioactive Materials

From time to time, radioactive materials will be shipped to the university and processed through your receiving department. I wanted to take this opportunity to again review the handling procedures for when this material arrives.

Radioactive material may arrive via any number of methods including special air mail and air freight shipments. The vendor will indicate that the material is radioactive, type of radioisotope (32P, 3H, or some combination of number and chemical symbol) and the activity, usually in μCi or mCi (such as 250 μCi). The package may have labeling including UN2910, UN2911, or White I. Under no circumstances are these packages to be opened for inspection or verification of contents. Contact the Radiation Safety Officer (RSO) for pick-up at (321) 674-8889 or at juliette2019@fit.edu. Under certain circumstances, when the RSO is out of the office, a member of EHS can be contacted to pick up the package at (321) 674-7715 or at ehs@fit.edu.

Our State of Florida Radioactive Materials License requires that all shipments of radioactive material must be delivered to the recipient within three (3) hours of its arrival at the university, so please call me or EHS asap to arrange a pick-up.

I have provided you with a short presentation on how to recognize these packages as containing radioactive material; how to properly handle the packages; what potential hazards exist; and how to protect yourself from radiation exposure. All personnel must review this presentation and take a short quiz to indicate they understand this training.

New personnel must view this presentation on hire. Send completed quizzes to me.

The receiving department has done a great job in the receipt of radioactive materials packages. My continued thanks to you and your dedicated staff.

It is the goal of Florida Tech to keep all possible radiation exposure As Low As Reasonably Achievable (ALARA). Your awareness of these instructions will help in achieving this goal.

If you or any of your staff have any questions about this memo, please feel free to contact me at extension 8889.

Memo

To: Dewey Yeatts, Director, Facilities Management

From: Juliette Jones - RSO

CC: Selvin McLean

Date: April 28, 2021

Re: Radiation Caution Sign and Potentially Hazardous Areas

As you are aware, there are labs at the university that use radioactive materials. These labs are posted with a Notice to Employees, an Emergency Notice, and a sign containing the radiation symbol and words "Caution: Radioactive Materials." Facilities personnel should not enter these labs without an escort during times the lab is in operation (i.e. when radioisotope experiments are being performed). Facilities personnel who need to gain access to the labs should contact the lab supervisor to arrange for entry and escort or to determine if any radioisotope experiments are being conducted at the date and time of required entry. I am including examples of the postings to assist you in the identification of these areas.

The Radiation Safety Office (floor plan attached) is a designated storage area for radioactive waste. No one may enter this facility without my express permission and personal escort or, in my absence, that of Selvin McLean, the Director of Environmental Health and Safety.

Please make sure all facilities personnel are aware of the meaning of these postings and instructions.

It is the goal of Florida Tech to keep all possible exposures to radiation as low as reasonably achievable (ALARA). Your help in ensuring your personnel are aware of the above information will help in achieving this goal.

If you have any questions about this memo please feel free to contact me at ext. 8889.

Enclosures: as stated

(Floor plan omitted from this copy of memo – see floor plan B-5)

Memo

To: Frank Iannone, Director of Campus Security

From: Juliette Jones - RSO

CC: Selvin McLean

Date: April 28, 2021

Re: Location of Radioactive Materials, Emergency Procedures

There are labs in Olin Life Sciences, Olin Physical Science, and the Radiation Safety Office that are authorized to store and/or use radioactive materials in either open/liquid form or as sealed sources. These labs will be posted with Notice to Employees, an Emergency Notice, and a sign containing the radiation symbol and words "Caution: Radioactive Materials." I am also enclosing floor plans showing the location of the various use and storage areas. Not all locations will necessarily have radioactive materials, but those that do will have these postings prominently displayed. Security personnel should not enter these labs without an escort during times that radioactive materials are in use. Security personnel who need to gain access to the labs should contact the lab supervisor to arrange for entry and escort or to determine if any radioisotope experiments are being conducted at the date and time of required entry. Please make all your officers aware of the potential for the presence of radioactive materials at these locations and the meaning of the postings.

In particular, the Radiation Safety Office is a designated area for the storage of radioactive waste. No one may enter this office without my express permission and escort or, in my absence, Selvin McLean, Director of Environmental Health and Safety. Contact Selvin or myself for entry to the Radiation Safety Office.

It is difficult for fire and police officials to evaluate accurately the magnitude of a radiation risk at the time of an emergency and to ensure that contamination or the spread of contamination is kept as low as reasonably achievable. It is important that the Radiation Safety Officer be notified as soon as possible when any emergency is reported that involves a posted radiation lab. This ensures that fire-fighting or other emergency activities will be governed by the restriction of the Radiation Safety Officer. Every radiation lab has an Emergency Notice posted along with a call list. Again, please make your officers aware of these procedures and the call list as they are usually first at the scene.

