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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 and Environmental Health and Safety are responsible for all radioactive material at Florida Tech at all times. We are required to keep track of all sealed sources and isotopes no matter whether they are being used, stored, and disposed of as waste or in an animal carcass. At the same time, we are 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 (As Low As Reasonably Achievable 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 the Florida Institute of Technology to provide necessary safeguards and procedures and to assure compliance with this policy and the related instruction.

1.1.1 The Radiation Safety Committee shall be responsible for establishing radioisotope protection regulations as set forth in the Florida Department of Health (DOH), Control of Radiation Hazard Regulations, chapter 64E-5.

1.1.2 The committee shall consist of at least four members of whom one will be the Radiation Safety Officer (RSO) and the other individuals knowledgeable in the safe use of radioactive materials. See Appendix A-4 for a list of the Radiation Safety Committee.

1.1.3 The committee will meet semiannually or on call of the chairman or any two committee members.

1.1.4 The committee has final authority in all radioisotope safety operations at the Florida Institute of Technology.

1.1.5 The RSO is responsible for the operational aspects of radiation safety to ensure compliance with the Radiation Safety Committee Rules and Regulations, as well as the State of Florida, and any other applicable regulations.

1.2 It is the responsibility of each person in charge of a source of ionizing radiation to report the use or planned use of same to the Radiation Safety Committee and to obtain the RSC’s advice on radiation protection.
1.3 All proposed uses of radioactive materials or plans to produce or obtain radioactive material shall be submitted to the RSC for prior approval.

1.4 Every individual authorized to enter radiation use areas should keep in mind their personal responsibility with regard to radiation protection. They should continuously consider all implications of their activities which affect the safety of others and themselves. They should know when to consult radiation protection specialists and should avail themselves of their guidance early in their planning. They should never allow their enthusiasm in their work to distract them from these safety responsibilities.

1.5 All reports to government agencies should be made through the Radiation Safety Committee.

1.6 In the case of a radiation emergency, notify the RSO or any of the members of the Radiation Safety Committee. For detailed instructions see the Appendix A-6.

1.7 Minors and pregnant women.

1.7.1 Exposure of minors. No individual under the age of 18 will possess, use or transfer radioactive material in such a manner as to cause an annual exposure in excess of 10% of the standard specified in 64E-5.304.

1.7.2 Each individual who has declared pregnancy shall wear a radiation badge at waist level. Radiation exposure shall not exceed 500 mrem during the gestational period as specified in 64E-5.304.

1.8 Our license does not allow for the administration of radioactive material to humans.

1.9 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 the State of Florida, Department of Health.
1.10 Any individual who wishes to work with radioisotopes must register with the Radiation Safety Committee and show evidence of prior training and experience in handling isotopes.

1.11 All Principle Investigators in whose laboratory radioactive material is used must file with the Radiation Safety Officer a brief protocol stating the amount of isotope being used, the nature of the experiment, the safety procedures being used, and the names of personnel involved in such experiments.

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

1.13 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 secure when unoccupied, even if only briefly.

1.14 All users must be familiar with the applicable sections of the State of Florida DOH, Control of Radiation Hazard regulations, chapter 64E-5. All local safety procedures are based upon these regulations. Copies of 64E-5 are available at the Radiation Safety Office or on their website.

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 the Florida Institute of Technology who will use or directly supervise the use of radioactive material.

2.1.2 To qualify as a PI, one must file documentation which states the training and experience in the use of radioactive material with the State of Florida, Dept. of Health through the Radiation Safety Officer.

2.1.3 After approval, PI are listed on the license as individual users.

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 RSO form 1 (Appendix D-2) must be submitted by the PI to the RSO in duplicate for each project requiring radioactive materials.

2.3.1 Protocols detailing how the isotope will be used, disposed of and safety precautions must accompany RSO form 1 (as per line 2.3).

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 RSO form 2 (Appendix D-3) for each user listed in line 6.

