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1. **Purpose**

The rules and regulations contained in this document are established for the following purposes:

1.1. To provide adequate protection to those handling radioactive materials or radiation producing machines, as well as to the visitors and the general public, in the process of conducting research or other licensed permitted activities at Tufts University, Tufts University School of Veterinary Medicine and Tufts University School of Dental Medicine.

1.2. To ensure compliance with applicable conditions of all licenses issued by the Commonwealth of Massachusetts Radiation Control Program.

1.3. To ensure compliance with applicable regulations of state, federal, and local agencies.

2. **Administration and Delegation of Authority**

The President of Tufts University delegates authority in matters pertaining to the University Radiation Safety Program to the Office of the Vice Provost. The Office of the Vice Provost:

2.1. Assumes overall responsibility for the Radiation Safety Program (RSP) through the Radiation Safety Committee (RSC) and Radiation Safety Officer (RSO).

2.2. Participates jointly with Deans, Directors, and Department Chairpersons, through the RSC and the Radiation Safety Officer to establish RSP policies that provide adequate radiation protection and continue to meet regulatory requirements.

2.3. Supports the development and continuing review of the RSP to ensure that radiation protection requirements are met.

2.4. Appoints the RSC members and delegates authority to that body in matters pertaining to radiation safety.

2.5. Ensures the implementation of appropriate controls based upon the recommendations of the RSC.

The RSC shares responsibility for providing a safe work environment and conducts a program of licensing, review and evaluation of proposals for use of radioactive materials and radiation producing machines.

The Vice Provost delegated to the Radiation Safety Officer (RSO) the authority to manage the Radiation Safety Program, identify radiation safety hazards, initiate, recommend or provide corrective actions and ensure compliance with regulations for the safe use of radioactive materials and radiation producing machines. The RSO has the authority to immediately stop any operation involving the use of radioactive material or radiation producing machines in which health or safety may be compromised or which may result in non-compliance with the applicable regulations.
3. **Organization and Responsibility of the Radiation Safety Committee**

3.1. **Objective and Responsibility**

The RSC is charged with providing independent expert advice to Administration, Directors, Investigators and others specifically working with or in areas containing radioactive materials or radiation producing machines. Members often review an array of complex scientific, technical, and policy issues, including questions related to the development and evaluation of the RSP.

The RSC receives its authority from the Vice Provost of the University and includes representatives of Tufts University and Tufts University School of Dental Medicine in Boston, as well as Tufts University School of Veterinary Medicine in Grafton. The Committee meets on a quarterly basis to review the current status of and advise on the development of the RSP, and to ensure that the safe handling of radioactive material and use of radiation producing machines is optimized.

The Committee is a forum of experts that provide technical and administrative guidance and effectively review safety controls and procedures, security procedures, training programs, annual RSP audits, facility design, amendments to regulatory licenses and internal RSP permits.

The following list summarizes the primary objectives and responsibilities of the Committee:

3.11. To support the development of radiation safety policies and procedures.
3.12. To review and approve radioactive material permits.
3.13. To review the RSP Annual Audit and continuous development of the RSP.
3.14. To advise management on radiation protection requirements and regulatory updates.
3.15. To review deficiencies and incidents and assess what corrective actions if any are required.

3.2. **Organization**

The RSC is comprised of the Chairperson, the Radiation Safety Officer, a representative of the Office of the Vice Provost, and faculty members from the academic departments to ensure broad representation and expertise. Faculty representatives are nominated by the Chairperson and appointed by the Vice Provost. Additional Staff members may be chosen for special expertise including industrial hygiene, environmental health, maintenance, radiological safety, custodial services, security, facilities Services and additional staff trained.
and experienced in the safe use of radioactive materials and radiation producing machines.

Non-voting members serve as a resource to the RSC and represent areas where there is potential for radiation safety hazards. They provide additional expertise and assist in maintaining safe working conditions and practices. All Committee members are listed on form RSP-011, entitled ”Radiation Safety Committee Members” and are responsible for ensuring that they or their alternate are fully prepared for RSC meetings.

Members routinely share their thoughts and recommendations specific to the RSP during discussion at RSC meetings. When presenting a question for a vote, the Chairperson and/or RSO should solicit and answer questions about its implications before the vote begins. The purpose for this is to minimize any ambiguity and maximize the effectiveness of voting by ensuring that members clearly understand the question at hand. For instances requiring a vote, the Committee decides by a majority vote of members. When the vote is a tie, the Committee defers the final decision to the RSC Chairperson.

The Committee meeting is considered official if the Chairperson, RSO and 50% of the members (quorum) are present. RSP actions that require immediate endorsement by the RSC can be made effective by an agreement between the RSC Chairperson and the RSO provided these actions are reviewed and approved at the next RSC meeting.

Committee minutes and agenda should be distributed to all committee members in advance of the scheduled meeting. Records of past meetings are maintained by the RSO or designee.

4. **The RSC Chairperson, Radiation Safety Officer and Radiation Safety Program Support Staff**

The Chairperson has the responsibility for implementing the RSC objectives and conducting the Committee meeting. The Committee may choose to appoint a co-Chairperson that assumes the responsibility of the Chairperson in his/her absence.

The RSO operates under the authority of the RSC. This individual acts as liaison with regulators, oversees all radiation safety aspects of the RSP, and reports directly to the Director of EHS. The duties of the RSO are as follows:

4.1. To interpret regulatory requirements and ensure compliance.
4.2. To maintain communication with PI’s, RSC, Administration, and regulators.
4.3. To conduct regulatory audits of the RSP and advise management and the RSC on methods that support program development.
4.4. To establish and secure comprehensive records that demonstrates control of radioactive materials and radiation producing machines.
4.5. To evaluate permits submitted by Principal Investigators for conducting research, veterinary or dental application, involving radioactive materials or radiation producing machines.

4.6. To register individuals working in permitted areas designated for the use of radioactive material or radiation producing machines.

4.7. To maintain internal and external dosimetry program.

4.8. To provide dosimetry for the purpose of monitoring external exposure to radiation and demonstrating compliance with regulations.

4.9. To oversee laboratory inspection, surveys and area monitoring, as necessary.

4.10. To oversee radioactive waste management program.

4.11. To oversee radiological instrumentation program.

4.12. To oversee radiological surveillance program.

4.13. To oversee acquisition, transfer and receipt of radioactive materials.

4.14. To investigate radiological incidents and communicating to the RSC and PI’s as needed, to include lessons learned, corrective and preventive actions.

4.15. To provide Radiation Safety training to PI’s, and all radiation workers as needed.

4.16. To provide emergency response services as needed to recover and return to normal conditions.

4.17. To oversee contractors employed providing radiological services to maintain and develop the RSP and fulfill Tufts University license conditions.

4.18. To maintain adequate qualified staffing to fulfill license obligation and meet regulatory compliance.

The Radiation Safety Program is staffed by a RSO, Health Physicist (covering Grafton and Medford campus), and additional support staff contracted as needed to support the RSP daily function.

5. Radioactive Materials License and Registration of Radiation Producing Machines

5.1. Radioactive Material License

Tufts University has been issued a Type B Broad-Scope Radioactive Materials License by the Commonwealth of Massachusetts Department of Public Health Radiation Control Program (DPH-RCP). The license details the possession, use, storage, receipt and transfer of radioactive materials, giving full responsibility for the control and proper use of such materials to the RSC. This license is on file in Tufts EHS and imposes certain limitations with respect to radionuclide, chemical compound, and quantity. It states that radioactive materials shall be used by, or under the supervision of individuals designated by the RSC. It also specifies a list of conditions of approval, all of which must be continually satisfied in the conduct of work involving these materials. All work must be performed in such a way that the rules and regulations detailed in 105 CMR Part 120 are satisfied.

5.2. Cesium -137 Irradiator License
Tufts University has been issued an irradiator license by the DPH-RCP. Specific training is required for authorization to use the device. The RSO should be contacted for more information if needed.