It is the goal of Florida Tech to keep all possible exposures to radiation as low as reasonably achievable (ALARA). Your help in ensuring your personnel are aware of the location of radioactive materials and what to do in the case of an emergency will help achieve this goal.

If you have any questions about this information, please feel free to contact me at ext. 8889.

Enclosures: as stated

(Floor plans omitted from this copy of memo – see Appendix Section B)

Memo

To:

From: Juliette Jones - RSO

CC: Dr. Alan C. Leonard

Date: April 28, 2021

Re: Investigation of Radiation Exposure

The objective of personal radiation monitoring is to measure occupational radiation exposures to aid in the detection of unnecessary radiation dosages. The prompt investigation of any, above average, exposures will be useful in determining methods of preventing unnecessary radiation exposures from recurring.

During the period from _____to _____, your personal radiation monitoring device indicated an exposure of _____ mr. The current permissible exposure level for x and gamma radiations is _____ mr per month.

Please answer the following questions and return this statement as quickly as possible so that our records maybe properly evaluated.

1. How did the exposure occur?

   _____

2. Why did the exposure occur?

   _____

3. What has been done to prevent recurrence of such an exposure?

   _____

4. Remarks:

   _____

   _____

Signed _____ Date ____

(Employee)

Signed _____ Date _____

(Supervisor)

Appendix D: FORMS

RADIOACTIVE MATERIAL USE AUTHORIZATION

(Prepare in original and one copy)

Department	☐ New Request ☐ Modification	Date Period	Ref. Number

1. Title or Brief Description of Project:

2. Procedure Including Special Techniques and Safety Precautions: (Information to be submitted on additional sheets in duplicate.)	3. Completion date

4. Radioactivity Requirements

A. Element and Isotope	B. Physical Form
C. Total Quality Required	**D. Estimated Activity Per Experiment**

5. Location of Use

☐ F.I.T ☐ Temporary Site (Specify) _____	Building	Room Number

6. Users (Submit Supplemental Form for Each Individual)	7. Signature of Request Originator	Date
Use Supervisor	**Title of Position**	**Extension**

8. Signature of Department Head	Date	10. Radiation Safety Committee ☐ Disapproved ☐ Approved, subjected to conditions noted in Item 12.
Title	**Extension**	

9. Signature – Radiation Safety Officer	Date	Chairman – Radiation Safety Committee	Date
Title or Position	**Extension**	**11. Expiration Date**	

12. An approved "Radioactive Material Use Authorization" shall be subject to all applicable rules, regulations, and orders of the F.I.T Radiation Safety Committee now of hereafter in effect and any conditions specified below:

a) Standard Conditions

(1) The Use Supervisor shall insure compliance with F.I.T Radioisotope Use Manual and statements and procedures contained within this request.

(2) The Use Supervisor shall provide health and safety procedures covering radiological protection, control, and security of radioactive material, to each individual using of having responsibility for use of such material.

b) Special Conditions (To be completed by Radiation Safety Committee.)

RSO - 1

Ref. Number _____

IONIZING RADIATION USER APPROVAL REQUEST

Name _____ Department _____

Bldg/Location _____ Tel. # _____

TRAINING (Use Supplemental Sheets if Necessary

	Formal	Informal	Location	Duration
1. Principles and practices of radiation protection	Yes No	Yes No		
2. Radioactivity measurements, standardization and monitoring techniques and instruments.	Yes No	Yes No		
3. Biological effects of radiation.	Yes No	Yes No		

EXPERIENCE (Use Supplemental Sheets if Necessary)

Type of X-Ray/accelerator and/or Nuclide	Maximum Energy and/or Curies	Purpose in Use	Location	Duration

I certify that I have read and understand the following:

1. Florida Tech Radioisotope Use Manual Yes No

2. Florida DOH – Control of Radiation Hazard Regulations Yes No

3. Local Procedures and Methods of Control Yes No

Signature of User _____ Date _____

Approved _____ Date _____
(Radiation Safety Officer)

RSO-2

REQUEST FOR FILM BADGE SERVICE

The following information is necessary for initiation of Film Badge Service: (Please print or type).

Full Name: _____
Last First Middle

Social Security No: _____ Date of Birth: _____

Local Address: _____

_____

I have previously worked in the following institutions(s) where radioactive material has been used and records of my exposure have been kept: (If none, indicate NONE)

Institution: _____

Department: _____

Address: _____

_____

Dates of Employment: From _____ To _____

_____

I authorize the release of all my radiation exposure data as listed above.

