

Duquesne University Radiation Safety Program

*Effective May 23, 2003
Revised November 11, 2010*

Prepared by: Radiation Safety Office

Contents

Introduction	3
Administration	4
Organization	
Radiation Safety Committee	
Radiation Safety Office	
Responsibilities	5
Radiation Safety Committee	
Radiation Safety Officer	
Principal Investigator	
Radionuclide Users	
Radiation-Producing Machine Users	
Ancillary Personnel	
Emergency Response Personnel	
Procurement Personnel	
Training	8
General Requirements	
Radioisotope Users	
Radiation-Producing Machine Users	
Ancillary Personnel	
Emergency Personnel	
Authorization to Use RAM or RPMs	10
RAM Use Requirements	
RPM Use Requirements	
Radionuclide Procurement and Control	11
Purchasing	
Receiving	
Maintaining an Inventory	
Transferring Radioactive Material to Duquesne University	
Disposing of Radioactive Material	
Surveillance	14
Surveys	14
Radioactive Material	
Radiation-Producing Machines	
Personal Monitoring and Bioassays	15
Personal Monitoring	
Bioassays	
Security	15

Radioactive Material Radiation-Producing Machines	
Duquesne University Radiation Laboratory Safety Rules	16
Emergencies Fire Injury Spill Personnel Contamination	16
Radioactive Waste Management and Disposal	17
Radioactive Material Radiation-Producing Machines	

Attachment A: Health Physics (HP) Procedures

Attachment B: Radiation Safety Office (RSO) Forms

Attachment C: University Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation

Record of Review/Changes

Date of Review	Changes	Signature
12/3/2003	RSO reports to Director of Environmental Health and Safety instead of Associate Academic Vice President for Research. Updated RSC members.	Megan G. Marks
7/12/2003	Format changes. Updated RSC members.	Vanessa Fowler
7/25/2007	Updated RSC members. Added RSO 10, 11 & 12. Changes to attachment C per EHS Audit findings.	Vanessa Fowler
2/20/09	Updated entire Radiation Safety Program	Paula Sweitzer
11/12/10	Updated RSC members.	Paula Sweitzer

I. INTRODUCTION

Ionizing radiation emitted from Radioactive Material (RAM) and Radiation-Producing Machines (RPMs) are used at Duquesne University for teaching and research purposes. The radiation therefrom will be used for the following purposes:

1. Theoretical analysis, exploration and experimentation.
2. Extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and/or demonstration purposes, including but not limited to, the experimental production and testing of models, devices, equipment and processes.
3. Demonstration, teaching, and instruction in courses offered by the University to graduate and undergraduate students.
4. Radiation and radioactive materials covered by this license will not be used for internal administration or external application to human beings.

The above uses may present risks to the user, other individuals, and the environment. Therefore, the Radiation Safety (RS) Program at Duquesne University has two major objectives:

1. Ensuring personnel are exposed to doses of radiation As Low As Reasonably Achievable (ALARA).
2. Achievement of full compliance with state and federal laws and regulations governing the use of Radioactive Material (RAM) and Radiation Producing Machines (RPMs).

The Commonwealth of Pennsylvania Department of Environmental Protection (PADEP) license the use of RAM and RPMs to Duquesne University:

1. Radioactive Material license and Radiation-Producing Machine registration:
 - a. Type B specific license of broad scope obtained from the PADEP Bureau of Radiation Protection.
 - b. Authorizes the use of any Naturally occurring or Accelerator-produced Material (NAM) specified in Appendix D of 25 PA Code Section 217.72
 - c. Authorizes the use of any Radiation Producing Machines (RPMs).
 - d. Authorizes the use of the following special nuclear material.
2. Limited Materials License:
 - a. Authorizes use of the following byproduct, source, and/or special nuclear material

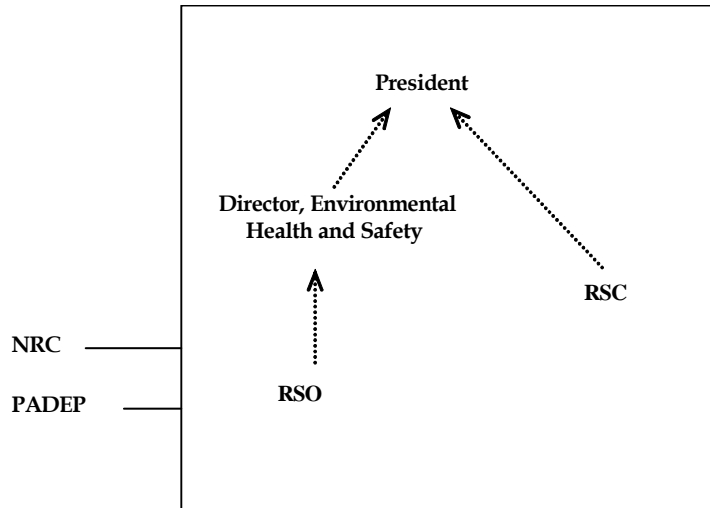
Byproduct, source, and/or special nuclear material	Maximum amount that license may possess at any one time under the license
Hydrogen 3	50 millicuries
Carbon 14	25 millicuries
Phosphorus 32	25 millicuries
Sulfur 35	10 millicuries
Iodine 125	10 millicuries

