

**Radiation Safety Program  
Attachment C**

**Regulations Concerning the Use of Radioisotopes  
and Other Sources of Ionizing Radiation**

*Effective August 31, 2000  
Revised November 11, 2010*

**I. GENERAL**

**A. Purpose**

These regulations are established to provide that the conditions of use of all sources of ionizing radiation shall meet recognized standards of safety and government regulatory requirements, that University users are informed concerning safety procedures, and that the University laboratories are adequately equipped for safety.

**B. Scope**

These regulations apply to the use of all radioisotopes or other sources of ionizing radiation at Duquesne University. They are designed to assure the safe use of radiation sources and compliance with applicable state and federal regulations.

**C. Definitions**

For the purpose of these regulations, the following definitions apply, in addition to those given applicable government regulations.

- (1). **Radiation Source** - Any material or device which emits or can emit ionizing radiation, including radioactive materials, x-ray machines, particle accelerators, and the like.
- (2). **Restricted Area** - Any area to which access is limited for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials
- (3). **Radiation Area** - An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
- (4). **High Radiation Area** - An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.
- (5). **User** - A member of the staff of the University actually responsible for the use of a particular source or sources of radiation.
- (6). **Rem** - A unit of radiation dose to a tissue that is equivalent to that produced by 1 Roentgen of exposure of soft tissue to x or gamma rays.
- (7). **Curie (Ci)** - A unit of radioactivity, specifying the amount of radioactive material having  $3.7 \times 10^{10}$  disintegrating atoms per second; 1 microCurie ( $\mu\text{Ci}$ )= $10^{-6}$  Ci.

**D. Responsibilities**

- (1). The *user* of a radiation source is responsible for the observance, by all persons handling the source, of the safety procedures required by these regulations and agreed to by the user, and any specific requirements specified on the user's *Statement of Agreement*, RSO2 or RSO2a.

- (2). The Radiation Safety Committee is responsible for reviewing all proposed uses of radiation sources, and for reviewing annually the activities and records of the Radiation Safety Office.
- (3). The Radiation Safety Officer is responsible for assuring that all users of radiation sources are informed of, and agree to follow, the Duquesne University *Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation* and provisions of 10CFR 19 and 20 and Pennsylvania Regulation Title 25, Chapters 219, 220, and 227, or other applicable license conditions or regulations; that all work areas in which the use of radiation sources is authorized are properly equipped and maintained; that the University facilities for the collection, storage, and transfer of radioactive waste materials are adequately safeguarded; and that survey and personnel monitoring, and record keeping requirements comply with applicable regulations. The Radiation Safety Officer serves as Chairman of the Radiation Safety Committee.
- (4). The Radiation Safety Officer is responsible for implementing all aspects of the radiation safety program; for ensuring that all users are following designated safe handling procedures; for maintaining current status on all licenses possessed by the University; for ensuring that all users are informed of their rights and responsibilities pertaining to the safe use of radiation and radioactive materials; for reviewing all applications for the use of radiation and radioactive materials and making recommendations concerning these applications to the user and to the Radiation Safety Committee; and for maintaining all records pertaining to the overall radiation protection program. The Radiation Safety Officer reports directly to the Director of Environmental Health and Safety.
- (5). The University Physician is responsible for making the physical examinations and arranging for blood counts, radioassays, whole body counts, etc. called for under these regulations or requested by the Radiation Safety Officer.
- (6). The University's Science Buyer is responsible for assuring that all radiation sources are procured by the University only upon the approval of the Radiation Safety Officer University *Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation*, paragraphs (a) through (d) of Section 2.

## II. PROCUREMENT, INVENTORY AND CONTROL OF SOURCES

### A. *Procurement Procedure*

- (1). Any user who wishes to procure a radiation source shall submit his/her initial request to the Radiation Safety Office on *Application for Authorization to Procure and Use Radiation or Radioactive Materials*, Form RSO1. All pertinent information on the operations or experiments to be carried out with radioactive material, qualification of users, radiological safety procedures, proposed methods of disposal for radioactive wastes, and facilities and equipment available to ensure safe operations, should be included on, or attached to this form. Consultation is available through the Radiation Safety Office.
- (2). The Radiation Safety Officer will evaluate the proposed operations and experiments, recommend revisions where appropriate, and approve with comments if required.
- (3). The Radiation Safety Officer will: (1) assist the user in ordering the appropriate radiation source(s) and require that the user complete a *Request for Approval to Purchase Radioactive Materials*, Form RSO3, (2) examine the need for the University license amendment application or other registration procedures, (3) designate the place of delivery of any radioactive materials for receipt, survey, inventory and deliver to the user's authorized work area. Therefore, all orders of radioactive material must be made through the Radiation Safety Officer.
- (4). The Radiation Safety Officer will be informed of the receipt of any ordered radiation source(s), will prepare and submit any registration forms required by government

agencies, and survey, inventory, deliver and monitor the initial installation and/or use of the radiation source(s).