Name: _____

Date: _____ Department: _____
(Florida Tech)

_____

In order to permit compliance with part IX 64E-5.903(3) of the Regulations of the Florida Department of Health which requires that a report of radiation exposure be furnished to any individual after termination of employment or association involving exposure to radiation, please list an address where such a report will reach you in the event of your termination.

_____

_____

Return this form to:
Florida Institute of Technology
Radiation Safety Officer
Melbourne, FL 32901
RSO-3

INFORMATION REQUIRED FOR USE AND DISPOSAL OF RADIOACTIVE ANIMALS

Date of Experiment: _____ To: _____

Person Conducting Experiment: _____

Type of Radioactive Material Used (Name isotope and amount in μ): _____

Amount of Injection per Animal (in μCi): _____

Animal Species: _____

Number of Animals Used: _____

Total Amount of Radioactive Material Used (in μCi): _____

Estimated Residual Activity in All Animals (in μCi): _____

Estimated Residual Activity in All Cage Waste (in μCi): _____

Disposal Date: _____

Animal Colony Pathology if any: _____

Date: _____

Please Return completed form to Radiation Safety Office

RSO-4

TRANSFER OF RADIOISOTOPES

Within Florida Tech _____ Outside _____ Export _____

From: _____

To: _____

_____

Isotope: _____ Activity (in μCi): _____

Compound: _____ Medium: _____

Amount: _____ Value: _____

Ship (to be completed by the RSO)

As Is: _____ Keep Frozen: _____ Refrigerate: _____ Prevent Freezing: _____

Shipping Date: _____ Via: _____

Packing Method: _____

_____

_____

Remarks: _____

_____

_____

Signature: _____

Date: _____

The compound and completed form should be sent to the Radiation Safety Office.

RSO-5

RADIOACTIVE MATERIALS USE & DISPOSAL LOG

Control Number/Stock Vial Source: _____

_____ _____
Month Laboratory

_____ _____
Submitted by Approved by - RSO

Date	Radioactive Material	Quantity (µCi)			Name of Person
		Received	Used	On Hand	

Disposal

Date placed in storage	Quantity placed in storage (µCi)	Date of disposal	Name of disposer	Survey Instrument		Background Radiation Level (mR/hr)	Radiation Level at Surface of Container (No Shielding) mR/hr
				Model	Serial #		

MONTHLY INVENTORY

Isotope in Stock

Date: _____ Laboratory: _____ Supervisor: _____

Isotope

32-P

Amount in μCi	Compound	Storage Mode

Total Amount of 14-C in μCi: _____

3-H

Amount in μCi	Compound	Storage Mode

Total Amount of 3-H in μCi: _____

Other

Amount in μCi	Compound	Storage Mode

Total Amount of Other in μCi: _____

Return completed form before the tenth of the month.

RSO-7

RADIOACTIVE WASTE INVENTORY

Date Begun _____ Submitted by _____

Laboratory _____ Submitted by _____

Date	Radioactive Material	Quantity Used (μCi)	% in Retained waste	Waste		Total Qt. Isotope in waste	Used
				Form	Location		

RSO-8

WEEKLY (OR MONTHLY) RADIATION MONITOR REPORT

Date: _____ Survey Done By: _____

Location: _____ Survey Instrument: _____ LSC: _____

RESULTS OF METER SURVEY:

_____

_____

_____

_____

_____

RESULTS OF WIPE TESTS

Location	DPM/100 cm^2				
	3H	14C	32P	125I	Other
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Complete this form for any week in which radioactive materials are used. Return to the Radiation Safety Officer before the tenth of the month along with inventory and badges.

RSO-9

DAILY RADIATION MONITOR REPORT

Supervisor: _____ Laboratory: _____

Survey Meter: _____ Date: _____

	Radioisotopes Used	Amounts	DPM/100 cm^2	Survey done by
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Other (Sat – Sun)				

The immediate work area must be wipe tested or surveyed at the end of each day of use of any unsealed radioisotope at any quantity.

Use Form RSO-9 to report weekly laboratory survey and wipe tests

Return this form to the Radiation Safety Officer before the tenth of each month with your inventory and radiation badges.

RSO-10

3H BIOASSAY RECORD

Name: _____ Month: _____

Participation # _____ Laboratory: _____

Room #: _____

Initial Report _____ Terminal Report _____

Date	H-3 Used (μCi - Form	Urinalysis				Comments
		BKG CPM	CPM/ml	Corrected dPM/ml	μCi/L	
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

RSO-11

EXPOSURE HISTORY REQUEST

To whom it may concern,

I am currently working at the Florida Institute of Technology (Florida Tech), 150 West University Blvd., Melbourne, FL 32901-6988 and will be handling radioisotopes. Therefore, I request that you send me a copy of my Occupational Radiation Exposure History in your files to the Radiation Safety Officer (RSO) at Florida Tech so that RSO may have my complete radiation history, as required by the State of Florida and the U.S. Nuclear Regulatory Commission safety regulations. I have listed my name, social security number, department and dates of employment at your institution to expedite the location of my radiation history.

