Welcome to the Tufts University (TU) Annual Radiation Safety Refresher training. All individuals either working with or handling radioactive materials, handling radiation producing machines or equipment, or other personnel that are required to work in a permitted radiological laboratory are to attend radiation safety refresher training on an annual basis.
Introduction

1. Tufts University has been licensed to handle radioactive materials for over 40 years.
2. Radiation Safety is a high priority and it is a condition of our license that we carefully handle radioactive materials and meet stringent regulatory requirements to ensure safety for employees, contractors, visitors, neighbors, and the general public.
3. There has never been an injury from radioactive materials on any of the three campus locations.
4. Tufts University, is committed to maintain this safety record and invites suggested ways to improve our safety programs.

Objectives

1. Review characteristics of radioactive materials, radiation and radiological contamination.
2. Review warning signs and postings identifying areas where radioactive materials are located or radiation producing machines are used.
3. Review the characteristics of the Radiation Safety Program.
5. Be aware of the services offered by Radiation Safety staff.

Introduction & Objectives

It is important that all members of the Radiation Safety Program (RSP) are acutely aware of the hazards in their work environment and communicate hazards effectively with colleagues, visitors and safety professionals. The objectives chosen serve as a quick review of standard procedures, new developments and current practices that represent the TU Radiation Safety Program.
The Massachusetts Department of Public Health Radiation Control Program (DPH) issued to Tufts University a Type B Broad-Scope Radioactive Materials License for the Boston / Grafton & Medford Campus. 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 Radiation Safety Committee (RSC). The license is on file in TU Environmental Health and Safety 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, all of which must be continually satisfied and in accordance with the rules and regulations detailed in 105 CMR Part 120. The DPH is also the registration issuing agency for machines and devices that emit ionizing or non-ionizing radiation.
The “Notice to Employees Standards For Protection Against Radiation” is required to be conspicuously posted and provides information regarding employer and employee responsibilities, what is covered in the regulations, exposure monitoring, the unannounced inspection process, and the Department of Public Health location and contact number for employees interested in further detail.

Tufts EHS encourages individuals to contact Radiation Safety at 6-3450 if you have any questions or concerns regarding radiation protection at TU.
Radiation Safety Committee (RSC)

Committees meet on a quarterly basis and have the authority to approve or suspend the authorization for use of radioactive material, radiation producing machines.

The RSC is comprised of the Chairperson, the Radiation Safety Officer, a representative of the Office of the Vice Provost, staff from other key departments and faculty members from the academic departments to ensure broad representation and expertise. 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 main function for this committee is to support the development of radiation safety policies and procedures, advise on the development of the RSP, and to ensure that the safe handling of radioactive materials and use of radiation producing machines is optimized.
The RSC receives its authority from the Vice Provost for Research. Faculty RSC representatives are nominated by the Chairperson and appointed by the Vice Provost. The Office of the Vice Provost for Research:

- Assumes overall responsibility for the Radiation Safety Program (RSP) through the Radiation Safety Committee (RSC) and Radiation Safety Officer (RSO).
- Supports the development and continuing review of the RSP to ensure that radiation protection requirements are met.
- Ensures the implementation of appropriate controls based upon the recommendations of the RSC.

More information (i.e. Committee function, scheduled meetings and current members) is provided by visiting:
http://viceprovost.tufts.edu/research-offices/radiation-safety
Radiation Safety Officer

Regulations require the Boston, Grafton and Medford Campus to provide a qualified Radiation Safety Officer responsible for:

1. Advising management on the status and development of the campus radiation safety program.
2. Providing for comprehensive audits of the radiation safety program.
3. Intervening in any procedure that involves a hazardous situation, compromises the radiation safety program or violates regulatory requirements or license conditions.
4. Maintains licenses and liaises with State and Federal regulatory agencies.