5.3. **Registration of Radiation Producing Machines**

Radiation producing machines, such as x-ray diffraction units, lasers or electron microscopes potentially can cause injury and should be used by trained personnel only. Training is provided by EHS and documented prior to handling any radiation producing device. The following machines are required to be registered with the RSO.

5.3.1. Laser Systems: Class 3B or 4 lasers; additional information is provided by visiting the Tufts University Laser Safety section website at: [http://publicsafety.tufts.edu/ehs/?pid=103](http://publicsafety.tufts.edu/ehs/?pid=103).

5.3.2. X-ray or Accelerators: x-ray diffraction units, linear accelerators, irradiators, and similar devices designed to produce ionizing radiation.

5.3.3. Electron microscopes: x-rays are produced internally and normally do not pose a radiation hazard due to shielding. However, leakage can potentially occur through gaskets or other manufactured points.

6. **Principal Investigator (PI)**

The DPH-RCP license authorizes the RSC to appoint Principal Investigators to be responsible for assigned areas where sources of ionizing radiation are located. There are specific requirements that must be satisfied before an individual is permitted to handle radioactive material or operate radiation producing machines. PI candidates considered by the RSC are required to:

6.1. Complete the PI application process, and receive recommendation by the RSO to be appointed; or,

6.2. Complete the PI sponsorship application process, and receive recommendation by the RSO to be appointed.

Each new Principal Investigator must complete a permit application using form RSP-001 ([Appendix A](#)) entitled “Radioactive Material Permit Application” and form RSP-005 ([Appendix B](#)) entitled “Radioactive Materials Principal Investigator Applicant Training and Experience” and submit it to the TU-EHS RSO. Investigators intending to work with radioactive materials but whom are not “permitted” may apply to work under the supervision of a Principal Investigator from another project serving as a "sponsor" and are required to complete a sponsorship request form RSP-004 ([Appendix C](#)) entitled “Radioactive Material Sponsorship Request”. That "sponsor" must become thoroughly familiar with the proposed use and assume full responsibility for that
work during his/her sponsorship for a period up to 6 months. If the investigator 
has not satisfied the requirement for appointment within six months, the 
sponsorship agreement expires.

7. Principal Investigator Appointment Process

7.1. **PI application process:**

7.1.1. Receive Department Chairperson recommendation to solely manage 
their respective operation or research involving the use of 
radioactive materials.

7.1.2. Contact the RSO ((617)636-3450), complete RSP-005 and submit 
the electronic version and original to the RSO.

7.1.3. Receive approval by the RSO.

7.1.4. Attend Radiation Safety for Principal Investigator’s training and 
receive PI examination preparation guide, RSP-009 (Appendix D), 
entitled “Principal Investigator Exam Preparation Guide, Non 
Human-Use”, provided by the RSO.

7.1.5. Successfully pass the written PI examination.

7.1.6. Receive recommendation by the RSO to be appointed by the RSC as 
a PI.

7.2. **PI sponsorship application process:**

Sponsorship is permitted for 6 months to those individuals planning to work 
with radioactive materials under the supervision of a permitted Principal 
Investigator from the same department and as recommended by his/her 
Department Chairperson.

7.2.1. Receive Department Chairperson recommendation to manage their 
respective operation or research involving the use of radioactive 
materials under the sponsorship of a RSC PI.

7.2.2. Complete RSP-004 and RSP-005 and submit the electronic version 
and original to the RSO.

7.2.3. Receive approval by the RSO.

7.2.4. Attend Radiation Safety for Principal Investigator’s training and 
receive the PI examination preparation guide, RSP-009, provided by 
the RSO.

7.2.5. Successfully pass the written PI examination within 6 months from 
the sponsorship date.

7.2.6. Receive recommendation by the RSO to be appointed by the RSC as 
a PI.

Those individuals appointed as PI’s by the RSC are eligible to apply for a 
Radioactive Materials Permit (RSP-001). Each permitted Principal Investigator 
will be responsible for ensuring that all activities within their laboratory or other
permitted area and involving radioactive material are in compliance with Tufts policy and the applicable regulations. Permitted Principal Investigator’s are responsible for all radioactive materials use within their assigned areas including radionuclide inventory control, waste management, effluent control, radioactive material procurement, supplies, safe procedures and the registration and training of employees, contractors and visitors.

Only persons authorized by the RSC may be considered "Permitted Principal Investigators". Those who qualify with regard to experience and who have successfully completed the examination will be permitted to use radioactive materials on their own responsibility. PI applicants who pass the examination may be authorized by the RSO to exercise the privileges of a PI pending RSC approval at the next meeting.

Examinations taken at other institutions do not fulfill this requirement. Individuals that meet either criterion are not required to take the examination:

7.2.7. The investigator is board certified in either Nuclear Medicine or Radiation Oncology, or:
7.2.8. The investigator is individually named in an institutional license granted by the U.S. Nuclear Regulatory Commission (NRC) or an Agreement State. A copy of this license or certification must be submitted to the RSO for verification.

8. Principal Investigator Responsibility

Each PI under whom work with radioactive materials is being conducted is responsible for the following:

8.1. Providing Radiation Safety staff with radiological data to accurately reflect the work environment conditions in areas in which radioactive materials are stored or handled.
8.2. Controlling radioactive material and ensuring radionuclide inventories are current and accurate. Inventory includes any change due to transfer of radioactive materials, waste, effluent release, and loss due to radioactive decay.
8.3. Ensuring that adequate radiation monitoring equipment is available as needed.
8.4. Notifying Radiation Safety staff of any personnel changes to existing permits for those working in laboratories where radioactive materials or radiation producing machines are handled.
8.5. Following RSC approved radioactive materials procurement protocol and ensuring those delegated to perform purchases on behalf of PI’s are appropriately trained and qualified.
8.6. Ensuring that radioactive materials are disposed of according to Radiation Safety policy.
8.7. Informing Radiation Safety staff of changes in procedure which may increase the potential for radiation exposure or contamination.
8.8. Ensuring that personnel likely to receive 10% of the external or internal occupational exposure limits (500 mrem deep dose or 500 mrem internal) are assigned to the radiation dosimetry program.

8.9. Establishing appropriate procedures to ensure that radioactive materials and areas are properly labeled and posted respectively.

8.10. Strictly conforming to the RSC policy regarding security of radioactive materials (i.e.: that radioactive materials are under full surveillance at all times, and are properly stored and controlled when not in use).

9. **Radioactive Materials Permit**

Each PI requesting to use radioactive materials within their area under their jurisdiction is required to complete and forward RSP-001 to the RSO or Radiation Safety staff. Each permit details general information, contacts, radionuclides and associated inventory requested, description of work involving radioactive materials, areas of use, trained personnel, radiological instrumentation, and additional information that either characterizes or describes the radioactive material and/or application. Permits are signed by the PI and departmental chairperson, and reviewed by the RSO prior to submission to the RSC. The RSO reviews permits for the purpose of managing radionuclide inventory, to ensure the safe handling of radioactive materials and adequate radiation protection controls are implemented. Applications completed and submitted by PI’s are either approved by the RSO as written, or returned for additional information or edit. Those permits approved by the RSO are subject to RSC review and approval. Upon approval by the RSC, permit applications are assigned a unique permit number by the RSO or designee and filed within EHS. Copies of signed permits are provided to PI’s for their record and future reference. Each approved permit is valid for a period of five years.

The permit application is available by visiting the Tufts EHS website: [http://publicsafety.tufts.edu/ehs/downloads/RSP-001.pdf](http://publicsafety.tufts.edu/ehs/downloads/RSP-001.pdf). Both electronic and signed originals should be forwarded to the RSO upon completion.