All personnel involved in the radiation safety program are invited to recommend improvements. The continued success of the program will be dependent not only upon keeping exposures ALARA and complying with the rules and regulations, but also on the program's ability to adapt to changing research methods.

Any questions or comments regarding this plan please contact the Radiation Safety Officer at (412) 396-4763 or by email at sweitzerp@duq.edu.

II. ADMINISTRATION

A. Organization



This chart shows the organization of those responsible for directing the radiation safety program at Duquesne University. The radiation safety program is governed by external regulatory requirements (i.e. PADEP license) as well as by Duquesne University policy. While the radiation safety program must meet the conditions specified by the license, Duquesne University has the responsibility for designing, implementing, and maintaining the program. A series of Radiation Safety (RS) Office Forms and Health Physics (HP) Procedures are currently being used to aid in meeting all license and regulatory commitments. The RS Office Forms and HP Procedures are attached to this Radiation Safety Program.

B. Radiation Safety Committee

The Duquesne University Radiation Safety Committee (RSC) is established to oversee the use of byproduct material. The Radiation Safety Officer (RSO) appoints its members of which report directly to the (RSO) and has access to the president of Duquesne University.

The RSC, by recommending and reviewing radiation safety procedures and implementation thereof, at least annually, ensures that Duquesne University complies with the PADEP regulations. The RSC is comprised of User Representatives and Additional Representatives. User Representatives are members of academic units in which RAM or RPMs are used. Additional Representatives are members of other academic or administrative units with a view to ensuring effective organizational communications necessary to support the radiation safety program.

Representative Name	Department
Carl Anderson	Pharmacy
Partha Basu	Chemistry
George Bender	EHS

Dan Bodnar	Instrumentation
Rick Clemente	Physical Therapy
Rod Dobish	Facilities Management
Vanessa Fowler	EHS
Dave Johnson	Pharmacy
Lenore Resick	Nursing
Alan Seadler	Office of Research
Dave Seybert	Dean – BSNE
Monica Sorescu	Physics
Omar Steward	Chemistry
John Stolz	Biology
Chris Surratt	Pharmacy
Paula Sweitzer	EHS

C. Radiation Safety Office

The Radiation Safety Office consists of only the Radiation Safety Officer (RSO). The RSO reports to the Director of Environmental Health and Safety. The RSO implements the university policies and procedures. The RSO conducts day-to-day activities associated with the radiation safety program at Duquesne University.

III. RESPONSIBILITIES

A. Radiation Safety Committee

The RSC at Duquesne University meets quarterly to discuss Radiological Problems.

B. Radiation Safety Officer

The RSO is responsible for the daily coordination and management of the radiation safety program. The RSO has authority to immediately terminate a project that is found to be a threat to health, safety or property. The following are the responsibilities and duties of the RSO.

1. Directing the routine monitoring or special surveys of all areas where radioactive materials and RPMs are used.
2. Performing periodic reviews and surveys of work areas to ensure compliance with license conditions.
3. Directing the surveys required during delivery and opening of radioactive material received at Duquesne University.
4. Supervising the shipment, including surveys, of radioactive material leaving Duquesne University.
5. Ensuring an inventory of all radionuclides is maintained and only the quantities and form authorized by the PADEP material license are used at Duquesne University.
6. Supervising and coordinating the system for disposal of radioactive waste.
7. Ensuring all radioactive material not in current use, including waste is stored properly.
8. Supervising the distribution and processing of personnel monitoring devices, the collection, processing and evaluation of bioassays and the maintenance of personnel exposure and bioassay records.

9. Ensuring radiation detection instrumentation used for quantitative radiation protection surveys are calibrated by a licensed vendor or calibrated by procedures approved by the PADEP.
10. Conducting training programs for personnel working with radioactive material and radiation producing machines or frequenting restricted areas.
11. Supervising or directing activities in response to an unplanned occurrence involving radioactive materials (spill) or RPM.
12. Ensuring records of surveys, radiation monitoring, and disposal are maintained.
13. Providing consulting services on all aspects of radiation safety to personnel at all levels of responsibility.
14. Tracking RPMs and their maintenance.