The license requires Tufts University to appoint a qualified RSO to oversee all aspects of the Radiation Safety Program. The RSO operates under the authority of the Vice Provost for Research, is responsible for managing the Radiation Safety Program and to ensure compliance with regulations for the safe use of radioactive materials and radiation producing machines. This individual acts as liaison with regulators and reports directly to the Director of EHS and Executive Management.
The Radiation Safety Program continues to develop and seek improvements to enhance current services. The bulleted services are provided to all campus locations to assist researchers and operations to fulfill their specific goals. For more information regarding EHS services please visit the EHS website (http://publicsafety.tufts.edu/ehs/), or contact EHS at (617)636-3615 or email ehs-staff@elist.tufts.edu
The Radiation Safety website is a subsection of the EHS website, and provides users with safety related information, procedures and forms. To access the Radiation Safety Program website please visit http://publicsafety.tufts.edu/ehs/radiation-safety/.
Radiation Safety Contacts

Primary Radiation Safety contact:
- RSO (617) 636-3450 or (617) 308-3781 (c)
- Health Physics Support Group is located on 3rd Floor Holmes Building, Boston, MA
  - Main office phone (617) 636-6168
  - Emergency Page for HPG # 2413
  - Tufts MC Page Service (617) 636-5111
- After hours call Tufts University campus police (617) 636-6911

The contact numbers are provided in case of an emergency to request services or seek further information. The Health Physics Group is contracted to provide Radiation Safety support to the Boston Campus. It is important to recognize that 24 hour emergency response support is available by contacting Tufts Police.
Radiation Control

The primary objective is to minimize radiation exposure to our body and reduce the radiation levels in the work environment. Time, distance and shielding can be utilized to effectively reduce external radiation exposure.

**Time** – Reduce the time spent working with radiation sources.

**Distance** – Increase our distance from radiation sources.

**Shielding** – Use appropriate shielding material (lucite, lead, aluminum).

Radiation exposure to individuals from external sources may be controlled and limited by any one or any combination of the following measures. Those that use radioactive materials or radiation producing machines should not produce unnecessary radiation. Research or operations that require using radioactive materials or radiation producing equipment should be justified.
Regulations require that each person must keep their radiation exposure and exposure to others as low as reasonably achievable. This is known as the ALARA concept. ALARA is also a Massachusetts Department of Public Health regulatory requirement, and to comply with the ALARA requirement, no person should conduct an operation that generates unnecessary radiation. Managers and staff should continually seek methods for minimizing unnecessary radiation exposure. Investigation levels have been established for the purpose of controlling occupational exposure to radiation.
Monitoring for external radiation exposure is achieved by employing optically stimulated luminescent dosimeters (OSLD). Dosimeters are assigned to personnel based upon the above established criteria. Dosimetry records are treated similarly to medical records. Personnel assigned to the dosimetry program can review their records in private and request to transfer records to another licensee.

Dosimeters are also assigned to areas for the purpose of demonstrating compliance with regulatory exposure limits or to monitor group exposures or work environments.
Dosimetry reports represent the external radiation exposure while working at Tufts. There are approximately 110 assigned badges amongst the three campus locations. The 2017 total whole body radiation exposure for all research participants summed was approximately 5-10 mrem. The 2017 total whole body radiation exposure is equivalent to one person being exposed to naturally occurring radiation over the course of 5-10 days.
Contamination Controls

Common sources of contamination are:

- Broken or leaking containers
- Opening containers, pouring & dispensing
- Handling contaminated objects (all forms) and surfaces
- Liquid spills and airborne releases
- Tracking unrecognized spilled materials
- Airborne activity in the air handling system.

Direct or indirect generation
- transferring, handling, tracking (walking through), or spilling the material.

Contamination control continues to be our greatest challenge when working with radioactive materials. Controls should be designed to ensure radioactive materials are handled safely and remain in the permitted area. When controls are compromised or non-existent the potential for materials to be released to unrestricted areas increases. Personnel working with radioactive materials are expected to routinely monitor the immediate and surrounding work area for contamination.
Regulations require that operators maintain current posted signs and labels to indicate the quantities and types of radioactive material on hand and in storage. The presence of contamination should also be indicated especially if it is outside the designated storage or handling areas.

