

HEALTH PHYSICS MANUAL

Wayne State University
Radiation Safety Program

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PREFACE

Wayne State University has been granted a series of Licenses by the United States Nuclear Regulatory Commission for procurement, possession, and usage of radioactive materials. Continuation of the licensure requires that the University maintain an effective Radiation Safety Program.

The State of Michigan has Radiation Protection Regulations pertinent to all sources of ionizing radiation. In order to comply with these State regulations as well as the Federal directives, this Radiation Safety Handbook has been prepared and established as the official guide in all matters related to Radiation Protection and Control for Wayne State University and its affiliated institutions.

Therefore, it is the responsibility of each user of ionizing radiation to observe the rules and regulations contained in the Handbook so that the University may continue operations utilizing sources of ionizing radiation while ensuring the health and welfare of its personnel, its students, and the general public.

GLOSSARY

AFFILIATED INSTITUTIONS Those establishments that appear on, and are subject to the conditions of, the various licenses issued to Wayne State University by the U.S. Nuclear Regulatory Commission for the use of radioactive materials.

CONTAMINATION, RADIOACTIVE: Deposition of radioactive material in any place where it is not desired, and particularly in any place where its presence may be harmful.

DOSIMETER: Instrument used to detect and measure an accumulated dosage of radiation; in common usage it is a pencil size ionization chamber with a built-in self-reading electrometer; used for personnel monitoring.

EXPOSURE, EXTERNAL: Exposure to ionizing radiation when the radiation source is located outside the body and the radiation must then penetrate into the deeper tissues.

EXPOSURE, INTERNAL: Exposure to ionizing radiation when the radiation source is within the body as a result of deposition of radionuclides in the body tissue.

FILM BADGE: A pack of photographic film used for approximate measurement of radiation exposure for personnel monitoring purposes. The badge may contain two or three films of differing sensitivity, and it may contain a filter which shields part of the film from certain types of radiation.

GENERAL POPULATION: All persons who are not designated as being specifically engaged in a field of endeavor which subjects them to exposures of ionizing radiation. Further, by law, this population is limited to dosages of ionizing radiation of only one-tenth that allowed for the occupational population.

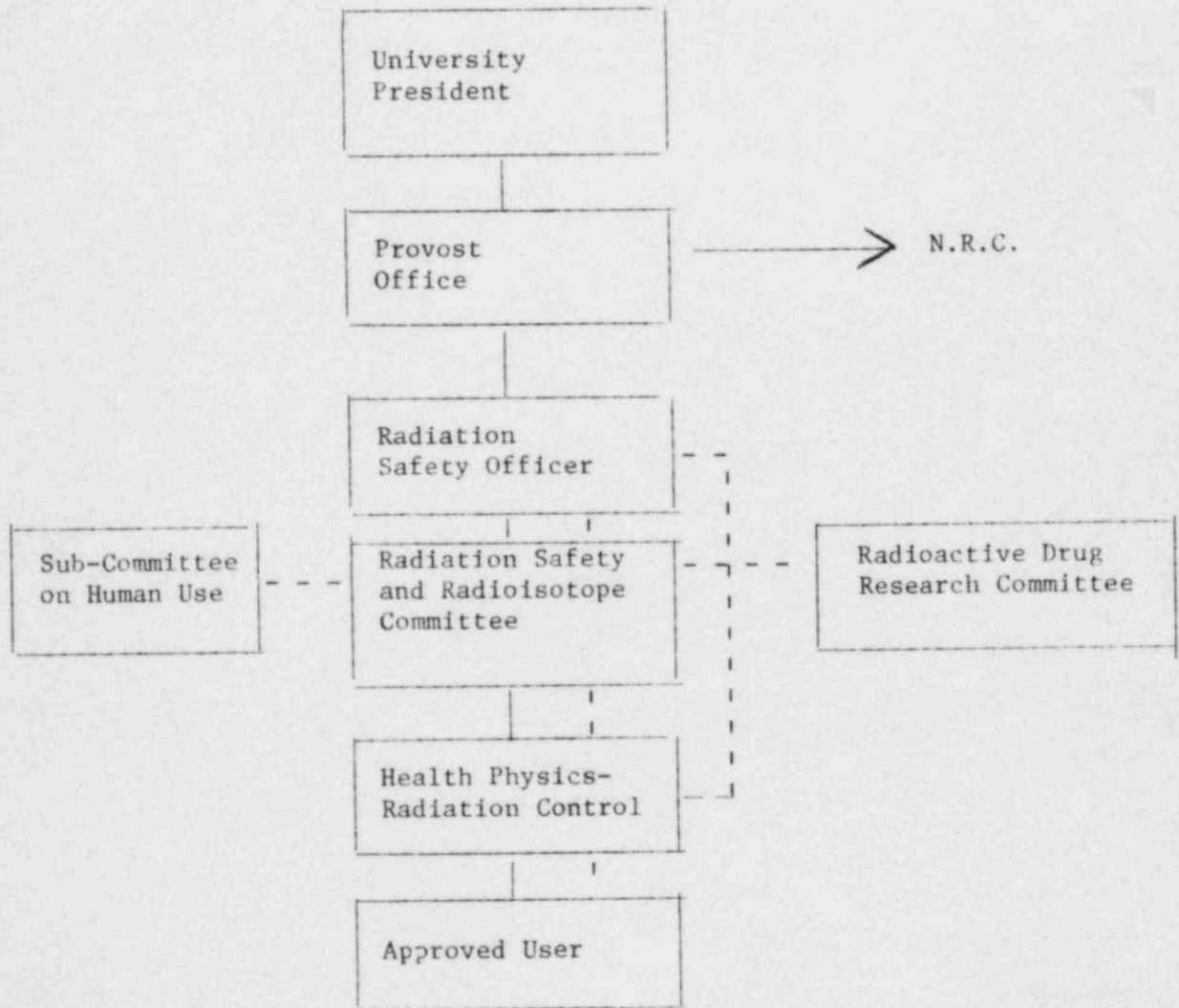
OCCUPATIONALLY EXPOSED POPULATION: All persons who are designated as being specifically engaged in a task which subjects them to possible exposures of ionizing radiation.

