

# UNIVERSITY OF SOUTH CAROLINA



## RADIATION SAFETY MANUAL

Environmental Health and Safety

University of South Carolina

Columbia

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## Radiation Hazards

The University of South Carolina radiation safety program is designed to accomplish the following goals:

- 1) To establish specific policies related to the safe acquisition, use and disposal of radioactive materials and to provide the administrative organization needed to support the University's Broad Academic License issued by the South Carolina Bureau of Radiological Health;
- 2) To establish policies related to the safe use of equipment that produces ionizing or non-ionizing radiation;
- 3) To develop a program that seeks to maintain radiation exposures to University employees, students and visitors as low as is reasonable achievable (ALARA). The program incorporates the philosophy of NRC Regulatory Guide 8.10 concerning ALARA policies.

### A. Administrative Functions and Responsibilities

#### 1. The Radiation Safety Committee

The Radiation Safety Committee shall consist of the Radiation Safety Officer and faculty members appointed by the President or Provost who are qualified by training or expertise in the safe use of radioactive materials and/or ionizing or non-ionizing radiation. The Committee will elect a chairperson who will conduct the meetings. The Radiation Safety Committee will meet whenever called by the chairperson, but at least quarterly. The functions of the Radiation Safety Committee shall be:

- a. To oversee and regulate the usage of ionizing and non-ionizing radiation including:
  - 1) Radioactive materials as defined and regulated by South Carolina Regulation 61-63, "Rules and Regulations for Radiation Control (Title A)", as promulgated pursuant to Section 13-7-40 et.seq. of the 1976 S.C. Code, May 2005 edition;
  - 2) X-rays as defined and regulated by South Carolina Regulation R61-64, "Rules and Regulations for Radiation Control (Title B)", January 2009 edition;

- 3) Any other equipment capable of producing ionizing radiation;
  - 4) Laser radiation as defined in "Standards for the Safe Use of Lasers" promulgated by the American National Standards Institute, (ANSI), Z136.1, 2007;
  - 5) Radiofrequency electromagnetic fields, as defined in "IEEE Standard for Safety Levels with respect to Human Exposure to Radiofrequency and Electromagnetic Fields, 3 kHz to 300 GHz" promulgated by the Institute of Electrical and Electronic Engineers, Inc. (IEEE), C95.1, 2010 and "Recommended Practice for Measurements and Computations of Radiofrequency Electromagnetic Fields with Respect to Human Exposure to such fields 100 kHz – 300 GHz" promulgated by the Institute of Electrical and Electronic Engineers, Inc. (IEEE), C95.3, 2010;
  - 6) Ultraviolet radiation as defined in "Occupational Exposure to Ultraviolet Radiation" promulgated by the National Institute for Occupational Health (NIOSH), HSM 73-11009, 1972.
- 
- b. To recommend policies pertaining to the use of radioactive materials and equipment capable of producing ionizing or non-ionizing radiation;
  - c. To advise the Radiation Safety Officer on the interpretation of policies and procedures related to radiation safety;
  - d. To review the qualifications and grant approval of each principal investigator desiring to use radioactive materials;
  - e. To review all proposed procedures for research involving the use of radioactive materials;
  - f. To review personnel dosimeter reports.



## 2. The Radiation Safety Officer

The Radiation Safety Officer (RSO) must ensure that the policies established by the Radiation Safety Committee are followed by all individuals whose work involves the use of radioactive materials and/or ionizing or non-ionizing radiation. The RSO will communicate with senior management and the Radiation Safety Committee regarding program implementation and compliance status. The RSO is a member of the Radiation Safety Committee and will serve as a liaison between the University and state or federal regulatory agencies. The RSO reports directly to senior management and has the authority to immediately terminate any activities that are found to be a threat to public health, safety or property. Specific duties of the Radiation Safety Officer include:

- a. Ensuring that all aspects of the radiation safety program are in compliance with state and federal regulations or other recognized standards;
- b. Reviewing all applications for the use of radioactive materials or equipment capable of producing ionizing or non-ionizing radiation;
- c. Providing consultation concerning radiological safety procedures to all potential users of radioactive materials and/or ionizing or non-ionizing radiation;
- d. Supervising radiation measurement and protection activities including monitoring for radiation exposure, survey methods, waste disposal and radiological safety practices;
- e. Supervising the maintenance of the following records by the radiation safety office:
  - 1) personnel dosimeter records
  - 2) quarterly inventories
  - 3) waste disposals
  - 4) orders for all radioactive materials
  - 5) wipe tests of all incoming packages containing radioactive materials
  - 6) registration of all x-ray producing devices
  - 7) leak tests of sealed radioactive sources
  - 8) bioassay results
  - 9) incident reports
  - 10) files on each user of radioactive materials including his/her authorization request and other supporting documents
  - 11) laboratory inspection reports
  - 12) records on electronic products emitting radiation
  - 13) inventory of sealed sources

- 14) in-laboratory training
  - 15) dose calibrator linearity checks
  - 16) irradiator records.
- f. Establishing on-line training courses for radioactive material users and users of equipment producing ionizing or non-ionizing radiation;
  - g. Supervising and coordinating the disposal of radioactive waste;
  - h. Providing direction in cases of accidents or emergencies related to radiation matters;
  - i. Providing direction for decontamination arising from radiation accidents;
  - j. Coordinating the posting and restricting of radiation areas and storage and safeguarding of radioactive materials.

### 3. The Health Physicists

The health physicists are under the direct supervision of the Radiation Safety Officer. The duties of the health physicists can include but are not limited to the following:

- a. Assisting the Radiation Safety Officer in administering the radiation safety program;
- b. Ordering, receiving and testing all incoming packages containing radioactive materials;
- c. Collecting radioactive waste;
- d. Collecting and distributing personnel monitoring devices;
- e. Analyzing bioassays when needed;
- f. Responding to accident or emergency situations;
- g. Performing laboratory inspections for users of radioactive materials;
- h. Performing inspections of x-ray and non-ionizing sources of radiation.

#### 4. The Principal Investigator

In addition to the requirements stated in each policy, the principal investigator must assume responsibility for the following matters:

- a. Supervising and conducting annual in-laboratory training which includes instructing each individual user in the safe use of radioactive materials or radiation producing equipment; ensuring completion of required radiation safety courses; and instructing the individual user in the course of action in the event of an emergency;
- b. Careful planning of each experimental procedure; the amount and types of radiation or radioactive material must be determined for the experiment and the appropriate safety precautions must be outlined;
- c. Complying with all applicable state and federal regulations or other recognized standards;
- d. Informing the Radiation Safety Office of major changes in techniques, equipment modifications, operating procedures, or lab setups that may lead to increased personnel exposure or contamination levels in the laboratory;
- e. Ensuring personnel are properly monitored by requesting dosimeters as applicable;
- f. Furnishing the Radiation Safety Office with personnel changes or sabbatical leaves; if the principal investigator terminates employment with the University, all radioactive materials/electronic products shall be properly disposed and a final survey of the laboratory shall be performed as needed;
- g. Assisting with any decontamination or emergency response activities that may be required in the principal investigator's authorized areas;
- h. Providing immediate notification to the Radiation Safety Office when there is an over-exposure to radiation indicated, gross contamination in a laboratory, lost or stolen radioactive material, or any other situation which may result in a hazard to persons in the area.

## 5. The Individual User

In addition to the requirements stated in each policy, the individual user has the following responsibilities:

- a. Performing all work with radiation in a manner that will keep exposures as low as reasonably achievable (ALARA);
- b. Complying with applicable state and federal regulations or other recognized standards;
- c. Completing on-line training offered by the Radiation Safety Office and making an appointment to take the examination;
- d. Utilizing appropriate personal protective equipment and monitoring devices;
- e. Informing the principal investigator and the Radiation Safety Office of any known hazardous conditions, or of an apparent overexposure.

### **B. ALARA Program**

The University of South Carolina is committed to maintaining radiation exposures to employees, students and visitors as low as is reasonably achievable (ALARA). The following program has been developed in support of the University's ALARA program:

1. The Radiation Safety Committee has developed specific policies related to the safe acquisition, use and disposal of materials or devices capable of producing ionizing or non-ionizing radiation. All individuals working with radiation must abide by the provisions of the policies. The policies are contained in Part C.
2. Radiation safety personnel will conduct semi-annual inspections of all laboratories using radioactive materials. The inspections will include a contamination survey and wipe test of laboratory work areas and an audit of the records. Users classified as "Inactive" will be inspected annually. In addition, a yearly check of air flow in ventilation hoods that may be used for volatile radioactivity will be performed by Environmental Health & Safety personnel to ensure adequate capture velocity. Inspections of radiation producing equipment will be performed at periodic intervals to ensure that they are functioning in a safe and proper manner.

3. Radiation safety training programs have been established for University personnel. All individuals working with radioactive materials, lasers, and x-ray units are required to have training in radiation safety and are required to participate in the University's training program if they have no prior experience. Individuals with prior training will be required to provide proof of training such as a certificate or a letter from the RSO at another institution. In addition, the principal investigator shall provide annual in-laboratory training related to his or her specific laboratory for all employees/students associated with the laboratory.
4. The Radiation Safety Office will be responsible for the following safety related services:
  - a. a personnel monitoring service including badge exchanges, preparing reports required by regulations, maintaining records of all exposure data, investigating overexposures and notifying regulatory agencies of overexposures;
  - b. evaluation of internal exposures to personnel including the collection and analysis of air samples, bioassay samples (or in vivo counting), or thyroid monitoring;
  - c. removal of radioactive waste from the laboratories and processing the waste at a central location;
  - d. direction of decontamination efforts;
  - e. control of the ordering, receipt and distribution of all radioactive materials;
  - f. maintenance of survey equipment including calibration and operational checks;
  - g. leak testing of all sealed sources.

**C. RADIATION SAFETY POLICIES AND PROCEDURES  
RADIOACTIVE MATERIALS**

USC NOVEMBER 1985  
(Revised May 2011)

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 1

Radioactive Materials Authorization Request Format

## A. Policy and Procedure

This policy is designed to aid an investigator in obtaining authorization to use radioactive materials under the University's Broad Academic License.

## B. Definitions

1. broad academic license - a specific license which grants broad authority to the University concerning the acquisition, receipt, ownership, possession, use and transfer of any chemical or physical form of radioactive material for any authorized purpose; all principal investigators are authorized users on a single institutional license.
2. general license - a license that becomes effective without the filing of applications with the NRC or an Agreement State or the issuance of licensing documents to particular persons or institutions. It is the responsibility of the vendor to register general licensed devices for the purchaser with the appropriate regulatory agency.

## C. Responsibilities

1. The principal investigator has the responsibility for understanding and complying with all the provisions of the broad academic license and the Radiation Safety Manual.
2. The health physicist will assist the radiation safety officer in reviewing authorization requests and will work with the applicant to correct any deficiencies.
3. The radiation safety officer will review authorization requests, forward them to members of the radiation safety committee for review and will issue authorizations to the principal investigators.
4. The radiation safety committee will review requests for authorization and approve or disapprove the requests.