C. Principal Investigator

Principal Investigators (PIs) must ensure that the following are accomplished, but may delegate the implementation.

1. Submit Radionuclide Authorization (RA) applications to the RS Office for approval prior to the use of radionuclides.
2. Ensure that laboratory workers have received Duquesne University RS Training and proper dosimetry before working with RAM or RPMs.
3. Implement corrective actions to prevent recurrence of radiological program operating errors.
4. Train research staff and students in lab specific protocols.
5. Ensure that laboratory work is performed in accordance with Duquesne University RS Program requirements.
6. Immediately notify the RSO of significant radiological accidents (such as spills, personnel contamination or injuries from a RPM).
7. Maintain an accurate and thorough radioactive material inventory for the laboratory on the Health Physics Radioactive Materials Inventory form distributed by the RS Office.
8. Notify the RSO of all transfers of radioactive material or radiation generating devices to or from another laboratory or licensee.
9. Present the RSO with modifications in the methods used for handling radioactive material for authorization.
10. PIs for RPMs shall ensure that the RS Office is informed of all purchases, disposals, transfers, or movements of RPMs.
11. Notify the RSO within 30 days of any new user(s) of RAM or RPMs.
12. Notify the RSO within 30 days of the intended procurement and use of any isotope not specified in the license.

D. Radionuclide Users

Radionuclide users have the responsibility to know and abide by the following rules.

1. Keep dosimeters in the designated storage area when not in use.
2. Know the specifications listed in Duquesne University Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation.

3. Record radionuclide use in the Health Physics Radioactive Materials Inventory form distributed by the RS Office.
4. Estimate the activity of radioactive waste, package it in a container designated by the RS office, and label it appropriately.
5. Notify the RSO of spills, loss of radioactive material(s), or personnel contamination.
6. Prevent unauthorized personnel from entering the laboratory.
7. Ensure that doors are locked or material is under constant surveillance if the laboratory cannot be secured.
8. Perform periodic contamination checks to ensure that no radioactivity is spread to the clean areas of a laboratory.
9. Ensure that radioactive material is **only** removed from its respective laboratories by the staff of the RS Office.
10. Perform procedures with the intent of minimizing exposure to radiation and radioactivity and generation of contaminated waste materials.
11. Follow the general safety instructions while working with radioactive materials. (See Duquesne University's *Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation*, Section V: General Safety Procedures and Equipment)

E. Radiation-Producing Machine (RPM) Users

RPM users have the responsibility to know and abide by the following rules.

1. Do not remove or handle the area dosimeter badges.
2. Keep hands, eyes, and body from the direct beam path.
3. Immediately report actual or suspected overexposures to the RSO.
4. Conduct qualitative radiation surveys at the start and end of a use period for each device.
5. Prevent unauthorized or untrained personnel from working with a RPM.
6. Inform the Radiation Safety Officer of the acquisition, disposal, transfer, or alteration of all RPMs.
7. Operate RPMs in accordance with established written procedures.
8. PIs for RPMs shall ensure that the RS Office is informed of all maintenance to be performed on RPMs.

F. Ancillary Personnel

Ancillary Personnel have the responsibility to know and abide by the following rules.

1. Determine the laboratory safety conditions with the Radiation Safety Office staff before initial entry.
2. Check with the laboratory supervisor or the principal investigator for entry authorization.
3. Ensure that coworkers have received training from the Radiation Safety Office before entering the laboratory.
4. Obtain authorization from the RS Office prior to performing any maintenance within a RAM laboratory.

G. Emergency Response Personnel

Emergency Response Personnel have the responsibility to know and abide by the following rules.

1. Determine the general nature of the hazard.
2. Ensure that the actions taken are appropriate to the level of hazard.
3. Inform the RSO of the response to any emergencies involving RAM or RPMs.
4. Maintain exposures ALARA during the response action to the emergency.

H. Procurement Personnel

Procurement Personnel have the responsibility to know and abide by the following rules:

1. Shipping and Receiving
 - a. Shall immediately contact the Radiation Safety Office when radioactive material arrives.
 - b. Shall place radioactive material packages in the secured refrigerator located in receiving.
2. Purchasing shall ensure, by written procedure, orders for RAM, RPMs or instruments containing RAM are approved by the RSO.

NOTE: ONLY THE RSO OR HIS/HER DESIGNATE CAN ORDER RADIONUCLIDES AND SHALL APPROVE ALL TRANSACTIONS FOR RPMs AND EQUIPMENT OR INSTRUMENTS CONTAINING RAM

IV. TRAINING

A. General Requirements

Training is mandatory (required by 10 CFR 19.12 and Title 25 of the Pennsylvania Code Chapter 219) for all personnel who work with licensed quantities of RAM, RPMs or personnel who frequent restricted areas and for PI's. Training for radionuclide users, operators of RPMs, ancillary personnel and PIs is conducted initially with an annual refresher.