- (5). Any periodic surveys, leak tests, or other safety supervision will be carried out and recorded by the Radiation Safety Officer in accordance with applicable government regulations, and by the user in accordance with the *Statement of Agreement*, RSO2 or RSO2a. The Radiation Safety Officer shall determine the need and frequency of any personnel monitoring, bioassay, or medical examinations for the user and his/her personnel, and shall arrange for, and keep records and reports of these services.
- (6). No radioactive wastes or unwanted radiation sources may be disposed of by the user, or transferred to the Radiation Safety Office.

### **III. MAXIMUM PERMISSABLE LIMITS OF EXPOSURE**

#### **A. *Restricted Areas***

- (1). Radiation Sources may be used only in authorized work areas as specified by the *Statement of Agreement*, RSO2 or RSO2a. These areas will be considered *Restricted Areas* as defined by 10CFR20.
- (2). For the purpose of the University *Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation*, the user shall ensure, unless authorized otherwise in writing by the Radiation Safety Officer, that no employee or registered student of the University shall receive more than 100 millirem (0.1 Rem) in any one week to any portion of his/her body. Further, no employee or student under age 18 shall receive while working in any restricted area more than 10 millirem (0.01 Rem) to any portion of his/her body in any one-week.
- (3). No employee or student over age 18 shall be exposed to airborne concentrations in excess of 10% of the values specified in Table I, Column 3, Appendix B of 10CFR20.

#### **B. *Unrestricted Areas***

Exposure rates or concentrations in unrestricted areas shall be controlled so that no person outside the authorized work areas can receive more than 100 millirem (0.1 Rem) to any portion of his/her body in one year.

### **IV. PERSONNEL MONITORING OR BIOASSAY ANALYSES**

The Radiation Safety Officer will arrange routine personnel monitoring and/or bioassay analyses whenever he/she deems that routine or accidental conditions of operation may possibly expose individuals to levels or concentrations exceeding 10% of any of the limits specified in 10CFR subpart C.

### **V. GENERAL SAFETY PROCEDURES AND EQUIPMENT**

#### **A. *Protective Clothing***

- (1). It shall be the responsibility of the user and/or his/her supervisor to see that appropriate protective clothing (laboratory coats, coveralls, etc.) is worn whenever clothing contamination is probable.
- (2). Laboratory coats or other protective garments worn in the laboratory are not to be worn elsewhere, especially in places where smoking, drinking, and eating are common practice. Any clothing contaminated with radioactivity shall be turned in to the Radiation Safety Office for disposal.

#### **B. *Gloves***

- (1). Suitable gloves shall be worn whenever hand contamination is probable, especially when there are breaks in the skin. Most gloves will not stop penetrating beta particles, hence

remote handling with tongs and sufficient glassware shielding is necessary in working with strong sources of energetic beta emitters. Surgical or waterproof gloves can eliminate deposition of active material on hands, and will help to prevent accidental ingestion of radioactive material.

- (2). Techniques shall be used when putting on and removing gloves to avoid the possibility of contaminating the inside surfaces.
- (3). Rubber gloves are not recommended. Although if used, Rubber gloves are to be washed and cleaned, if practical, before removal. All rubber gloves are to be stored and handled so as to prevent contamination of the inside surfaces and should be inspected for leaks before use.
- (4). Care shall be exercised when using organic solvents to avoid skin contact with radioactive material. (Solvents may make the skin more permeable)