#### D. Procedures

1. Any requests for an authorization to use radioactive materials must be prepared on form, (EHS-F-RAD-011), New Authorization Application found online at: <http://ehs.sc.edu/Radiation/Forms.htm>.
2. The following information must be included in the application:
  - a. Name, title, department, laboratory address, phone numbers, and e-mail address of individual who will be responsible for the use of radioactive materials (hereafter called the principal investigator or authorized user);
  - b/c. Provide principal investigator's training and experience with radiation, including any type of instruction in radiation safety, prior licenses or authorizations, and information regarding the isotopes, maximum activity levels used at a time, institution, and length of time work was performed;
  - d. Applicant must provide a description of the general scope of the research to be conducted and a brief protocol for each isotope being requested. For sealed sources, the manufacturer's name, model, and serial number must be listed;
  - e. Using the chart that is provided on page two of the application, list the specific techniques that will be used for each isotope. The activity required for each experiment and the expected frequency must be completed to properly assess possession limits. All limits are subject to change at the discretion of the radiation safety office or radiation safety committee;
  - f. The investigator must also provide information on the types of waste generated from the research. (Refer to Policy #7 – Preparation & Disposal of Radioactive Waste) Please note the restrictions to the waste since it is difficult to dispose of some types of waste;
  - g. A laboratory sketch (need not be to scale) detailing radioactive material work areas, storage areas, waste storage areas, hoods, hot sinks and shielding;
  - h. A brief description of the appropriate contamination controls which will be utilized (ex. wipe tests, GM surveys and personnel monitoring) as well as the types of shielding;



- i. List the radiation instruments to be utilized, including manufacturer, model and serial number of each instrument. Provide a room number where the instrument is located;
  - j. Provide two references, including phone numbers and e-mails, of individuals who can attest to the principal investigator's experience with radioactive materials;
  - k. After reading the University's Radiation Safety Manual, sign the application.
3. The completed forms must be returned to the Radiation Safety Office for review. The principal investigator will be notified of any discrepancies or clarifications needed.
4. The Radiation Safety Officer will forward the completed authorization request form to three members of the Radiation Safety Committee for their review.
5. After approval, the Radiation Safety Officer will grant an authorization to the principal investigator. The Radiation Safety Office will then assist the principal investigator with posting and record keeping requirements.
6. All requests for changes in the principal investigator's authorization agreement (i.e. changes in possession limits, adding or deleting isotopes, new protocols etc.) must be made directly to the Radiation Safety Office.

#### E. References

1. "A Guide for Preparation of Applications for Laboratory Use of Radioactive Materials." SC Bureau of Radiological Health Licensing Guide, April 1994.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 2

USC NOVEMBER 1985  
(Revised May 2011)

Radiation Safety Training

## A. Policy and Purpose

This policy is designed to ensure that all employees working with or near radioactive materials or radiation emitting devices receive proper training.

Radiation safety training consists of two parts: (1). formal training classes offered by the Radiation Safety Office, (2). annual in-laboratory training offered by the principal investigator or his/her designate.

Implementation of this policy will ensure compliance with State Regulation RHA 6.4 and RHB 10.3 as well as ANSI Standard Z136.1-2007, 5.2.

## B. Definitions

1. formal training classes – classes offered by the Radiation Safety Office and approved by the SC Bureau of Radiological Health. These classes are offered on-line at: <http://ehs.sc.edu/Radiation/Training.htm> and must be taken by individual users of radioactive materials or radiation emitting devices.
2. annual in-laboratory training – training offered by the principal investigator or his/her designate to make all employees aware of radiation hazards in the laboratory and to emphasize the importance of working safely with radiation.

## C. Responsibilities

1. The principal investigator is responsible for ensuring that all laboratory employees working with radioactive materials, x-rays or lasers complete the appropriate formal training class offered on-line by the Radiation Safety Office and for the training of each employee in specific safety measures associated with each research protocol and/or the operation of each radiation emitting device. Specific training conducted by the principal investigator or his/her designee must be documented in writing.

2. The individual user (employee) must complete the on-line training classes offered by the USC Radiation Safety Office and must participate in all specific training sessions provided by the principal investigator or his/her designee.
3. The health physicist must ensure during periodic laboratory inspections that all laboratory employees have received pertinent training.
4. The radiation safety officer must provide on-line training classes to all employees in need of training in radiation safety. In addition, the radiation safety officer must ensure that principal investigators offer specific training and annual in-laboratory training to all employees and ensure that this training is documented.

#### D. Procedures and Practices

1. The Radiation Safety Office will provide on-line training programs for users of radioactive materials, x-rays and lasers. Student achievement will be assessed by having each participant take an examination and answering at least 80% of the questions correctly. A certificate of achievement will be mailed to each successful participant.
2. A radiation safety training lesson has been developed for USC employees, students and/or visitors who are not actually working with radiation but have a need to visit research laboratories or medical offices where radioactive materials or radiation emitting devices may be present. This 20 minute lesson will familiarize the participant with these radiation sources and help to avoid unnecessary exposure. The address for the website is: <http://breeze.sc.edu/p38564061/>.
3. Before an employee begins work with radioactive materials or radiation emitting devices, the principal investigator must ensure that the employee has received specific instruction on techniques and protocols related to the laboratory work that they will be required to perform. For radioactive materials users, the training must include:
  - a. proper handling of radioactive materials
  - b. waste disposal procedures
  - c. storage of radioactive materials
  - d. emergency procedures
  - e. other matters the principal investigator deems appropriate.

- For x-ray and laser users, the training must include:
  - a. operating and alignment procedures
  - b. function of all safety devices
  - c. use of personal protective equipment, if applicable
  - d. emergency procedures
  - e. other matters the principal investigator deems appropriate.
  
- 4. The principal investigator is responsible for annual laboratory training which will include:
  - a. a review of operating, alignment and emergency procedures, if applicable
  - b. functions of safety devices
  - c. use of personal protective equipment
  - d. hazards associated with equipment
  - e. a review of pertinent protocols.

All annual in laboratory training must be documented using form (EHS-F-RAD-42) for x-ray users and laser operators and form (EHS-F-RAD-44) for radioactive material users. Records must be maintained for review by the Radiation Safety Office.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 3

USC NOVEMBER 1985  
(Revised May 2011)

Ordering, Receipt and Transfer of Radioactive Materials

## A. Policy and Purpose

This policy is designed to ensure that radioactive materials are ordered, received and/or transferred in a safe manner and that all activities are in compliance with state regulations governing the possession and use of radioactive materials and federal regulations concerning the transport of radioactive materials.

## B. Definitions

1. transport index (TI) - a number placed on a package of "Yellow Label" radioactive materials by the shipper to denote the degree of control to be exercised by the carrier. The transport index is the highest measured dose rate at one meter from the surface of the package;

## C. Responsibilities

1. The principal investigator is responsible for ensuring that he/she is authorized to receive any radioactive material ordered from a vendor or received from another investigator. The amount of radioactive material received plus the amount already in possession must not exceed the authorized limits. The principal investigator is also responsible for assuring that orders from his/her lab are properly placed.
2. The health physicist is responsible for receiving orders for radioactive materials from the principal investigator or his designate. The health physicist will check to ensure that the principal investigator is authorized to receive the isotope and authorized for the amount ordered. The order will be processed as outlined below.
3. The radiation safety officer will handle any problems that occur with a shipment and will ensure that all shipments are handled in a safe manner after receipt by the University. The radiation safety officer will also oversee the transfer of radioactive materials to investigators at other institutions.

## D. Procedures

### 1. *Ordering*

- a. Purchase requisitions for radioactive materials will be written by the principal investigator and marked "Radioactive Material Order". Purchase requisitions will be processed by each departmental office (also by the Dean's office for Medical School requisitions) and sent directly to the Radiation Safety Office. The health physicist will check the requisition against the authorization of the individual placing the order. If approved, the order will be assigned a radiation safety inventory number, signed, and sent to Purchasing.

- b. Orders on purchase requisitions that need to be phoned in will be handled as outlined above until they reach the Purchasing Office. Once a P.O. has been cut for the order, it will be called in by Purchasing Office personnel.
- c. Call-in orders from blanket purchase orders will be placed only by the Radiation Safety Office. Principal investigators must send an e-mail to [radsafe@mailbox.sc.edu](mailto:radsafe@mailbox.sc.edu) before 3:00 p.m. with appropriate ordering information (vendor, blanket P.O. #, catalog number(s), amount to be ordered and any special ordering instructions). These orders will be checked against the individual's authorization and blanket purchase order number, and if approved will then be called in to the vendor. **In order to ensure the integrity of the approval process, credit cards may not be used to order radioactive materials.**
- d. Any order that does not meet the approval of the Radiation Safety Office (i.e. individual not authorized for isotope ordered, order exceeds authorized limits for certain isotope or the blanket P.O. has expired) will be immediately referred back to the individual placing the order.

## 2. Receipt

- a. All packages containing radioactive materials for the Columbia and School of Medicine campuses will be delivered directly to the Radiation Safety Office.
- b. Packages that are damaged or appear to be leaking will be handled by the Radiation Safety Office and appropriate actions will be taken.
- c. The transport index on each package will be checked and recorded by radiation safety personnel using a portable GM survey instrument.
- d. The packing slip attached to the package will be examined and checked against ordering information. The contents of the package will also be checked against the packing slip once the package has been opened.
- e. Wipe tests will be performed by Radiation Safety on each incoming package. The outside of the box and each successive layer of packaging will be tested. Wipe tests will be analyzed with either a liquid scintillation counter, a multi channel analyzer with NaI detector, or an alpha/beta counter. Wipe test results will be recorded at the top of Radioactive Material Worksheet (EHS-F-RAD-013 or EHS-F-RAD-014) and delivered to the laboratory with the radioactive package.



- f. If contamination is detected on any of the packing material, the packing material will be disposed of as radioactive waste.
- g. If contamination (measured DPM's greater than 3 times background on the liquid scintillation counter or the alpha/beta counter) is detected on the vial and found to be less than 1,000 DPM alpha or 20,000 DPM beta or gamma, an attempt will be made to decontaminate the vial through washing. If contamination exceeds levels listed above, or if a contaminated vial cannot be decontaminated, the vendor will be notified to send a replacement shipment. The contaminated package will be disposed of by radiation safety personnel.
- h. If no contamination is found or if decontamination is successful, the package will be delivered to the principal investigator along with a record of GM survey and wipe test results. The Radiation Safety Office will also keep a copy of all survey and wipe test results.

### 3. *Regional Campus Orders*

- a. Investigators on regional campuses can use a regular purchase order or set up a blanket purchase order to obtain radioactive materials.
- b. The package will be delivered directly from the vendor to the regional campus at a designated location. The radioactive item will not go to the institution's central supply.
- c. The package should be handled by as few persons as possible. The investigator is responsible for performing the wipes of the packages, recording all receipts, wipe results and GM readings on form (EHS-F-RAD-40). Any problems with packaging will be immediately brought to the attention of the Radiation Safety Office for appropriate actions. At the Baruch Field Laboratory, visiting researchers must use form (EHS-F-RAD-41) to monitor radioactive material usage.

### 4. *Transfers*

- a. If radioactive material is received from another investigator at the University, this receipt must be recorded on standard transfer form (EHS-F-RAD-024) found in the radioisotope logbook.

- b. If radioactive material is transferred to an investigator at another University, the transfer must be recorded on a transfer form (EHS-F- RAD-020) that is obtained from the Radiation Safety Office. The Radiation Safety Office will provide the necessary instructions for proper packaging. Extreme caution must be used in transferring radioactive material. The material must be packaged in a manner that would reduce the spread of contamination in the event of an accident (i.e. use of absorbent material, unbreakable container, etc.). Shipments of radioactive material must be made in compliance with U.S. Department of Transportation (DOT) Regulations. If such shipments are necessary, contact the Radiation Safety Office for assistance.
  
- c. If radioactive material is being received from another institution, it is the responsibility of the laboratory to inform the Radiation Safety Office of its expected arrival day. The material must be delivered to the Radiation Safety Office so that the necessary surveys can be conducted.

#### E. References

1. 49 CFR, Parts 100-177, Requirements for Transportation of Radioactive Materials.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY, NO. 4

USC NOVEMBER 1985  
(Revised May 2011)

External Exposure Monitoring

## A. Policy and Purpose

Personnel dosimeters provide a record of individually accumulated radiation doses. South Carolina Regulations RHA 3.17 and RHB 3.12 require that all occupationally exposed workers be monitored for radiation exposure. This policy provides the necessary control for monitoring personnel and maintaining exposures below prescribed limits set by the State of South Carolina.