B. Radioisotope Users

Faculty, staff, laboratory personnel or students who work with radioactive material (RAM) are considered Radioactive Material "Users". "User" training is provided before an individual can enter a restricted area and work with the radioactive material. "Users" are trained through Blackboard prior to receiving authorization for work in areas where radioactive materials are handled. In addition, those personnel, working under a Principle Investigator also receive protocol specific training from the authorized user. Training for "Users" and their PI's consists of instruction in the following subject matter.

1. Principles of radiation and radioactivity
 - a. radioactive decay
 - b. half-life
 - c. natural background radiation
2. Applicable state and Duquesne University radiation safety regulations
 - a. dose limits

- b. area postings
- 3. Hazards associated with the use of radioactive material
 - a. biological effects
 - b. acute vs. chronic effects
 - c. health risks
- 4. Modes of Exposure
- 5. Procedure for reporting an actual or suspected exposure
- 6. Contamination and radiation controls
 - a. surveys
 - b. exposure control, penetrability of different types of radiation, half-value layers
- 7. Radioactive Material/Waste/Controls
- 8. Personnel monitoring devices
 - a. dose monitoring methods
 - b. thermoluminescence detectors (TLDs)
- 9. General RAM laboratory precautions and good practices
- 10. "User" rights and responsibilities
- 11. RAM Use Authorization and Procurement
- 12. RAM Use and Disposal Inventory Records
- 13. RAM spill procedures
- 14. Waste disposal and segregation
- 15. Emergency actions
- 16. Prenatal Exposure Policy

C. Radiation-Producing Machine Operators

All RPM operators and PIs of RPM operators receive training in the following subject matter.

- 1. Principles of radiation
- 2. Applicable state and Duquesne University radiation safety regulations
 - a. dose limits
 - b. area postings
 - c. warning and safety devices incorporated into the equipment
 - d. extra precautions necessary due to absent or bypassed safety devices
- 3. Hazards associated with the use of RPMs
 - a. biological effects
 - b. acute vs. chronic
 - c. health risks
- 4. Modes of Exposure
- 5. Acute radiation exposure and symptoms associated with an acute localized radiation exposure
- 6. Procedures for reporting an actual or suspected exposure
- 7. Protective action and radiation controls
 - a. Use of survey and personnel monitoring equipment
 - b. exposure control, penetrability of different types of radiation, half-value layers
- 8. Personnel monitoring devices
 - a. dose monitoring methods

- b. thermoluminescence detectors (TLDs)
- 9. General RPM laboratory precautions and good practices
- 10. Procedures for performing maintenance on RPMs
 - a. report all maintenance performed on RPMs to RSO
 - b. prior to reactivating use of RPM receive approval from RSO
- 11. "User" rights and responsibilities
- 12. Prenatal Exposure Policy

D. Ancillary Personnel

Personnel who frequent restricted areas but do not work with radioactive material and do not receive exposure in excess of 100 mrem per year are considered "Ancillary Personnel". Ancillary Personnel receive training in the following subject matter.

- 1. Types of radiological posting, labels, and tags
- 2. Potential radioactive material hazards
- 3. "User" rights and responsibilities
- 4. Emergency actions

E. Emergency Personnel

Emergency personnel receive training in the following subject matter.

- 1. Radioactive material hazards
- 2. Exposure modes
- 3. Contamination and radiation control
- 4. Emergency actions

F. Exemptions

None

V. AUTHORIZATION TO USE RAM OR RPMs

A. RAM Use Requirements

Application for the use of RAM is described in Duquesne University's *Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation*, Section II: Procurement, Inventory, and Control of Sources. A brief outline of the HP1.1, *Procurement Procedure to Handle Radioisotope Shipment*, follows:

- 1. Under no circumstances may radioactive material be ordered, delivered, or transferred to Duquesne University without proper authorization.
- 2. The Principle investigator must complete the form RSO 1, *Application for Authorization to Procure and Use Radiation or Radioactive Materials* before any work using RAM begins.
- 3. The application, along with its instructions, is available in the RS Office, Room B8 Mellon Hall and on our website at www.ehs.duq.edu.