Thank you for your prompt attention.

_____

_____

Social Security No. _____

Dept. of Employment _____

Dates of Employment _____

Please return to:

Radiation Safety Officer
Department of Environmental Health and Safety
Florida Institute of Technology
150 W. University Blvd.
Melbourne, FL 32901-6988

RSO-12

REQUEST FOR RADIOISOTOPE DISPOSAL

Date: _____ From: _____
(Responsible Investigator)

I. Liquid Wastes:

Isotope	% Chemical Composition	Total Microcuries	Total Volume	Microcuries per ml	Container Identification

II. Scintillation Vials:

Isotope	Number of Trays	Total Microcuries	Total Volume	Description of Vial

III. Solid Wastes

Isotope	Chemical Form	Total Microcuries	Major Constituents	Container Identification

The total radioactivity of each listed radioisotope has been ascertained by calculations or laboratory counting methods and represents an accurate assessment of the radioactive waste.

Signature: _____

RSO-13

RADIOACTIVE MATERIALS ORDER FORM

To order radioisotope, complete this form and forward to the Radiation Safety Officer (instructions on reverse). A copy of the completed PO will be returned for your information.

1. Use Supervisor: _____

2. Vendor: _____

3. Vendor Address: _____

_____

_____

4. Catalog Number: _____

5. Isotope Description: _____

_____

6. Sealed Source Description: _____

_____

7. Quantity (μCi or mCi): _____

8. Price: _____

9. Price Quote Attached: Yes No

10. Date Needed: _____

11. Account Number: Index _____ Org. _____ Fund._____

12. Comments: _____

_____

_____

DO NOT WRITE BELOW THIS LINE – OFFICE USE ONLY

Ref. # _____ Current ___ Yes___ No Date: _____

Control #: _____ Date Received: _____

Location: _____ PR #: _____ PO #: _____ R#:_____

RSO-14

INSTRUCTIONS FOR ORDERING RADIOISOTOPE

1. Print the name of the scientist listed on the license that is authorized to supervise the use of this radioisotope. The use supervisor must initial his approval.

2. Company from which the isotope is ordered.

3. Include phone number (800 number if known).

4. Self-explanatory.

5. Use the catalog description so there is no confusion.

6. Self-explanatory.

7. Self-explanatory.

8. If you are not using the latest catalog and have not called for a current price – check "yes". If you have a current price – check "No". If you received a quote number, please provide the name of the person that provided the quote and the quote number.

9. Include dates needed only if you are ordering short half-life isotopes.

10. Self-explanatory.

11. Additional ordering/shipping instructions. Please indicate if you want order called in. If a blanket order is requested, please provide all necessary instructions.

RADIOACTIVE MATERIAL DISPOSAL FORM

Date Placed in Storage: _____

Date of Disposal: _____

Material: _____

Quantity (μCi): _____

Control #: _____

Survey Instrument

Model:_____ Serial #: _____

Background Radiation Level: _____

Radiation Level at Surface
Of Container (No Shielding) _____

Name of Disposer: _____

RSO-16

OP-OUT OF RECEIVING PACKAGES RADIOACTIVE MATERIALS APPROVAL

Name:_____

Department: Property Management Bldg./Location: 22

I would like to op-out of receiving/handling radioactive materials due to the following reason(s):

_____

_____

_____

_____

_____

_____

_____

Signature of employee: _____Date:_____

Signature of Supervisor: _____Date:_____

Signature of RSO: _____Date:_____

RSO - 17

RADIOACTIVE SEALED SOURCE USE LOG

Date	Isotope	Serial #	Activity (microcuries)	Time		Name of Person
				Checked Out	Checked In	

RSO - 18

Appendix E: INSTRUCTIONS/PROCEDURES/DEFINITIONS

HYDROGEN 3 BIOASSAY PROCEDURES

I. Conditions Requiring Bioassay:

A. Routine Bioassay is required when quantities processed by an individual at any one time, or total amount processed per month, exceed those for the respective forms of tritium as shown in the attached Table 1.

B. Above 0.1 of, but less than, the levels in Table 1, routine bioassay is required unless a written justification is submitted for not performing bioassays.