10. **Amendments to and Renewal of Radioactive Materials Permit**

Permits are issued for a 5 year period and expire thereafter unless renewed. It is the responsibility of PI’s to conduct a timely renewal of their respective permit within 30 days prior to expiration. PI’s may renew by submitting an electronic copy of RSP-001 to the RSO. The RSO is responsible for reviewing the permit renewal and communicating the request at the next RSC meeting.

Amendments are submitted by using RSP-001, to be recognized by the Department Chairperson, forwarded to the RSO, and used to correct errors, request changes, or change information pertinent to the radioactive materials permit. All amendments, regardless of its magnitude, must be requested in writing.
11. Radiation Safety Training

11.1. PI’s and Radiation Workers

All personnel whom work in a designated radioactive materials use area are required to attend Introduction to Radiation Safety training. Training sessions are scheduled in advance and posted on the Tufts EHS website: http://publicsafety.tufts.edu/ehs/?pid=36. The two hour introductory training is required for all members working within a Registered Radioactive Materials laboratory. During the final 15 minutes of the session, participants complete a written examination (quiz) that will be reviewed in class as needed. The topics covered include:

11.1.1. Regulatory review
11.1.2. Radiological handling techniques
11.1.3. Radiation Safety philosophy
11.1.4. Administrative & engineering controls
11.1.5. Personal protective equipment
11.1.6. Radiological instrumentation
11.1.7. Radiation Safety monitoring and surveillance
11.1.8. Waste Minimization strategies and guidelines

Annual refresher training is provided to faculty, staff and students whom are currently authorized to work with radioactive materials or ionizing radiation sources, or frequenting an area where these materials are used or stored. Contact Tufts University EHS at ehs-training@tufts.edu for an appointment and to confirm location.

11.2. Support Staff (Custodial Services, Facilities, Police)

New Employee Orientation is provided to all personnel hired at Tufts University. Individuals are introduced to safety requirements and practices applicable to their line of work. Annual refresher training is provided to Support Staff whom frequent areas where radioactive materials are used or stored.

12. Radioactive Material Procurement, Receipt, Transfer and Inventory

12.1. Procurement

12.1.1. Researchers

All radioactive materials purchases are ordered directly through the Purchasing Department. Only radioactive material permitted PI’s, or designees receiving PI approval, are permitted to order radioactive materials. Orders are placed either electronically or by
filling out RSP-012 (Appendix E), entitled “Radioisotope Requisition”, and submitting to the Tufts Purchasing Department. Forms are available by contacting EHS.

The Purchasing Department receives radioactive materials authorization data from Radiation Safety staff to control procurement of radioactive materials. Purchasing provides permit verification to ensure compliance with radionuclide possession limits and places the order with the manufacturer.

PI’s are permitted to establish blanket orders with vendors. Blanket orders are established by contacting Tufts Purchasing and with the approval of the Radiation Safety Officer. Ordering limits are conservatively established based upon permitted possession limits for each radionuclide approved by the RSC. Only PI’s or those approved by the PI are permitted to place orders using a blanket order. Orders are placed by filling out RSP-013 (Appendix F), entitled “Tufts University (Boston Campus) Radioactive Materials Procurement Blanket Order Notification”, and submitting to the Tufts Purchasing Department. Forms are available by contacting EHS. Confirmation of orders must be immediately faxed to Radiation Safety staff at 617-636-7777. Failure to comply with this notification process may result in the revocation of the blanket order.

12.1.2. Nuclear Medicine (Grafton)

The immediate approval of a purchase order for radioactive material is delegated by the Nuclear Medicine Physician to the Nuclear Medicine Technologist or trained equivalent. Only PI’s or those approved by the PI are permitted to place orders directly with manufacturers licensed to distribute radioactive materials. All orders are communicated to Radiation Safety staff using form RSP-014 (Appendix G), and faxed to EHS at (617-636-2419).

12.2. Receipt

12.2.1. Boston

All Boston radioactive material shipments are addressed to the attention of the RSO and delivered to the receiving dock at 25 Harvard St. Shipments are checked in by Radiation Safety staff and monitored for radiation and contamination within three hours of receipt. The materials are delivered to the laboratories in the afternoon of the day that they are received. Only individuals from
Radiation Safety staff are allowed to accept radioactive material packages.

The individual who receives the order is required to:

12.2.1.1. Print his/her name legibly on the receipt slip and also indicate the number of stock vials contained in the package.

12.2.1.2. Carefully check the packing slip to ensure that the material that is detailed on the packing slip matches the material in the delivery box.

12.2.1.3. Immediately store the material in an approved location under lock and key.

12.2.1.4. Log the receipt of the material in the inventory logbook of the laboratory.

12.2.2. Grafton

Radioactive Materials packages intended for Research PI’s or Medical PI’s are delivered to the 200 Westboro Road Receiving dock and 200 Westboro Nuclear Medicine laboratory respectively. Packages received by Receiving are inspected for damage, received and secured for check-in within three hours by the research laboratory. Packages received by Nuclear Medicine are inspected for damage and appropriately monitored within three hours and their receipt recorded for inventory control.

12.3. Transfer

PI’s interested in transferring radioactive materials to another qualified Tufts PI are required to contact the RSO or Radiation Safety staff. Radioactive materials are not allowed to be transferred until competing and faxing form RSP-015 (Appendix H), entitled “Radioactive Material Inter-Permit Transfer”, and receiving approval by the RSO. Transfer of radioactive material outside the Tufts community is not permitted for PI’s and restricted to Radiation Safety staff only.

12.4. Inventory

It is the responsibility of PI’s to maintain an accurate inventory of radioactive materials within their designated area. Radiation Safety staff provides a “Radioactive Package Inventory Sheet” for each delivery of radioactive materials and can be used to document all use of radioactivity.

PI permits document the possession limit for each approved radionuclide. Possession limits are defined as a maximum quantity of radioactive material allowed, including the quantity decremented from the total inventory as
radiological waste. The radionuclide requisition form and blanket order notification form provides a space in which the PI must document the quantity of radioactivity currently inventoried. PI’s or designees should maintain an up-to-date inventory of radioactive material at the storage container location.


This policy is necessary to comply with the Massachusetts Radiation Control Program’s Title 105 CMR Part 120.235 “Security and Control of Licensed and Registered Sources of Radiation”. Compliance will ensure the continued uninterrupted use of radioactive materials.

Each project authorized to work with licensed material must establish sufficient means of locking all stored radioactive materials. Examples are lockable refrigerator / freezer, secured-lockable container within a refrigerator / freezer, or lockable fume hood. Access to stored radioactive material must be restricted to authorized users (It may be useful to consolidate radioactive samples stored in various locations to minimize the number of freezers, etc. that must be constantly locked). The storage container must remain locked at all times except when material is being removed from or returned to storage. PI’s should provide Radiation Safety staff a copy of the key or combination to the lock.

To ensure radioactive materials remain to be secured and controlled, PI’s are expected to:

13.1. Lock laboratories when not occupied by a radiation worker, unless all radioactive material has been secured against unauthorized removal.

13.2. Train personnel within the laboratory to challenge strangers who enter to ensure radioactive materials remain secure.

The RSO uses his/or her discretion to either suspend future radioactive material procurement or the use of radioactive materials for those that fail to adhere to the Security Policy. Under conditions of non-compliance, PI’s are required to submit in writing the proposed corrective action to ensure control of radioactive materials.

Repeat offenders are subject to suspension of permit and the immediate removal of radioactive materials. Suspended permits are reinstated by the Radioactive Materials Permit application process and subsequent review and approval by the RSC.

14. **Radiological Surveillance**

To comply with regulations, conditions of the license, and to provide for a safe work environment, lab personnel are required to maintain contamination and radiation levels below regulatory limits and as low as reasonably achievable. License conditions require that each PI provide adequate monitoring equipment to conduct contamination and radiation surveys and that they be conducted at the frequency that is commensurate with the level of radioactivity being handled within the laboratory. Radiation Safety staff provides additional surveillance by conducting unannounced surveys, and
communicating with PI’s by written notification when identifying deficiencies or non-compliant conditions. Conditions that warrant immediate correction are communicated verbally to the PI. Notifications are reported to the RSO who will present the notification and PI response at the next scheduled RSC meeting.

