

AIR PRODUCTS AND CHEMICALS, INC.

RADIATION SAFETY MANUAL

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RADIATION SAFETY MANUAL

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
1.0	PURPOSE OF MANUAL	1
2.0	THE RADIATION SAFETY COMMITTEE.	1
2.1	Purpose of Committee	1
2.2	Organization of Committee.	2
2.3	Responsibilities of Committee.	2
2.4	Appeal of Committee Actions.	4
3.0	THE RADIATION SAFETY OFFICER.	4
3.1	Authority of the Officer	4
3.2	Responsibilities of the Officer.	5
4.0	AIR PRODUCTS REGULATIONS GOVERNING THE USE OF RADIOACTIVE MATERIALS	7
4.1	Procurement of Radioactive Material.	7
4.2	Responsibilities of Project Supervisor	8
4.3	Responsibilities of All Users.	9
4.4	Classification of Areas.	11
4.5	Procedures for Using Radioactive Materials	13
4.6	Transfer of Radioactive Materials.	16
4.7	Disposal of Radioactive Waste.	17
4.8	Personnel Monitoring	21
5.0	RADIATION EMERGENCY PROCEDURES.	25
5.1	Minor Spills	26
5.2	Major Spills	27
5.3	Accidents.	27
5.4	Injuries to Personnel.	28
5.5	Over-Exposure or Ingestion	29
5.6	Fires.	29
5.7	Call List for Radiation Emergencies.	30

Appendix Contents

1.0

PURPOSE OF MANUAL

The purpose of the radiation safety manual is to ensure that all personnel working with radioisotopes are informed and knowledgeable in the safest manner in which to handle these materials. The manual also ensures that Air Products and Chemicals, Inc. (hereafter referred to APCI) is in compliance with Federal regulations and the restrictions placed on APCI by its NRC radioisotope license.

2.0

THE RADIATION SAFETY COMMITTEE

2.1

Purpose of the Radiation Safety Committee

The purpose of the Radiation Safety Committee of APCI is the promotion of the best practice in safe handling and use of radioisotopes throughout the Trexlertown laboratory campus.

The establishment of a Radiation Safety Committee is required by the federal government before an institutional program for the use of radioisotopes in research and development under a broad scope will be licensed.

Federal and state government regulations concerning radioisotopes shall be implemented by the action of the committee in association with individual radioisotope users, project managers and the departmental coordinator.

2.2

Organization of the Radiation Safety Committee

The Radiation Safety Committee shall be appointed by the Corporate Safety Department.

Membership shall consist of personnel experienced in handling radioisotopes, the practice of radiation protection, or those who have a desire to institute practices of safety in regard to radiation. All laboratories using radioisotopes will be represented on this committee.

The activities of the committee are directed by the chairperson, who is the Radiation Safety Officer (RPO).

Meetings of the committee shall be called by the RPO at his/her discretion, not less than once per quarter (calendar year) or by petition by any member of the committee.

2.3

Responsibilities of the Radiation Safety Committee

2.3.1

Assume the responsibility for the radiation safety aspects for all APCI programs involving radioisotopes.

2.3.2

Review and grant permission for, or disapprove the use of, radioisotopes in any amount within APCI from the standpoint of radiation safety. A simple majority of the committee is required for approval.

2.3.3 Review and prescribe special conditions, requirements and restrictions that may be necessary for safe handling of radioisotopes including additional training of personnel and physical examinations (e.g., blood test, urine specimens, etc.) before commencing work with radioisotopes, designation of limited areas of use, proper disposal methods, and procedures to be followed after spills or other radiation accidents. The committee must approve any project involving radioisotopes before it can be initiated.

2.3.4 Receive and review periodic and/or urgent reports regarding:

- a. Results of area monitoring
- b. Personal exposures as measured by suitable dosimeters.
- c. Accidents in handling, storage, or use of radioisotopes.
- d. Loss or theft of any amount of radioisotopes.
- e. Records of radioisotopes procurement and disposal.

2.3.5 Recommend remedial action if safe procedures are not being observed where radiation hazards exist or if these procedures are not in compliance with government regulations.

2.3.6 Keep department safety representatives and radioisotope users advised of current rules and recommendations of various government agencies concerned with radiation safety and the safe use of radioisotopes.

2.3.7 Keep a written record of actions taken in approving or disapproving the use of radioisotopes and other transactions, communications and reports involved in the work of the committee.

2.4 Appeal of Committee Actions

Actions taken by the Radiation Safety Committee may be appealed to the Corporate Safety Department by the staff member or department concerned.

3.0 THE RADIATION SAFETY OFFICER

3.1 Authority of the Radiation Safety Officer

The RPO is in effect, the Nuclear Regulatory Commission's (NRC) representative at APCI. The RPO's responsibilities are delegated via the Corporate Environmental Director who reports to the Corporate Safety Director. The RPO, or authorized representative, has the authority to stop all operations with radioisotopes where a potential hazard or violation exists. Resumption of operations may take place only upon authorization from the Radiation Safety Committee.