SURVEY, RADIOLOGICAL: Evaluation of the radiation hazards incident to the production, use, or existence of radioactive materials or other sources of radiation under a specific set of conditions. Such evaluation customarily includes a physical survey of the disposition of materials and equipment, measurements or estimates of the levels of radiation that may be involved, and a sufficient knowledge of processes using or affecting these materials to predict hazards resulting from expected or possible changes in materials or equipment.

I. ADMINISTRATIVE CONTROLS

A. Organization

The administrative control of the University's Radiation Safety Program is schematically represented by the chart below. There are two channels of administrative authority. The first channel is for appointments and executive responsibility, and the second channel for review and approval of applications.



_____ Appointments and Executive Responsibility

- - - - - Application Review and Approval

B. Radiation Safety and Radioisotope Committee

1. Function

The Radiation Safety and Radioisotope Committee has the responsibility of establishing and enforcing the University's Radiation Safety Program to ensure the safety and welfare of University personnel and property, as well as protecting the surrounding Community from the potential hazards of all sources of ionizing radiation.

The Committee formulates and enforces such policies that are necessary to establish uniformly safe practices throughout the University for the use of all sources of ionizing radiation.

2. Membership

The Chairman of the Committee is appointed by the President of the University; members of the Committee are appointed upon the recommendation of the Radiation Safety Officer, after solicitations of nominees from heads, chairmen or other appropriate administrative person of the various schools, colleges or departments.

3. Meetings

The Committee shall meet regularly once every Quarter. Meetings, other than regular meetings, may be called by the Chairman or any three members of the Committee. Minutes of the proceedings shall be recorded and circulated by the Secretary to the membership and to certain personnel of the University having a specific interest in the proceedings.

4. Procedures

The meetings shall generally be conducted according to the principles of Robert's Rules of Order and the Chairman shall use them as a guide at the request of any individual member.

a. The Order of Business shall proceed as follows:

- (1) Review of minutes of the previous meeting.
- (2) Old business.
- (3) New business.

b. The Voting procedures are:

- (1) A simple majority of the entire membership shall constitute a quorum.
- (2) For revisions of the University Radiation Safety Program, an approval by two-thirds of the entire membership shall be required.
- (3) For all matters not concerning the revisions of the Radiation Safety Program, approval by a simple majority of a quorum shall be required.