The following is a detailed outline of radiological surveillance conducted by permitted laboratory personnel:

14.1. **Laboratories, which use gamma-emitting or beta-emitting radionuclides**

14.1.1. **Daily closeout** surveys of the laboratory shall be made by a responsible individual. The survey will include a check to be sure that radionuclides are properly identified and secured from unauthorized persons, that areas in which gamma or high energy beta-emitting materials are handled are contamination free (GM survey meter measurements) and that major equipment (hood, etc.) necessary for the handling of such material is functional. The performance of each such survey shall be permanently logged on the Daily Close-Out form (See Appendix I for survey form to be used). Required documentation includes a check indicating if materials were used or not, check marks corresponding to each area of the laboratory that were surveyed, and who performed the survey. List unusual findings in the box that corresponds to the diagram of the laboratory and provide comments on how the findings were corrected. If radionuclides were not used on a given day, a contamination survey is not required, **but documentation needs to be made on the daily closeout form that no radioactive materials were used.**

14.1.2. **Weekly wipe test** surveys are required for any week when radioactivity is used. Wipe tests are conducted to determine the removal component of contamination that potentially exists at locations within the lab. The logging of weekly surveys shall include a diagram of the laboratory to identify wipe location points. The wipe tests results shall be recorded on the wipe test form in the blank that corresponds to the numbered diagram of the laboratory. If radioactivity was not used in any given week, a wipe test is not required, but an entry of “No RAM Used” or equivalent, is required to be recorded.

14.2. **Tritium (³H) use only laboratories**

14.2.1. **Daily closeout** surveys shall be made to determine that radionuclides are properly identified and secured against unauthorized personnel. An entry on the daily closeout form is
also required each day to indicate if radioactive materials were used or not.

14.2.2. **Weekly wipe test surveys** are required for any week when radioactivity is used. Wipe tests are conducted to determine the removal component of contamination that potentially exists at locations within the lab. The logging of weekly surveys shall include a diagram of the laboratory to identify wipe location points. The wipe tests results shall be recorded on the wipe test form in the blank that corresponds to the numbered diagram of the laboratory *(See Attachment I for wipe test survey form to be used).* If radioactivity was not used in any given week, a wipe test is not required, but an entry of “No RAM Used” or equivalent, is required to be recorded.

14.3. Additional surveys shall be made following any unusual procedure or incident which may have resulted in unusual external radiation or contamination levels. Excessive contamination levels (more than 200 dpm/100 cm²) shall be brought to the attention of the Radiation Safety staff and the area in question shall be decontaminated and resurveyed to ALARA conditions. The survey logbook shall be available for review by Radiation Safety staff on their routine surveys through the laboratories, and for review by State compliance inspectors during their inspection. Principal Investigators and laboratory supervisors shall ascertain that the necessary survey equipment is available to perform the required procedures and that a specific individual is assigned the tasks. Radiation Safety staff are available to assist in setting up an appropriate survey program if such help is needed.

14.4. **Action Levels**

14.4.1. GM Survey - Twice Background

14.4.2. Wipe Test Survey - 200 dpm/100 cm²

The Commonwealth of Massachusetts Radiation Control Program does not accept time gaps between wipe tests. Radiological surveillance will not be required if a project involving the use of radioactive material is stopped for an extended period of time and an entry is made in the logbook with the notation that wipe tests and/or GM surveys will be performed when work with radioactivity is conducted. Radiation Safety staff must be formally notified when use of radioactive material is suspended for an extended period of time.

14.5. **Survey Meter Registration and Calibration**

Radiation Safety staff are available for recommendations regarding appropriate radiological surveillance equipment. All newly purchased survey meters must be registered with the Radiation Safety program prior to use. Radiation Safety staff is required to calibrate all survey meters on an annual basis. Please check
the date on the calibration sticker attached to the survey meter to ensure that it has been calibrated within the required timeframe. Batteries are supplied as needed along with a fixed check source to perform a constancy check.

15. Radioactive Waste Management

15.1. Radioactive Waste Containers

Radioactive laboratory waste is to be stored in containers, which have been approved by the RSO, and are specifically labeled, “Caution Radioactive Waste”. These containers have been distributed throughout the institution for the purpose of temporary radioactive waste storage. There are several types that may be used:

15.1.1. 18 and 22-gal. Rubbermaid Storage-for-Decay containers - Dry/Solid
15.1.2. Plexiglas boxes - Dry/Solid 32-P waste
15.1.3. Red “Sharps” boxes - sharps/hypodermic needles/syringe waste
15.1.4. 55-gal. yellow regulated drums - regulated LSV waste

15.2. Color Coding System

All radioactive waste will be separated into half-live categories. Each container will be labeled with colored stickers indicating the isotopes that may be disposed into it.

15.2.1. Pink half-lives ≤ 15 days
15.2.2. Yellow half-lives > 15 days ≤ 120 days
15.2.3. Purple half-lives > 120 days

15.3. Disposal of Waste in the Laboratory

15.3.1. Dry/Solid waste is to be placed in clear plastic bag liners in an appropriate radioactive waste container. Before disposing users should ensure all radiation symbols are either obliterated or defaced. Waste containers must have an external inventory card to provide information such as estimated quantity of radioactivity, radionuclide, user’s initials, & disposal date. Only approved forms of Dry/Solid waste are allowed in the containers. The following is a list of approved dry/solid waste:

15.3.1.1. Papers
15.3.1.2. Plastics
15.3.1.3. Rubber / Gloves
15.3.1.4. Eppendorf tubes (containing minute amounts of liquid)
The following is a list of unacceptable forms of dry/solid waste:

15.3.1.5. Glass
15.3.1.6. Lead
15.3.1.7. Liquids of any kind
15.3.1.8. LSC vials (containing liquid)
15.3.1.9. Hypodermic syringes/needles
15.3.1.10. Radiation symbols (unless defaced)
15.3.1.11. Animal carcasses/parts/bedding
15.3.1.12. Biohazardous material

15.3.2. Liquid Scintillation Vials (containing scintillation fluid)

Vials are disposed of in separate containers labeled for scintillation vial waste. Waste containers must have an external inventory card to provide information such as estimated quantity of radioactivity, radionuclide, user’s initials, & disposal date. Lab personnel are to provide a best estimate of the total activity disposed. The following waste categories exist:

15.3.2.1. $^3$H and $^{14}$C scintillation vials (averaging less than 0.05 $\mu$Ci/g over the entire drum) placed in black deregulated vial drums.
15.3.2.2. Scintillation vials containing all other isotopes should be placed in containers provided by Radiation Safety staff, specifically intended for scintillation vial use, with an accompanying inventory card.

Dry/Solid waste cannot be placed in these containers.

15.3.3. Inorganic/Organic Liquids (water soluble/dispersible)

This form of waste is permitted to be disposed in sinks as designated by Radiation Safety staff only. The following conditions are established and followed prior to liquid waste disposal in sinks:

15.3.3.1. The sink must be approved and labeled by Radiation Safety staff, to include a dilution chart and disposal log.
15.3.3.2. A maximum of 2.0 mCi in one day and an average of no more than 0.5 mCi per day in one week may be disposed.
15.3.3.3. Contact Radiation Safety staff if larger quantities require disposal. Radiation Safety staff coordinate
all waste disposal to comply with applicable regulations.

15.3.4. Insoluble Liquids

This form of waste is not to be disposed of by lab personnel. Please contact Radiation Safety staff prior to conducting research involving insoluble liquids.