3.2

Responsibilities of the Radiation Safety Officer

The RPO will have the responsibility for ensuring adherence to all NRC regulations and rulings issued by or subscribed to by the Radiation Safety Committee and will advise and assist the Radiation Safety Committee with regard to the current applicable regulations of the NRC, the United States Public Health Services, state and local agencies, and all similar codes and regulations.

- 3.2.1 Implement the organization, administration and management of the Radiation Safety Program at APCI.
- 3.2.2 Interpret regulations which govern the use of sources of ionizing radiation and disseminate information on radiation safety.
- 3.2.3 Ensure that a manual of Radiation Safety Regulations and procedures for APCI is prepared and kept current.
- 3.2.4 Ensure that all radiation protection programs are appropriately maintained.
- 3.2.5 Coordinate the dosimetry service, maintain personnel exposure records, and give timely notification of exposures to supervisors as well as individuals exposed.

- 3.2.6 Review all requests for procurement of radioisotopes to assure compliance with limitations for possession and use.
- 3.2.7 Supervise the procurement, receipt and arrangement for delivery and shipment of all radioactive materials coming to or leaving APCI.
- 3.2.8 Maintain records of procurement and receipt of radioactive materials.
- 3.2.9 Supervise the radioactive waste disposal program and maintain disposal records.
- 3.2.10 Maintain running inventory of radioisotopes at APCI.
- 3.2.11 Ensure that employees are properly instructed in handling radioactive materials.
- 3.2.12 Conduct periodic radiation surveys and wipe tests in laboratories and storage areas; leak tests on significant sources.
- 3.2.14 Ensure that radioactive materials are properly secured against unauthorized removal when not in use.

- 3.2.15 Ensure that surveying and monitoring equipment is calibrated.
- 3.2.16 Verify and report to appropriate authorities any radiation incident which may have resulted in injury to, or contamination of, personnel or damage to property.
- 3.2.17 Note and take steps in order to correct nuclear and radiation safety problems as well as general laboratory safety problems.

4.0 REGULATIONS GOVERNING THE USE OF RADIOACTIVE MATERIALS

4.1 Procurement of Radioactive Material

All radioactive materials covered under licenses issued to APCI shall be procured through the RPO.

An instruction sheet and the Radioactive Material Requisition (Form RSO-1) can be obtained from the RPO. Examples of this form are included in Appendix A.

4.1.1 Approval of Request for Authorization to Use Radioactive Materials

Approval of an applicant using the request form (RSO Form APFT, see Appendix A) will be granted by the Radiation Safety Committee on the basis of the applicant's experience and

training; proposed use, type, and level of material to be used; facility where the material will be used and stored and the personnel involved.

Request forms (RSO Form APFT) can be obtained from the RPO and should be submitted in duplicate to the RPO who will circulate requests to the Radiation Safety Committee. Significant deviations from the approved amounts of isotopes or the ways in which they are used must be authorized via the request form approval route.

4.2 Responsibilities of Project Supervisor

Those persons who have approval from the Radiation Safety Committee to use radioisotopes are responsible for the safe use of radioisotopes by individuals under their supervision. They are also responsible for:

- a. Compliance with APCI rules for safe handling of radioactive materials and all NRC regulations.
- b. Instruction of employees under their supervision in the use of safety devices and procedures, that is, to comply with all recommendations relative to wearing dosimeters, to survey their hands and clothing to submit urine and blood samples if specified by the committee, etc., which are designed to control or reduce their total exposure.

- c. Proper planning of an experiment or procedure to ensure that adequate safety precautions are observed.
- d. Communication to the RPO of all pertinent information regarding changes in the experimental protocol, (e.g., employee, operational and procedure changes, alteration of physical plant, etc.).
- e. Limiting the use of radioisotopes to authorized users.
- f. Maintaining required records of receipts, use, storage and disposal of radioisotopes.
- g. Keeping an inventory of radioisotopes on hand.
- h. Receiving instruction in radiation safety as determined by the RPO.
- i. Designation and maintenance of an appropriate isotope storage area.
- j. Conducting a dry run performance of unfamiliar operations in order to preclude unexpected complications.

Responsibilities of all Users

Each person who has contact with radioisotopes has a responsibility to:

- a. Refrain from smoking, eating, drinking, food preparing and applying cosmetics in radioisotope laboratories.
- b. Survey hands, shoes, body and clothing for radioactivity and remove all contamination before leaving the laboratory.
- c. Check work areas by performing wipe tests for contamination after each use period and keep a written record of results.
- d. Conduct decontamination procedures when necessary.
- e. Report immediately to the RPO the details of spills or other accidents involving radioactivity.
- f. Wear the recommended personnel radiation detectors such as film badges and/or pocket ionization dosimeters and/or Thermo-luminescent Dosimeters (TLD).
- g. Use all recommended protective measures such as protective clothing, respiratory protection, remote pipetting devices, ventilated and shielded glove boxes and hoods.