2.3.3.1 Users will provide evidence to the Radiation Safety Committee of either formal or informal training in radioisotope handling procedures (Appendix Form RSO-2). Users must also verify that they have read and understood the Florida Tech Radiation Safety Manual, the applicable sections of the State of Florida, DOH, Control of Radiation Hazard Regulations 64E-5 and the local procedures and methods of control. 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 to be sufficient in scope for users of radioactive materials. 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 will normally satisfy the Radiation Safety Committee as formal training in the handling of radioisotopes. The radioisotope course must cover the basic principles of detection of radiation, detection systems, safe handling procedures of radioisotopes, safety requirements needed for working with radioisotopes, storage of radioisotopes, solid and liquid waste contamination, and disposal of radioisotopes.

2.3.3.4 Satisfactory completion of other radioisotope handling courses, either at Florida Tech (See Appendix A-7) or from
previously attended formal radioisotope handling courses other than at Florida Tech, may also satisfy the Radiation Safety Committee provided the radioisotope handling course was of sufficient scope to ensure proper training.

2.3.3.5 All authorized users are required to take annual refresher training. Annual refresher training is available through the RSO our online through EHS.

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 Radiation Safety Manual available to all users for referral and questions. Also, the appropriate rules and regulations must be presented to the project personnel so that anyone connected with the license has all pertinent information concerning the license available to them.

2.5 The RSO will review the completed application, establish that the proposed work area is a safe, and determine that all proposed equipment is operational.

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

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 check the quantity against our inventory, and our possession limits. The radioactive material is given a control number and sent to the purchasing agent for processing.

3.2 The RSO must be notified on a transfer form of any incoming 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 so that it can be given a control number.

3.3 The university purchasing agent is required to return all unauthorized purchase requisitions to the Radiation Safety Office. See memo to Purchasing Agent in Appendix C-2.

4.0 Procedures for Examining and Safely Opening Incoming Packages

4.1 All incoming shipments to the university are routed through the university receiving section.

4.2 The university receiving section is required to inform the Radiation Safety Office of the receipt of any radioactive shipment. See memo to Receiving Dept. in Appendix C-4.

4.3 The RSO will conduct a survey of the external surface of the package within 3 hours of its receipt at the university if received during normal working hours, or not later than 3 hours from the beginning of the next working day if received after working hours.

4.3.1 Packages labeled with a Radioactive White I, Yellow II, or Yellow III 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 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 Packages containing radioactive material with physical damage to them will be monitored for radioactive contamination regardless of labeling.

4.5 The shipment is identified as to radioisotope, purpose for use, and the PI it belongs to. Information is available in the packing slip.

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.

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 All radioactive materials are processed through the Florida Tech Receiving Section except for special air mail and air freight shipments. The common carrier has the responsibility for shipments not deliverable to the Receiving Section during work hours.

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
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 Personal Monitoring Devices (PMDs) such as specified film badges and/or dosimeters are required, and process monitoring carried out. 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 storage and shielded if necessary). Radioisotope work areas and storage locations must be secured from unrestricted access (i.e. doors locked and closed).

6.1.1 PMD’s must be worn whenever handling high energy beta (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.
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 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 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 unsealed 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).

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

6.8 Personal Protective Equipment (PPE) must be used when any possibility of personal contamination exists (e.g., gloves, laboratory aprons, laboratory coats, and safety glasses).

6.9 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 equipped with a pancake type “frisker” probe.
6.9.1 Instructions for personnel monitoring.

6.9.1.1 The probe is passed slowly and deliberately over the surface of hands, feet, and clothing to be surveyed, with a distance of approximately 5 mm (3/16”) between the surface and the probe window.

6.9.1.2 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 of the pancake to help prevent pancake contamination.

6.10 All working surfaces adjacent to all manipulations involving unsealed materials shall be covered with an absorbent imperviously backed covering.

6.11 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.

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

6.13 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.

6.14 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 isotopes with half-lives less than 90 days.
6.15 Any experiment involving gaseous or easily volatile radioisotope must receive the advance approval of the RSO and amendment of our radioactive material license.

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

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

6.15.3 Special Precautions

6.15.3.1 Wear plastic gloves.

6.15.3.2 No mouth pipetting.

6.15.3.3 No smoking, eating or drinking while handling radioisotope.

6.15.3.4 After each handling operation involving high energy beta (200 eV or greater) or gamma-emitting radioisotopes, check clothing, hands, floor, and bench tops for contamination using a scintillation type monitor or a GM type survey meter equipped with a pancake type “frisker” probe.