15.3.5. Biohazardous Material

Radioactive waste resulting from work done with a biological hazard must be treated to neutralize the hazard. Active biohazards cannot be placed in the radioactive waste containers. Contact EHS for further information concerning waste biohazard management.

15.3.6. Animal Carcasses/Parts/Bedding

Contact Radiation Safety staff if you have any animal carcasses/parts/bedding contaminated with radioactive material to dispose of.

15.3.7. Glass

Laboratory personnel are expected to decontaminate glassware to remove “removable contamination” and ensure the generation of waste is minimized. Contact Radiation Safety staff to schedule the removal of glassware that contains fixed contamination.

15.3.8. Hypodermic Syringes/Needles (all “sharps”, scalpels, razors, etc.)

All “sharps” contaminated with radioactive material are to be placed in red sharps boxes approved by Radiation Safety staff.

15.3.9. Lead

Contact Radiation Safety staff if you have contaminated lead. Radiation Safety staff will also collect all contaminated or clean lead containers for recycling. It should be noted that improper disposal of lead violates EPA waste guidelines and under no circumstances should lead be disposed of as regular waste.

15.4. Laboratory Waste Removal

Waste containers within the lab are emptied by Radiation Safety staff in accordance with the following conditions:
15.4.1. The Radiation Safety staff are notified that a radioactive waste container is 3/4 or more filled and needs to be emptied. Waste will be removed within two working days of notification (6-6168).

15.4.2. Arrangements have been made with the Radiation Safety staff such that the container is to be emptied on a scheduled basis (i.e. daily, weekly, etc.). These arrangements are made on an individual basis. Radiation Safety staff member will bring a transport vessel (typically a wheeled waste cart) to the lab for transferring waste. A visual inspection of the waste will be made to assure that the waste has been properly prepared. If the waste meets the set disposal criteria, it is placed in the waste cart along with the attached inventory card, and removed to the appropriate waste processing area.

Conditions for waste pick-up denial:

15.4.2.1. Improperly filled out or blank inventory card.
15.4.2.2. Unacceptable items present in the waste
15.4.2.3. Inaccessibility to waste (i.e. locked lab)
15.4.2.4. Mixing of waste types (i.e. filled LSV in Dry/Solid waste)
15.4.2.5. radioactive labels have not been obliterated or defaced.

15.5. Waste Handling

Waste obtained from a laboratory and brought to a Waste Processing Area is handled in one of the following manners:

15.5.1. Dry/Solid waste characterized as Storage-for-Decay waste: This waste is segregated by isotope and placed in an appropriately labeled drum to be held for decay.
15.5.2. Dry/Solid waste falling outside the category of Storage-for-Decay waste: This material is packaged for off-site disposal.
15.5.3. Animal Carcasses/Parts/Bedding: This material is placed in the facility’s storage freezer for decay. Long half-lived waste (greater than 120 days) are shipped offsite for disposal.
15.5.4. Liquid Scintillation Vial Wastes: These are brought to that facility’s LSV processing area and placed in a 55-gallon LSV drum for eventual off-site disposal.
15.5.5. Inorganic (water soluble) or Organic (non-water soluble) Liquid Waste:
These materials are brought to the facility’s liquid waste storage area.

15.5.6. Organic (water soluble) Liquid Waste:
This material is disposed of in approved laboratory sinks.

15.5.7. Lead:
All lead is collected and scanned. Clean lead is defaced and recycled, and contaminated lead is placed into storage.

16. Control of Radiation Exposure & Contamination

16.1. ALARA Program

Occupational radiation exposures to radiation workers are maintained “As Low As Reasonably Achievable (ALARA)”. Exposures in excess of 10 % of the established annual limits shall be investigated by the RSO and reported to the RSC. Under all circumstances exposure to ionizing radiation shall be kept as low as reasonably achievable. Radiation Safety staff provides services specifically to ensure exposures meet ALARA conditions by:

16.1.1. Providing dosimetry/ bioassay services as necessary and to evaluate external and internal exposures to radiation sources.
16.1.2. Communicating dosimetry results to employees, faculty and staff when ALARA action levels are exceeded.
16.1.3. Maintaining dosimetry reports and exposure monitoring for regulatory review and demonstrating compliance.
16.1.4. Training employees, faculty and students to minimizing exposures to themselves and others to ALARA levels.
16.1.5. Encouraging employees, faculty and students to report unusual occurrences that potentially lead to non-ALARA conditions, or occurrences that involved unacceptable exposures or contamination.

The external exposure from radiation sources shall be controlled in such a way as to assure that no individual receives a total dose in excess of the following values:

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<th>mrems per year</th>
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<tr>
<td>Whole body; head, trunk, gonads,</td>
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<tr>
<td>Arms above elbow and legs above knee</td>
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<tr>
<td>Lens of the Eye</td>
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<tr>
<td>Extremities: hand, elbow, arms below elbow, 50,000 feet, and legs below knee</td>
</tr>
<tr>
<td>Skin of whole body</td>
</tr>
</tbody>
</table>

The total effective dose equivalent from internal and external exposure combined must not exceed 5000 mrem in a year. The total effective dose equivalent from internal and external exposure combined must not exceed 500 mrem in a year for minors. The allowable dose “declared pregnant worker” with respect to the fetus
shall be no more than 500 mrem per gestation period. Contact the RSO for further information regarding the guidelines involving a voluntary declaration of pregnancy. The above values are in addition to natural background radiation exposure and to radiation administered for medical reasons.

16.2. Personal Dosimetry

Dosimetry for measuring external exposure to radiation is provided by Radiation Safety staff. PI’s or designees, responsible for managing (i.e., collecting / distributing) dosimetry under their respective permit provide timely updates of personnel changes to Radiation Safety staff. Radiation Safety staff are responsible for evaluating exposure conditions and assigning personnel to the dosimetry program as needed.

16.3. Internal Exposure Control

Exposure to airborne chemicals in laboratories is minimized by utilizing ventilated enclosures, closed reaction systems, temperature control systems, mechanical pipetting devices and/or any such appropriate mechanism. Monitoring for adequacy of such control procedures may be summarized as follows:

16.3.1. All work with radioiodine (NaI) compounds above 0.1 mCi must be conducted in an approved fume hood. Contact Radiation Safety staff for the location of the nearest approved fume hood. Mini-hoods are required to be used for all procedures utilizing more than 1.0 mCi of sodium iodide. Thyroid counts are performed on personnel between one & two working days after procedures involving more than 1.0 mCi of radioiodine. Biodosimetry results are compared to Reference Man expected values using intake retention fractions that are characteristic of the associated ICRP model.

16.3.2. Urinalysis is performed on a monthly basis on all persons routinely handling more than 10 mCi of ^{3}H-labeled compounds at any one time; and on a weekly basis when the quantity handled exceeds 100 mCi.

16.3.3. Results that indicate the presence of 10% or more of the Committed Effective Dose Equivalent or Committed Dose Equivalent to the organ would lead to a thorough investigation by the RSO and the adoption of additional procedural restrictions as needed.

17. Transporting Radioactive Material

The Broad-Scope License includes no provision for the transportation of radioactive material outside of the university premises by the licensed investigators. Under no
circumstances should any user pick up radioactive material from a supplier, return an improper shipment to the supplier, borrow radioactive material from another institution in the area, or in any way transport radioactive materials in his/her own private vehicle. Such transportation of material must be by authorized transportation agencies and in compliance with Department of Transportation regulations. Contact the RSO for assistance should such transportation become necessary.

The transportation of radioactive materials within the institution (hand-carrying from laboratory to laboratory) shall be done in such a manner as to ensure radiation and contamination remains ALARA. All material must be doubly contained, shielded if warranted, properly labeled, and must never be left unattended. Under no circumstances should the dose rate on the surface of the container being carried exceed 20 mrem/hour, nor should the dose rate at 30 cm from the surface of the carrying container exceed 2 mrem/hour. The RSO must approve inter-permit transfers before they occur. Please refer to 12.3 if an inter-permit transfer is needed.