## B. Definitions

1. personnel dosimeter - a packet consisting of either film, thermoluminescent (TLD) crystals or optically stimulated luminescence (OSL) compounds that can measure the amount of ionizing radiation present over a certain period of time;
2. deep dose equivalent (DDE) - dose to the body at a depth of one centimeter measured by a personnel dosimeter;
3. committed effective dose equivalent (CEDE) – projected dose to the body from internal radiation sources measured by whole body counts or bioassays;
4. total effective dose equivalent (TEDE) - the sum of the DDE and CEDE;
5. regulatory limits - the following regulatory limits have been established by South Carolina Regulation 61-63, RHA 3.5 and 61-64, RHB 3.4:

An annual limit, which is the more limiting of:

- a. the total effective dose equivalent being equal to 5 rem; or
- b. the sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rem;

The annual limits to the lens of the eye, to the skin and to the extremities, which are:

- a. an eye dose equivalent of 15 rem; and
- b. a shallow dose equivalent of 50 rem to the skin or to each of the extremities.

### C. Responsibilities

1. The principal investigator must request badge service from the radiation safety office for all personnel working in an area where radioactive material or radiation producing equipment is used. A request for dosimeters must be made using the Badge Request form (EHS-F-RAD-008). Any changes in personnel or badges that are lost or damaged must be reported immediately. Personnel who work only with pure alpha emitters or pure beta emitters having a maximum energy of less than 0.2 MeV will not be required to wear personnel dosimeters.
2. The individual user must follow all of the guidelines of this procedure.
3. The health physicist will coordinate the exchange of badges on the designated exchange schedule. The badges will be forwarded to the commercial dosimeter processing service. Records of exposure will be maintained for each occupationally exposed worker. Exposure histories will be requested from previous employers and copies of current exposure records will be forwarded to future employers, upon request.
4. The radiation safety officer will review all requests for film badge service and will issue dosimeters at his discretion. All results will be reviewed and any abnormal readings will be investigated. The radiation safety officer will take any immediate action concerning overexposures that is deemed necessary and will make a full report to the radiation safety committee and the Bureau of Radiological Health.

### D. Procedures and Safety Practices

1. Always wear a dosimeter when working in restricted areas.
2. Whole body badges must be worn on the trunk of the body nearest to the source of radiation (collar, belt, pocket, etc.)
3. A ring badge must be worn on a finger that would be nearest to the radiation source. Rubber gloves must be worn over the badge to prevent contamination of the badge.
4. Do not take the badge home. Leave it at the workplace in a safe area away from radiation sources.
5. Never intentionally expose a badge to ionizing radiation. This could result in the suspension of privileges and is illegal.

6. Do not wear the badge while being exposed to medical x-rays or fluoroscopes. The badge is only for monitoring occupational exposure, not medical exposure.
7. Do not tamper with the badge (except during periodic changes). Erroneous readings could result.
8. Do not open the packet that contains the dosimeter device.
9. Protect the badge from moisture (i.e., rain, washing machines, etc.) and excessive heat (i.e. dryer, car, etc.).
10. Notify the Radiation Safety Office of any change in status: termination of employment, leave of absence, maternity leave, name change etc.
11. Keep all exposure records indefinitely.
12. The badge is assigned to one person and must not be worn by another individual for any reason.
13. Badges must be returned on time to avoid a \$25.00 per badge charge.

#### E. References

1. South Carolina Rules and Regulations for Radiation Control (Title A), Regulation 61-63.
2. South Carolina Rules and Regulations for Radiation Control (Title B), Regulation 61-64.
3. Cember, Herman Introduction to Health Physics 2nd ed., Pergamon Press, Volume 105, New York, 1987, pp. 257-261.
4. Knoll, G.F., Radiation Detection and Measurement 2nd ed., J. Wiley and Sons, New York, 1989, pp. 693-695.
5. Shleien, Bernard , Radiation Safety Manual for Users of Radioisotopes in Research and Academic Institutions Nucleon Lectern Associates, 1987.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 5

USC NOVEMBER 1985  
(Revised May 2011)

Radioiodine Bioassays

## A. Policy and Purpose

Bioassays provide a measurement of internal radiation dose to personnel. South Carolina Regulation RHA 3.8 requires that bioassays be performed whenever there is a possibility of internal body contamination as a result of isotope usage. This policy provides the necessary control for monitoring personnel for radioactive iodine and maintaining internal exposures below prescribed limits set by the State of South Carolina.

## B. Definitions

1. bioassay - the determination of the kind, quantity and/or concentration, and location of radioactive material in the human body by direct measurement or by analysis of materials excreted or removed from the body.
2. whole body count - measurement of internal radiation present in the body (gamma or high energy beta) by using a sensitive detecting device(s) placed over the entire body or parts of the body; by proper calibration of the detecting device, an accurate measurement of the amount and location of the radioactive materials can be made;
3. committed effective dose equivalent (CEDE) – projected cumulative dose to the body from internal radiation sources measured by whole body counts or bioassays.

## C. Responsibilities

1. The principal investigator has the responsibility of ensuring that all laboratory employees working with free iodine (NaI) monitor their thyroids for the presence of radioactive iodine. In addition, the investigator must ensure that written records of all thyroid monitoring results be maintained with copies forwarded on a quarterly basis to the radiation safety office. The radiation safety office must be immediately notified if unusual levels are detected.
2. The individual user is responsible for handling all radioiodine compounds in a safe manner and must monitor the thyroid gland at the appropriate intervals as outlined in this policy.
3. The health physicist will ensure that all thyroid monitoring records are forwarded to the radiation safety office on a quarterly basis and will maintain them for review by the radiation safety office and /or regulatory agencies. The thyroid monitoring equipment that is currently being used will be calibrated yearly by the Radiation Safety Office.



4. The radiation safety officer will ensure that thyroid analyses are accurately performed and analyzed. All routine thyroid monitoring results will be reviewed quarterly. The principal investigator will be advised of appropriate measures to be taken when unusual levels are detected.

#### D. Procedures and Safety Practices

1. All volatile radioiodine compounds (ex. NaI), regardless of quantity, must be handled in a fume hood that has a minimum face velocity of 125 linear feet per minute. Radioactive iodine that is bound to a non-volatile agent may be handled outside a fume hood in an open room.
2. Thyroid monitoring is necessary when an individual handles a volatile form of radioactive iodine in excess of 1 millicurie. This would include the eluting of the stock vial for use in experiments. In addition, individuals working with non-volatile radioactive iodine in quantities greater than 10 millicurie must be monitored. Results of the thyroid monitoring must be recorded on form a. (EHS-F-RAD-019).
3. All individuals handling radioiodine or who are sufficiently close to the process where intake is possible must participate in the monitoring program.
4. Thyroid monitoring must be performed at the following intervals:
5. Base line prior to beginning work with radioiodine; if iodinations are performed on successive days, another base line is not required; however, if the interval between iodinations is at least two weeks, then another base line measurement will be necessary;
6. 48 hours following work with radioiodine in quantities listed in item 2 above;
7. If an incident occurs while working with radioiodine or if any measurements are significantly higher than normal readings, notify the Radiation Safety Office immediately. Daily thyroid monitoring must be performed during periods when abnormal readings are obtained. The Radiation Safety Officer will investigate the cause of unusual thyroid counts and make recommendations for corrective action.

## E. References

1. ICRP Publication 10, "Report of Committee IV on Evaluation of Radiation Doses to Body Tissues from Internal Contamination Due to Occupational Exposure, Recommendations of the International Commission on Radiological Protection", Pergamon Press, Oxford, pp. 17, 1968.
2. ICRP Publication 10A, "The Assessment of Internal Contamination Resulting from Recurrent or Prolonged Uptakes, Recommendations of the International Commission on Radiological Protection", Pergamon Press, Oxford, 1969.
3. S.C. Department of Health and Environmental Control, - "Requirements for Bioassay of Iodine-125 and Iodine-131", September 16, 1982.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY, NO. 6

USC NOVEMBER 1985  
(Revised May 2011)

General Laboratory Safety Procedures

## A. Policy and Purpose

This policy provides general guidelines for the safe handling of radioactive materials in the laboratory. The safety procedures contained in this policy apply to all laboratories and must be used in conjunction with other safety procedures that are pertinent to each specific laboratory.

## B. Definitions

1. airborne contamination - any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors or gases;
2. fixed contamination - radioactive material that cannot be removed from a surface by normal wiping action;
3. loose contamination - radioactive material that can be removed from a surface by normal wiping action;
4. radiation area - any area in which ionizing radiation exists at such levels that the whole body could receive in any one hour, a dose in excess of 5 millirem or in any 5 consecutive days, a dose of 100 millirem;
5. high radiation area - any area accessible to individuals in which there exists radiation at such levels that the whole body could receive in any one hour, a dose in excess of 100 millirem.

## C. Responsibilities

1. The principal investigator must ensure that the general safety procedures are observed by all individuals working in the laboratory and must establish additional safety practices, when necessary, to assure the safe utilization of radioactive materials.
2. The individual user must exercise extreme caution when working with radioactive materials and must observe all provisions of this procedure.
3. The radiation safety officer will assess the level of compliance of the general safety procedures contained in this procedure.

#### D. Procedures and Safety Practices

The following items are general radiation safety procedures that must be followed by each laboratory using radioactive materials.

1. Appropriate personal protective equipment or apparel must be utilized by persons working with radioactive materials, e.g., gloves, lab coats, lab aprons, goggles, etc.
2. Radioactive materials must be stored under lock and key or the door to the laboratory must be locked when unattended, to prevent exposure to unauthorized persons and/or loss or theft of the materials. All radioactive materials will be stored such that the exposure rate at the surface of the storage area is less than 2.0 mR/hr.
3. Work with radioactive materials must be performed in ventilated fume hoods if the manipulation of such materials involves any possibility of airborne contamination.
4. Animals injected with radionuclides must be handled with extreme caution. Animal bedding must be double bagged and treated as radioactive biological waste. All cages must be monitored for radioactivity and decontaminated, when necessary. Appropriate warning signs shall be posted on the cages. Adequate ventilation must be provided when animals are injected with radionuclides and there is a possibility that the animals may exhale and disperse the radioactive material into the room. The University's Animal Resource Facility will not kennel animals that contain radionuclides.
5. Pipetting of radioactive solutions by mouth is strictly prohibited.
6. Smoking, drinking, eating, and applying of cosmetics is prohibited in areas where radioactive materials are used or stored.
7. Food and drink must not be kept in refrigerators used to store radioactive materials.
8. Contaminated glassware and other utensils must be kept separate from other laboratory glassware or utensils and must be labeled "radioactive".
9. Personnel monitoring badges, when required in a laboratory, must be kept in an area free of radioactivity when not in use. Badges should not be taken home from work.
10. Remote handling equipment (long-handled tongs, remote pipettes, etc.) will be routinely used in handling high levels of radioactive materials.
11. If a personnel monitoring device has been assigned, it must be worn at all times while in areas where radioactive materials are being used.