4. All pertinent information of 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 application.
5. The completed and signed application should be sent to the RS Office (Room B8 Mellon Hall) for review and approval by the RSO.
6. The RSO will evaluate the proposed operations and experiments, recommend revisions where appropriate.
7. The application will then be circulated to the RSC for approval and signature.
8. The RSO evaluates the request and grants approval provided the following conditions are met.
 - a. The radioactive material will be used in accordance with Duquesne University's Radioactive Material License requirements and Radiation Safety Procedures as approved by the RSC.
 - b. The facilities to be used are adequate.
 - c. The personnel using the material have the necessary training.
 - d. Bioassays are performed when needed.
 - e. Personnel monitoring devices are used when needed.
 - f. The proper survey frequency and types of survey monitoring instruments are used.
 - g. Protocols used will ensure minimization of personal exposures and generation of contaminated waste materials.
9. The applicant will be informed of the Committee's decision by a returned copy of the application.
10. The RSO will obtain a signed copy of the form RSO 2, *Statement of Agreement* from the prospective user prior to the commencement of the project outlined in the application.

B. RPM Use Requirements

1. Approval to use an electron microscope is not required - only notification of acquisition to RSO.
2. The Principal Investigator must have (or do) the following prior to the use of a RPM:
 - a. RSO approval for use of device.
 - b. Written operating procedures (the Vendor's Operating Manual or instructions written by the lab can be used).
 - c. Engineering controls to prevent entry of a portion or all of the body into the primary beam.
 - d. Written bypass procedures (for beam alignment) to ensure personnel safety while interlocks are disabled.
 - e. Radiation detection instrumentation to perform surveys during use.

VI. RADIONUCLIDE PROCUREMENT AND CONTROL

To carefully monitor all radioactive material, Duquesne University must follow strict guidelines concerning the receipt, distribution, control, and inventory of radioactive material.

A. Purchasing

1. Radioactive Material

The purchasing of RAM is accomplished in accordance with the current revision of Duquesne University's *Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation*, Section II: Procurement, Inventory, and Control of Sources. The following is a brief outline of that procedure:

- a. The user must complete the form RSO 3, *Request for Approval to Purchase Radioactive Material*. This form details purchasing information and the nature and amount of radioactive materials to be purchased. This form can be obtained from the Radiation Safety Office in Room B8 Mellon Hall or our website at www.duq.edu/ehs
- b. The RSO will evaluate the form. The requested amount must be within the authorization form limits. If approval is granted, the RSO completes the appropriate section of the form, noting any restrictions on quantity or receipt location.
- c. The RSO contacts the Purchasing Department and designates the delivery date for the approved RAM to arrive on the RSO 3. The Purchasing Department retains a copy of the RSO 3 for their records. The original RSO 3 is retained in the RS Office.
- d. The RSO completes the form after the radionuclide is received and assigns an inventory number to the RAM.

2. Radiation-Producing Machines

Researchers shall inform the RSO when RPMs are being purchased. This is to ensure registration in accordance with Title 25 of the Pennsylvania Code Chapter 216.

B. Receiving

1. Radioactive Materials

- a. Per 10 CFR 20. 1906, all RAM shipments at Duquesne University shall be opened and inspected within 3 hours of receipt during normal working hours and within 18 hours of receipt if received after normal working hours.
- b. The requested RAM arrives at the Receiving Department (B12) of Mellon Hall.
- c. The Receiving Department personnel immediately notify the Radiation Safety Office of the arrival of the RAM.
- d. The RSO, or authorized designee, performs contamination and radiation surveys of the exterior surface of the package.
 - i. The outside of the package is surveyed using a survey meter.
 - ii. The dose (mr/hr) rate on the surface and at 3 feet from the package surface is recorded on the RAM inventory form.
 - iii. Levels in excess of 200 mr/hr at the surface or levels in excess of 10 mr/hr at 3 feet from the package surface require immediate notification to the RSO.
- e. The RSO or authorized designee will open the package(s) in the designated work space in B12 and perform a survey of the package(s) interior and radionuclide container.
- f. The quantity and isotopic content of the package are verified with inventory log or RAM inventory sheet.

- g. Inspection and opening of the RAM orders are completed on the RAM refrigerator.
- h. Wipe tests are performed on the outer and inner package of the RAM order.
- i. Smears are counted using a liquid scintillation counter.
 - i. A Blank is used to determine background.
 - ii. Activity is reported in dpm/cm².
 - iii. Activity < 2200 dpm/cm² indicates the package is free of contamination.
- j. If the radioactive material and surveys are within the accepted limits specified by 10 CFR 20.1906, the package(s) are labeled with an inventory number(s) and delivered to the Authorized User.

2. Radiation-Producing Machines

Once RPMs have been received by the PI, setup and RSO 4, *Radiation-Producing Machine Use and Control*, has been received by the RSO, the RSO will then perform the initial start up survey. After a successful start up survey the RPM is available for research by the PI and his/her staff and/or students.