- h. Keep personnel exposure to radiation as low as reasonably achievable and specifically below the maximum permissible dose (mpd) levels as stated in 10-CFR-20.101.
- i. Maintain good housekeeping practices in the laboratories.
- j. Label radiation equipment and segregate radioactive waste and equipment to avoid cross contamination.

4.4 Classification of Areas

4.4.1 Unrestricted Areas

An area is unrestricted and does not require control measures if:

- a. An individual, continually present in the area cannot receive more than two (2) mRem in any one (1) hour, or one hundred (100) mRem in any seven consecutive days, to any portion of the body.
- b. When allowance is made for expected occupancy and time variations in dose rate, no individual is likely to receive more than 500 mRem in a calendar year.

4.4.2

Restricted Areas

- a. By Federal regulation all areas within the laboratory in which dose levels do not conform to the standards for unrestricted areas shall be restricted and shall be under control of the RPO for radiation safety purposes.
- b. A caution sign - CAUTION RADIATION AREA - shall be prominently displayed at the entrance to each restricted area and the laboratory supervisor who is in charge of each such areas shall be responsible for controlling access to this area.

4.4.2.1

Posting of Areas and Other Labeling Requirements

Signs are required by law to denote areas or containers with levels of radiation or radioactivity specified in the following sections.

- a. CAUTION RADIATION AREA - Any area accessible to individuals in which there exists ionizing radiation at such levels that a major portion of the body of such individuals could receive an absorbed dose greater than 100 mRem in any five consecutive days.

- b. CAUTION HIGH RADIATION AREA - Any area accessible to individuals in which there exists ionizing radiation at such levels that a major portion of the body could receive an absorbed dose greater than 100 mRem in one hours.
- c. CAUTION RADIOACTIVE MATERIALS - Although federal regulations exempt certain containers, rooms, etc., containing radioactive materials less than amounts specified as per 10-CFR-20.203 (e), (f) and 10-CFR-20 Appendix C, for the purposes of this manual, all containers, rooms, refrigerators, etc., containing any radioactive materials should have a CAUTION RADIOACTIVE MATERIALS sign, also indication of isotope and maximum amount when necessary, in order that all persons are aware of the presence of radioactive materials.
- d. Only signs of the design specified in 10-CFR-20 shall be used.

4.5 Procedures for Using Radioactive Materials

4.5.1 Protective Rules for Preventing Personal Contamination

Extreme personal cleanliness and careful techniques are the primary means of preventing contamination and protecting against ingestion of radioactive materials. In order to minimize

contamination and prevent entrance of radioactive materials into the body, the following rules shall be observed in laboratories where radioisotopes are used.

- a. Eating, drinking, food preparation, food storage, application of cosmetics and smoking shall not be permitted in laboratories where radioactive materials are stored or used.
- b. Storage of food and beverages is not permitted in the same storage location (refrigerator, etc.) as radioactive materials.
- c. The use of food containers for handling or storing radioactive materials is forbidden.
- d. Pipetting of radioactive solutions by mouth shall not be permitted. Remote devices shall be used for such applications.
- e. No experiments with radioisotopes should be undertaken until trial runs, complete in every detail, are made with non-radioactive materials. Such runs should be made until the procedure is reproducible, and improvements incorporated as needed.

- f. Any work with materials susceptible to atmospheric distribution (e.g., vaporizing, spillage, dusting, effervescence of solution, or other releases of potentially harmful quantities of radioactive gas) shall be confined in a suitable hood or glove box.
- g. Personnel shall not be permitted to work with radioisotopes if there are uncovered open cuts or abrasions on the body. Extreme precaution must be taken to avoid cuts or puncture wounds, especially when working with materials of high activity or of a high hazard.
- h. Care must be exercised when using organic solvents to avoid skin contact with radioactive materials. Appropriate gloves should be worn for handling radioisotopes.
- i. Monitoring of hands, feet and clothing is recommended, especially where large amounts of radioactive materials are being used. Protective garments should be left in the laboratory when work is completed or until monitored and found free of contamination.

4.5.2 Protective Rules for Controlling Contamination of Laboratory Facilities and Equipment

- a. Auxiliary containers, blotters, and covers shall always be used where danger of spills and contamination of the person or equipment is possible.
- b. Contaminated equipment, or equipment that has been used and is suspected of contamination, shall be isolated in designated areas in the laboratory or in suitable storage spaces.
- c. Tools, equipment and apparatus when used in handling radioactive material, should be placed in non-porous metal trays or pans which are lined with absorbent disposable paper. This paper should be monitored and changed frequently.
- d. Care should be taken that equipment, not immediately necessary to the operations being performed, is not brought into the working area.
- e. Equipment and tools shall be routinely monitored following their use. No equipment shall be returned to stock unless it is known to be completely free of contamination inside and out.

- f. Contamination shall not be allowed to remain on working surfaces or floor unless appropriately shielded. (For purposes of this rule, contamination is taken to mean amounts of beta-gamma activity greater than 100 dpm or alpha activity greater than 20 dpm as determined by standard wipe test on a surface of 100 cm².)