The posting “CAUTION RADIOACTIVE MATERIALS” is used by personnel to identify surfaces or objects that become contaminated with radioactive materials. The posting is also used to identify where radioactive materials are used or stored. When labeling contaminated objects or surfaces, it is prudent to provide additional information, such as the radionuclide (e.g. $^{32}$P, $^3$H, $^{99m}$Tc), an estimate of the quantity of radioactivity, the date for which the activity is estimated and the estimated radiation levels.
How do I Recognize Radiological Hazards?

- Containers, packages, equipment and rooms containing radioactive materials must be labeled.
- Also areas where there is significant radiation must be conspicuously posted.

Department of Transportation shipments involving radioactive materials are carefully packaged by Radiation Safety staff to contain the material (prevent leakage) and reduce external radiation to safe levels using shielding.
Radiation Control Postings

- Permitted Radioactive Materials laboratory
- Sinks assigned and approved by Radiation Safety
- Signs are installed by Radiation Safety

Laboratory entrances are required to be posted for each area or room in which radioactive materials are stored or used. This does not imply that a “radiation area” exists. Personnel working in permitted areas are expected to challenge unauthorized individuals that enter. Radiation Safety staff designate sink locations for the disposal of liquid effluent as indicated on a laboratory map and provide all safety postings or labels needed by researchers.
Radiation Control Postings

- “CAUTION, RADIATION AREA”: potential to receive in excess of 5.0 mrem (0.05 mSv) in any one hour at 30 cm from the radiation source or from any surface that the radiation penetrates.
- Potential locations
  - \( ^{32}P \) areas
  - xray machines
  - Waste Decay storage areas
  - Patients
  - DOT Packages (YIII)

There are few radiation areas that exist at TU and under normal working conditions radiation areas are limited to Veterinary Medicine at the Grafton Campus. This is due to the type and quantity of radioactive material used by medical staff in Grafton. Researchers on all three campuses work with small quantities and pure beta emitting material that is not capable of producing intense radiation fields as defined by the above term “Caution Radiation Area”. This is the primary reason why researchers exposure to radiation is well below regulatory limits.
Geiger Mueller (GM) counters are used by researchers and Radiation Safety staff to ensure ALARA conditions are achieved. Instruments are calibrated by using a gamma radiation standard on an annual basis by an outside contractor, and are primarily used by researchers for contamination control purposes. GM instruments can also be used for monitoring radiation, such as x-ray or gamma ray radiation fields. Beta radiation assessment is inaccurate using TU calibrated GM instruments unless the detector is calibrated to a similar beta radiation source (i.e. calibration source energy and geometry needs to be considered).
Direct monitoring is required on a daily basis for personnel that handle radioactive materials. Contamination assessment is conducted by facing the active area of the window toward the surface. While keeping the detector probe approximately 1 cm away from the surface, slowly move the detector over surfaces while listening to the audible response. The purpose for distancing the detector from the surface (assuming that a detection efficiency has been established at a specific distance) of interest is to determine the quantity of contamination that potentially exists and ensuring the detector remains contamination free.
Wipe test paper is designed to collect the removable contamination component while swiping an area of 100 cm$^2$. Personnel are required to record the removable contamination results on a weekly basis in units of disintegrations per 100 cm$^2$. For LSC instruments that report the result in units of counts per minute (cpm), simply multiply the result by the efficiency of the detector. For example, 100 cpm$\times$0.50 = 200 dpm.
Actions taken during a spill

- Secure the area and stop all work: place absorbent material over the spill to prevent the further spread of contamination
- Warn others: inform all laboratory personnel of the spill and its location and contact Tufts Police 6-6911
- Isolate the spill area: use materials to create a boundary, including signs, to prevent laboratory staff from entering the area
- Minimize your exposure: keep away from the spill area unless actively decontaminating the area