### **C. *Equipment and Fixtures***

- (1). Entrances to all areas in which radiation sources or radioactive materials are employed must be suitably marked as required by 10CFR20 and 10CFR19 Pennsylvania Regulation Title 25, Chapters 219, 220, and 227, or other applicable license conditions or regulations. These entrances must be locked when the room is not attended or the radioactive material must be in a locked cabinet.
- (2). Hoods in which hazardous radioactive material is actively handled shall be marked radioactive, and shall be provided with nonporous, inert floors, such as glass, tile or metal; preferably a stainless steel tray should be used to catch possible spills. All work with such materials shall be done over such surfaces, or over special absorbent paper backed by nonporous material, to minimize danger from spills. All working surfaces shall be of such nature as to be easily decontaminated (nonporous) or readily replaceable (kraft paper).
- (3). People engaged in research using hazardous radioactive materials which may be or may become volatile or dispersible at any time shall conduct work only in a room equipped with adequate ventilation and under a hood with suction discharging at top of the building. It is important that there be no back draft between the radioactive hood and any other hoods on the system.
- (4). A minimum hood face velocity of 80 feet per minute should be provided. For procedures that may involve more than 1 microcurie of alpha emitting material, or more than 10 microcuries of beta gamma materials in process, the Radiation Safety Officer should be consulted regarding the possible need for closed systems and filtration of air exhaust. These facilities may sometimes be required.
- (5). Meticulous care shall be taken to see that the moving parts of open centrifuges are maintained free of contamination. Covers of centrifuges handling radioactive materials must be closed during operation.
- (6). Equipment and laboratory ware contaminated with radioactive material shall be stored in an operating hood for decay or in a closed container for disposal.

### **D. *Eating and Smoking Rules***

- (1). Smoking in a laboratory or operating room where radioactive materials are handled is forbidden.
- (2). Eating, storing or preparation of food, or application of cosmetics, in a laboratory or operating room where radioactive materials are handled is forbidden. The use of any food containers in handling or storing chemicals is forbidden. Food and radioactive materials should never be stored together.

**E. Contamination of Persons**

- (1). Hand and shoe contamination - General
  - a. All persons while working with radioactive materials wherein detrimental hand and shoe contamination is possible are to:
- (2). Keep fingernails short.
- (3). Wear protective gloves or shoe covers.
- (4). Refrain from smoking or eating.
- (5). Wash hands thoroughly before eating, smoking, or leaving work.
- (6). Check hands, clothing, and shoes for contamination before leaving the authorized work area.
- (7). Ingestion, inhalation, injection.
- (8). Pipetting by mouth is forbidden.
- (9). Glass blowing in laboratories containing radioactive materials is forbidden.
- (10). Any person who swallows, inhales, or receives an injection of a radioactive material or who may have been overexposed to radiation from any source is to report immediately to the Radiation Safety Officer (see *Emergency Action Procedure*, HP10.1).

**F. Changes of Operations with Radioactive Materials**

- (1). Experimental work involving radioactive materials shall not be allowed until suitable protective measures have been taken and agreed upon with the Radiation Safety Officer
- (2). In case of any permanent change of personnel or permanent vacating of quarters, it shall be the duty of the individual and his supervisor to notify the Radiation Safety Office and see that the area and equipment are properly surveyed, and if necessary, decontaminated before it is vacated.

**G. Storage and Handling**

- (1). Quantities of materials emitting more than 0.1 mrem/hr at 1 meter shall be stored in a central storage laboratory when not in regular use. Aliquots of the stored materials may be transferred to the working laboratories when appropriate. Hazardous quantities of material should be transferred to the working area in leak proof, rugged containers, and shall be securely covered and kept in such a place as to minimize any chance of spillage or exposure to personnel. Suitably shielded containers should be provided for radioactive materials.
- (2). All transfer of material between storage facilities and working areas must be done in such a manner as to avoid the possibility of spillage or breakage. Double containers should be used to eliminate breakage and contamination danger. The outside container should be leak proof and shatterproof.
- (3). Any work with materials susceptible to atmospheric distribution (that is, dusting, spillage, vaporizing, effervescence of solution, etc.) shall be done in an adequate hood, or in a glove box, as specified in these regulations.

**H. Disposal of Unwanted or Waste Radioactive Materials or Equipment**

- (1). All disposal of radioactive material must be arranged through the Radiation Safety Officer.
- (2). Waste material should be collected in leak proof, shatterproof containers, and sealed. The Radiation Safety Officer will collect these materials and their corresponding inventories from the *user*. The Radiation Safety Officer will dispose of the waste in accordance with requirements of 10CFR20.303 or by transfer to a licensed commercial waste disposal company.
- (3). The Radiation Safety Officer, and not the *users*, will perform all sink disposals of radioactive waste. Special sinks may be designated by the Radiation Safety Officer for

the disposal of small quantities of radioactive waste from glassware washings, etc. No more than 1 microcurie in any one day or 10 microcuries in any one-year may be disposed of by this method by the Radiation Safety Officer. Each microcurie released to sanitary drainage shall be diluted to at least 1000 liters of water, or according to requirements of 10CFR20.303

- (4). The *user* will keep records of disposal or transfer of all radioactive material, including the quantities in microcuries, the type of nuclides. These *user's* records must be available for inspections by regulatory agencies and the Radiation Safety Officer.
- (5). No radiation sources or contaminated items may be transferred to other laboratories or *users*.