C. Maintaining an Inventory

1. The RSO 5, *Health Physics Radioactive Materials Inventory Form*, is provided to each laboratory for each shipment and must be maintained by the laboratory for recording use, transfer and disposal of RAM.
2. Instruction for maintaining a proper RAM inventory is provided to each individual during the "User" training session.
3. Laboratory personnel are responsible for the upkeep on the RAM Inventory Form(s).
4. When the material is completely used and the inventory balance for that shipment is zero, the RS Office collects all waste material and the respective inventory form.

D. Transferring Radioactive Material to Duquesne University

1. This includes free material from other institutions or vendors.
2. To transfer radioactive material from another licensee to Duquesne University, you must have an approved form RSO 1, *Application for Authorization to Procure and Use Radiation or Radioactive Materials*.
3. The RSO will determine if Duquesne University's license allows the possession and use of the requested amount and type of RAM.
4. Laboratories are requested to contact the Radiation Safety Office to arrange the details of the transfer.

E. Disposing of Radioactive Material

The disposing of RAM at Duquesne University is in accordance with the Duquesne University's *Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation*, Section V, H: Disposal of Unwanted or Waste Radioactive Materials or Equipment.

1. Only personnel from the Radiation Safety Office or designated by the RSO are authorized to remove and dispose of RAM.

2. High activity materials of short half-life shall never be discarded down the drain immediately, but shall be retained in suitable storage facilities until the radioactivity has decreased by at least 10 half-lives.
3. Waste material with half-lives longer than 120 days should be collected in leak proof, shatterproof containers, sealed and returned to Radiation Safety Office, where it will be disposed of in accordance with requirements of 10CFR20.303.
4. No radiation sources or contaminated items may be transferred to other laboratories or users.
5. The users should ensure that short half-life materials (less than 120 days) are separated from long half-life materials (more than 120 days). For example, separate ^{32}P from ^3H or ^{14}C and maintain ^{35}S separate from both ^3H , ^{14}C and ^{32}P .
6. Radioactive material with half-lives longer than 120 days are packaged and shipped under the supervision of the RSO to a licensed radioactive waste disposal facility, if available.
7. Glass, incinerable, liquid, and liquid scintillation vial waste shall be separated from each other.
8. Chemical hazardous waste, to the maximum extent possible, should not be mixed with radioactive materials.

VII. SURVEILLANCE

The RSO will, at an interval not to exceed 12 months, review the radiation protection program content and implementation. Surveillance will be conducted in accordance with HP2.1, *Annual Assessment Procedure for Radiation Safety Program*.

In addition, the RSO at an interval not to exceed 12 months, conduct a review of the Radiation Protection Program with the Director of Environmental Health and Safety.

VIII. SURVEYS

A. Radioactive Material

1. Surveys are performed in accordance with Duquesne University's *Regulations Concerning the Use of Radioisotopes and Other Sources of Ionizing Radiation*, Section VI: Survey and Record Keeping Requirements. Surveys are taken to ensure area exposure rates are maintained ALARA, to prevent the spread of contamination, ensure that material is being used in accordance with the laboratories' Radionuclide Authorization and to ascertain if any RAM is missing.
2. Sealed sources are leak tested or inventoried as required by the appropriate license and regulating body (either the NRC or PADEP). Leak tests are performed depending on the activity of the sealed source. Leak tests will be performed in accordance with HP3.1, *Leak Testing of Sealed Sources*.
 - a. All sealed beta gamma-emitting sources shall be leak tested by smear or wipe surveys as frequently as 6 months. Records shall be kept of such leak tests in accordance with regulatory requirements.
 - b. All alpha-emitting sources shall be leak tested at least every 3 months. Records shall be kept of such leak tests in accordance with regulatory requirements.
3. If leak tests indicate removable contamination levels in excess of 0.005 microcuries then the source(s) will be (are) removed from service and prepared for disposal.

B. Radiation-Producing Machines

Surveys of RPMs are performed in accordance with HP4.1, *Radiation-Producing Machine Use and Control*, to ensure that area exposure rates are maintained ALARA.

IX. PERSONAL MONITORING AND BIOASSAYS

A. Personal Monitoring

1. Thermoluminescent dosimeters (TLD) badges will only be posted in areas that house any x-ray diffraction units at Duquesne University. Provide monitoring in accordance with HP5.1, *Training, Dosimetry Issue and Exposure Records*.
2. No personal monitoring will be required for work with hydrogen-3 or alpha only emitting radionuclides.
3. A written justification by the RSO is required for all other situations where personal monitoring is not required.
4. Those being monitored, will be done so on a quarterly basis. The personal monitoring device, thermoluminescent dosimeter, will be processed with an NVLAP accredited facility. The badge processing frequency is once every three months.