4.6 Transfer of Radioactive Materials

4.6.1 On-Campus Transfers

- 4.6.1.1 Radioactive materials shall not be transferred from one department or laboratory to another without approval by the RPO, since approval for the use of the materials is given only for the original working area.

- 4.6.1.2 All transfers between laboratories, or from storage areas to working areas, shall be done in such a manner as to minimize the probability of spillage or breakage. Double containers should be used, including suitable shielding, for such transfers.

4.6.2 Off-Campus Transfers

- 4.6.2.1 Radioactive material shall not be shipped or transferred to or from APCI without approval of the RPO and acceptance from the RPO of the recipient unit. Approved shipments must be packaged

and labeled in accordance with Department of Transportation regulations, the NRC regulations or the U.S. Postal regulations, whichever is applicable.

4.7 Disposal or Radioactive Waste

4.7.1 General Considerations

- 4.7.1.1 Except as specifically authorized by the Radiation Safety Committee, no radioactive materials shall be disposed of directly into the sanitary sewage system, into the atmosphere, or into cold trash baskets (non-radioactive waste). All radioactive wastes must be collected by the user in suitable containers for processing and disposal by the RPO.
- 4.7.1.2 Any accidental releases of activity into the environment must be reported immediately to the RPO.
- 4.7.1.3 The RPO will arrange for disposal of all dry and liquid radioactive waste periodically.
- 4.7.1.4 All types of waste should be separated by half-life, short (less than 30 days), and long (more than 30 days).

4.7.2 Dry Waste

4.7.2.1 Containers

Waste containers for disposal of dry contaminated wastes are to be available in all laboratories using unsealed radioisotopes. Normally these should be a metal waste container with a step-pedal operated lid and plastic bag liner. Waste cans should be conspicuously labeled with a CAUTION RADIOACTIVE MATERIALS sign.

4.7.2.2 Segregation by Half-Life

Dry waste, contaminated with short-lived radioactivity (half-life is less than 30 days) should be collected in a separate container from dry waste contaminated with long half-life (greater than 30 days) material. These materials shall be stored in a specially designated site. Care shall be taken to ensure integrity of all containers; routine monitoring for spills shall be carried out.

Normally the short-lived material will be held for 10 half-life periods and then disposed of as non-radioactive waste.

4.7.2.3 Labeling of Waste for Disposal by Radiation Safety Officer

All dry radioactive waste for disposal by the RPO shall be sealed and properly labeled with a standard radioactivity caution label and should bear the following additional information:

- a. User's name, department and charge number.
- b. Isotope(s).
- c. Approximate quantity of activity.
- d. Date.

4.7.3 Liquid Waste

4.7.3.1 Containers

Containers for liquid waste should be 5 gallon plastic carboys or 30 gallon liquid drums, filled with solid pak, of the type provided by Teledyne/Isotopes.

4.7.3.2 Labeling of Waste for Disposal by the Radioactive Safety Officer

All liquid containers shall be properly labeled with a CAUTION RADIOACTIVE MATERIAL sign. In addition, waste containers shall bear the following additional information.

- a. User's name, department and charge number.
- b. Isotope(s).
- c. Approximate quantity of activity.
- d. Date.
- e. Principle solvents or reagents in container (e.g., water, acid, etc.) including approximate pH.

4.7.3.3 Strong Acids, Bases, or Other Solvents

Unless special arrangements are made with the RPO, the user is required to neutralize or otherwise dilute strongly acidic or basic waste solutions to the point that they can be reasonably mixed in solidifying or absorbing agents without causing violent chemical reactions or releasing strong fumes and vapors or volatilization of the isotope to gaseous state.

In case of organic solvents, especially those which may be highly volatile or otherwise reactive, appropriate precautions must be noted on the waste containers.

4.7.4 Gaseous and Airborne Wastes

In cases where the release of volatile radioactive products or radioactive aerosols are anticipated, means should be provided to trap such materials (either by chemical or physical methods). The resulting product may then be handled as a liquid or dry waste whichever is appropriate.

4.7.5 Biological Wastes

All microbiological samples containing radioisotopes will be steam sterilized in an autoclave and then disposed as either liquid or solid waste, whichever is appropriate. A specially designated autoclave shall be used for this purpose. Routine examinations for contamination shall be carried out.

4.8 Personnel Monitoring

4.8.1 External Monitoring

4.8.1.1 NRC Requirements

Any person working with radioactive material is required to wear a personnel dosimeter whenever entering a restricted radioisotope area where he/she may be likely to receive a dose in any calendar quarter in excess of 25 percent of the values stated in 10-CFR-20.101.

Maximum Permissible Dose in Rems/calendar quarter - 10-CFR-20.101

Whole body, head & trunk, active	1.25 Rem
bloodforming organs, lens of eyes	
or gonads	

Hands, forearms, feet and ankles	18.75 Rem
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Skin of whole body	7.5 Rem
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4.8.1.2 APCI Requirements

In addition to the NRC requirements, personnel dosimeters are required for all personnel working with radioactive isotopes excepting sealed sources.