12. Lead and/or Plexiglas shields must be used for sources having high radiation intensity. Contact the Radiation Safety Office for information concerning the type and amount of shielding that would be required for your laboratory set-up.
13. Hands, shoes and clothing must be frequently monitored.
14. Liquid and solid radioactive waste must be placed in approved containers. Liquid waste containers are provided by the Radiation Safety Office.
15. When working with a new procedure in which radioactive materials are to be used, a dry run (without the isotope) should be considered to isolate any problem areas.
16. In the case of a spill or breakage, the area (table top, floor, etc.) must be decontaminated until all loose activity is removed. Fixed contamination must be reduced to the practical minimum. DECONTAMINATION IS TO BE PERFORMED BY LABORATORY PERSONNEL, NOT BY HOUSEKEEPING PERSONNEL.
17. All persons involved in a spill and decontamination activities must be checked immediately after the spill and after decontamination is finished. A Geiger-Mueller survey meter is to be used as required. After such an accident, the general area especially floors, doors, handles, stair railings, etc. must be surveyed.
18. Label all work areas where radioactive materials are used with "radioactive" tape.
19. All areas in which radioactive material and/or ionizing or non-ionizing radiation is used or stored must be in compliance with Occupational Safety and Health Act, 1970 (OSHA), where applicable.
20. Entrance doors to rooms and laboratories in which radioactive materials are stored or used will be posted with a conventional sign bearing the words "CAUTION - RADIOACTIVE MATERIALS". Also, in addition to the foregoing requirement, some areas may be required to post a sign bearing the words "CAUTION - HIGH RADIATION AREA" or "RADIATION AREA"; these areas will be designated by the radiation safety office, in compliance with state regulations.

#### E. References

1. U.S. Department of Health, Education and Welfare Publication No. (NIH) 79-18, The National Institutes of Health Radiation Safety Guide, 1979 Edition.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 7

USC NOVEMBER 1985  
(Revised May 2011)

Preparation and Disposal of Radioactive Waste

## A. Policy and Purpose

This policy is designed to ensure that all radioactive waste is handled safely and is sorted for ease of disposal. Implementation of this policy will ensure compliance with State Regulation RHA 3.55, concerning the general requirements for waste disposal.

## B. Definitions

1. aqueous liquid - liquid radioactive waste which has no constituents defined as hazardous by 40 CFR, Part 261. (ex. buffer solutions, nutrient media, lysed cells);
2. mixed waste - waste which meets both the NRC's definition of radioactive waste in 10 CFR Part 61.55 and the EPA's definition of hazardous waste in 40 CFR Part 261;
3. non-hazardous scintillation fluids- scintillation fluids that have no constituents defined as hazardous by 40 CFR, Part 261, and are labeled as biodegradable or environmentally safe. (will not contain toluene, xylene, or have a flash point <140 F);
4. radioactive waste- any material that contains:
  - a. radioactive contaminated general laboratory trash such as glass, paper, lab clothing, gloves, culture dishes, syringes, etc;
  - b. animal carcasses, animal tissues, or bedding containing residual radioactive tracers;
  - c. sealed radioactive sources used for instrument response checks or research;
  - d. aqueous solutions containing radioactive contaminants;
  - e. vials containing scintillation fluids and radioactivity;
  - f. outdated or empty stock vials.



### C. Responsibilities

1. The principal investigator is responsible for preparing all waste material for transport from the laboratory. The material must be sorted and labeled as outlined in this policy.
2. The individual user must dispose of radioactive waste in a safe manner and must follow the provisions outlined in this policy.
3. The health physicist is responsible for ensuring that all radioactive trash is properly sorted, labeled and tagged. The health physicist has the authority to reject or return any waste that has not been properly handled by the principal investigator.
4. The radiation safety officer will oversee the packaging, transport and disposal of all radioactive waste generated by the University.

### D. Procedures and Practices

1. The Radiation Safety Office must be notified by e-mail at [radsafe@mailbox.sc.edu](mailto:radsafe@mailbox.sc.edu) when a radioactive waste pick-up is needed. All waste will be picked up according to the following schedule unless changes are required:
  - a. all requests from the School of Medicine Campus will be handled every Thursday;
  - b. all requests from the Columbia campus (Biology, Chemistry, Physics, Pharmacy, School of Public Health and Psychology) will be handled every Tuesday;
  - c. all requests from all other campuses will be arranged as needed.
2. The Radiation Safety Office must receive a waste pick-up request no later than 3:00 p.m. the day before the scheduled pick-up; otherwise, the waste will be handled the following week.
3. In the event of inclement weather, holidays, etc., the schedule will be changed to the next available day.
4. Radiation safety will reject any material that is not properly packaged, labeled or tagged.

5. The activity (mCi or uCi) for each type of waste must be recorded on form (EHS- F-RAD-027) and the disposal of radioactive waste shall be handled as follows:

*a. Solid Waste*

- 1) Solid waste must be placed in covered, trash containers that are lined with plastic bags. The containers must be labeled with "radioactive" tape or radiation warning signs.
- 2) No liquid whatsoever shall be put into the solid waste. If any liquid is found in the collected solid waste, the waste will be returned to the principal investigator's laboratory to be separated.
- 3) Pasteur pipettes, needles, razors and other sharp objects must be packaged in a cardboard box.

*b. Liquid Waste*

- 1) Two and one half gallon plastic carboys are provided, on request, from the Radiation Safety Office for collection of bulk liquids.
- 2) Bulk liquids must be separated as follows:
  - a. Aqueous liquids
    - 1) C-14 and H-3 (tritium) can be combined;
    - 2) It is preferred that all other isotopes be separated for ease of analyzing.

a. Mixed liquids

The generation of mixed liquids (radioactive and hazardous) must be avoided due to severe disposal restrictions. If the generation of this type waste is unavoidable, the Radiation Safety Office must be contacted prior to its generation to ensure a disposal option is available. Bulk scintillation media with C-14 and/or H-3 may be classified as "Hazardous Only" providing a radioactive limit is not exceeded.

- 3) All liquid waste must be readily soluble with no trace of mold, bacteria, tissues, or other materials that would prohibit pouring.

- 4) Carboys with blood or blood by-products must be adequately processed by the laboratory to eliminate any bio-hazardous component.
- 5) Liquids can only be accepted with a pH range of 6 to 9.

*c. Scintillation Vials*

- 1) **Only vials containing non-hazardous scintillation fluid will be accepted for disposal.**
- 2) Vials will be picked up with the scintillation fluids in them if they are packed in scintillation vial trays and separated as follows:
  - a). C-14 and H-3 can be combined;
  - b). All other isotopes must be separated; for example P-32 vials and S-35 vials go into different waste drums, so they must be placed in separate trays.

*d. Biological waste*

The principal investigator must supply the following information for each animal carcass containing radioactive material: isotope amount injected and animal weight. All carcasses must be double-bagged in plastic and sealed before being frozen. Animal bedding must be double-bagged and sealed with the isotope and approximate activity noted on the tag.

6. No liquid radioactive waste shall be disposed of in the sanitary sewer system. When cleaning contaminated glassware, the first two rinses must be poured into a plastic carboy and treated as liquid waste. Any remaining residue in the glassware can be washed in the sink labeled for radioactive use.
7. Any waste with infectious agents will not be picked up by the radiation safety staff until certified by the biohazards manager that all such agents are deactivated and/or rendered as non-infectious.

**E. References**

1. 40 CFR, Part 261, Hazardous Waste Identification
2. 10 CFR, Part 61, Licensing Requirements for Land Disposal of Radioactive Waste.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 8

USC NOVEMBER 1985  
(Revised May 2011)

Laboratory Surveys and Contamination Control

## A. Policy and Purpose

This policy is designed to provide appropriate controls over radioactive contamination of personnel, equipment and work areas and to satisfy the requirements of State Regulation RHA 1.7 concerning tests and surveys.

## B. Definitions

1. disintegrations per minute (dpm)-the number of radioactive transformations that would be expected to occur in a material in a period of a minute;
2. counts per minute (cpm)-the number of radioactive transformations that are actually detected by an instrument;  
$$\text{dpm} = \frac{\text{cpm}}{\text{instrument efficiency}}$$
3. fixed contamination -radioactive material which has been fixed on a surface and cannot be removed by ordinary decontamination methods;
4. loose contamination -radioactive material which has been deposited on surfaces and which can be removed by wiping;
5. geiger-mueller (GM) survey meter-an instrument for detecting radiation; it consists of a counting instrument and a gas-filled GM tube that responds to ionizing radiation;
6. liquid scintillation counter (LSC)-an instrument used to measure the activity of radioactive substances; it consists of a phosphor or scintillation cocktail, a photomultiplier tube and electronic circuits that count signals in an appropriate fashion; liquid scintillation counters are extremely efficient for counting beta radiation but much less efficient for counting alpha or gamma radiation;
7. restricted area-area in which access is controlled by the authorized user for purposes of protection of personnel from exposure to radiation and radioactive materials;
8. wipe test-a test for finding loose contamination by wiping a surface (100 cm ) with a filter disc; the disc is then counted in a radiation measuring instrument;
9. survey-the process of examining an area for radioactive contamination through the use of an appropriate survey instrument.

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### C. Responsibilities

1. The principal investigator has the responsibility of ensuring that all surveys and wipe tests are performed in accordance with the provisions of this policy.
2. The individual user must survey his/her hands, clothing, feet and work area at the completion of each experiment. In addition, occasional surveys must be performed while the experiment is in progress.
3. The radiation safety officer shall ensure that all survey instruments are calibrated at the appropriate intervals. In addition, the radiation safety officer or his designate will periodically assess the contamination control program for each laboratory and will respond to emergencies.

### D. Procedures and Safety Practices

1. Each laboratory must have adequate instrumentation for detecting and counting contamination. A Geiger-Mueller (GM) survey instrument is essential for detecting contaminated areas (excluding H-3) in the laboratory. More sophisticated instrumentation, such as a liquid scintillation counter (or gamma scintillation counter), is necessary for accurately counting radioactive emissions from wipe samples.
2. Survey instruments will be calibrated at intervals not to exceed one (1) year. The Radiation Safety Office will make the appropriate arrangements for instrument calibration.
3. The GM survey instrument must be used to monitor the work area during and after completion of each experiment. The individual user must also monitor his/her hands, feet and clothing for contamination.
4. Wipe tests using absorbent filter paper must be performed in the laboratory work area on a weekly basis. If radioactive materials are not used during a particular week, then a wipe test is not necessary. However, **a notation stating that isotopes were not used is to be recorded on the wipe test log.**
5. The survey meter must be used in those areas inaccessible to a wipe, for example, cracks in benches, grills in hoods, areas around radioactive waste containers.

6. Before removing any piece of equipment from a restricted area, a wipe test must be performed on the equipment to ensure that no loose contamination is present. Large appliances (refrigerators) or sink drains must be free of contamination prior to any work by maintenance personnel. Equipment Clearance form (EHS- F-086).
7. If a laboratory or facility designated as a restricted area is being changed to an unrestricted use, a copy of the exit survey and wipe test results must be forwarded to the Radiation Safety Office.
8. Weekly wipe test results must be recorded in the principal investigator's log book using form (EHS-F-RAD-006).
9. If contamination is found to exceed three times the background level in the laboratory, then decontamination procedures must be instituted and must continue until further wipe tests indicate that the area has been decontaminated.
10. If contamination is found to exceed 20,000 dpm beta/gamma or 1,000 dpm alpha, then Radiation Safety Policy No. 8 must be instituted. The principal investigator must halt all traffic into and out of the area to minimize the spread of contamination to adjacent laboratories and offices. The Radiation Safety Officer must be immediately notified and all personnel in the contaminated area must remain there until the Radiation Safety Officer or his designated representative has arrived.
11. The clean-up of a contaminated area will be performed by the principal investigator and laboratory personnel under the supervision of the Radiation Safety Office. **At no time are University custodial personnel to be involved in the decontamination process.**
12. Laboratories using sealed sources in gas chromatographs must ensure that all sources are secured against loss or theft. Wipe tests of the sealed sources will be performed by radiation safety personnel at appropriate intervals. Copies of the wipe test results will be maintained by the Radiation Safety Office.
13. Although the sealed source may be removed from the gas chromatograph, the actual source housing must never be disassembled by laboratory staff.

## E. References

1. NCRP Report No. 57, "Instrumentation and Monitoring Methods for Radiation Protection, National Council on Radiation Protection and Measurements", Washington, D.C. May, 1978.
2. Penn, A.C., "A Guide to the Safe Use of Radioactive Material" Job Safety and Health Vol.5, No. 6, June, 1977, pp. 11.



UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 9

USC NOVEMBER 1985  
(Revised May 2011)

Decontamination of Laboratories and Personnel

## A. Policy and Purpose

This policy is designed to provide safe and effective methods for the decontamination of laboratory work areas, equipment and personnel in order to minimize personnel radiation exposure and prevent the spread of contamination.

## B. Definitions

1. external contamination - contamination found on the skin or hair;
2. internal contamination - contamination of the blood and organs by inhalation, ingestion, or absorption of radioactive materials.

## C. Responsibilities

1. The principal investigator shall ensure that laboratory contamination is adequately contained and proper decontamination procedures are utilized, when necessary.
2. The individual user is responsible for informing the principal investigator of any contamination (local or widespread) found in the laboratory and will work with the principal investigator in decontaminating the laboratory and/or personnel, if necessary.
3. The radiation safety officer will oversee decontamination efforts when a significant portion of the laboratory is contaminated and will ensure that laboratory and personnel are safely decontaminated.

## D. Procedures and Safety Practices

### *1. Laboratory Decontamination:*

- a. If laboratory contamination is localized (e.g., a small portion of a workbench or floor) and is found to be more than three times the normal background levels for the laboratory (determined by GM survey or smear results), then decontamination procedures must be instituted by laboratory personnel.
- b. If laboratory contamination is widespread (e.g., on workbench, chairs, floor, refrigerator, etc.) or if removable contamination in any area exceeds 1,000 dpm alpha or 20,000 dpm beta/gamma, then decontamination procedures must be supervised by the Radiation Safety Officer or his designate.

- c. Attempts should be made to keep contamination localized. Use dry paper towels to absorb liquid or cover a dry spill with a damp cloth.
- d. To reduce the further spread of contamination, eliminate all traffic in the area. If floor contamination is extensive, rope off the area and lock all doors leading to the area. A step-off area must be established at the contamination boundary and shoes, lab coats, gloves, etc. must be removed in the step-off area to avoid spreading contamination. All personnel leaving a contaminated area must have their hands, feet, shoes and clothing surveyed.
- e. Radcon® or cleaners containing alcohol (409®, Fantastik®) are usually most effective in removing loose contamination from hard surfaces. Gloves and protective clothing must be worn when decontaminating an area. Generally, glassware and counter tops can be decontaminated by repeated washings.
- f. Survey the area repeatedly with a GM counter or by taking wipe samples. Continue to clean the area until contamination is removed. If contamination cannot be removed, contact the Radiation Safety Office for further instruction.

## 2. *Personnel Decontamination*

- a. External contamination (even in small amounts) must be treated seriously. External contamination results in local skin exposure. Radioactive materials can penetrate intact skin, especially when organic solvents are present. Contamination may also be ingested or inhaled and may be spread to other areas or personnel. Therefore, it is most critical to remove loose contamination as quickly and safely as possible.
  - 1). The following procedure is to be used to decontaminate the skin:
    - a). Wet contaminated area and apply mild soap; use luke-warm water-not hot water;
    - b). Work up a good lather and use a soft bristled brush, if necessary;
    - c). Repeat at least 3-4 times; monitor between washes;
    - d). If necessary, use a mild abrasive such as lava soap or a paste of cornmeal and Tide, 50/50, wash and dry the skin and monitor again.

2). The following procedure is to be used to decontaminate the hair:

- a) Shampoo hair with head deflected backwards; wear gloves!
- b) Rinse with 3% citric acid; wash again and rinse;
- c) Dry hair with dryer and monitor.

3). If eyes are contaminated:

- a). Spread eyelids;
- b). Rinse thoroughly with water in a direction from the nose to the lateral angle of the eye.

4). If whole body contamination exists:

- a). Remove all clothing;
- b). Shower immediately with water; brush with mild soap;
- c). Repeat at least 4 or 5 times;
- d). Towel dry and monitor;
- e). If unsuccessful, await for physician's orders.

5). Any wound acquired in the presence of radionuclides must be considered contaminated until proven otherwise. The following procedure is to be instituted:

- a). Rinse wound under running water;
- b). Delimit contaminated area with waterproof material;
- c). Decontaminate skin around the wound;
- d). Remove wound cover and apply a sterile dressing;
- e). Notify the Radiation Safety Officer immediately.

b. Internal Contamination:

1). If internal contamination is suspected, the following action is to be taken:

- a). Notify the Radiation Safety Officer;
- b). Determine the time of accident, the type of uptake (ingestion, inhalation, and absorption), the isotope involved, and the chemical nature and level of activity of the contaminant.

### 3. *Decommissioning of a laboratory*

When a principal investigator is vacating a laboratory, all equipment must be decontaminated, all radioactive materials and chemicals must be disposed in a proper manner and all work surfaces and storage locations must be free of any contaminants (both radioactive and non-radioactive). The University has developed a laboratory decommissioning policy that must be followed under these circumstances. It can be found at the Environmental Health & Safety website at:

<http://ehs.sc.edu/Acrobat/EHS-M-017.pdf>

#### E. References

1. International Atomic Energy Agency (IAEA), Technical Reports Series NO. 152, Evaluation of Radiation Emergencies and Accidents, Vienna, 1974, 136 pages.
2. NCRP Reports N. 65, Management of Persons Accidentally Contaminated with Radionuclides, Washington, DC, April 1980, 205 pages.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 10

USC NOVEMBER 1985  
(Revised May 2011)

Record-Keeping

## A. Policy and Purpose

This policy specifies the various records that must be maintained by each authorized user to be in compliance with State Regulations RHA 1.5 and RHA 3.35.

## B. Definitions

1. bioassay-determination of the kind, quality or concentration, and location of radioactive material in the human body by direct (in vivo) measurement or by analysis of materials excreted or removed from the body (in vitro);
2. radioisotope log book-log containing all the records necessary to be in compliance with state regulations; when a principal investigator obtains authorization to use radioactive materials, the Radiation Safety Office will issue a standard log book to the investigator which contains all of the forms necessary for proper record-keeping;
3. wipe test-a test for determining loose contamination by wiping a surface (100 cm<sup>2</sup> area) with a filter disc; the disc is then counted in a radiation measuring instrument;
4. survey - a process of examining an area for radioactive contamination through the use of an appropriate survey instrument.

## C. Responsibilities

1. The principal investigator must assure that all records required by the State or by the radiation safety office are properly maintained.
2. The individual user must be knowledgeable of all records pertinent to the radioactive materials authorization and must assist the principal investigator in properly maintaining the records.
3. The radiation safety officer must supervise the maintenance of records for all radioactive material use at the University.

## D. Procedures

1. The following records must be maintained by each laboratory and must be available for inspection at any time by representatives of the State Bureau of Radiological Health or the Radiation Safety Office:
  - a. Radioactive Material Authorization - this lists the isotopes and possession limits, and the conditions under which these materials may be used;
  - b. Current Annual in laboratory training form (EHS-F-RAD-44);
  - c. A copy of the USC Radiation Safety Manual (EHS-M-001);
  - d. A card posted in a prominent place in your laboratory indicating the location of a copy of "Title A, South Carolina Rules and Regulations for Radiation Control";
  - e. A worksheet for each radioactive material shipment received by the laboratory (EHS-F-RAD-013/014). The worksheet will serve as a receipt, utilization and disposal record for that particular shipment. If more than one isotope or more than one form of isotope is received in any shipment, a separate worksheet must be used for each isotope. The top portion of the worksheet will be completed by the Radiation Safety Office when the initial wipe tests on the package are performed. Each use of a portion of the shipment must be recorded on the worksheet along with the date used and a brief description of the procedure performed. Whenever a portion of the shipment is discarded as solid or liquid waste, the disposal portion of the worksheet is to be completed including the type (solid, liquid, scintillation vials), amounts and dates of disposal;
  - f. A separate log for all radioactive waste picked up by the radiation safety personnel (EHS-F-RAD-027);
  - g. Copies of all wipe tests must be recorded on the Weekly Wipe Test Log form (EHS-F-RAD-026). If radioactive material is used intermittently, records must indicate the dates of discontinuance and resumption of use and that no wipe tests were performed during that period. Background measurements must be indicated for each survey and wipe test performed;



- h. Copies of transfer forms for radioactive materials transferred either to or from the principal investigator (EHS-F-RAD-024);
  - i. Copies of quarterly inventories of all radioactive materials in the possession of the principal investigator. If the current authorization has been classified as “Inactive” and there are no radioactive materials on hand, quarterly inventories will no longer be necessary until the authorization is reactivated. (EHS-F-RAD-023);
  - j. Copies of decontamination reports, if needed;
  - k. Copies of yearly survey instrument calibration records;
  - l. Copies of thyroid monitoring or bioassay results.
2. In addition, the following documents provided by the radiation safety office should be posted near a laboratory telephone:
- a. Emergency contact numbers(02/07)
  - b. Notice to Employees (SC-RHA-20)
  - c. The card indicating where Title A can be found.

## E. References

1. South Carolina Bureau of Radiological Health, Radioactive Material Inspection Report - Academic Licenses.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 11

USC NOVEMBER 1985  
(Revised May 2011)

Decontamination of University Buildings  
due to the release of Radioactive Materials  
from a Generally Licensed Device

## A. Policy and Purpose

This policy is designed to provide effective methods for assessing the levels of radioactive contamination in University buildings and to the occupants as a result of damage to devices possessed by the University under a general license. The methods are designed to minimize radiation exposure to the general public and prevent the spread of contamination.

## B. Definitions

Before an individual or institution can possess radioactive materials in the United States, a license must be obtained which specifies the conditions under which the radioactive material can be possessed and used. Licenses for radioactive materials are of two types: specific and general.

1. specific license - a license issued by the US Nuclear Regulatory Commission (NRC) or an Agreement State to an individual or institution that requires the filing of a formal application. The license specifies the amount and type of radioactive material that may be possessed and lists the conditions under which the materials may be possessed and utilized by the licensee.
2. general license - a license that becomes effective without the filing of applications with the NRC or an Agreement state or the issuance of licensing documents to particular persons or institutions. For example, individuals possessing smoke detectors or tritium exit signs automatically have a general license to possess these materials upon the purchase of the devices. It is the responsibility of the vendor to register the devices for the purchaser with the appropriate regulatory agency.
3. contamination - radioactive material that has left the confines of the device in which it was held.

## C. Responsibilities

1. The supervisor or maintenance employees have the responsibility of immediately reporting any damaged devices containing radioactive materials to the Radiation Safety Officer.
2. The radiation safety officer has the authority to close any building or portions of buildings that are potentially contaminated with radioactive materials and to confiscate any contaminated items. He also has the authority to quarantine and monitor any individuals potentially contaminated with radioactive materials to assess potential health risks to the individuals.

3. The building managers must support the Radiation Safety Officer in his efforts to assess the extent of radioactive contamination and return the building to a level that is safe for the occupants.

#### D. Procedures and Safety Practices

1. When a device containing radioactive material is damaged, the Radiation Safety Officer must be immediately contacted (777-5269) for determining if contamination is present and assess the extent of the contamination. The Radiation Safety Officer must report the incident to the S.C. Bureau of Radiological Health and request assistance, if necessary.
2. If contamination is minimal, then the affected area must be sealed off to prevent the further spread of radioactivity. Decontamination efforts must be directed by the Radiation Safety Officer and must begin as soon as possible. Potentially contaminated individuals must be monitored and decontaminated, if necessary.
3. If contamination is localized and can be removed by radiation safety personnel, the following personal protection items must be used:
  - a. protective clothing
  - b. shoe covers
  - c. rubber gloves

Any personal protective item that becomes contaminated must be placed in a plastic bag and disposed of as radioactive trash. When decontamination is complete, all personnel involved in the clean-up must submit urine samples to the Radiation Safety Office for analysis of possible internal contamination.