5. Duties

The Committee shall:

- a. Review and act upon applications for the procurement and use of sources of ionizing radiation within the University and its affiliated institutions. Applications shall be reviewed from the standpoint of radiation safety. Use of radioactive material in humans shall be reviewed initially by the Sub-Committee for Human Use, after which the applications shall be further reviewed and acted upon by the Committee.
- b. Prescribe specific conditions that may be necessary for the safe handling of any source of ionizing radiation in connection with granting approval of an application.
- c. Review and take appropriate action with regard to violations of the University's Radiation Safety Program.

6. Enforcement

- a. In the event of a failure to observe the rules and regulations governing the safe use of sources of ionizing radiation, the Radiation Safety Officer or Health Physics-Radiation Control personnel shall inform the offending investigator(s) (1) of the violations and (2) that an unfavorable report will be made to the Committee unless they are remedied.
- b. If a remedy has not been effected within a reasonable period of time, the Radiation Safety Officer and/or Health Physics-Radiation Control personnel shall bring the violation to the attention of the Committee at its next regular meeting, or a special meeting may be called to consider the violation. After consideration of such a report, the Committee may make recommendations for mandatory remedial action, with compliance failure being just cause for withdrawal of the Committee's approval of the user's application.

In enforcement cases, per 6.b., the approved user may be present at the Committee hearing if he so desires.

7. Appeal of Committee Decision

- a. Decisions of the Committee may be appealed to the President of the University. A copy of all such appeals must be forwarded in writing to the Chairman of the Committee at the same time they are forwarded to the President for action.

C. Sub-Committee for Human Use

1. Function

The Sub-Committee for Human Use shall be the advisory body to the parent Committee in all matters related to the exposure of humans to ionizing radiation from any source.

2. Membership

The Chairman of the Committee is appointed by the President of the University; members of the Committee are appointed upon the recommendation of the Radiation Safety Officer, after solicitations of nominees from heads, chairmen or other appropriate administrative person of the various schools, colleges or departments.

3. Meetings

Meetings shall be called as necessary by the Chairman or any three members of the Sub-Committee. Meeting procedures shall be the same as for the parent Committee.

4. Duties

The Sub-Committee for Human Use shall:

- a. Review and act upon all applications for the usage of sources of ionizing radiation either in or on humans.
- b. After action, forward the application to the parent Committee for endorsement. The Sub-Committee may request an applicant to appear for further clarification of his application.
- c. Advise the parent Committee regarding the exposure of humans to ionizing radiation.

C.1. Radioactive Drug Research Committee

1. Function

The Radioactive Drug Research Committee shall be the advisory body to the parent Committee in determining the conditions under which radioactive drugs for research purposes are considered safe and effective and to protect the human subject from possible adverse effects of the radioactive drug.

2. Membership

The Chairman of the Committee is appointed by the President of the University. Members of the Committee shall be composed of the membership of the Sub-Committee on Human Use.

3. Meetings

Meetings shall be called as necessary by the Chairman or any three members of the Committee. Meeting procedures shall be the same as for the parent Committee.

4. Duties

The Radioactive Drug Research Committee shall:

- a. Review and act upon all applications involving radioactive drugs for research purposes and assure the protection of the human subject from possible adverse effects.
- b. After action, forward the application to the parent Committee for endorsement. The Radioactive Drug Research Committee may request an applicant to appear for further clarification of his application.
- c. Advise the parent Committee regarding the exposure of humans to ionizing radiation.

D. Radiation Safety Officer

1. Duties

In the expedition of his duties, the Radiation Safety Officer shall:

- a. Be the Chairman of the Radiation Safety and Radioisotope Committee.
- b. Inform and advise the Committee with regards to the status of the Radiation Safety Program.
- c. Advise the President of the University or his designated officer, on all matters relating to radiation safety.
- c. Advise Health Physics-Radiation Control on all matters relating to their jurisdiction in radiation safety.

E. Health Physics-Radiation Control

1. Function

Health Physics-Radiation Control shall be responsible for the surveillance and maintenance of the Radiation Safety Program of the University on a daily basis and shall be responsible for notifying the Radiation Safety and Radioisotope Committee and the President of the University as to the status of said program.

2. Organization

Health Physics-Radiation Control shall be composed of one or more Health Physicists plus a sufficient number of technicians and secretarial personnel to carry out the functions and duties of the unit.