**I. *Cleaning and Maintenance of Equipment in Contaminated Areas***

Only properly instructed personnel may perform cleaning and maintenance in restricted areas. The University janitorial staff may clean floors in restricted areas by ordinary procedures only after proper instruction and as arranged by the Radiation Safety Officer.

**J. *Transportation of Materials and Sources***

Radiation sources shall never be transferred from one *user* to another, according to the procedures of Section 2 of these regulations. Approval for the use of radioisotopes is given only to a specific *user* for specific applications within areas designated on *Application for Authorization to Procure and Use Radiation or Radioactive Materials*, Form RSO 1 and approval by the Radiation Safety Committee. The Radiation Safety Officer may approve transportation of sources for use by the same *user* for experiments or operations previously approved by the Radiation Safety Committee.

## **VI. SURVEY AND RECORD KEEPING REQUIREMENTS**

- A. All laboratories using ionizing radiation must be accessible for monitoring by the Radiation Safety Officer at all times. Approval for the use of sources of ionizing radiation may be withdrawn immediately by the Radiation Safety Officer whenever imminent danger to health or property is apparent. In the event that such approval is temporarily withdrawn, the Radiation Safety Committee will review any corrective measures before giving approval to resume operations with the radiation sources involved.
- B. The user may be required to perform regular surveys and keep records of such surveys as deemed necessary by the Radiation Safety Officer to meet requirements of regulatory agencies.
- C. The Radiation Safety Officer will provide advice on surveys and tests considered desirable to ensure good laboratory practice and minimize the unnecessary spread of small quantities of radioactive materials to unwanted areas.
- D. All sealed beta gamma-emitting sources shall be leak tested by smear or wipe surveys as frequently as 6 months and records shall be kept of such leak tests in accordance with regulatory requirements. All alpha-emitting sources shall be leak tested at least every 3 months. The Radiation Safety Officer will carry out and maintain records of these tests.
- E. Caution signs, symbols, labels will be maintained on all radiation sources, radioactive material containers, radiation areas, and high radiation areas as specified in the regulation 10CFR20 and Pennsylvania Regulation Title 25, Chapters 219, 220, and 227, or other applicable license conditions or regulations.

- F. In addition to the above general survey requirements, users of analytical x-ray machines, accelerators, and veterinary x-ray devices shall make surveys to ensure compliance with Pennsylvania Regulation Title 25, Chapters 219, 220, and 227, or other applicable license conditions or regulations.

## **VII. POSTING NOTICES, INSTRUCTION OF PERSONNEL**

### **A. *Notices Required by Regulations***

- (1). As required by 10CFR Parts 19.11, 20.303, 20.204 and 10CFR Parts 19.12, 19.13, and 20.206, and Pennsylvania Regulation Title 25, individuals working in restricted areas must be informed of regulations providing for their safety and copies of Form NRC 3 (Nuclear Regulatory Commission) and Form H 702.004P (Commonwealth of Pennsylvania) must be posted so that these individuals will observe them when entering or leaving their place of employment. The Radiation Safety Officer will provide these forms.
- (2). Copies of the applicable regulations and licenses shall also be posted or made available to individuals working in restricted areas, as required by 10CFR19.11(b).

### **B. *Instruction and Training of Personnel***

Before beginning any operations with radiation sources the user shall discuss with the Radiation Safety Officer the procedures to be followed and shall hold a briefing session on radiological safety procedures for all personnel working in the restricted area where the sources are located.

## **VIII. MEDICAL EXAMINATIONS AND CLINICAL TESTS**

- A. All persons for whom personnel monitoring and/or bioassay procedures are required in accordance with Section 4 of these regulations, shall report for an initial baseline blood test and physical examination as well as baseline in vivo radioactivity measurements or bioassays where deemed applicable by the Radiation Safety Officer. These tests and examinations must precede any work with the radiation sources, and will be arranged with the University physician or appropriate clinics through the Radiation Safety Officer.
- B. Copies of any reports of radiological test or radiobioassays must be filed with the Radiation Safety Office before work with radiation sources begins.

## **IX. NOTIFICATION OF ACCIDENTS OR LOSS INVOLVING RADIATION SOURCES**

### **A. Notification**

The Radiation Safety Officer must be notified immediately of any accident involving radiation sources or radioactive contamination, or any loss or theft of radioactive material so that appropriate emergency procedures can be invoked for protection of health and property and regulatory requirements for notifying regulatory agencies may be met.