4. If contamination is widespread throughout a building, then all occupants are to be monitored and decontaminated, if necessary. Clothing and personal items will be confiscated if found to be contaminated. If internal contamination of an individual is suspected, then bioassay samples must be submitted by the individual to the Radiation Safety Office for analysis. A determination of the proper procedures for decontaminating the building must be made after all persons have been monitored and treated.
5. The building may not be occupied until decontamination efforts result in acceptable radiation levels.
6. Attempts must be made to decontaminate equipment, clothing or personal items only after treating contaminated persons. If such items cannot be adequately cleaned, then they must be sent to a low-level radioactive waste disposal facility for burial.

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 12

USC NOVEMBER 1985  
(Revised May 2011)

Radiation Dose to the Embryo/Fetus

## A. Policy and Purpose

This policy is designed to inform University employees of the potential health risks to the embryo/fetus from exposure to ionizing radiation and to satisfy the requirements of the revision to S.C. Regulations R61-63 (Title A) and R61-64 (Title B).

## B. Definitions

1. bioassay - determination of kinds, quantities, concentrations and locations of radioactive material in the body whether by direct measurement (in-vivo) or by analysis and evaluation of materials excreted or removed from the body;
2. committed effective dose equivalent – projected dose to the body from internal radiation sources, through inhalation, ingestion or absorption; (Note: CEDE does not apply to x-ray users)
3. declared pregnancy- when a University employee officially declares, in writing, her condition to the Radiation Safety Officer; by completing the "Declaration of Pregnancy" form.
4. deep-dose equivalent (DDE) – whole body dose at a depth of 1 cm from an external source of radiation;
5. embryo/fetus - official term used in the regulations which refers to the developing human organism from conception until the time of birth;
6. occupationally exposed- exposure of a person who normally works with radiation as a part of the job, as opposed to exposure received from a medical exposure.

## C. Responsibilities

1. The principal investigator will take precautions to ensure that the declared pregnant employee/student does not exceed a dose to the embryo/fetus in excess of the limits established by State regulations and will ensure that substantial variations above a uniform monthly exposure rate are avoided. In addition, the principal investigator will work with the Radiation Safety Officer to determine if additional precautions or engineering controls are necessary to reduce potential radiation exposure.
2. The individual user (pregnant employee/student) has the responsibility of deciding when or whether to formally declare her pregnancy to the Radiation Safety Office. In addition, she must take all of the precautions necessary to keep her exposure and the exposure to the embryo/fetus as low as reasonably achievable.

3. The radiation safety officer will ensure that a declared pregnant employee/student is fully aware of the potential risks to the embryo/fetus and will ensure that radiation dose to the embryo/fetus is below the limits established by State regulations.

#### D. Procedures

1. Since the developing embryo/fetus is considered relatively radiosensitive, all employees/students who have the potential of becoming pregnant must be informed of the potential risks associated occupational exposure of the embryo/fetus to ionizing radiation. In addition, they must also be informed of the proper controls to be employed to limit the risk. Detailed information related to this matter can be found in the NRC Regulatory Guide 8.13, "Instructions Concerning Prenatal Radiation Exposure".
2. In order to properly monitor the external and internal dose to the employee/student and the embryo/fetus, it is strongly suggested that the pregnant worker declare her condition to the radiation safety officer as soon as possible using form (EHS-F-RAD-009). However, it is the responsibility of the pregnant worker to decide when or whether she wishes to formally declare her condition. If a University employee/student wishes to declare her pregnancy, she must do so by completing the form and returning it to the Radiation Safety Office.
3. The dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant employee/student, must not exceed 0.5 rem. The dose to the embryo/fetus is determined by the sum of the deep dose equivalent (external dose) to the declared pregnant employee/student and the committed dose equivalent (internal dose) from radionuclides in the embryo/fetus and the declared pregnant worker.
4. External dose to the embryo/fetus will be monitored with a whole body dosimeter, (if appropriate) that will be placed in the abdominal region.
5. Air samples of the work area or bioassay (urine samples) from the declared pregnant employee/student may be necessary to properly assess internal doses from radiation exposure. The Radiation Safety Officer will advise the employee about whether either of these steps is necessary for her particular use of radiation.

6. South Carolina Regulations R61-63 and R61-64 states that efforts must be made to avoid substantial variation above a uniform monthly exposure rate (.05 rem) to a declared pregnant employee/student.
7. Any employee/student may alter work routines to further reduce radiation exposure if the proposed alterations are approved by the principal investigator.
8. Accidental exposures to a declared employee/student that are deemed to be potentially significant by the employee and/or supervisor, will be immediately evaluated by the Radiation Safety Officer.

#### E. References

1. Nuclear Regulatory Guide 8.13, "Instructions Concerning Prenatal Radiation Exposure".
2. "Radiation Dose to the Embryo/Fetus." SC Bureau of Radiological Health Licensing Guide, October, 1993.



UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 13

USC JUNE 2006  
(Revised May 2011)

Handling Radioisotopes at the Baruch Marine Field Laboratory

#### A. Policy and Purpose:

This policy is designed to ensure that the ordering, use and disposal of radioactive materials by individuals working at the Baruch Marine Field Laboratory in Georgetown, S.C. is handled in a safe and legal manner. Since the Baruch Laboratory is a satellite location, it does not have the daily access to the support staff of the USC Radiation Safety Office. Therefore, adjustments to our standard handling procedures are needed in order for radioactive materials to be used at this site.

#### B. Definitions:

1. Liquid radioactive waste - waste containing radioactive materials in an aqueous or organic solution.
2. Solid radioactive waste - laboratory trash including paper, gloves, glassware, utensils, etc; sealed or plated radioactive sources or powders containing radioactivity or contaminated by radioactive materials.
3. Liquid scintillation waste - waste containing scintillation solvents, fluors and radioactive material. Scintillation fluid can only be the biodegradable/ non-hazardous type (flash point must be  $>140^{\circ}$ ).
4. Wipe test - a procedure in which a piece of filter paper is rubbed on a surface and its radioactivity is measured to determine if the surface is contaminated with loose radioactive material.
5. Survey - a determination of radiation dose rates emanating from a surface by using an appropriate survey instrument.
6. disintegrations per minute (dpm)-the number of radioactive transformations that would be expected to occur in a material in a period of a minute;
7. counts per minute (cpm)-the number of radioactive transformations that are actually detected by an instrument;  
$$\text{dpm} = \text{cpm} / \text{instrument efficiency}$$

## C. Procedures:

### 1. Ordering

- a. If a researcher wishes to order radioactive materials using a purchase requisition, the authorized user must write "Radioactive Material Order" on the requisition. Purchase requisitions are processed by the researcher's department and the department representative must send the purchase order to the Radiation Safety Office for review. If approved, the order will be processed and sent to Purchasing.
- b. Blanket purchase orders will be placed only by the Radiation Safety Office. Authorized users must notify the Radiation Safety Office with appropriate ordering information (including the vendor, blanket P.O. #, catalogue number(s), amount to be ordered and any special ordering instructions). Requests for isotopes are e-mailed to the radiation safety office at [radsafe@mailbox.sc.edu](mailto:radsafe@mailbox.sc.edu).
- c. Any order that does not meet the approval of the Radiation Safety Office (i.e. individual not authorized for isotope ordered or order exceeds authorized limits for certain isotope) will be immediately referred back to the individual placing the order.

### 2. Receipt

- a. Packages containing radioactive materials will be delivered to the Baruch Marine Field Laboratory. The individual signing for the package must contact the investigator who will take possession of the package as soon as possible. If necessary, the package may be placed on the laboratory bench or in the refrigerator/freezer (if necessary) of an authorized room.
- b. The investigator or a trained laboratory staff member will be responsible for checking the incoming package for removable contamination, and recording all receipts, wipe results, and GM readings. Call the Radiation Safety Office immediately if any problems with packaging are discovered.
- c. The packing receipt attached to the package will be examined and checked against the ordering information. The contents of the package will also be checked against the packing slip once the package has been opened. The packing receipt must be signed by the authorized user or a laboratory representative and faxed to the Radiation Safety Office at (803): 777-5275 for proof of delivery. The Radiation Safety Office will forward a copy of the packing receipt to Accounts Payable.

- d. A trained laboratory staff member will open the package. Gloves and protective clothing will be used when appropriate for the item being checked. A GM reading at the surface and one meter from the package must be made and recorded on the Isotope Receipt Log (EHS-F-RAD-040). The inner container and packing material will be checked for signs of leakage or damage.
- e. Wipe tests will be performed on each incoming package. The outside of the box and each successive layer of packaging will be wipe tested. Wipe tests will be analyzed with a liquid scintillation counter.
- f. If contamination is detected on packing material, the packing material will be disposed in the radioactive waste.
- g. If contamination (measured DPM's greater than 3 times background on the liquid scintillation counter) is detected on the vial and found to be less than 20,000 DPM, an attempt can be made to decontaminate the vial. Place the vial on absorbent paper and spray it with a cleaning solution (Fantastic, 409, etc.). If the vial cannot be decontaminated, contact the company and have them send a replacement shipment. Store the contaminated package in a secure location until it can be turned over to the Radiation Safety Office for disposal.
- h. If no contamination is found or if decontamination is successful, record the GM survey and wipe test results on the Isotope Receipt Log, (EHS-F-RAD- 040).

### 3. *Radioactive Material Use*

- a. When an authorized USC researcher or a visiting researcher uses radiation in the laboratory, Form (EHS-F-RAD-41) entitled Radioactive Material Use Form must be completed. This form identifies the researcher, the isotopes being used and the types and amount of radioactive waste generated. The original copy of this form should be placed in the laboratory log book and a copy mailed to the Radiation Safety Office in Columbia. This form helps the Radiation Safety Office monitor the activities at the laboratory and helps in the planning for waste pick-ups.

#### 4. *Waste Handling*

Radioactive waste must be handled in the following manner:

- a. Solid radioactive waste must be stored in thick plastic bags and kept in an area of the lab where human traffic is low. Once a bag is filled, it must be secured with a tie or “radioactive” tape. A radioactive waste pick-up receipt tag must be filled out completely and attached to the bag. **Absolutely no liquids** can be disposed with the solid trash. Any amount of liquid found in the solid waste could result in the rejection of an entire shipment of waste at the final disposal facility. Costs of repackaging the solid waste will be the responsibility of the laboratory.
- b. Liquid scintillation vials must be stored in the cardboard trays with dividers. This is necessary to prevent spillage of the vials during transport back to Columbia. A waste tag must be filled out completely and attached to the trays.
- c. Bulk liquid radioactive waste must be stored in the carboys provided by the Radiation Safety Office. Since the Baruch Marine Field Laboratory does not have a sanitary sewer, (it has a septic tank), no radioactive liquids can be poured down the laboratory drains. If glassware is to be cleaned, the rinse water must be placed in the plastic carboys. Disposable plastic glassware is recommended. A waste tag must be filled out completely and attached to the carboy.
- d. Contact the Radiation Safety Office for waste removal.

#### 5. *Laboratory Surveys and Wipe Tests*

If isotopes other than H-3 (H-3 cannot be detected using a GM survey meter) are used, then a GM survey of the work areas must be performed at the end of the experiments. In addition, wipe tests of the work areas must also be performed to check for removable contamination. Count the wipes on the liquid scintillation counter. If any wipes are 3 times the background count, then the contaminated area must be cleaned using the procedure mentioned in the training class. The wipes are recorded on the form (EHS-F-RAD-026).

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO.14

USC SEPTEMBER 2006  
(Revised May 2011)

Security Controls for Gamma Irradiator Facility

**NOTE: This policy contains sensitive information and access to this document is restricted to individuals who have an established need-to-know.**

If an individual wishes to obtain approval to use the gamma irradiator, contact the Radiation Safety Office at 777-5269.