4.8.1.3 Exemptions From Personnel Monitoring

Personnel dosimeters may not be required in cases where it has been definitely established by the RPO that external exposure will not exceed the specified limits. Exemptions will depend on the intensity and energy of the radiation and working conditions involved.

4.8.1.4 Dosimeter Information

- a. The RPO issues film badges to individuals who require them. Individuals must fill out a Request for Personnel Dosimeter form (Form RSO-2, Appendix A).
- b. The badge, when required, must be worn at all times when the individual is occupationally exposed. It should be worn in a fashion so as to indicate whole body exposure (breast pocket, collar, or belt) except in the case of ring, wrist or ankle badges.
- c. Badges are issued once per month.
- d. When not in use, the badge should be stored in a location away from radiation (above background), excessive heat or moisture.

- e. Badges must be turned in to the RPO within 48 hours of the change date specified on the badge.
- f. If the film badge is lost or damaged, the maximum legal exposure must be entered on the individual's radiation exposure record unless the individual's Report of Missing Dosimeter (Form RSO-3, Appendix A) shows evidence of no possible exposure. Therefore, it will be to the individual's advantage to return "lost badges" that have been found so that actual exposure may be determined.

4.8.1.5 Records and Reports

- a. Permanent records of film badge exposures are maintained by the RPO (Form RSO-4, Appendix A).
- b. In cases where individual monthly doses exceed 100 millirem, the RPO will notify the individual through a written Radiation Exposure Report (Form RSO-5 Appendix A). The individual shall fill out the information requested on the report and return it to the RPO so that recommendations can be made to prevent recurrence of exposure.

4.8.2 Internal Monitoring of Personnel

4.8.2.1 Routine Urine Analysis

Urine analysis shall be required for persons working with unsealed tritium (^3H) in an open room or bench in amounts greater than 100 millicuries at any one time or the total amount processed per month, or with unsealed tritium in a ventilated fume hood in amounts greater than 1 curie, or such other materials as the Committee may specify. The frequency of such analysis will be dependent on the particular level and circumstances of use and will be determined by the RPO for each situation in accordance with U.S.N.R.C. Draft Regulatory Guide "Applications of Bioassay for Tritium."

4.8.2.2 Special Urine Analysis

Individuals who are known or suspected to have accidentally swallowed, inhaled, absorbed, or otherwise ingested radioactive materials will be required to submit urine specimens to the RPO for analysis. The number and frequency of such samples will be established by the RPO based on type and level of material and condition of intake. Other tests as well as a complete physical examination may be required. Annual physicals are given to all lab personnel.

5.0

RADIATION EMERGENCY PROCEDURE

Emergencies resulting from accidents in isotope laboratories may range from minor spills of radioactivity, involving relatively no personal hazard to more serious radiation incidents and spills, posing a hazard and possible bodily injury. Because of the numerous complicating factors which may arise and because of the wide range of variety of hazards, set rules of emergency procedure cannot be made to cover all possible situations.

In any emergency, however, the primary concern must always be the protection of personnel from radiation hazards. The secondary concern is the confinement of the contamination to the local area of the accident if possible.

5.1

Minor Spills in Unprotected Areas Involving No Radiation Hazard to Personnel (In Any Amount)

- a. Notify all other persons in the area immediately.
- b. Permit only the minimum number of persons necessary to deal with the spill into the area.
- c. Confine the spill immediately.

1. Liquid Spills - Don protective gloves, drop absorbent paper on spill.
 2. Dry Spills - Don protective gloves, drop dampened absorbent paper on spill.⁽¹⁾
- d. Notify the RPO or other member of the Radiation Safety Committee.
 - e. Permit no one to resume work in the area until approval of the RPO is secured.

5.2 Major Spills - Involving Radiation Hazards to Personnel

- a. Notify all other persons in area immediately of hazard.
- b. Request all persons not involved in the spill to vacate the room at once and notify the RPO or other member of the Radiation Safety Committee.

⁽¹⁾Water may be used except when chemical reaction with water would generate an air contaminant. Oil should then be used.

- c. Wait for specific instructions on the appropriate procedure for spill clean-up.
- d. If spill is on skin, flush thoroughly with water. If the spill is on clothing, discard outer clothing at once and flush exposed skin areas with water.
- e. Vacate the room and prohibit entrance to contaminated area.
- f. Permit no person to work in area until the approval of the RPO is secured.
- g. Under no circumstances should an untrained person attempt to examine or clean up the radioactive material.

5.3 Accidents - Involving Radioactive Dusts, Mist, Fumes, Organic Vapors and Gases

- a. Notify all other persons to vacate the room immediately.
- b. Hold breath and cut off all easily accessible escape valves. Switch off air circulating devices if possible.
- c. Vacate the room.

- d. Notify the RPO or other members of the Radiation Safety Committee at once.
- e. Ascertain that all doors giving access to the room are closed and locked. If necessary, post guards to prevent accidental opening of doors.
- f. Do not reenter the room until approval of the RPO is secured.