6.15.3.5 Wash your hands after each handling operation.

6.15.3.6 Anyone with an open wound on the hand must not handle radioisotopes.
6.15.3.7 Wastes are to be stored in a closed can in a hood behind plastic or lead-lined shielding until picked up.

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

7.3 Before transferring, the RSO must be notified immediately in writing on a transfer form of any transfer of radioisotope from one use PI to another within Florida Tech.

7.4 Before transferring, the RSO must be notified immediately in writing on a transfer form of any transfer of radioisotope to another institute outside of Florida Tech. All transfers must be approved by the RSO.

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 readings should not exceed 0.2mR/hour at 1 cm from the refrigerator/freezer.
8.3 All refrigerators which contain isotopes are to be posted with the radiation sign and the name and phone number of the Principle Investigator.

8.4 A list(s) will be posted on each refrigerator (RSO form 6 Appendix D-7) noting the types and activities of isotopes contained therein. Each Principle Investigator must make an inventory of the amount of each isotope in his possession every month and report the amount to the RSO on RSO form 7 (Appendix D-8).

8.5 The RSO must be notified immediately whenever there is a discrepancy in the amount or number of radioactive materials posted.

8.6 Laboratories using radioisotopes must have the prescribed notices prominently displayed. This includes: signs ("Caution: Radioactive Material") affixed on all entrance doors, the NRC form 3 (Notice to Employees), emergency telephone numbers (including the RSO and DOH, Orlando), Florida DOH Form 1081 Notice to Workers, and emergency procedures.

8.7 Each storage container must have the proper label affixed ("Caution: Radioactive Material", amount, date, isotope); containers in use may have 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 DOH Control of Radiation Hazard Regulations 64E-5.315) must wear Personal Monitoring Devices (PMD’s). These are sent to all authorized users at the beginning of each month by the RSO and must be returned at the end of the month with the inventory sheet and monitoring records, for processing.

9.2 A routine survey and monitoring schedule must be observed for all laboratories using unsealed radioisotopes.
9.2.1 The immediate work area where unsealed radioisotopes are used must be wipe tested or surveyed at the end of each day of use by the user. Use form RSO-10 (Appendix D-11) to report the results of the daily survey or wipe tests.

9.2.2 Radiation surveys are required weekly for labs where radioactive materials are in use to check for contamination, and surveys are required monthly for storage locations of radioactive materials.

   9.2.2.1 High energy betas (P32) and gamma emitters, must be surveyed with a calibrated meter with a GM pancake “frisker” probe. Low energy betas (C14, H3) and alpha emitters should be surveyed by wipe test/scintillation counter.

9.2.3 A copy of laboratory surveys must be forwarded to the RSO at the end of each month for review.

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 200 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.

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 laboratory 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 as low as reasonably achievable in all restricted and unrestricted areas. All requirements of Part IV section 64E-5.304 and 64E-5.312 will 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 mrem per calendar quarter.

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

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

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

9.7 Radioactive Animals.

9.7.1 Before starting any experiment with radioisotope in animals, the RSO must be notified on the proper form. All such experiments must be carried out in designated radioisotope use areas.

9.7.2 Each use supervisor is responsible for the cleaning of the cages and trays. Waste is to be placed in radioactive waste containers provided.

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 used at Florida Tech for instrumental calibration, laboratory experiments, and/or gas chromatography detectors (ECD).

10.2 The following procedure must be followed:

10.2.1 ECD sealed sources must not be removed from their container.

10.2.2 Keep sources locked when not in use.
10.2.3 Keep a log of use. Users must be trained in radiation safety and use of radioactive sealed sources as well as receive annual refresher training.

10.2.4 All licensed sealed sources will be inventoried annually, and the records are kept by the RSO for three years. A leak test must be performed at least every 6 months except for:
(a) Sealed sources containing only radioactive material with a half-life of less than 30 days;
(b) Sealed sources containing only radioactive material as a gas;
(c) 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
(d) Sealed sources that are listed on the license for storage only.

10.3 The 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 any one intending to use greater than 1 mCi of H3.
11.4 Hydrogen 3.