**RADIATION SAFETY POLICIES AND PROCEDURES ELECTRONIC  
PRODUCTS**

USC NOVEMBER 1985  
(Revised May 2011)

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 1

Electronic Products Capable of Producing  
Ionizing or Non-Ionizing Radiation

## A. Policy and Purpose

This policy provides administrative control over the use of electronic products capable of emitting ionizing or non-ionizing radiation and is designed to ensure that such devices are operated in a safe manner and are in compliance with the appropriate state or federal regulations or guidelines promulgated by recognized governing committees. This policy excludes FCC regulated equipment unless modified or used for a purpose not originally intended by the manufacturer. Policies and procedures for laser products are located in Policy No.2 of this section.

## B. Definitions

1. radiofrequency electromagnetic radiation - electromagnetic radiation consisting of relatively long wavelengths ( $3.0 \times 10^{-4}\text{m}$  -  $3.0 \times 10^4\text{m}$ ), low energy ( $4.1 \times 10^{-11}\text{ev}$  to  $4.1 \times 10^{-3}\text{ev}$ ) and low frequency (1 kHz to 300 MHz);\*

hertz (Hz) - unit of frequency equal to one cycle per second;  
gigahertz (GHz) - one billion cycles per second;  
kilohertz (kHz) - one thousand cycles per second.

2. microwave radiation - radiofrequency wave radiation occupying the portion of the electromagnetic spectrum between the far infrared and conventional radio frequency portion; commonly regarded as extending from 300MHz to 100 GHz;\*
3. ultra-violet radiation - non-visible electromagnetic radiation with a wavelength of 3nm to 380nm; a portion of the ultraviolet spectrum is considered ionizing radiation;\*
4. x-radiation - penetrating electromagnetic radiation consisting of photons originating in the extra-nuclear portion of the atom;

\*Ranges are approximate; no exact end points exist.

## C. Responsibilities

1. The principal investigator must notify the Radiation Safety Office of the intended purchase of electronic devices capable of emitting ionizing or non-ionizing radiation in the wavelength bands specified above. The principal investigator must notify the Radiation Safety Office of any changes in operational status (operative, inoperative), location or orientation of equipment.



2. The individual user (equipment operator) must observe all safety precautions and operating procedures while using radiation emitting equipment and must inform the principal investigator or the radiation safety officer of any apparent safety problems associated with the use of such equipment.
3. The radiation safety officer has jurisdiction over all aspects of and has the authority to suspend any operation that constitutes a radiation health hazard to the equipment operators, other laboratory personnel or general public.
4. The health physicists will conduct surveys of all radiation emitting devices at appropriate intervals and will forward survey reports to the radiation safety officer for review.

#### D. Procedures

1. All equipment capable of producing x-radiation must be registered with the South Carolina Bureau of Radiological Health. Registration for each piece of equipment will be coordinated through the Radiation Safety Office and a copy of each registration will be maintained in the principal investigator's file.
2. Prior to the installation of diagnostic x-radiation producing equipment, the Radiation Safety Office must be contacted to ensure that adequate shielding is present to protect adjacent areas.
3. Before any electronic equipment capable of producing x-radiation is placed in use, the Radiation Safety Office must be notified so that the device may be surveyed to determine any safety hazards from its use. If after normal use of such electronic equipment, the operator suspects a radiation hazard may exist, a radiation survey by the Radiation Safety Office must be requested.
4. A copy of each equipment operating and safety instructions must be forwarded to the Radiation Safety Office and a copy will be maintained in the principal investigator's file.
5. No individual will be allowed to operate ionizing radiation producing equipment unless that person has completed the on-line training and can demonstrate knowledge and competence in the safe use of the equipment, the purpose or necessity of each safety device and radiation safety procedures.

The Radiation Safety Office will provide on-line training programs for users x-rays. The course can be found at: <http://ehs.sc.edu/Radiation/Training.htm>. Student achievement will be assessed by having each participant take an examination and answering at least 80% of the questions correctly. A certificate of achievement will be mailed to each successful participant. Call the Radiation Safety Office to make an appointment for the exam (777-5269).

6. A copy of the written operating and safety procedures must be in close proximity to equipment capable of producing ionizing radiation. Operators of each unit must be aware of the location of the procedures and the procedures must be readily available. Operators must sign and date the procedures as verification that they have been read.
7. Under no circumstance will any unit capable of producing ionizing or non-ionizing radiation be operated with any interlock or safety device by-passed without the written authorization of the Radiation Safety Officer. Maintenance and alignment procedures performed by qualified technicians are exempt from this requirement.
8. Equipment must be operated in accordance with the written operating and safety procedures provided for each unit. Requests to deviate from the operating and safety procedures must be directed to the Radiation Safety Officer for approval. Such requests must outline the procedure to be changed and the necessity for such action.
9. The Radiation Safety Officer may apply additional safety requirements as it is deemed necessary to protect the health of operators or the general public.
10. The Radiation Safety Office must be sent a copy of the purchase requisition form when ordering microwave devices for research use, ultra-violet lamps or any radiofrequency emitting devices to be used for research applications or instruction. Equipment specifications and facility use will be reviewed and appropriate recommendations will be made regarding safe operation. The radiation safety officer will suspend any operation that constitutes a health hazard to personnel or the general public.
11. Any experimental device capable of emitting ionizing or non-ionizing radiation (such as high voltage devices or radio-frequency electromagnetic devices) must be examined by the Radiation Safety Office prior to commencement of experimentation. The Radiation Safety Officer will prohibit use of any experimental device that constitutes a health hazard to the device operators or the general public.

#### IMPORTANT NOTICE REGARDING THE USE OF TRANSILLUMINATORS

Transilluminators are laboratory viewing devices that contain ultraviolet light sources and can present a serious hazard to the skin and eyes. If you or your employees are using one of these devices in your laboratory, please take the following precautions:

- 1). Wear rubber gloves and a long sleeved shirt or laboratory coat to protect your hands and lower portions of your arms from UV light.
- 2). If there is a potential for the eyes and face to be exposed, a polycarbonate full face shield stamped with the ANSI Z81.1-1989 UV certification must be worn. Goggles will not be sufficient.
- 3). Important: make sure that the shield you are using is adequate to block out the particular wavelengths of UV light emanating from the equipment. You can find the UV wavelength in your owner's manual and if you are ordering a face shield or already have one, check in the catalogue from which it was ordered to determine the UV wavelengths that the shield will block.
- 4). Make sure the transilluminator is properly labeled with a caution statement. Contact the Radiation Safety Office (777-5269) if labels are needed.

#### E. References

1. Institute of Electrical and Electronic Engineers, Inc.(IEEE), IEEE Standard for Safety Levels with Respect to Human Exposure to Radiofrequency and Electromagnetic Fields from 3kHz to 300GHz.(IEEE C95.1-2010).
2. Institute of Electrical and Electronic Engineers, Inc. (IEEE), Recommended Practice for Measurements and Computations of Radiofrequency Electromagnetic Fields with Respect to Human Exposure to such fields 100KHZ-300GHZ, (IEEE C95.3-2010
3. National Institute for Occupational Health (NIOSH). Occupational Exposures to Ultraviolet Radiation, HSM 73-11009, 1972.
4. The Health Physics and Radiological Handbook, Nucleon Lectern Associates, 84-60506, 1984.

**D. RADIATION SAFETY POLICIES AND PROCEDURES  
ELECTRONIC PRODUCTS**

USC NOVEMBER 1985  
(Revised May 2011)

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 2

Laser Products

## Laser Products

### A. Policy and Purpose

The Radiation Safety Committee has developed the following laser safety policy in accordance with the American National Standard Institute's Standard For The Safe Use of Lasers (ANSI Z136.3-2007), which is the laser industry's standard for all persons who operate Class II, Class III, and Class IV laser products.

### B. Definitions

#### Laser Classification

##### 1. *Class 1*

A class 1 laser is safe under all conditions of normal use. This means the maximum permissible exposure (MPE) cannot be exceeded. This class can include high-powered lasers within an enclosure that prevents exposure to the radiation and that cannot be opened without shutting down the laser. The maximum emission is also related to the pulse duration in the case of pulsed lasers and the degree of spatial coherence.

##### 2. *Class 1M*

A Class 1M laser is safe for all conditions of use except when passed through magnifying optics such as microscopes and telescopes. Class 1M lasers produce large-diameter beams, or beams that are divergent. The MPE for a Class 1M laser cannot normally be exceeded unless focusing or imaging optics are used to narrow the beam. If the beam is refocused, the hazard of Class 1M lasers may be increased and the product class may be changed. A laser can be classified as Class 1M if the total output power is below class 3B but the power that can pass through the pupil of the eye is within Class 1.

##### 3. *Class 2*

A Class 2 laser is safe because the blink reflex will limit the exposure to no more than 0.25 seconds. The blink reflex is an involuntary blinking of the eyelids elicited by stimulation of the cornea from activities such as touching or having a foreign body hit the cornea or possibly from a bright light. Stimulations such as this normally elicit a response of the opposite eye, as well.

The rapid reflex could occur at a rate of as little as 0.1 second. The evolutionary purpose of this reflex is to protect the eyes from foreign bodies and bright lights. It only applies to visible-light lasers. Class-2 lasers are limited to 1 mW continuous wave, or more if the emission time is less than 0.25 seconds or if the light is not spatially coherent. Intentional suppression of the blink reflex could lead to eye injury. Many laser pointers are class 2.

#### 4. *Class 2M*

A Class 2M laser is safe because of the blink reflex if not viewed through optical instruments. As with class 1M, this applies to laser beams with a large diameter or large divergence, for which the amount of light passing through the pupil cannot exceed the limits for class 2.

#### 5. *Class 3R*

A Class 3R laser is considered safe if handled carefully, with restricted beam viewing. With a class 3R laser, the MPE can be exceeded, but with a low risk of injury. Visible continuous lasers in Class 3R are limited to 5 mW. For other wavelengths and for pulsed lasers, other limits apply.

#### 6. *Class 3B*

A Class 3B laser is hazardous if the eye is exposed directly, but diffuse reflections such as from paper or other matted surfaces are not harmful. Continuous lasers in the wavelength range from 315 nm to far infrared are limited to 0.5 W. For pulsed lasers between 400 and 700 nm, the limit is 30 mJ. Other limits apply to other wavelengths and to ultra-short pulsed lasers. Protective eyewear is typically required where direct viewing of a class 3B laser beam may occur. Class-3B lasers must be equipped with a key switch and a safety interlock.

#### 7. *Class 4*

Class 4 lasers include all lasers with beam power greater than class 3B. By definition, a class-4 laser can burn the skin, in addition to potentially devastating and permanent eye damage as a result of direct or diffuse beam viewing. These lasers may ignite combustible materials, and thus may represent a fire risk. Class 4 lasers must be equipped with a key switch and a safety interlock. Most entertainment, industrial, scientific, military, and medical lasers are in this category.

## C. Responsibilities

1. The principal investigator must notify the Radiation Safety Office of an intended purchase. The Radiation Safety Office must also be notified of any other acquisitions of lasers, through a donation or loan of equipment. The principal investigator must notify the Radiation Safety Office of any changes in operational status or reconfiguration of major equipment and must also appoint a laboratory laser safety officer.
2. A laboratory laser safety officer (LSO) must be appointed for each facility and must be registered with the radiation safety office. The laboratory Laser Safety Officer has the following responsibilities:
  - a. Ensuring proper registration of all lasers and personnel operating the lasers;
  - b. Ensuring all personnel have completed the Basic Laser Safety Training program as required by Part D-2 of this policy and the in-laboratory training. Records of this training must be maintained in the safety logbook.
  - c. Developing, maintaining and updating, as needed, all operating, alignment and emergency procedures for the lasers and the facility under their control;
  - d. Acting as the contact for the Radiation Safety Office;
  - e. Enforcing the safety standards defined in the USC Laser Safety Policy;
  - f. Supervising personnel with access to the facility to ensure against unauthorized entrance or accidental exposure to laser radiation;
  - g. Ensuring all new personnel have completed the medical surveillance requirements of the University's Occupational Health & Safety Office;
  - h. Updating all records upon changes in personnel or equipment by contacting the Radiation Safety Office;
  - i. Reporting all incidents involving safety violations or injury to the Radiation Safety Office at 777-5269;
  - j. Ensuring personal protective equipment (eyewear, protective clothing) is properly maintained and worn.