5.4 Injuries to Personnel - Involving Radiation Hazard

- a. Wash minor wounds immediately (within 15 minutes if possible) under running water while spreading edges of gash. (Note: light tourniquet action to stop venous return but not to restrict arterial flow may be desirable to stimulate bleeding.)
- b. Notify the RPO, or other member of the Radiation Safety Committee, or dial 7711.
- c. Permit no person involved in a radiation injury to return to work without approval of the RPO.

5.5

Over-Exposure or ingestion

- a. Any person who suspects over-exposure to radiation from any source must report immediately, by phone or in person, to the RPO. (Any exposure in excess of 1.25 Rem whole body delivered in a period of 13 weeks or less is regarded as an over-exposure for purposes of these regulations.)
- b. Any person who swallows, injects, absorbs, or otherwise ingests radioactive materials (excluding normal environmental contaminants and excluding medical diagnosis or therapy) must report the intake immediately to the RPO.

5.6

Fires - Involving Radioactivity

- a. Only attempt to put out small fires (those that can be extinguished with an available extinguisher) if radiation hazard is not immediately present.
- b. Pull fire alarm.
- c. Call 7711 and report the nature of the emergency.
- d. Notify the RPO.
- e. Fire fighting or other emergency activities should be governed by recommendations made by the RPO.

A phone list itemizing the work and home phone number of the RPO, the Radiation Safety Committee and laboratory supervisor must be posted outside any area where radioisotopes are used. An example of this phone list is found below.

In case of accidents, spills, loss, theft or fire involving radioactive material, call the RADIATION SAFETY OFFICER FIRST. IF NO ANSWER, call the other emergency personnel listed on telephone chart.

	<u>Office</u>	
1. Eugene J. Handwerk Radiation Safety Officer	Extension - 8606	Home - 767-0169
2. Marsha Timmerman	Extension - 7405	Home - 437-1237
3. Radiation Safety Consultant	302-451-8737	Home - 302-656-8086

APPENDIX A

FORMS FOR RADIOISOTOPE WORK

Form RSO-1:

"Radioactive Material Requisition"

RSO Form APFT:

"Project Proposal for Use of Radioactive Materials"

"Statement of Training and Experience"

Form RSO-2:

Request for Personnel Dosimeter

Form RSO-3:

Report of Missing Dosimeter

Form RSO-4:

"Radiation Exposure Record"

Form RSO-5:

"Radiation Exposure Report"

PROJECT FOR USE OF RADIOACTIVE MATERIALS

Date: _____ New Project _____ Amendment _____ Renewal _____

1. Applicant: _____ Department _____ Phone _____

2. Nuclide(s)	3. Chemical/Physical form(s)	4. Position of label where applicable
a. _____	a. _____	a. _____
b. _____	b. _____	b. _____
c. _____	c. _____	c. _____
d. _____	d. _____	d. _____
e. _____	e. _____	e. _____

5a. Amount per experiment (millicuries)	5b. Amount per shipment (millicuries)	5c. Amount on hand at any one time (millicuries)
_____	_____	_____

6. Outline the purpose and method of your project. (Give sufficient detail concerning the problem and methods of use of the radioactive material to provide a basis for an evaluation of health hazards and contamination potential.)*
7. Identify all procedures which may cause particular problems and evaluate any radiation hazard from (a) the quantity of radioactivity in starting material, (b) the volatile, disposal of radioactive wastes, and (c) other contaminated items*.
8. Note the instrumentation or methods used to ascertain the radiation level present due to item a, b, and c in question #7. (List make, model, and range for radiation monitors.)*

*Use separate sheets of paper where necessary.

9. Indicate storage conditions for the material, including location and type of possible contamination. (Specify design thickness and type of shielding material which will be used when applicable.)*
10. Specify the precautions and procedures that will be taken during your possession of the nuclide to*:
- a. Prevent unauthorized removal of radioactive material.
 - b. Prevent contamination and excessive levels of radiation in work or adjacent areas.
11. Outline the procedures to be used in the disposal of all materials which are contacted by the radioisotopes*.

*Use separate sheets of paper where necessary.

Approval Recommended: _____ Date: _____
Radiation Safety Officer

Approved: _____
Radiation Safety Committee

STATEMENT OF TRAINING AND EXPERIENCE

1. Name _____ 2. Social Security No. _____
3. Type of Training (Circle Yes or No in Columns I and II. If "Yes" is indicated in either column, complete items III and IV).

TYPE	FORMAL COURSE	ON THE JOB	WHERE TRAINED	DURATION OF TRAINING
(A) Principles and Practices of Radiation Protection.	<u>Circle One</u> Yes No	<u>Circle One</u> Yes No		
(B) Radioactivity Measurement monitoring techniques, and instruments.	<u>Circle One</u> Yes No	<u>Circle One</u> Yes No		
(C) Mathematics and calculations basic to the use and measurements or radioactivity.	<u>Circle One</u> Yes No	<u>Circle One</u> Yes No		
(D) Biological effects of radiation.	<u>Circle One</u> Yes No	<u>Circle One</u> Yes No		

4. Formal Courses (If "Yes" circled in column I for any of items above, complete this item, listing all courses pertaining to use of radiation or radioactive materials, atomic and nuclear structure, radiochemistry, radiation biology, nuclear engineering, etc.).