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 and the forms for reporting the results of the urinalysis to the RSO are found in the Appendix.

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, 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).

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.

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 the chemical content of the waste. This is needed to determine waste can be disposed by decay or sewer or if it also needs to be treated as hazardous waste. 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). The material will then be released by the Radiation Safety Committee to be disposed of as conventional waste. Any radiation signs/labels shall be removed before disposal of any material.

12.6.2 Sewer disposal -- All radioactive material to be discharged into the sanitary sewer must be readily soluble or dispersible in water and will meet the requirements of 64E-5.330, State of Florida Bureau of Radiation Control ALIs, DACs, and Effluent Concentrations, July 1993, Table III. See section 12.8 of this manual.

12.6.3 All long-lived radioactive liquid material 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 also Section 12.9 of this manual.

12.6.4 All solid wastes are collected by the RSO and are disposed of as in Section 12.9 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 Radiation Safety Committee.

12.7.2 All radioactive material to be discharged into the sanitary sewerage system must be readily soluble or dispersible in water.

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 ALIs, DACs, and Effluent Concentrations, July 1993, Table III. 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 assayed prior to disposal.

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 sufficient quantities have been 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.

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.

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 to be 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 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.

13.1.1 Emergencies resulting from accidents of this nature may range from a minor spill of radioactivity, involving relatively no personal 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, if at all possible. Quick, efficient action taken under the following guidelines should tend to reduce any hazard to personnel and/or resultant area contamination.

13.1.2 The prompt evaluation of a radiological incident and immediate remedial action 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 approved areas and with the security and fire department. If a radiation incident or hazard is suspected, call 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 give phone numbers to provide 24-hour emergency coverage.
13.2.2 Persons splashed with radioactive solution shall wash immediately with ample quantities of soap and water.

13.2.3 The RSO shall be informed immediately of any inhalation or ingestion of radioactive material.

13.3 Minor accidents - Contamination levels below 1000 DPM/100 cm², 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 accident - Contamination levels above 1000 DPM/100 cm², exposure levels greater than 2 mR/hr at 5 cm, or spills greater than 2 L.

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 two minutes. Rinse thoroughly. Collect all rinse water with a container: do not allow down the drain.

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.

13.4.11 Permit no person 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 wear 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.

13.6.2 Immediately call the hospital for 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. 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. 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. 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 decontamination personnel, and allow for replacements.

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 decontaminate equipment until they can be monitored.

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 A: **ORGANIZATION AND GENERAL INFORMATION**

- ALARA Policy................................................................. A-2
- Radiation Safety Organization........................................ A-4
- Radiation Safety Committee.......................................... A-5
- Emergency Call List..................................................... A-6
- Radiation Safety Training Course Syllabus...................... A-7
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, of procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are As Low As Reasonably Achievable (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 to be 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.
The undersigned certify that the commitments set forth above have been implemented.

Signature (RSO)  
------------------  
Juliette M. Jones - RSO

Signature (Management)  
------------------  
Selvin McLean, CESLO-Director EHS
RADIATION SAFETY COMMITTEE

MEMBERS:

1. Chairman A.C. Leonard, Professor, Department of Biological Sciences

2. J. M. Jones, Radiation Safety Officer, Department of Environmental Health and Safety

3. Dr. C.D. Polson, Associate Professor, Department of Biological Sciences

4. Dr. D.J. Carroll, Associate Professor, Department of Biological Sciences
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SYLLABUS
RADIATION SAFETY TRAINING COURSE
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 area
Appendix B: FLOOR PLANS/FACILITY DESCRIPTION

SECOND FLOOR, F.W. OLIN LIFE SCIENCES BUILDING, DEPARTMENT OF BIOLOGICAL SCIENCES

ROOM # 231-Microbial Genetics Laboratory
RADIATION SAFETY OFFICE
Radiation Safety Office and Store Room
SECOND FLOOR, F.W. OLIN PHYSICAL SCIENCES BUILDING
Room 242 and 243 Advanced Physics Laboratory

LEGEND:

- Storage and Use of Radioactive Materials
- Use only
- Storage only
Biosciences Radioactive Storage and Use Location