C. Except as stated in I.D. below, bioassay is not required for process quantities less than 0.1 of those in Table 1.

D. Special bioassay measurements should be performed to verify the effectiveness of respiratory protection devices and other protective clothing. If an individual wearing a respiratory protective device or protective clothing is subjected to a concentration of tritium in air (in any form) such that his or her intake with no protection would have exceeded that which would result from exposure for 40 hours per week for 13 weeks at uniform concentrations of tritium in air as specified in Appendix B, Table I, Column I, 10 CFR 20, * bioassays should be performed to determine the resulting actual tritium intake. These special bioassay procedures should also be conducted, for personnel wearing respirators, if for any reason the average tritium concentration in air and the duration of exposure are unknown.

II. Who Should Participate:

All workers involved in the processing of tritium, under conditions specified in I above, or sufficiently close that intake is possible, should participate.

III. What Types of Bioassays Should be Performed:

A. Baseline (including Pre-employment, or Pre-operational Urinalysis, not more than one month prior to beginning work with tritium requiring bioassay under Section I above).

B. Routine Urinalysis.

Multiplying the concentration given in Appendix B, 5×10^{-6} μCi/ml, by 6.3×10^{8} ml gives the corresponding quarterly intake of tritium by inhalation. This is assumed equal to the uptake of tritium (as HTO) by absorption through the skin unless the form of tritium in the air can be demonstrated to have lower uptakes. The total uptake, including skin absorption, would be assumed to be about 6.3 mCi, which delivers a dose commitment of about 1.25 rems to standard man.

C. Post-operational. Within one month of last possible exposure to tritium.

D. Diagnostic. Within one week of any sample exceeding levels given as action points in Section V below, See V.A.2.(d).

IV. How Often:

A. Initial Routine Samples. Within 48 hours following entry of an individual into an area where operations require bioassay according to Section I.A and B above, and then every two weeks or more frequently thereafter as long as the individual is working with 3H.

B. After 3 Months. The sampling frequency selected in accordance with Section IV.A above may be changed to quarterly if, after three months, the following three conditions are met:

(1) The average urinary tritium concentration from specimens obtained during the three-month period does not exceed 3 μCi/l;

(2) Where measurements of the concentration of tritium in air are required as a condition of the license, the quarterly average concentration (μCi/ml) to which workers are exposed multiplied by the factor 6.3 x 108 ml, does not exceed 08.mCi; and

(3) The working conditions during the three-month period, with respect to the potential for tritium exposure, are representative of working conditions during the period in which a quarterly urinalysis frequency is employed, and there is no reasonable expectation that the criteria given in (1) and (2) above will be exceeded.

V. Action Points and Corresponding Actions.

A. Bi-weekly or More Frequent Sampling.

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

(a) A survey of the operations involved, including air and area monitoring, should be carried out to determine the cause(s) of exposure and evaluate potential for further larger exposures.

(b) Implement any reasonable corrective actions indicated in the survey that may lower the potential for further exposures.

(c) A repeat urine sample should be taken within one week of the previous sample and should be evaluated within a week after collection.

(d) Any evidence from (a) and (b) indicating that further work in the area might result in an employee receiving a dose commitment in excess of the limits established in 20.101 should serve as cause to remove the employee from work in this operation until the source of exposure is discovered and corrected.

(2) If urinary excretion rates exceed 50 μCi/liter, the following course of action should be taken:

(a) Carry out all steps as in 1. (a) to (d) above.

(b) If the projected dose commitment exceeds 5 rems, report the incident to the NRC in accordance with 20.403 of 10 CFR Part 20.

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

(d) Carry out repeated sampling (urine collections of at least 100 ml each) at approximately one-week intervals, at least until samples show an excretion rate less than 5 μCi/liter. If there is a possibility of long-term organic compartments of tritium that requires evaluation; continue sampling as long as necessary to ensure that appreciable exposures to these other compartments do not go undetected.

B. Quarterly Sampling. Carry out actions at levels indicated under A. above, and if the excretion rate continues to exceed 5 μCi/liter, also reinstitute bi-weekly (or more frequent) sampling for at least the next six-month period, even when urinary excretion falls below 5 μCi/liter.

Table 1

ACTIVITY LEVELS OR CONCENTRATIONS ABOVE WHICH BIOASSAY SHALL BE REQUIRED

TYPE OF OPERATION	HTO FORM (& FORMS OTHER THAN THOSE ON RIGHT-HAND COLUMNS	HT OR T_2 GAS IN SEALED PROCESS VESSEL	NUCLEOTIDE PRECURSORS	HTO MIXED WITH MORE THAN 10 Kg OF INERT H_2O OR OTHER SUBSTANCES
Process in open room w/possible escape of tritium from process vessel	0.1 Ci	100 Ci	0.01 Ci	0.01 Ci/Kg
Process w/possible escape of tritium, carried out within a fume hood of adequate face velocity and performance reliability	1 Ci	1000 Ci	0.1 Ci	0.1 Ci/Kg
Processes carried out within glove boxes, ordinarily closed, but w/possible release of tritium from process and occasional exposure to contaminated box and box leakage	10 Ci	10,000 Ci	1 Ci	1 Ci/Kg

Quantities present (< 10 Kg) may be considered either the amount processed by an individual at any one time (when accidental intake is more likely), or the amount of activity entered into process (throughput) during any one month (when routine handling of repeated batches is the more likely source of exposure). Concentrations in the right-hand column may be used when activity in process is always diluted in more than 10 Kg of other reagents, as in nuclear reactor coolant systems.