Title of Course	Where Trained	Course Content
(A)		
(B)		
(C)		
(D)		

5. Experience (List actual use of radioactive materials, details of formal laboratory courses or on the job training.)

Isotope	Maximum Amount	Where Experience	Duration	Type of use

6. Was film badging required in experience situation? _____ Yes _____ No

7. Additional Comments or Remarks:

Employee Signature

Supervisor Signature

RPO Signature

Date

Date

Date

THIS FORM FOR ONLY FOUR FORMS OF SAME NUCLIDE

APCI
Form RSO-1

RADIOACTIVE MATERIAL REQUISITION

Control
No.:

Note: Complete a separate requisition for each different Nuclide;

Department	User	Phone		
Project Number	Licensee	License Number		
Quantity (mCi)	Catalog No.	Nuclide and Form	Charge Number	Est. Price
1.	1.		1.	1.
2.	2.		2.	2.
3.	3.		3.	3.
4.	4.		4.	4.

Total

Vendor Suggested _____ Date Desired _____

Remarks _____

Requested by _____ Building _____ Date of this Request _____

Approved by (Department head or authorized agent) _____ Date _____

----Do not write below this line----

Approved by R.P.O. _____ Date _____

Comments _____

(To be completed when order received)

P.O. Number _____ Date Received _____ User Notified _____

☐ A.M.
☐ P.M.

Assay Information _____ Health Physics Survey _____

Quantity (mCi) _____ Exposure Rate-unshielded _____

Conc. (mCi/ml) _____

Vol. or Wt. _____ Exposure Rate-unshielded _____

Sp. Act. _____

Time of Assay _____ Surface Contamination _____

Total Solids _____ alpha: _____

Normalcy _____ beta-gamma: _____

Purity _____

Lot No. _____ Other precautions _____

Ser. No. (sealed source) _____

Other _____

Received by: _____ Date _____

REQUEST FOR PERSONNEL DOSIMETER

Badge No. _____

All of the information requested below is required by the NRC. No badge can be issued without a completed requisition.

1. Name _____
Last, First, Middle (Please Print)
2. Sex _____
3. Social Security No. _____
4. Birthday _____
Month-Day-Year
5. Location _____
Department _____ Building _____
6. Will you be working _____ radioisotopes; _____ x-rays; _____ other?
7. Have you previously been associated through employment or course work with an employer or University, etc. where you were required to wear a dosimeter (film badge, TLD, pocket ionization chamber, etc.). Do not include any diagnostic or therapeutic radiation exposure. List most recent employer first.

	<u>Employer & Address</u>	<u>Started</u>	<u>Terminated</u>
A.	_____ _____	_____	_____
B.	_____ _____	_____	_____
C.	_____ _____	_____	_____
D.	_____ _____	_____	_____

Signature of Requester_____
Signature of Radiation Safety Officer

RADIATION EXPOSURE REPORT

Date _____

It has been reported by the personnel dosimetry service that the dosimeter worn by _____, dosimeter number _____, for _____ has received a total dose of _____ millirems. The dosimetry service additionally reported _____

1. Reason for exposure - check appropriate reason(s):

Exposure due to _____ x-rays or _____ radioisotopes.

- ☐ Adequate protection devices not available.
- ☐ Failure to use protection devices.
- ☐ Badge exposed while it was not being worn.
- ☐ None of the above, explain below.
- ☐ Unknown.

2. Explain all reasons checked in Item 1.

Recommendation of Radiation Safety Officer to prevent recurrence of exposure:

Signature of Employee

Signature of Radiation Safety Officer

REPORT OF MISSING DOSIMETER

Date _____

Name _____

Badge # _____

Date of Missing Badge _____

The dosimeter described above has not been returned to the RPO. In order to keep adequate radiation exposure records as required by the NRC, the badge must be returned to the RPO.

If the dosimeter is available, return it with this form to the RPO.

If the dosimeter is not available, answer the following questions and return this form immediately to the RPO.

1. Reason dosimeter was not returned.

2. Type of radiation to which you were exposed during the month in question. If you were working with radionuclides, please list them.

3. Vacations during the month in question. Give dates.

4. Any unusual radiation exposure during month in question.

Signature of Dosimeter WearerACTIONS OF THE RADIATION SAFETY OFFICER

Date _____

Signature of Radiation Safety Officer

COMMENTS

APPENDIX B

EXPLANATION OF TABLES I, II, AND III

Laboratories are classified based on three factors: (1) radiotoxicity hazard of nuclides in use; (2) maximum amounts of activity stored and used in the area; and (3) type of use in terms of relative hazard of the handling procedures.