3. Training

Health Physics-Radiation Control shall be responsible for all teaching and instructional programs related to the safe handling of all sources of ionizing radiation throughout the University.

4. Consulting

Health Physics-Radiation Control shall provide consultation services relative to all subjects related to radiation safety.

5. Other

In addition, Health Physics-Radiation Control shall have the responsibilities for:

- a. Surveys - shall inspect and survey all areas and facilities where sources of ionizing radiation are employed, as well as those surrounding areas where the effects of radiation may be a contingency.

- b. Personnel Monitoring — shall supervise and maintain this service and investigate each case of excessive or abnormal exposure to determine the cause and take action to prevent recurrences.
- c. Waste Control — shall operate a complete waste control program, consisting of collection, storage, and ultimate disposal of radioactive waste materials.
- d. Instrument Calibration — shall operate an instrument calibration program, wherein the approved users can obtain uniform calibration for their required survey and monitoring instruments.
- e. Procurement Control — shall supervise the procurement and transfer of all sources of ionizing radiation to assure compliance with the conditions of the University's Licenses.
- f. Records — shall maintain records necessary for compliance with all regulations.
- g. Leak Tests — shall perform leak tests for those investigators employing radioactive sources requiring such tests under conditions of the University's Licenses.
- h. Maintaining Relations — shall maintain relations with those Governmental agencies which regulate the use of ionizing radiation.
- i. Practical Research — shall conduct research as relates to radiation safety, which may include investigations into new methods and techniques of radiation control.

F. Approved User

1. Definition

An Approved User is any person who has been granted permission to use some form(s) of ionizing radiation at Wayne State University and/or its affiliated institutions by the Radiation Safety and Radioisotope Committee.

2. Qualifications

In order to qualify as an Approved User, the applicant shall:

- a. Be a member of the faculty or staff of the University or its affiliated institutions.
- b. Have the rank of Instructor or higher at the University.
- c. Be actively engaged in work, instruction, and/or research at the University or its affiliated institutions which requires the use of ionizing radiation.

3. Function

The Approved User shall have the primary safety responsibility for those sources of ionizing radiation for which he has been approved to use. He shall assure that their procurement, storage, and usage complies with the rules and regulations prescribed in this Handbook.

4. Duties

The Approved User shall:

- a. Confine his possession and use of sources of ionizing radiation to those limits, locations, and purposes authorized by the Committee, and no other.
- b. Not transfer, abandon, or dispose of such sources except through Health Physics-Radiation Control or as authorized by the Committee.
- c. Maintain records as specified under Section II D of this Handbook.
- d. Conduct or cause to have conducted the required surveys and leak tests.
- e. Limit the use of sources of ionizing radiation under his control to those persons subject to his direct supervision.
- f. Instruct the personnel under his supervision in the use of radiation safety procedures and equipment.
- g. Assure that personnel under his supervision have become familiar with the University's Radiation Safety Program and that they comply with all regulations therein.
- h. Plan his research and use of sources of ionizing radiation to assure that adequate safety precautions are taken.
- i. Communicate to Health Physics-Radiation Control pertinent information with respect to changes in operational procedures, new techniques, alterations in the physical facilities.
- j. At all times comply with Wayne State University's Radiation Safety Program as prescribed in this Handbook.

II. GENERAL INSTRUCTIONS

A. Application for Use of Sources of Ionizing Radiation

1. General Requirements

In order to process or use any source of ionizing radiation at the University and its affiliated institutions, approval must be obtained from the Radiation Safety and Radioisotope Committee.

- a. Considerations – Approval of any application shall be based upon its radiation safety aspects and the conditions of the various Licenses held by Wayne State University and its affiliated institutions.
- b. Applicant Rank – The minimum University rank required shall be that of Instructor.
- c. Training and Experience – The applicant's training and experience must meet the requirements of the Radiation Safety and Radioisotope Committee.

2. Human Usage Requirements

Applicant's training and experience must meet the requirements of the Sub-Committee for Human Use.

3. Procedures

All applications for possession and use of sources of ionizing radiation shall be made on appropriate forms obtainable from Health Physics-Radiation Control.

4. Approval of Application

After the Committee has received and acted upon an application, the applicant will be notified of its decision by the Chairman. Any revisions in the original application must be approved by the Committee.