Radioisotope Usage
Microbial Genetics Laboratory
Room 231

Isotope Usage/Swipe Test Locations
1. Water Bath
2. Solid Waste Storage
3. Centrifuge-Eppendorf
4. Refrigerator-Isotope Storage
5. Gel Dryer
6. Glass Work Sink (for radioactive glass)
7. Thermocycler
8. Liquid waste storage
9. Gel Rings

N
Radiation Safety Office and Store Room

1. Lead Lined Safe
2. Refrigerator Storage
3. Plastic Crate (sealed source storage)
4. Decommissioned Survey Meters
5. In-Use Survey Meters
Room 242 & 243 Advanced Physics Laboratory

1) High Res X-Ray Spectroscopy Exp.  4) Alpha Spectroscopy  7) Licensed Sources
2) Electronic Signal Exp.  5) SIPM Exp.  8) Generally Licensed Sources
3) Energy Loss Exp. (Alphas)  6) Arduino  9) Generally Licensed Sources
Appendix C: MEMORANDA

TO:

Shawn Hughes, Mail and Shipping Manager........................................C-2
John Czekanski, Property Administration...........................................C-4
John Milbourne, Director, Facilities Management................................C-5
Frank Iannone, Director of Campus Security......................................C-6
Radiation Exposure Report Memo.....................................................C-7
Memo

To: Shawn Hughes, Mail and Shipping Manager
From: Juliette Jones - RSO
CC: Dr. Alan C. Leonard, Selvin McLean, Director of EHS, John Czekanski, Property Administrator
Date: March 26, 2020
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) GE Healthcare
   c) American Radiolabeled Chemicals Inc (ARC)
   d) MP Biomedical
   e) Spectrum Techniques
   f) Siemens
   g) Eckert & Ziegler Isotope Products

2) Packages containing radioactive materials can be identified by:
   a) UN2910 – Label for Exempt Quantities of Radioactive Materials (most common)
   b) Radioactive Labels - White I, Yellow II, or Yellow III (White I is second most common, 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. All requisitions for radioactive materials will have my name on them and must come from me. 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, all orders for radioactive materials must include the license number before a vendor will forward the material. Also, the vendor has to have our license on file before they will sell to us. If you ever get an inquiry from a vendor as to what our 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: J. Czekanski, Property Administration
From: Juliette Jones - RSO
CC: Selvin McLean
Date: March 26, 2020
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). 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 me 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 protocol to help you train your personnel in 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 protocol and sign a statement that they have received this training.

New personnel must receive this training as soon as possible and an updated training list sent to me. Personnel who do not wish to deliver radioactive materials may be excused from doing so by signing a waiver.

The receiving department has always done a very good job in the handling of the radioactive material as it has come into the university. My continued thanks to you and your dedicated staff.

It is the goal of Florida Tech, the Radiation Safety Committee, and all radioisotope users 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: John Milbourne, Director, Facilities Management
From: Juliette Jones - RSO
CC: Dr. Alan C. Leonard
Date: March 26, 2020
Re: Radiation Caution Sign and Potentially Hazardous Areas

As you are aware, there are labs at the university that use radioactive materials. These labs have a radiation symbol posted on the door. Facilities personnel should not enter these labs without an escort during times the lab is in operation (radioisotope experiments being performed). Have any personnel that need entry contact the particular lab supervisor to arrange for entry and escort or to ascertain if any radioisotope experiments are being conducted. I am including a representative sample of this symbol and instructions with this memo 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 Dr. Alan C. Leonard, Chairman, Radiation Safety Committee.

Please make sure all personnel concerned are aware of the meaning of this symbol and the instructions provided.

It is the goal of Florida Tech, the Radiation Safety Committee, and all radioisotope users 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: Dr. Alan C. Leonard
Date: March 26, 2020
Re: Location of Radioactive Materials, Emergency Procedures

There are a number of labs/areas in the F.W. Olin Life Sciences Building, 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 a Radioactive Materials sign (example attached). 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 the symbol prominently displayed. Security personnel should not enter these areas without an escort during times the lab is in operation (radioisotope experiments being performed). If there is any question, please have your officers contact the particular lab supervisor to check on the status of the lab. Please make all your officers aware of the potential for the presence of radioactive materials at these locations and the meaning of the radioactive materials symbol.