18. Caution Signs, Postings and Labels

Each laboratory storing or using radioactive materials shall be posted with appropriate signs, in conformity with 105 CMR 120.000. Signs shall be installed or removed only by Radiation Safety staff. These signs contain contact numbers for research staff in each department and Radiation Safety support (Appendix L).

Each container in which radioactive material is to be stored for a period of time must be labeled in conformance with appropriate regulations. Specifically, the label must contain the words "Caution, Radioactive Material" along with the quantity, radionuclide and date of assay. Labeling is not required for laboratory containers such as beakers, flasks, and test tubes used transiently in the laboratory in the presence of the user. Appropriate labels are available by contacting Radiation Safety staff.

19. General Radiation Protection Requirements and Precautions

Following are the general requirements and precautions applicable to work with radioactive material:

19.1. There shall be no smoking, eating, storage of food or use of cosmetics where radioactive materials are being used, transferred or stored.
19.2. There shall be no mouth-pipetting of radioactive solutions.
19.3. Prior to the performance of a procedure involving radioactive material, radiation levels must be measured. Handling tongs, or a suitable remote handling device must be used for handling a source or container, which emits a dose rate, at contact, in excess of 100 mrem per hour, unless otherwise specially authorized by the RSO.
19.4. When performing procedures that might produce airborne contamination (i.e., evaporations, transfers of unsealed powdered or volatile radioactive material), an approved exhaust ventilation hood shall be used.
19.5. When hand or clothing contamination is possible, protective gloves and a lab coat shall be worn.

19.6. After handling unsealed radioactive material, hands shall be washed before leaving the laboratory, exposed hair, skin and clothing shall also be surveyed for contamination. The RSO shall be notified immediately if any individual is personally contaminated.

19.7. Objects and equipment that may have been contaminated with radioactive materials shall be surveyed for exterior surface contamination prior to their removal from the laboratory. If surface contamination is detected, the contaminated objects shall not be removed from the laboratory without the authorization of the RSO.

19.8. The RSO shall be notified immediately if any of the following circumstances is known or suspected to have occurred:

   19.8.1 Exposure to external radiation in excess of the values listed in 16.1.
   19.8.2 Exposure to inhalation, ingestion or accidental injection of radioactive material.
   19.8.3 The RSO shall be notified immediately if any individual is personally contaminated.
   19.8.4 Accidental release of radioactive material into laboratory atmosphere, drains or ventilation systems or onto surfaces (i.e.: spills).

20. Minors in the Laboratories

The RSC has formalized a policy, which states that: “Minors are not allowed to be present in laboratories in which radioactive materials are used unless they are in an organized work or training program which has the prior approval of the University Safety Office and RSO.”

The Commonwealth of Massachusetts’ regulations define a minor as an individual less than 18 years of age. 105 CMR 120.217 states that “The annual occupational dose limits for minors are 10% of the annual occupational dose limits specified for adult workers.”

The exposure to a minor who is employed at Tufts would have to be controlled so that the annual occupational total effective dose equivalent received would have to be less than 500 mrem/year. Any Principal Investigator who plans to have minors present in his/her laboratory must notify the RSO to review work activities of the minor and potential exposure levels prior to the start of such work.

20. Emergency Procedures

A member of the Radiation Safety staff is on call to help in any emergency involving radioactive material. The federal and state regulations governing the use of radioactive material include strict reporting requirements with regard to emergencies. In order for Tufts to comply with the applicable regulations, it is important that all spills,
accidental personal exposures or contamination (i.e. exposures to the skin, internal exposure due to inhalation, puncture, absorption or ingestion), or misplacement or loss of radioactive material be reported immediately to the RSO.

20.1. Radioactive Spill Procedures

20.1.1. Minor Spills of Liquids and Solids

20.1.1.1. Notify persons in the area that a spill has occurred.
20.1.1.2. Prevent the spread of contamination by covering the spill with absorbent paper.
20.1.1.3. Clean up the spill using disposable gloves and absorbent paper. Carefully fold the absorbent paper with the clean side out and place in a plastic bag or transfer to a radioactive waste container. Also put contaminated gloves and any other contaminated disposable material in the bag.
20.1.1.4. Survey the area with a radiation detector survey meter set on the lowest range. Check the area around the spill. Also check your hands, clothing and shoes for contamination.
20.1.1.5. Report the incident to Radiation Safety staff.
20.1.1.6. Radiation Safety staff will follow-up on the cleanup of the spill.
20.1.1.7. A Radioactive Spill Report must be completed, signed by the Principal Investigator, and forwarded to the RSO.

20.1.2. Major Spills of Liquids and Solids

20.1.2.1. Clear the area. Notify all persons not involved in the spill to vacate the room.
20.1.2.2. Prevent the spread of contamination by covering the spill with absorbent paper, but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.
20.1.2.3. Shield the source if possible. This should be done only if it can be done without further contamination or a significant increase in radiation exposure.
20.1.2.4. Close the room and lock or otherwise secure the area to prevent entry.
20.1.2.5. Notify Radiation Safety staff and the Radiation Safety Officer immediately.
20.1.2.6. Decontaminate personnel by removing contaminated clothing and flushing contaminated
skin with lukewarm water and then washing with mild soap. If contamination remains, induce perspiration by covering the area with plastic. Then wash the affected area again to remove any contamination that was released by the perspiration.

20.1.2.7. Radiation Safety staff will supervise cleanup of the spill.

20.1.2.8. A Radioactive Spill Report must be completed, signed by the Principal Investigator, and forwarded to the RSO.
Appendix A

RSP-001  Radioactive Materials Permit Application  GS 6/10

Tufts University School of Medicine  
Radiation Hazards Control Group

SECTION 1: GENERAL INFORMATION

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<td></td>
<td>200 Harrison Avenue</td>
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<td>105 Posner Hall</td>
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<td>Boston, MA 02118</td>
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<td></td>
<td>Or email: <a href="mailto:geoff.sirr@tufts.edu">geoff.sirr@tufts.edu</a></td>
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Principal Investigator

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Preferred Contact

Lab Supervisor (if same as PI information above leave blank)

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Telephone  Email address
### SECTION 2: RADIOISOTOPE USAGE INFORMATION

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<tr>
<th>Select Radionuclide</th>
<th>Chemical and/or Physical Form</th>
<th>Maximum Activity Needed (possession limit) in units of mCi</th>
<th>Estimated Maximum Activity per Procedure</th>
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### SECTION 3: DESCRIPTION OF PROJECT

A. Please describe the project or procedure detailing radioactive material application:

### SECTION 4: USE AREAS

<table>
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<th>Building</th>
<th>Room</th>
<th>Maximum Activity (mCi)</th>
<th>Location Use (Areas)</th>
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<tr>
<td>Building</td>
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<td>Maximum Activity (mCi)</td>
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<td>Room</td>
<td>Maximum Activity (mCi)</td>
<td>Waste</td>
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SECTION 5: TRAINED PERSONNEL

List all personnel (including applicant and contact person) who will be working with radioactive material as authorized by this permit.