3. The individual user must observe all safety precautions and operating procedures while using lasers and must inform the laboratory laser safety officer or the radiation safety officer of any apparent safety problems associated with the use of the laser. Each operator must be adequately trained.
4. The radiation safety officer has jurisdiction over all aspects of laser safety and has the authority to suspend any operation that constitutes a radiation health hazard.

#### D. Procedures

##### 1. Registration

- a. All lasers must be registered with the Radiation Safety Office prior to installation and use.
- b. All laser operators must be registered with the Radiation Safety Office prior to working with lasers.

##### 2. Training

- a. Prior to beginning work with any Class III or Class IV laser, all operators must complete the on-line laser safety course and pass the accompanying exam with a minimum grade of 80%. Arrangements for taking the exam should be made with the Radiation Safety Office (777-5269). The on-line course can be found at: <http://ehs.sc.edu/Radiation/Training.htm>.
- b. Exemptions from taking the laser safety course may be granted by the Radiation Safety Officer. Individuals with prior training will be required to provide proof of training such as a certificate or a letter from the RSO at another institution. In addition, the principal investigator shall provide annual in-laboratory training related to his or her specific laboratory for all employees/students associated with the laboratory.

##### 3. Inspections

- a. All newly registered lasers and facilities will be inspected by staff of the Radiation Safety Office prior to operation using the ANSI Z136.1, 2007 Standard for the Safe Use of Lasers for inspection criteria.
- b. Investigators must allow inspections of lasers and laser facilities at least yearly.



- c. Investigators must notify the Radiation Safety Office prior to any change in the laser or facility arrangement.
- d. An inspection by radiation safety personnel may be requested by any person in the facility who feels one is warranted.

#### 4. *Medical Surveillance*

- a. All individuals working with Class III and Class IV lasers will be required to have an ophthalmic exam provided by University Specialty Clinics, Department of Ophthalmology, prior to beginning work with the lasers and after any suspected abnormal exposure.
- b. Records must be maintained indefinitely

#### 5. *General Requirements*

- a. The Radiation Safety Office will provide each laser laboratory with a red "Laser Safety" log book that will contain all safety related records;
- b. When possible, the laser should be operated in well lit areas to reduce pupil size and minimize possible eye damage;
- c. Jewelry must not be worn in a laser controlled area as laser beams may reflect off the jewelry and cause damage to the eyes or skin;
- d. The laser beam must never be intentionally stared into or directed into the eyes;
- e. All materials capable of specular reflection and considered ancillary must be covered or eliminated;
- f. If after normal use of a laser, the operator suspects that a safety hazard may exist, a request for a radiation safety survey should be made to the Radiation Safety Office.
- g. The Radiation Safety Officer may apply additional safety requirements as deemed necessary to protect the health of the operators or the general public.

#### E. References

1. American National Standards Institute, Inc., American National Standard for the Safe Use of Lasers, Z136.1-2007.

**D. RADIATION SAFETY POLICIES AND PROCEDURES  
ELECTRONIC PRODUCTS**

USC NOVEMBER 1985  
(Revised May 2011)

UNIVERSITY OF SOUTH CAROLINA  
RADIATION SAFETY POLICY NO. 3

Medical Laser Products

## Medical Laser Products

### A. Policy and Purpose

The Radiation Safety Committee has developed the following laser safety policy in accordance with the American National Standard Institute's Standard For The Safe Use of Lasers In Health Care Facilities (ANSI Z136.3-2005), which is the laser industry's standard for all persons who operate Class II, Class III, and Class IV laser products in a medical setting.

### B. Definitions

#### Laser Classification

##### 1. *Class 1*

A class 1 laser is safe under all conditions of normal use. This means the maximum permissible exposure (MPE) cannot be exceeded. This class can include high-powered lasers within an enclosure that prevents exposure to the radiation and that cannot be opened without shutting down the laser. The maximum emission is also related to the pulse duration in the case of pulsed lasers and the degree of spatial coherence.

##### 2. *Class 1M*

A Class 1M laser is safe for all conditions of use except when passed through magnifying optics such as microscopes and telescopes. Class 1M lasers produce large-diameter beams, or beams that are divergent. The MPE for a Class 1M laser cannot normally be exceeded unless focusing or imaging optics are used to narrow the beam. If the beam is refocused, the hazard of Class 1M lasers may be increased and the product class may be changed. A laser can be classified as Class 1M if the total output power is below class 3B but the power that can pass through the pupil of the eye is within Class 1.

##### 3. *Class 2*

A Class 2 laser is safe because the blink reflex will limit the exposure to no more than 0.25 seconds. The blink reflex is an involuntary blinking of the eyelids elicited by stimulation of the cornea from activities such as touching or having a foreign body hit the cornea or possibly from a bright light. Stimulations such as this normally elicit a response of the opposite eye, as well.

The rapid reflex could occur at a rate of as little as 0.1 second. The evolutionary purpose of this reflex is to protect the eyes from foreign bodies and bright lights. It only applies to visible-light lasers. Class-2 lasers are limited to 1 mW continuous wave, or more if the emission time is less than 0.25 seconds or if the light is not spatially coherent. Intentional suppression of the blink reflex could lead to eye injury. Many laser pointers are class 2.

#### 4. *Class 2M*

A Class 2M laser is safe because of the blink reflex if not viewed through optical instruments. As with class 1M, this applies to laser beams with a large diameter or large divergence, for which the amount of light passing through the pupil cannot exceed the limits for class 2.

#### 5. *Class 3R*

A Class 3R laser is considered safe if handled carefully, with restricted beam viewing. With a class 3R laser, the MPE can be exceeded, but with a low risk of injury. Visible continuous lasers in Class 3R are limited to 5 mW. For other wavelengths and for pulsed lasers, other limits apply.

#### 6. *Class 3B*

A Class 3B laser is hazardous if the eye is exposed directly, but diffuse reflections such as from paper or other matted surfaces are not harmful. Continuous lasers in the wavelength range from 315 nm to far infrared are limited to 0.5 W. For pulsed lasers between 400 and 700 nm, the limit is 30 mJ. Other limits apply to other wavelengths and to ultra-short pulsed lasers. Protective eyewear is typically required where direct viewing of a class 3B laser beam may occur. Class-3B lasers must be equipped with a key switch and a safety interlock.

#### 7. *Class 4*

Class 4 lasers include all lasers with beam power greater than class 3B. By definition, a class-4 laser can burn the skin, in addition to potentially devastating and permanent eye damage as a result of direct or diffuse beam viewing. These lasers may ignite combustible materials, and thus may represent a fire risk. Class 4 lasers must be equipped with a key switch and a safety interlock. Most entertainment, industrial, scientific, military, and medical lasers are in this category.

### C. Responsibilities

1. A laser safety officer (LSO) must be appointed for each facility and must be registered with the radiation safety office. The Laser Safety Officer has the following responsibilities:
  - a. Must notify the radiation safety office when new lasers are purchased.
  - b. Must ensure the proper registration of all lasers and personnel operating the lasers;
  - c. Must ensure all personnel have appropriate training.
  - d. Must develop, maintain and update, as needed, all operating, alignment and emergency procedures for the lasers and the facility under their control;
  - e. Must act as the contact for the Radiation Safety Office;
  - f. Must enforce the safety standards defined in the USC Medical Laser Safety Policy;
  - g. Must supervise personnel with access to the facility to ensure against unauthorized entrance or accidental exposure to laser radiation;
  - h. Must ensure all new personnel have completed the medical surveillance requirements of the University's Occupational Health & Safety Office;
  - i. Must update all records upon changes in personnel or equipment by contacting the Radiation Safety Office;
  - j. Must report all incidents involving safety violations or injury to the Radiation Safety Office at 777-5269;
  - k. Must ensure personal protective equipment (eyewear, protective clothing) is properly maintained and worn.
2. The individual user must observe all safety precautions and operating procedures while using lasers and must inform the laser safety officer or the radiation safety officer of any apparent safety problems associated with the use of the laser. Each operator must be adequately trained.

3. The radiation safety officer has jurisdiction over all aspects of laser safety and has the authority to suspend any operation that constitutes a radiation health hazard to the health care personnel or patient.

#### D. Procedures

##### 1. *Registration*

- a. The health care facility (HCF) must register all lasers with the Radiation Safety Office prior to installation and use.
- b. The HCF must register all laser operators with the Radiation Safety Office prior to their working with lasers.

##### 2. *Safety Programs*

- a. The health care facility must establish a safety program to include:
  - 1). Delegation of authority and responsibility for the supervision of evaluation and control of laser hazards to the laser safety officer.
  - 2). Criteria and procedures for allowing health care personnel (HCP) to enter and/or work in laser area.
  - 3). Application of protective measure
  - 4). Reporting accidents
  - 5). Education of authorized personnel in the assessment of laser hazards.

##### 3. *Training*

- a. The laser safety training program will provide a thorough understanding of all procedures required for establishing and maintaining a safe environment during the use of the Health Care Laser System (HCLS).
- b. The laser safety program must be presented to LSO's, clinicians, support staff, peri-operative staff
- c. Training must be documented.

##### 4. *Inspections*

- a. All newly registered lasers and facilities will be inspected by staff of the Radiation Safety Office prior to operation.

- b. Inspections of lasers and laser facilities will be conducted at least yearly and will use the ANSI Z136.3, 2005 Standard for the Safe Use of Lasers in Health Care Facilities for inspection criteria.
- c. The Radiation Safety Office must be notified prior to any change in the laser or facility arrangement or of the purchase of new laser devices.
- d. An inspection by radiation safety personnel may be requested by any person in the facility who feels one is warranted.

#### 5. *Medical Surveillance*

- a. All individuals working with Class III and Class IV lasers will be required to have an ophthalmic exam provided by University Specialty Clinics, Department of Ophthalmology, prior to beginning work with the lasers, after a suspected abnormal exposure and at the termination of employment with the University.
- b. Records must be maintained indefinitely

#### E. References

- 1. American National Standards Institute, Inc., American National Standard for the Safe Use of Lasers, Z136.3-2005.

# Appendix

## Radiation Safety Forms

<b>Name of Radiation Safety Form</b>	<b>Form Number</b>
<b>Badge Request Form</b>	EHS-F-RAD-008
<b>Declaration of Pregnancy Form</b>	EHS-F-RAD-009
<b>New Authorization Application</b>	EHS-F-RAD-011
<b>Thyroid Monitoring</b>	EHS-F-RAD-019
<b>Quarterly Inventory</b>	EHS-F-RAD-023
<b>Transfer Form</b>	EHS-F-RAD-024
<b>Weekly Wipe Test Log</b>	EHS-F-RAD-026
<b>Waste Disposal</b>	EHS-F-RAD-027
<b>Baruch Marine Field Lab Use Log</b>	EHS-F-RAD-041
<b>X-ray and Laser Annual In-Lab Training Form</b>	EHS-F-RAD-042
<b>Radiation Materials Annual In-Lab Training Form</b>	EHS-F-RAD-044
<b>Equipment Clearance Form</b>	EHS-F-086

All of the above forms can be found at: <http://ehs.sc.edu/Radiation/Forms.htm>.