DEPARTMENT OF BIOLOGICAL SCIENCES
FLORIDA INSTITUTE OF TECHNOLOGY

Information and Guidelines Concerning use of the Animal Facilities and Animal Care

The department maintains a three-room animal facility under USDA registration number 58-20. The inner-most room of the facility houses venomous reptiles. The middle room houses rats and mice used for both research and teaching. The outer-most room is for cleaning and storage of materials. The facility is regularly inspected by the USDA and the department has on file an assurance agreement with the NIH.

I. General Information and Rules

A. If you anticipate performing any research experiment or teaching exercise involving the use of animals, you must consult with the chairman of the Animal Care Committee prior to ordering and/or performing the experiments. Each order must be approved by the chairman of the Animal Care Committee.

B. Each individual MUST maintain a permanent record of the number of animals on hand for and/or utilized in their research. This is required for the annual report to the USDA. This record should also contain the method used for sacrificing the animals.

C. Animals must be treated humanely at ALL times. Failure to do so will result in the immediate loss of your privilege to use the animal facilities and to keep animals.

D. Chronic experiments that involve prolonged pain or discomfort to the animal must have prior approval of the Animal Care Committee.

E. All procedures which involve pain to the animals must be performed using an appropriate anesthetic. (WARNING: Ether, while extremely valuable as an anesthetic is highly explosive and should not be used near flame, heat, or non-explosion-proof electrical equipment).

F. All cages MUST be labeled with the following information:

1. Animal type (e.g., "C57BL/6J female");
2. Name of the person responsible;
3. Any special instructions (e.g., "FASTING");
4. Date animal(s) was/were received.

(Each researcher may wish to add other information to the label, but the above information MUST be there.)

G. Since space in the animal facility is at a premium, it is of great importance to refrain from usurping space from other researchers. Space for animals will be allocated by the chairman of the Animal Care Committee.

H. The animal rooms are principally for keeping animals. Auxiliary supplies and equipment must be stored elsewhere.

I. Each researcher is responsible for the general cleanliness of their area. Any mess made by your animals is your responsibility to clean up.

J. Dirty litter and animal carcasses MUST be placed in sealed plastic bags (available in the Supply Room) and IMMEDIATELY taken to the dumpster (located behind the Link Engineering Building). DO NOT leave these materials for the janitors.

K. Radioactive carcasses and litter MUST be sealed in plastic bags and stored frozen in a deep freeze until they can be removed by waste disposal.

II. Animal Care

A. DO NOT crowd animals in cages (e.g. 5 mice/cage, 3 rats/cage, 1 rabbit/cage).

B. Cages MUST be clean at all times. Small mammal cages must be cleaned 3 times/week; larger animal cages must be cleaned on a daily basis. Cages for domestic animals (dogs, cats, rabbits) must be sanitized biweekly.

C. Litter should be deep enough to keep the cages dry between changes.

D. Animals MUST have access to food and water at all times (unless fasting for experimental purposes, in which case they must be labeled appropriately). Food must be placed off the cage floor to avoid contamination with excreta. Water must be in a spill-proof container.

E. Cages and water bottles should be washed with detergent, rinsed well, and air-dried before replacing animals. (It is a good idea to have a second set of cages available to expedite the cleaning process).

F. During cleaning, minimal handling of the animals is recommended.

G. All animals injected with radioisotopes must be isolated from all other animals. Consult RSO for instructions on construction of barium hydroxide trap.

III. Cleaning Facility and Storage

A. Food MUST be kept in a covered metal container in the respective animal room.

B. Paper, litter, food, and other solids should not be rinsed down the sink.

C. Before opening a new one, check for an already open container of food or litter.

D. Clean litter is stored in a plastic trash can.

E. Keep supplies neat; if you use the last of anything, obtain a replacement.

F. Fire laws require that the walkway be kept clear.

G. The cart in the clean-up room is NOT a storage shelf. It is to be used for transporting only. Make sure it is returned to the clean-up room when finished.

H. When finished cleaning cages, clean the clean-up room. Make sure the counters are wiped and the floor is swept.

I. Monitor all cages housing animals containing radioisotopes.

Report all abuses and violations of the guidelines to the chairman of the Animal Care Committee IMMEDIATELY!