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>This person has received training and / or has experience handling radioactive materials.</th>
<th>If Yes, was this individual trained by Tufts University Radiation Safety?</th>
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SECTION 6: RADIOLOGICAL INSTRUMENTATION INFORMATION

<table>
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<tr>
<th>Room Location</th>
<th>Liquid Scintillation Counter</th>
<th>Gamma Counter</th>
<th>Geiger Counter</th>
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Detail the lab surveillance technique for this permit (e.g. direct monitoring using GM with weekly wipe test)

SECTION 7: SPECIAL RADIATION CONCERNS / ADDITIONAL INFORMATION

A. Will radioactive material be used with animals? ☐ Yes ☐ No
B. Will radioactive material be used with any biohazardous materials? ☐ Yes ☐ No
   If yes, does this research involve or result in any biohazards (such as infectious agents)? If so, detail the steps that will be taken to inactivate the hazard. For information on approved inactivation techniques contact Tufts Biosafety Officer (extension 7615).
C. Will radioactive material be mixed with any hazardous chemicals? ☐ Yes ☐ No
   If yes, please include the name of the chemical.
D. Does this research involve or result in any chemically hazardous material (hazardous as defined: reactive, corrosive, flammable or toxic)? If so, detail the steps that will be taken to neutralize the chemical hazard. For questions contact Tufts Chemical Safety Officer (extension 7615).
E. rDNA Research Registration:

All research utilizing recombinant DNA must be registered with the Tufts Safety Office. If you are not registered with the Tufts Safety Office for this, please call them to arrange registration (extension 7615).

Does this research utilize rDNA techniques? Yes ☐ No ☐
If yes, please give registration number, title and approval date.

Registration Number:
Approval Date: Click here to enter a date.
Title:

SECTION 8: CONFIRMATION & SIGNATURE

I have received, read, understand, and agree to follow the requirements of the Tufts University Radiation Safety Manual.

<table>
<thead>
<tr>
<th>Signature of the Applicant</th>
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<tr>
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<tr>
<th>Signature of Department Head</th>
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Application is subject to RSO approval and ratification by the Radiation Hazards Control Group at the next quarterly meeting.

Page 4 of 5
Radioactive Materials Principal Investigator Applicant Training and Experience

1. Applicant Information

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2. Training

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3. Experience
   a. Radioactive Materials Handling
      i. Have you previously used radioactive materials? If yes, specify the radionuclide, form, quantity and location of use by completing the table below.

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b. Have you worked as an Authorized User or Principal Investigator authorized to handle radioactive material at another institution? If yes, please specify the institution and dates of experience.

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4. Confirmation and Signature

I have received, read, understand, and agree to follow the requirements of the Tufts University Radiation Safety Manual. I hereby authorize any or all of the above information to be disclosed to pertinent and required personnel for the purpose of fulfilling the partial requirements of radioactive materials permitting.

Signature of Applicant : ________________________ Date: _____/_____/_____

*Please append CV or Resume along with this application
Radioactive Materials Sponsorship Request

The Tufts University School of Medicine’s Broad Scope License issued by the Commonwealth of Massachusetts Radiation Control Program, authorizes the Tufts Radiation Hazards Control Group (RHCG) to appoint Principal Investigators to be responsible for assigned areas where sources of ionizing radiation are located. Sponsorship is permitted for 6 months to those individuals planning to work with radioactive materials under the supervision of a permitted Principal Investigator from the same department and as recommended by his/her Department Head. Those who successfully complete sponsorship, to include a written radiological safety examination, will be eligible to apply for a Radioactive Materials Permit (RSP-001) issued by the Environmental Health and Safety Radiation Safety Officer (RSO). Each permitted Principal Investigator will be responsible for ensuring that all uses of radioactive material in his/her laboratories are in compliance with all regulations. Permitted Principal Investigator’s are responsible for all activities in their assigned areas including radionuclide inventory control, waste management, effluent control, radioactive material procurement, supplies, safe procedures and the registration and training of employees, contractors and visitors.

The sponsor assumes full responsibility for the respective researcher’s work and must sign for all radioactive material acquisitions during the sponsorship.

I have read the above statement and am familiar with my obligation to successfully complete a written examination within six months of the initial signature date.

Person Applying for Sponsorship:

Last Name: __________________________ First Name: __________________________

Signature________________________________________ Date: ___/___/___

Sponsor Signature________________________________ Date: ___/___/___

Dept. Head Signature______________________________ Date: ___/___/___

Tufts University Approval

Tufts University Radiation Safety
Geoffrey C. Sirr Jr., RSO, CHP
Contact: email: Geoff.sIRR@tufts.edu Phone: (617)636-3450, (617)308-3781

Signature: ____________________________________ Date: ___/___/___
Principal Investigator Exam Preparation Guide, Non Human-Use

I. Study References:
   A. Visit the following link and review all hyperlinked / bulleted topics listed under the header
      Radiation Safety: http://publicsafety.tufts.edu/ehs/?pid=44&c=76 . Non-ionizing references, Laser
      Safety related topics can be omitted.
   B. NRC Reg Guide, 8.13, Instruction Concerning Prenatal Radiation Exposure
   C. NRC Reg Guide, 8.29, Instruction Concerning Risks from Occupational Radiation Exposure
   D. Demonstration of the need to provide Monitoring to Occupationally Exposed Persons (MA-98-01-
      April 20, 1998):
         http://www.mass.gov/?pageID=ehs2terminal&L=8&L0=Home&L1=Consumer&L2=Community+Health
         +and+Safety&L3=Environmental+Health&L4=Environmental+Exposure+Topics&L5=Radiation+Control
         &L6=Radioactive+Materials&L7=Advisories+and+Policies&sid=Ecohls2&b=terminal&content&f=dph_env
         ironmental_radiationcontrol_c_radioactivepolicies_ma_98_01&csid=Ecohls2
   E. PerkinElmer Inc. “Guide to the Safe Handling of Radioactive Materials in Research”:
   F. Department of Public Health Radiation Control Program Standards for Protection Against
   G. Radiological Health Text Book Loanded by EHS : “An Introduction to Radiation Protection”
      [Paperback] Alan Martin (Author), Samuel A. Harbison (Author)
      a) Chapter 2, 3, 4 (pp. 31-36), 5, 6, 8 (pp. 64-70), 9 (pp. 82-87, 94-96), 11, 14, 15 & 17
   H. Closing meeting with Radiation Safety Officer: “Principal Investigator Obligation and
      Responsibilities”

II. Outline for PI’s:
   A general understanding of the following terms and their associated concepts and a detailed
   understanding of the Rules and Mode of Functioning of the TUSM Radiation Hazards Control
   Group are expected.

   A. Basic Radiation Safety Theory and Fundamentals (Ref. E, G)
      1. Radiation
         a. Ionizing radiation and non ionizing
         b. Electromagnetic and particulate radiations (gamma, beta, alpha)
         c. Penetrating ability (gamma, beta, alpha)
         d. Relative internal and external hazard (gamma, beta, alpha)
         e. Interactions with matter
      2. The quantities and units of measure
         a. Radioactivity
            i. Curie (Ci )
            ii. Disintegrations per minute (dpm)
            iii. Becquerel (Bq)
         b. Exposure, Dose , Biological Effect
            i. Roentgen, Rad, Gray, Sievert, Rem
            ii. Quality Factors
3. Internal Dose (Ref. E, F)
4. External Dose (Ref. E, F)
5. Acute & Chronic exposure conditions
6. Total effective dose equivalent (TEDE)
7. The characteristics of radioactive material
   a. Physical Half-life
   b. Biological Half-life
   c. Effective Half-life
8. The properties of radionuclides (\(^3\)H, \(^{14}\)C, \(^{35}\)S, \(^{32}\)P, \(^{125}\)I, etc.). (Ref. E)

B. Sources of Ionizing Radiation (Ref. E, G)
   1. Sources of ionizing radiation under your supervision
      a. Radiation-generating equipment
      b. Radioactive materials- all isotopes used under your supervision
      c. Licensed Radioactive Materials verses Naturally Occurring Radioactive Materials
   2. Sources of background radiation exposure to U.S. population, F)
      a. Natural background
      b. Manmade contribution background radiation

C. Biological Effects and Risks of Exposure to Ionizing Radiation (Ref. E,G, H)
   1. Biological response to ionizing radiation
      a. Stochastic
      b. Deterministic
      c. Genetic
      d. Teratogenic
   2. Factors affecting biological response
      a. Total dose received
      b. Dose rate
      c. Type and energy of the radiation
      d. Area of the body irradiated
      e. Cell sensitivity
      f. Individual sensitivity
   3. Radiation risks
      a. Quantifying risks
      b. The acceptability of risks
      c. Perceived risks versus actual risks