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, Dr. Alan C. Leonard, Chairman, Radiation Safety Committee. If entry is required for any reason, please contact me or Dr. Dr. Leonard before attempting entry.

It is difficult for fire and police officials to evaluate accurately the magnitude of a radiation risk at the time of an emergency to ensure that contamination or the passing of contamination is kept as low as reasonably attainable. It is important that the Radiation Safety Officer be notified as soon as possible when any emergency is reported that might involve a radioisotope area. This ensures that fire fighting or other emergency activities will be governed by the restriction of the Radiation Safety Officer. Every lab that has radioactive material will have an emergency procedures protocol posted along with a call list (copy attached). 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, the Radiation Safety Committee, and all radioisotope users 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: March 26, 2020
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

FORM NO.
RSO-1 Radioactive Material Use Authorization........................................D-2
RSO-2 Ionizing Radiation User Approval Request..................................D-3
RSO-3 Request for Film Badge Service..................................................D-4
RSO-4 Information for Use and Disposal of Radioactive Animals...............D-5
RSO-5 Transfer of Radioisotope.............................................................D-6
RSO-6 Use Log and Disposal Form.......................................................D-7
RSO-7 Monthly Inventory Report..........................................................D-8
RSO-8 Radioactive Waste Inventory.....................................................D-9
RSO-9 Weekly Radiation Monitor Report...............................................D-10
RSO-10 Daily Monitor Report...............................................................D-11
RSO-11 Hydrogen 3 Bioassay Report....................................................D-12
RSO-12 Exposure History Request.......................................................D-13
RSO-13 Request for Radioisotope Disposal............................................D-14
RSO-14 Radioisotope Order Form..........................................................D-15
RSO-15 Instructions for Ordering Radioisotope......................................D-16
RSO-16 Radioactive Material Disposal Form..........................................D-17
RSO-17 Property Management Op-Out Form.........................................D-18
RSO-18 Radioactive Materials Use and Safety Attendance Sheet..............D-19
**RADIOACTIVE MATERIAL USE AUTHORIZATION**
(Prepare in original and one copy)

<table>
<thead>
<tr>
<th>Department</th>
<th>[ ] New Request</th>
<th>[ ] Modification</th>
<th>Date Prepared</th>
<th>Reference Number</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>A. Element and Isotope</th>
<th>B. Physical Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Total Quantity Required</th>
<th>D. Estimated Activity Per Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Location of Use

<table>
<thead>
<tr>
<th>[ ] Main Campus (FIT)</th>
<th>[ ] Temporary Site (Specify)</th>
<th>Building</th>
<th>Room Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

6. Users (Submit Supplement Form for Each Individual)  

7. Signature of Request Originator:  

<table>
<thead>
<tr>
<th>Principle Investigator</th>
<th>Title or Position</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

8. Signature of Department Head  

<table>
<thead>
<tr>
<th>Title or Position</th>
<th>Date</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

9. Signature – Radiation Safety Officer  

<table>
<thead>
<tr>
<th>Title or Position</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

10. Radiation Safety Committee

<table>
<thead>
<tr>
<th>[ ] Disapproved</th>
<th>[ ] Approved, subject to conditions noted in Item 12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

11. Expiration Date

<table>
<thead>
<tr>
<th>Date</th>
</tr>
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<tbody>
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<td></td>
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</tbody>
</table>

12. An approved “Radioactive Material Use Authorization” shall be subject to all applicable rules, regulations and the orders of the Florida Tech Radiation Safety Committee now or hereafter in effect and any conditions specified below

a. **Standard Conditions**
   - (1) The Principle Investigator shall insure compliance with Florida Tech Radiation Safety Manual and statements and procedures contained within the request.
   - (2) The Principle Investigator shall provide health and safety procedures covering radiological protection, control and security of radioactive material, to each individual using or having responsibility for use of such material.