B. Bioassays

1. Bioassays will be conducted for personnel using quantities of RAM where the potential intake will exceed 0.1 ALI for the radionuclide or combination of radionuclides used. The exception to this will be where radionuclide action levels are specified in Regulatory Guides such as for radioiodine in Regulatory Guide 8.20, "Applications of Bioassay for I-125 and I-131". In these cases the action levels specified in the regulatory guide shall be used. Bioassay frequency and collection and analysis methods are specified in HP5.2, *Collecting and Analyzing Bioassay Samples*.
2. Research involving sealed sources or RPMs does not require bioassay monitoring.

X. SECURITY

A. Radioactive Material

Duquesne University's licenses require that RAM be controlled in a manner to prevent unauthorized access or removal. A positive control of RAM is maintained at Duquesne University. Each RAM laboratory is kept locked or if the RAM laboratory is unlocked, a trained "user" attends the RAM to prevent unauthorized access or removal.

B. Radiation-Producing Machines

Research laboratories that have RPMs shall be kept locked to control access. Only trained operators are authorized to use RPMs. Because of the safety devices and warnings associated with RPMs, untrained faculty, staff and students may or may not be excluded from labs with RPMs. Untrained faculty, staff and students shall not operate nor attempt to operate RPMs.

XI. DUQUESNE UNIVERSITY RADIATION LABORATORY SAFETY RULES

- A. Wear protective clothing (i.e. laboratory coat, rubber or disposable plastic gloves, protective eyewear, etc.) when working with radioactive material.
- B. Separate long half-life waste material (longer than 120 days) from short half-life waste material. Then separate all short half-life waste materials (^{32}P , ^{125}I , and ^{35}S).
- C. Separate waste materials into the following categories: glass, incinerable (paper, plastic), liquid, and liquid scintillation vials.
- D. Do not mix hazardous chemicals with radioactive materials.
- E. Frisk when leaving laboratory.
- F. Conduct radiological work activities over surfaces lined with absorbent material.
- G. When moving bottles and flasks filled with radioactive liquid, stopper the bottles or flasks or otherwise contain the liquid material.
- H. Handle concentrated solutions of radionuclides or sealed sources with long handled tools.
- I. Do not eat, drink, chew tobacco, or smoke in the laboratory.
- J. Do not store food or drink in a radioactive material storage place (i.e. refrigerator).
- K. Do not pipette or perform any similar operation on radioactive materials by mouth suction.
- L. Do not work with unsealed radioactive material if you have an open wound or break in the skin that could be exposed to the material.
- M. Maintain positive control (i.e. radioactive material must be kept locked up or is under the direct control of the authorized user) of radioactive material at all times.
- N. Read your laboratory form RSO 1, *Application for Authorization to Procure and Use Radiation or Radioactive Materials* and follow the safety guidelines listed pertaining to the protocol and the form RSO 1

XII. EMERGENCIES

The safety guidelines pertaining to emergencies may be found in form HP10.1, *Emergency Action Procedure*. A detailed outline of the emergency procedure follows:

A. Fire

1. Warn others in the affected space and vacate the area.
2. Pull the fire alarm and call Campus Police at x2677. Give the location and type of fire, your name and telephone extension, and the presence of radioactive materials or hazardous chemicals in the affected area.
3. Leave the building and proceed to designated gathering point. The gathering point for Mellon Hall is Academic Walk.
4. Call the Radiation Safety Officer at x4763 and explain the nature of the emergency.

B. Injury

1. If it is a minor injury, e.g. small cut, provide first aid.
2. If it is a major injury, e.g. broken leg, call Campus Police x2677. Give the location and name of the injured individual, the nature of the injury, your name and telephone extension, and inform whether radioactive materials are involved.
3. Call the Radiation Safety Office at x4763 and explain the nature of the emergency.

C. Spill

1. Stop the source of the radioactive material spill.
2. Warn others in the area of the spill.
3. Isolate the area to prevent the entry of other personnel.
4. Minimize exposure by covering the spill and maintaining distance from the spill area.
5. Secure windows, fume hoods, doors, and other ventilation sources.
6. Call the Radiation Safety Officer at x4763 or call Campus Police at x2677 if there is no answer or if it is after normal working hours.
7. Assemble at a location as close to the affected area as is practical. If further exposure is minimal, then remain in the lab.

D. Personnel Contamination

1. Warn others in the area of contamination.
2. Call the Radiation Safety Officer at x4763 or call Campus Police at x2677 if there is no answer or if it is after normal working hours. The RSO or designate will respond, in person, to all personnel contamination situations.
3. If the contamination is minor (e.g., hands or forearms) wash the radioactive material off in a laboratory sink with warm water and soap. Re-frisk the affected area, if clean wait for the RSO or designate to frisk the affected area for release.
4. If the area is still contaminated, wash the affected area again and re-frisk. By this time the RSO or designate should be available for further instructions.

NOTE: Only the RSO or designate can make the determination for releasing the affected individual.