D. Radiation Protection Standards (Ref. F, G, H)
   1. Occupational limits and basis
      a. Epidemiological studies
      b. Dose response models
      c. National and international recommendations

E. Applied Radiation Safety Fundamentals (Ref. A, F, H)
   1. Irradiation by
      a. Internal sources/modes of intake
      b. External sources
   2. Radiation versus radioactive material and radioactive contamination
3. ALARA
4. Signs, labels, and postings
5. Access control to Radioactive Material Use Areas
6. Radiation exposure control - Time, Distance, Shielding
7. Personal protective equipment
8. Contamination control

F. Radiation/Contamination Monitoring (Ref. A, E, H)
   1. Radiation detection, measurement, and instrumentation of laboratory instruments
      a. Principles of detection (Gas-filled and scintillation fundamentals)
      b. Portable survey meters
      c. Laboratory detectors (GM, NaI)
   2. Personnel monitoring
      a. External monitoring (Personnel dosimeters)
      b. Internal monitoring (Bioassay assessment)

G. Various Institutional Responsibilities for Radiation Protection (Ref. A, H)
   1. Institution’s and Radiation Committee Responsibilities
   2. Radiation Safety Officer’s and Health Physics Section’s Role and Responsibilities
   3. PI’s responsibilities
      a. Rules and Mode of Radiation Committee-Institutional Policies
         i. Security of Radioactive Materials
         ii. Training requirements of laboratory staff
         iii. Radiation and contamination survey frequencies and record keeping requirements
         iv. Radioactive waste management
         v. Radioactive material orders
         vi. Laboratory visitors, minors in laboratory
         vii. Where copies of the applicable regulations, DPH-Radiation Control Program License, and
              it’s application are posted or made available for examination
   4. Individual’s responsibilities
      a. Following all radiological worker requirements, postings, and controls
      b. Obligated to report unsafe conditions to the RSO
   5. Individual’s rights
      a. Informed of risks and associated controls prior to commencing work
      b. Access to radiation dose records
      c. Access to copies of the applicable regulations, DPH-Radiation Control Program License, and
         Notice of Violations.
      d. Protection of the embryo/fetus (including the right of the worker to request “declared pregnant
         worker status”)

H. Emergency Response (Ref. A, H)
   1. Response to Major and Minor radioactive spills
   2. Personnel Decontamination methods
Appendix E

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<tr>
<th>ITEM</th>
<th>QUANTITY IN MILLCURIES</th>
<th>SPECIFICATIONS (ISOTOPE, FORM, SUPPLIER, CAT.NO.) (Quotation #’s, etc.)</th>
<th>UNIT PRICE</th>
<th>DO NOT WRITE IN THIS SPACE</th>
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<td>DUE DATE</td>
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Account # __________________________

Department __________________________

Location ____________________________

Extension __________________________

Licensee (Print) _____________________

Licensee (Signature) ________________

All orders should be shipped to the following address ONLY!

New England Medical Center
Proger Receiving Area
171 Harrison Avenue
Boston, MA 02111
Attn: F.X. Masse
Radioactive Materials Procurement (Boston Campus)  
Blanket Order Notification

Please complete and fax the following form to the Health Physics office (617-636-7777) and Purchasing Department (617-627-3081) as soon as you have requested a shipment under a blanket order. Radioactive packages will not be delivered to areas that fail to notify accordingly.

Today’s Date (Date ordered): __________________________

Purchase Order Number: ____________________________

Principal Investigator: ________________________________  
(Authorized Licensee only)

Deliver to: ___________________ Extension: ____________  
(Building/room #)

Name of person placing the order: ____________________________

Package Due Date: ____________________________

Radioisotope Manufacturer: ________________________________

<table>
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<tr>
<th>Item</th>
<th>Catalog Number</th>
<th>Quantity (#of Films or # of kits)</th>
<th>Total Amount of radioactivity ordered (uCi or mCi)</th>
<th>Radionuclide</th>
<th>Chemical Form</th>
<th>Amount on hand (uCi or mCi)</th>
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All Radioactive packages must be shipped to the following address ONLY!  
Tufts Medical Center  
Proger Receiving Area  
25 Harvard Street  
Boston, MA 02111  
Attention: F. X. Masse

When ordering radioactive material, please do not have the name of the Principal Investigator or the laboratory location printed on the attention line.
Radioactive Materials Procurement
(Grafton-Nuclear Medicine)

Please complete and fax the following form to EHS (617-636-2419) upon ordering radioactive materials.

Today’s Date (Date ordered): ______________________

Purchase Order Number: ______________________

Principal Investigator: ______________________
(Authorized Licensee only)

Deliver to: ______________________ Extension: _________
(Building/room #)

Name of person placing the order: ______________________

Package Due Date: ______________________

Radionuclide Manufacturer: ______________________

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<th>Item</th>
<th>Catalog Number</th>
<th>Quantity (# of Vials or # of kits)</th>
<th>Total Amount of radioactivity ordered (uCi or mCi)</th>
<th>Radionuclide</th>
<th>Chemical Form</th>
<th>Amount on hand (uCi or mCi)</th>
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Radioactive Materials Inter-Permit Transfer

Transfer of radioactive material is permitted following the approval of the RSO. All transfer requests should be faxed to EHS (617-636-2419) for Radiation Safety review.

1. Transferring Laboratory

   Principal Investigator: __________________________ Date of Transfer: ______/______/______

   Radionuclide: ______ Chemical Form: ______ Amount of Activity (uCi): ______

   Volume (ml): ______ Lot Number of Stock Solution: ______

   Person Performing Transfer: __________________________

   last name

   first name

   Laboratory Contact: (_____) _____-_______

2. Receiving Laboratory

   Principal Investigator: __________________________

   Current Inventory:

   Radionuclide: ______ (mCi): ______

   Radionuclide: ______ (mCi): ______

   Radionuclide: ______ (mCi): ______

   Radionuclide: ______ (mCi): ______

   Person Receiving Material: __________________________

   last name

   first name

   Laboratory Contact: (_____) _____-_______

3. RSO Approval:

   __________________________ Date: ______/______/______

   Signature
## Appendix I

### Daily Closeout Report

**Radioactive Materials Laboratory**

**Pt:** ______________

A checkmark in the box indicates that a reading < 0.1 mR/hr was present. Actual readings > 0.1 mR/hr must be recorded on the survey record below. Actions taken to correct findings > 0.1 mR/hr must be documented in comment section. Unless otherwise specified, all measurements are in mR/hr, and are made with a thin window GM probe.

<table>
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<tr>
<th>Survey Date</th>
<th>Survey Locations: Only generalized areas are indicated on diagram. Surveys should include pertinent areas (i.e. benches, tools, sinks, equipment, waste-containers, etc)</th>
<th>Survey Level 0.1 mR/hr</th>
<th>Survey Performed by Initials</th>
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Comments: __________________

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Appendix J

Radiological Support

EMERGENCY NUMBERS

1. Tufts Police (617)627-6911

2. Health Physics Office (617)636-6168
   (8:00 AM - 4:30 PM Monday-Friday)

3. RSO: Geoffrey C. Sirr Jr. (617)636-3450 Boston Office
   (617)308-3781 Cell

4. Health Physicist: Chris Rock 8-4556 Grafton Office
   (617)201-1770 Cell

5. Emergency page number (24h) Page # 2413

In order to page # 2413 it is necessary to call Tufts Medical Center Communications at 617-636-5111 or 5114 (from in-house phones dial 6-5111 or 6-5114). It will be necessary to speak to an operator and request that # 2413 be paged. You will be given an option to wait on the line and be connected or to leave a phone number.

6. EHS (617)636-3615 Boston Office