Events that involve a spill of radioactive material are required to be reported to Radiation Safety. The best approach is to contact Tufts Police and briefly describe the event (i.e. location of the spill, person involved, contact number, brief description of the event) and request to have Radiation Safety staff respond. Radiation Safety staff are available to support events involving personnel contamination, loss of control of material, injuries in a permitted area or security deficiencies. EHS provides manpower to ensure research at TU continues and the recovery from an adverse event is expedited.
Exiting the controlled area (spill)

- Survey of the boundary surrounding spill
- Establishing a step off area (buffer zone)
- Survey of those exiting the boundary
- Continued controlled access to the affected area

Those involved in a spill event often overlook the importance behind exiting a contaminated work space. Boundaries surrounding the spill should be established to include a neutral (cold) zone for exiting or stepping out of a contaminated area. To adequately control the radioactive materials it is often appropriate to seek assistance when exiting and survey all potentially contaminated surfaces before stepping into a non-contaminated area. Lastly, remain to be available at the contamination access location to prevent unauthorized access and communicate the conditions to the Radiation Safety staff upon their arrival.
Contact the Tufts Police in an event involving personnel contamination. Personnel are advised by Radiation Safety staff on appropriate decontamination techniques. The majority of radiation dose is accumulated over the time interval associated with the fixed component of contamination left after decontamination efforts are exhausted. It is important to recognize that a small amount (nanocurie qty’s) can cause a skin dose equivalent to or exceeding the TU quarterly ALARA I investigation level.
Contamination and Medical Treatment

➢ Radiation Safety Assistance

- Contact Radiation Safety
- Mild cleaning solution applied to epidermis
- Warm water & mild detergent for hands
- Never use chemical or physical abrasive
- The ultimate goal is to prevent contamination from getting on to your skin or inside your body

Immediately initiate skin de-contamination at a sink while waiting for Radiation Safety staff to arrive. Always use mild detergents and warm water to dissolve and flush the contamination from the skin surface. Abrasives or chemicals are not recommended since these items can remove the dead layer of skin and increase the potential for the radioactive material to expose viable cells and or enter the blood.
Proper PPE – personal protective equipment

- No open toed shoes or shorts
- Ensure your lab coat is completely closed, and that the sleeves do not expose skin at the wrist
- Double gloving
- Chemical resistance
- Safety goggles & glasses

PPE must be worn to protect workers in areas where the hazard cannot be removed or eliminated through engineering or general work practice controls.
Food or Drink Prohibited in Laboratory

- Evidence of eating or drinking
  - coffee cups, candy or gum wrappers
- Do not apply cosmetics or handle contact lens

Eating or drinking is strictly prohibited in the laboratory. Please do not dispose of empty food containers or wrappers in trash barrels located in the lab.
Radiation Safety Program Performance 2017

- Research groups handling radioactive material remain to be the least exposed to radiation
- Personnel exposures from either radioactive materials or radiation producing machines remains to be well below regulatory limits
- The greatest potential for radiation exposure continues to be from radiation producing machines, patients and nuclear medicine radioactive materials handling.
- Evidence of eating and drinking within the laboratory exist and increases the potential for internal exposure to radionuclides and or other agents.
- In 2017 we achieved our goal of zero incidents for radiation workers.
Radiation Safety Program Performance 2017

- This year the University appointed an associate VP for Research Compliance. The University continues to demonstrate compliance and support the Radiation Safety Program.
- The Department of Public Health Radiation Control Program approved the RSC request to add building (SEC) in Medford for the purpose of using radioactive materials in research.
- There were no regulatory inspections in 2017
Thanks for attending the 2018 refresher training

- Any questions? Contact (617) 636-3615
- Please remember to complete the Annual Radiation Safety Refresher quiz.