5. If the contamination is major and the RSO is not immediately available perform the following:
 - a. Remove all affected clothing. Have a lab-mate get you a “clean” lab coat if necessary.
 - b. Frisk your hands and feet (shoes, if they weren’t affected) and move to a nearby unaffected area.
 - c. Perform a frisk of the area of the body where the spill occurred to ensure that no skin contamination occurred.
 - d. If there is skin contamination, proceed to the showers of Mellon Hall dictated by the RSO or designate. Wash the affected area with warm soap and water, dry off the affected area and frisk the affected area.
 - i. If the area is no longer contaminated wait for the RSO or designate to frisk area for release.
 - ii. If the area is still contaminated, RSO or designate will give further instructions.

The RSO will make every effort to perform the above listed actions in a professional manner with the utmost concern for the affected individual. All efforts will be made to have a chaperone in case the affected individual is of the opposite sex of the Radiation Safety Office personnel providing assistance.

XIII. RADIOACTIVE WASTE MANAGEMENT AND DISPOSAL

A. Radioactive Material

When the sources are no longer useful the source is removed from the laboratory and taken to B12E Mellon Hall. There the material is logged in as waste and held for eventual transfer to a waste disposal company that is licensed to receive such waste in accordance with the appropriate Duquesne University

license and regulating body (either the NRC or PADEP). RAM waste is handle in accordance with HP6.1, *Radioactive Waste Removal, Packaging, Storage and Removal*.

B. Radiation-Producing Machines

Radiation-Producing Machines will be disposed of in accordance with HP4.1, *Radiation-Producing Machine Use and Control*.

Health Physics (HP) Procedures

Procedure Description	Procedure Number	Procedure Title
Procurement Procedures	HP1.1	<i>Procurement Procedure to Handle Radioisotope Shipment</i>
	HP1.2	<i>Procedure for Ordering RAM</i>
Radiation Safety Program	HP2.1	<i>Annual Assessment Procedure for Radiation Safety Program</i>
Sealed Source Procedures	HP3.1	<i>Leak Testing of Sealed Sources</i>
Radiation-Producing Machine Procedures	HP4.1	<i>Radiation-Producing Machine Use and Control</i>
Procedures for Exposure Control and Personnel	HP5.1	<i>Training, Dosimetry Issue, and Exposure Records</i>
	HP5.2	<i>Collecting and Analyzing Bioassay Samples</i>
	HP5.3	<i>Dosimetry Evaluation</i>
	HP5.4	<i>Dosimetry Change-Out</i>
	HP5.5	<i>Internal Exposure Monitoring Determination</i>
Procedures for Radioactive Waste Handling	HP6.1	<i>Radioactive Waste Removal, Packaging, Storage, and Removal</i>
Procedures for Instrument Operations and Calibrations	HP7.1	<i>Eberline E-120</i>
	HP7.2	<i>Victoreen 488A</i>
	HP7.3	<i>Victoreen 470A</i>
	HP7.4	<i>Victoreen 190</i>
	HP7.5	<i>Packard Tri-Carb 2250CA</i>
Procedures for Maintaining Inventory	HP8.1	<i>Unsealed Source Inventory</i>
	HP8.2	<i>Sealed Source Inventory</i>
	HP8.3	<i>Miscellaneous Ionizing Radiation Inventory</i>
Procedures for Surveys	HP9.1	<i>Laboratory Radiation and Contamination Surveys</i>
	HP9.2	<i>Surveys required for Radiation-Producing Machines</i>
Procedures for Emergency Situations	HP10.1	<i>Emergency Action Procedure</i>

Attachment B

Radiation Safety Office (RSO) Forms

<i>Number</i>	<i>Title</i>
RSO 1	<i>Application for Authorization to Procure and Use Radiation or Radioactive Materials</i>
RSO 2	<i>Statement of Agreement (Radioisotopes)</i>
RSO 2A	<i>Statement of Agreement (X-ray Units)</i>
RSO 3	<i>Request for Approval to Purchase Radioactive Material</i>
RSO 4	<i>Radiation-Producing Machine Use and Control</i>
RSO 5	<i>Health Physics Radioactive Materials Inventory Form</i>
RSO6	<i>Personnel Radiation Dose Assignment</i>
RSO7	<i>On-site Disposal Form</i>
RSO8	<i>Analytical X-ray Training Outline and Certification</i>
RSO9	<i>Certification of Radiation Safety Training</i>
RSO 10	<i>Temporary Dosimetry Assignment Form</i>
RSO 11	<i>Application for Issuance of Personnel Monitoring Device</i>
RSO 12	<i>Request for Release of Radiation Records</i>
RSO 13	<i>Certification of Instruction Concerning Prenatal Radiation</i>