### **B. Emergency Procedures**

In the event of an inadvertent release of radioactive material or suspected overexposure of personnel the *Emergency Action Procedure*, HP10.1 must be followed. This procedure must be posted in each restricted area where radiation sources are in use.

## **X. COMPLIANCE AND ENFORCEMENT**

- A. These University regulations constitute part of the license conditions under which Duquesne University is authorized to receive, possess, and utilize radioactive materials licensed by the Commonwealth of Pennsylvania Department of Environmental Protection, as well as other sources of ionizing radiation. Violations of these license conditions, applicable regulations, or good safety practice could result in a suspension of the University's Privilege to utilize radiation sources in essential teaching and research program.
- B. The University's regulations serve as a brief and simplified summary of the general procedures required to assist the *user* and the Radiation Safety Officer in ensuring compliance with safe practices and regulatory requirements. They do not relieve any person or the University from the responsibility of familiarization and compliance with the provisions of 10CFR 19 and 20, Pennsylvania Regulation Title 25, Chapters 219, 220, and 227, or other applicable license conditions or regulations.
- C. Any individual or *user* who willfully violates these regulations or shows an inability to comply with safe practices for any reason may have his/her authorization to possess and use radiation sources revoked by the Radiation Safety Committee.

## **XI. RADIATION SAFETY FORMS APPLICABLE TO THE USER**

### ***Application for Authorization to Procure and Use Radiation or Radioactive Materials, Form RSO1***

This form is to be completed prior to the procurement or use of any radioactive material at Duquesne University. The Radiation Safety Officer and two members of the Radiation Safety Committee must approve this application. All sections of this application must be complete prior to submittal to the Radiation Safety Officer. The approval process is not immediate and the applicant should submit the Form three weeks prior to his/her expectant start date.

### ***Statement of Agreement, Form RSO2***

This form is to be completed prior to the procurement or use of any radioactive material at Duquesne University. The user will receive this form upon completion of the required training session administered by the Radiation Safety Officer. This form will be given to all users of unsealed and sealed radioactive material.

### ***Statement of Agreement (PA), Form RSO2a***

This form is to be completed prior to the procurement or use of any radioactive material at Duquesne University. The user will receive this form upon completion of the required Radiation Safety Training session administered by the Radiation Safety Officer. This form will be given to all users of the X-ray diffraction units.

### ***Request for Approval to Purchase Radioactive Material, Form RSO3***

This form is to be completed prior to the procurement of any radioactive material at Duquesne University. The Radiation Safety Officer must approve the purchase of the requested material. All sections of this application must be complete prior to submittal to the Radiation Safety Officer. The approval process is not immediate and the applicant should submit the form one-week prior to his/her desired receipt date.

### ***Radiation-Producing Machine Use and Control, Form RSO4***

This form is to be completed prior to the procurement or use of radiation-producing equipment at Duquesne University. The Radiation Safety Officer must approve this application. All sections of this

application must be complete prior to submittal to the Radiation Safety Officer. The approval process is not immediate and the applicant should submit the Form three weeks prior to his/her expectant start date.

***Health Physics Radioactive Materials Inventory, Form RSO5***

The user will receive this form upon receipt of any radioactive material. The user must log his/her use of the material by listing the date, activity in Curies, purpose of use and initials. The form must be complete and accurate upon collection of any waste and/or remaining material by the Radiation Safety Officer.

***Personnel Radiation Dose Assignment, Form RSO6***

This form must be completed by the user and the Radiation Safety Officer in the event of accidental exposure to a radiation source or lost dosimeter. The two parties will review the information contained within the form and upon agreement shall signature the form.

***Analytical X-ray Training Outline and Certification, Form RSO8***

This form is to be completed prior to the procurement or use of an analytical x-ray diffraction unit at Duquesne University. The designated instructor will instruct the user on the safe use and operation of the analytical x-ray unit specified on the form. The instructor and user will acknowledge completion of training via their signatures.

***Certification of Radiation Safety Training, Form RSO9***

This form is to be completed prior to the procurement or use of any radioactive material or radiation-producing equipment at Duquesne University. The user will receive this form upon completion of the required Radiation Safety Training session administered by the Radiation Safety Officer.

***Emergency Action Procedure, Form HP10.1***

The Emergency Action Procedure must be posted in each restricted area where radiation sources are in use. This procedure is to be followed in the event of a release or spill of radioactive material.