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

D-2
Ref. Number _____

IONIZING RADIATION USER APPROVAL REQUEST

Name _____________________________  Department ___________________________

Bldg/Location ______________________  Tel. # _________________________________

TRAINING (Use Supplemental Sheets if Necessary)

<table>
<thead>
<tr>
<th>Formal</th>
<th>Informal</th>
<th>Location</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EXPERIENCE (Use Supplemental Sheets if Necessary)

<table>
<thead>
<tr>
<th>Type of X-Ray/accelerator and/or Nuclide</th>
<th>Maximum Energy and/or Curies</th>
<th>Purpose in Use</th>
<th>Location</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

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 institution(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

D-4
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
TRANSFER OF RADIOISOTOPES

Within Florida Tech _____  Outside _____  Export _____

From: _________________________________________________________________

To:  __________________________________________________________________
     __________________________________________________________________

Isotope: __________  Activity (in μCi): __________

Compound: ___________________  Medium: ___________________

Amount: ___________________  Value: ___________________

Ship

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:** ________________

<table>
<thead>
<tr>
<th>Month</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Submitted by</th>
<th>Approved by - RSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Radioactive Material</th>
<th>Quantity (μCi)</th>
<th>Name of Person</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Received</td>
<td>Used</td>
</tr>
</tbody>
</table>

## Disposal

<table>
<thead>
<tr>
<th>Date placed in storage</th>
<th>Quantity placed in storage (μCi)</th>
<th>Date of disposal</th>
<th>Name of disposer</th>
<th>Survey Instrument</th>
<th>Background Radiation Level (mR/hr)</th>
<th>Radiation Level at Surface of Container (No Shielding) mR/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Model</td>
<td>Serial #</td>
<td></td>
</tr>
</tbody>
</table>

RSO-6
MONTHLY INVENTORY

Isotope in Stock

Date: __________  Laboratory: __________________  Supervisor: __________________

**Isotope**

**32-P**

<table>
<thead>
<tr>
<th>Amount in μCi</th>
<th>Compound</th>
<th>Storage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

Total Amount of 14-C in μCi: ______________

**3-H**

<table>
<thead>
<tr>
<th>Amount in μCi</th>
<th>Compound</th>
<th>Storage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Total Amount of 3-H in μCi: ______________

**Other**

<table>
<thead>
<tr>
<th>Amount in μCi</th>
<th>Compound</th>
<th>Storage Mode</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

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 ______________________________

<table>
<thead>
<tr>
<th>Date</th>
<th>Radioactive Material</th>
<th>Quantity Used (µCi)</th>
<th>% in Retained waste</th>
<th>Waste Form</th>
<th>Location</th>
<th>Total Qt. Isotope in waste</th>
<th>Used</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

RSO-8
WEEKLY RADIATION MONITOR REPORT

Date: ________  Survey Done By: ________________
Location: ________  Survey Instrument: ________

RESULTS OF METER SURVEY:


RESULTS OF WIPE TESTS

<table>
<thead>
<tr>
<th>Location</th>
<th>3H</th>
<th>14C</th>
<th>32P</th>
<th>125I</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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<td>5.</td>
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<td>6.</td>
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<td>7.</td>
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<td>9.</td>
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<td>10.</td>
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</tbody>
</table>

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: ____________

<table>
<thead>
<tr>
<th>Radioisotopes Used</th>
<th>Amounts</th>
<th>DPM/100 cm²</th>
<th>Survey done by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuesday</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Wednesday</td>
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<td></td>
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<tr>
<td>Thursday</td>
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<tr>
<td>Friday</td>
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<tr>
<td>Other (Sat – Sun)</td>
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</tbody>
</table>

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 ______

<table>
<thead>
<tr>
<th>Date</th>
<th>H-3 Used (µCi - Form)</th>
<th>Urinalysis</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BKG CPM</td>
<td>CPM/ml</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<td>2</td>
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<td>18</td>
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</tbody>
</table>

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
REQUEST FOR RADIOISOTOPE DISPOSAL

Date: _____________  From: ________________________

(Responsible Investigator)

I. Liquid Wastes:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>% Chemical Composition</th>
<th>Total Microcuries</th>
<th>Total Volume</th>
<th>Microcuries per ml</th>
<th>Container Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

II. Scintillation Vials:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Number of Trays</th>
<th>Total Microcuries</th>
<th>Total Volume</th>
<th>Description of Vial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

III. Solid Wastes

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Chemical Form</th>
<th>Total Microcuries</th>
<th>Major Constituents</th>
<th>Container Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

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#: _______
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.