EMERGENCY PROCEDURES

Major Spills Involving Radiation Hazards to Personnel.

1. Contact the RSO as soon as possible.
2. Notify all persons not involved in the spills to vacate the room at once. Limit the movement of displaced persons to confine the spread of contamination.
3. If the spill is liquid and the hands are protected, right the container; otherwise, use a stick or lever. Use absorbent materials to prevent the spread of the spill.
4. If the spill is on the skin, flush thoroughly.
5. If the spill is on clothing, discard outer or protective clothing at once.
6. Switch off all fans.
7. Vacate the rooms.
8. Take immediate steps to decontaminate personnel involved as necessary.
9. Decontaminate the area (personnel involved in decontamination must be adequately protected). The Radiation Safety Officer will direct the decontamination.
10. Monitor all persons involved in the spill and cleaning.
11. Permit no person to resume work in the area without the approval of the Radiation Safety Officer.
12. A complete history of the accident and subsequent activity must be submitted to the Radiation Safety Officer.

Minor Spills Involving No Radiation Hazard to Personnel.

Notify all other persons in the room and area at once.

1. Survey people before they become dispersed and change clothes as necessary.
2. Permit only the minimum number of persons necessary to deal with the spill.
3. Confine the spill immediately:
   A) Liquid Spills: Don protective gloves; drop absorbent paper on spill.
   B) Dry Spills: Don protective gloves dampen area thoroughly, taking care not to spread the contamination. Water may generally be used except when chemical reaction with the water would generate an air contaminate when oil should be used instead.
4. Decontaminate; make a plan first.
5. A complete history of the accident and subsequent remedial or protective measures must be submitted to the Radiation Safety Officer.

Fires and Other Major Emergencies.

1. Notify all other persons in the room and building at once.
2. Notify the fire department and other local plant safety personnel as well as the Radiation Safety Officer.
3. Attempt to put out fires by approved means if radiation hazard is not immediately present.
4. Govern fire-fighting or other emergency activities by the restrictions of the Radiation Safety Officer. Avoid, if possible, the tracking of contamination or passing of contaminated equipment into clean areas by emergency workers.
5. Monitor all persons involved in combating the emergency.
6. Following the emergency, monitor the area and determine the protective devices necessary for safe decontamination.
7. Decontaminate; follow a plan.
8. Permit no person to return to work without the approval of the Radiation Safety Officer.

9. Prepare a complete history of the emergency and subsequent activity related thereto for the Radiation Safety Officer.

Accidents Involving Radioactive Dusts, Mists, Fumes, Organic Vapors and Gases.

1. Notify all persons to vacate the room immediately.
2. Close air vents (while wearing respiratory protection PPE if available).
3. Vacate the room; seal off area, if possible.
4. Notify the Radiation Safety Officer at once.
5. Ascertain that all doors giving access to the room are closed. Post conspicuous warnings or guards to prevent accidental opening of the doors.
6. Monitor all persons suspected of contamination. Proceed with decontamination of personnel.
7. Report at once to the Radiation Safety Officer all known or suspected inhalations of radioactive materials.
8. Evaluate the hazard and the safety devices necessary for safe reentry.
9. Determine the cause of contamination and rectify the condition.
10. Decontaminate the area only upon the advice of the Radiation Safety Officer.
11. Perform an air survey of the area before permitting work to be resumed.
12. Submit a complete history of the accident and subsequent activities to the Radiation Safety Officer.

Injuries to Personnel, Involving Radiation Hazard.

1. Wash minor wound immediately under running water, spreading the edges of the gash.
2. Report all radiation accidents involving personnel (wounds, overexposure, ingestion, and inhalation) to the Radiation Safety Officer as soon as possible.
3. Call at once a physician qualified to treat radiation injuries.
4. Permit no person involved in a radiation injury to return to work without the approval of the attendance physician and the Radiation Safety Officer.
5. Prepare a complete history of the accident and subsequent activity related thereto for the Radiation Safety Officer.

DECONTAMINATION TECHNIQUES

Decontamination techniques are needed for personnel and areas. Damp wiping and mopping with water and detergent are the first steps. If the chemical characteristics of the contaminant are not known, detergents of neutral pH are preferable to soaps, which (in some instances) may cause fixation of certain nuclides rather than removal. Complexing agents, e.g., citric acid or chelating agents (EDTA or DTPA) in combination with detergent or soap increase the cleaning efficiency; the action of chelating agents is accelerated by warming. Occasionally, weak hydrochloric or nitric acid may be of value. The procedure for decontamination is given below.

Pre-operational.

1. Plan the decontamination operation thoroughly and obtain supplies.
2. Provide adequate protection for all decontamination personnel and allow for replacements.
3. Provide safe storage of all radioactive wastes and decontamination supplies.