In Table I, radioisotopes are classified as to their relative radiotoxic hazard in relation to internal dose. The hazard of a radioisotope depends on the effective half-life of the nuclide in the body or organ, the type and energy of the emitted radiation, the physical and chemical form of the material, and the organ of maximum concentration.

For normal usage, laboratories are classified according to the total activity of the various classes of nuclides present in the lab. Table II gives the four laboratory classifications (high, intermediate, low, and very low) based on the hazard group and activity present. In cases of more than one nuclide in use in a laboratory, the classification will be determined by summing of the constituent nuclides.

The amount of nuclide permitted in a given laboratory may be increased or decreased according to type of usage. With high accident risk operations, the amount permitted within the classification is decreased. For simple, relatively safe operations, the amount in a given classification may be increased. As a guide, the modifying factors in Table III are used to determine the amount by which the permitted activity should be increased or decreased.

EXPLANATION OF TABLE IV

As per Section 4.7.1.1, specific authorization can be given for disposal of waste via sanitary sewer. In Table IV the federal guidelines are stated to insure that, based on the APCI water flow rate, concentrations of trace amounts or radioactivity released to the sanitary sewer under a specific authorization from the RPO would not exceed the guidelines as stated in 10-CFR-20.

TABLE I
SUGGESTED RADIOISOTOPE CLASSIFICATION
(UNSEALED SOURCES)

Class	Description	Examples*
I	Very High Hazard	Sr ⁹⁰ , Po ²¹⁰ , Pu ²³⁹
II	High Hazard	Ca ⁴⁵ , I ¹³¹
III	Moderate Hazard	P ³² , S ³⁵ , Co ⁶⁰ , Rb ⁸⁶ , Cs ¹³⁷
IV	Low Hazard	H ³ , C ¹⁴

*Radiation Safety Officer has a more complete list of examples.

TABLE II
SUGGESTED LABORATORY CLASSIFICATION

Radioisotope Class	Lab Grade			
	A (High)	B (Inter)	C (Low)	D (Very Low)
I	1 mCi	up to 1 mCi	up to 10 µCi	up to 0.1 µCi
II	10 mCi	10 mCi	100 µCi	1 µCi
III	100 mCi	100 mCi	1 µCi	10 µCi
IV	1000 mCi	1000 mCi	10 µCi	100 µCi

TABLE III
MODIFICATION FACTORS FOR LABORATORY CLASSIFICATION

Use	Factor
Storage Only	X 100
Simple Wet Operations (e.g., preparing stock solutions)	X 10
Normal Chemical Operations (e.g., analysis)	X 1
Complex Chemical Operation with High Risk of Spill	X 0.1
Simple Dry Operations (e.g., work with volatile compounds)	X 0.1
Dry Dusty Operations (e.g., grinding)	X 0.01

TABLE IV
FACTORS FOR GRANTING AUTHORIZATION TO DISPOSE OF
RADIOACTIVE MATERIALS VIA SANITARY SEWER

As per NRC regulations: No licensed material shall be discharged into sanitary sewerage unless it is:

1. Soluble
2. If diluted by water flow rate to sewer, concentration of material does not exceed that stated in Appendix B, Table I, Column 2 of 10-CFR-20 or;
3. Ten times the quantity of material in Appendix C or;
4. GROSS QUANTITY OF ALL LICENSED MATERIAL RELEASED TO SEWERAGE DOES NOT EXCEED 1.0 CURIE PER YEAR.

<u>Example of Soluble Material</u>	<u>Appendix B</u>	<u>Appendix C</u>
3-Hydrogen	$1 \times 10^1 \mu\text{Ci/ml}$	1,000 μCi
14-Carbon	$2 \times 10^2 \mu\text{Ci/ml}$	100 μCi
35-Sulfur	$2 \times 10^3 \mu\text{Ci/ml}$	100 μCi
32-Phosphorus	$5 \times 10^4 \mu\text{Ci/ml}$	10 μCi
109-Cadmium	$5 \times 10^3 \mu\text{Ci/ml}$	10 μCi

4-15-85

TELEPHONE OR VERBAL CONVERSATION RECORD

TIME

☐ A.M.
☐ P.M.

☐ INCOMING CALL

☐ OUTGOING CALL

☐ VISIT

PERSON CALLING

Gene Handwerk

OFFICE/ADDRESS

Air Products

PHONE NUMBER

EXTENSION

215-481-8606

PERSON CALLED

Jack Davis

OFFICE/ADDRESS

KI

PHONE NUMBER

EXTENSION

CONVERSATION

SUBJECT

Def Letter / Aban letter

SUMMARY

Air Products has received a abandonment letter and they will respond by 4-17-85 to our deficiency letter.
Cont # 18422

(Next Lic # 37-05105-08 for this license)

REFERRED TO:

ACTION REQUESTED

Do NOT void lic application review additl info when is arriving

ACTION TAKEN

☐ ADVISE ME OF ACTION TAKEN.

INITIALS

DATE

INITIALS

DATE

"OFFICIAL RECORD COPY"

ML10