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: ________________________
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 - 16
The purpose of this training is to ensure that all aspects of proper management regarding radioactive materials at Florida Institute of Technology (Florida Tech) are in order and in compliance with all Federal and/or State laws. The Radioactive Materials use and Safety Manual plan includes information on: general responsibility, obtaining permission for use, ordering radioactive materials, receiving radioactive materials, general laboratory safety, transportation within Florida Tech, storage and labeling, monitoring use, sealed sources, hydrogen 3 bioassays, radioactive waste disposal, emergency procedures, and decontamination techniques. Any questions regarding this training can be directed to the Radiation Safety Officer.

Radioactive Materials use and Safety training is an annual training.

With my signature, I agree that I had the opportunity to read and understand the facilities written Radioactive Materials use and Safety Manual that is in compliance with all Federal and/or State laws.

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Name (print)</th>
<th>Department</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

Email Address

________________

RSO – 17
Appendix E: INSTRUCTIONS/PROCEDURES/DEFINITIONS

Hydrogen 3 Bioassay Procedures...............................................................E-2

Information and Guidelines Concerning Use of the Animal.....................E-6

Facilities and Animal Care

Detailed Emergency Procedures...................................................................E-8

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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, $5 \times 10^{-6} \mu \text{Ci/ml}$, by $6.3 \times 10^{8}$ 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).

E-2
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 0.8 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

<table>
<thead>
<tr>
<th>TYPE OF OPERATION</th>
<th>HTO FORM (&amp; FORMS OTHER THAN THOSE ON RIGHT-HAND COLUMNS)</th>
<th>HT OR T₂ GAS IN SEALED PROCESS VESSEL</th>
<th>NUCLEOTIDE PRECURSORS</th>
<th>HTO MIXED WITH MORE THAN 10 Kg OF INERT H₂O OR OTHER SUBSTANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process in open room w/possible escape of tritium from process vessel</td>
<td>0.1 Ci</td>
<td>100 Ci</td>
<td>0.01 Ci</td>
<td>0.01 Ci/Kg</td>
</tr>
<tr>
<td>Process w/possible escape of tritium, carried out within a fume hood of adequate face velocity and performance reliability</td>
<td>1 Ci</td>
<td>1000 Ci</td>
<td>0.1 Ci</td>
<td>0.1 Ci/Kg</td>
</tr>
<tr>
<td>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</td>
<td>10 Ci</td>
<td>10,000 Ci</td>
<td>1 Ci</td>
<td>1 Ci/Kg</td>
</tr>
</tbody>
</table>

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 walk-way 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.
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.

Preoperational.

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.

Postoperational.

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**
   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:

<table>
<thead>
<tr>
<th>OFFICE</th>
<th>HOME</th>
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<tbody>
<tr>
<td>J.M. Jones, RSO</td>
<td>x.8889</td>
</tr>
<tr>
<td>Dr. A.C. Leonard</td>
<td>x.8577</td>
</tr>
<tr>
<td>Dr. D.J. Carroll</td>
<td>x.7133</td>
</tr>
<tr>
<td>Dr. C.D. Polson</td>
<td>x.7480</td>
</tr>
<tr>
<td>Security Office</td>
<td>x.8111</td>
</tr>
</tbody>
</table>
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/cm²).
6. DOH – Department of Health. The State of Florida Department of Health is the ultimate authority on the use of radioactive materials and radiation producing devices in the state of Florida.
7. 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/cm²).
8. PMDs – Personal Monitoring Devices. Florida Tech uses film badges (Landauer) that are worn monthly, and doses are reported quarterly.
9. 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.
10. 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.
11. 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).

12. Radioactive materials – Materials that produce radiation. They can be sealed sources or unsealed sources.

13. Radiation Producing Devices – Equipment that emits x-rays such as X-ray diffractors and electron microscopes.

14. RSC – Radiation Safety Committee: the committee that oversees the use of radioactive materials and radiation producing devices at Florida Tech.

15. RSO – Radiation Safety Officer: the person ultimately responsible for radiation safety at Florida Tech.

16. 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/cm²) averaged over an area of 1 square centimeter.

17. TEDE – Total Effective Dose Equivalent: the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).