Operational.

1. Always work toward the center of contamination.
2. Take care not to spread or track contamination to cleaner (lower activity) areas.
3. Monitor frequently and thoroughly.
4. cover clean areas with plastic sheets, kraft paper, or its equivalent.
5. Monitor all personnel and materials before permitting their movement to clean areas.

Post-operational.

1. Quarantine all used cleaning solutions and decontamination equipment until they can be monitored.

RADIOISOTOPE USE AND EMERGENCY PROCEDURES

I. Laboratory Guidelines for Isotope Use

A. DO's

1. Do read and become familiar with the Radioisotope Safety Manual.
2. Do wear protective laboratory apparel (coats, aprons, gloves, safety glasses).
3. Do wear your Film Badges while working with radioisotopes.
4. Do confine all radioisotope use to a tray lined with absorbent paper.
5. Do dispose of solid radioactive wastes in the proper container.
6. Do monitor yourself and your area (lab bench, sink, and floor) during and upon completion of the experiment.

B. DON'Ts

1. Do not smoke, drink, eat or use cosmetics in the lab where radioisotopes are used.
2. Do not keep food or drinks in the refrigerator where radioisotopes are stored.
3. Do not pipette radioactive solutions by mouth.
4. Do not work with radioisotopes in unauthorized areas.

II. Emergency Procedures

A. Persons splashed with radioactive solution shall wash thoroughly with soap and water for not less than two minutes.
B. If spill is on clothing, remove outer clothing at once and immediately survey skin under contaminated clothing. Contaminated clothing should be thoroughly washed with soap and water.
C. Wash minor wounds immediately under running water while spreading edges of the wound.
D. Report any ingestion or inhalation to the RSO as soon as possible.
E. Monitor all persons involved in the emergency.
F. For more details on emergency procedures, see section E-4 of the Radioisotope Use and Safety Manual.
G. Emergency call list:

	OFFICE	HOME
SL McLean, RSO	x.8889	
C. Martinsen, ARSO	x.7562	
Dr. C.D. Polson	x.7480	
Security Office	x.8111	--------

Definitions

1. 64E-5 F.A.C. – The agreement state regulations that govern radiation safety in Florida.
2. ALARA – As Low As Reasonably Achievable, the basic principle of radiation safety.
3. Authorized User: a person trained in the use of radioactive materials under the authority of a PI.
4. CDE – Committed Dose Equivalent: the dose to some specific organ or tissue of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.
5. DDE – Deep Dose Equivalent: the external whole-body exposure dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).
6. DoH – Department of Health. The State of Florida Department of Health Bureau of Radiation Control is the ultimate authority on the use of radioactive materials and radiation producing devices in the state of Florida.
7. EHS – Florida Tech's department of Environmental Health and Safety.
8. H3 – An abbreviation for Hydrogen 3 or Tritium.
9. LDE – Lens Dose Equivalent: the external exposure dose equivalent to the lens of the eye at a tissue depth of 0.3 centimeters (300 mg/cm^2).
10. LSC – Liquid Scintillation Counter or Liquid Scintillation Counts.
11. PMDs – Personal Monitoring Devices. Florida Tech uses film badges (Landauer) that are worn monthly, and doses are reported quarterly.
12. PPE – Personal Protective Equipment: included but is not limited to goggles, gloves, and lab coats. The purpose is to prevent injury and contamination to the authorized users.

13. PI – Principle Investigator or Use Supervisor: the person responsible for a specific permitted use of radioactive materials, the records regarding those uses, the restricting of areas of use and storage, purchasing of PPE and radiation equipment, and supervision of authorized users.
14. Radiation – Ionizing radiation (alpha, beta, gamma, and x-rays) for the purposes of this manual. Does not include non-ionizing radiation (i.e. infrared, microwave, ultraviolet, visible light).
15. Radioactive materials – Materials that produce radiation. They can be sealed sources or unsealed sources.
16. RAM – An abbreviation for unsealed radioactive materials.
17. Radiation Producing Devices – Equipment that emits x-rays such as X-ray diffractors and electron microscopes.
18. RSC – Radiation Safety Committee: the committee that oversees the use of radioactive materials and radiation producing devices at Florida Tech.
19. RSO – Radiation Safety Officer: the person ultimately responsible for radiation safety at Florida Tech.
20. SDE – Shallow Dose Equivalent: the external exposure dose equivalent to the skin or an extremity at a tissue depth of 0.007 centimeters (7 mg/cm^2) averaged over an area of 1 square centimeter
21. TEDE – Total Effective Dose Equivalent: the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).
22. Tritium – same as Hydrogen 3 or H3.