B. Procurement Procedures

All sources of ionizing radiation shall be procured under the direction of Health Physics-Radiation Control. See Appendix for procurement instructions.

C. Transfer of Sources of Ionizing Radiation

The transfer of any source of ionizing radiation must be approved by Health Physics-Radiation Control.

D. Records

Records relating to personnel exposure, radiation surveys, leak tests, inventories, waste disposals, and calibrations must be maintained and available for inspection as directed by Health Physics-Radiation Control.

E. Facilities and Laboratory Equipment

All designs and plans for new facilities, or alterations to existing facilities in which sources of ionizing radiation will be stored and/or used, shall be reviewed and approved by Health Physics-Radiation Control *prior* to the start of any construction or alteration operations. Assistance in the aforementioned matters may be obtained from Health Physics-Radiation Control.

1. Release of Facilities for Other Usage

Facilities in which radioactive material was either used or stored shall not be released for other purposes until the facility has been surveyed by Health Physics-Radiation Control.

2. Transfer of Facility Responsibility

The responsibility for the operation of a facility is placed in the hands of the Approved User by the Radiation Safety and Radioisotope Committee. This responsibility shall not be transferred to another individual until an application for such has been approved by Health Physics-Radiation Control.

3. Laboratory Equipment

Laboratory equipment which has either been used for radioisotope purposes or located within a radioisotope facility shall not be removed or transferred until after it has been monitored and determined to be free of radioactive contamination. The monitoring and/or decontamination shall be completed by the Approved User under the direction of Health Physics-Radiation Control.

III. RADIATION SAFETY

A. General

1. Objectives

The following sections contain recommendations which are intended to accomplish the objectives of the University Radiation Safety Program, which are:

- a. To maintain a level of radiation exposure as low as reasonably achievable (ALARA)
- b. To reduce the possibility of entry of radioactive material into the human body by ingestion, inhalation, absorption, or through open wounds.

- c. To reduce to the lowest practicable values the amounts of radioactive material released to the general environment.

Since these recommendations were made to cover most of the general situations and cannot possibly cover all circumstances, there may be instances in which these recommendations do not apply. In such situations, Health Physics-Radiation Control should be contacted for assistance or clarification, and if the problems cannot then be rectified they shall be presented before the Committee for resolution.

2. Permissible Dose Limits

Permissible dose limits and concentrations of radioisotopes in air and water have been established by both the Nuclear Regulatory Commission and the Department of Health of the State of Michigan. It must be emphasized that although these limits have been established under the concept that no probable radiation damage will occur at these levels, all exposure should be kept as low as reasonably achievable (ALARA).

The following Investigational and Action Levels have been incorporated as part of Wayne State University's ALARA concept:

<u>Area of Exposure</u>	<u>Investigational Levels</u> <u>(mrems per calendar quarter)</u>	
	<u>Level I</u>	<u>Level II</u>
1. Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads.	125	375
2. Hands and forearms; feet and ankles	1,875	5,625
3. Skin of Whole Body	750	2,250

- 1(a) Quarterly exposure of individuals to less than Investigational Level I.

Action Taken: Unless deemed appropriate, no further action will be taken in those cases where an individual's exposure is less than Table I values for Investigational Level I.

- 1(b) Personnel exposures equal to or greater than Investigational I, but less than Investigational Level II.

Action Taken: A review of the exposure of each individual whose quarterly exposures equal or exceed Investigational Level I will be conducted. Form H.P.-5 "Report of Radiation Exposure", shall be completed and submitted by the individual to Health Physics-Radiation Control. The "Report of Radiation Exposure" will be presented at the first Radiation Safety Committee meeting following the quarter when the exposure was recorded. If the exposure does not equal or exceed Investigational Level II, no action related specifically to the exposure is required unless deemed appropriate by the Committee or the Health Physics Department. However, the Committee

and/or Health Physics will consider each such exposure in comparison with those of others performing similar tasks as an index of ALARA program quality and record the review in the Committee minutes.

1(c) Exposure equal to or greater than Investigational Level II.

Action Taken: An investigation into the cause(s) of all personnel exposures equaling or exceeding Investigational Level II will be conducted by Health Physics and, if warranted, actions will be taken. The "Report of Radiation Exposure" will include the individual's exposure, investigation results and action(s) taken and will be presented to the Radiation Safety Committee at the first meeting following completion of the investigation. The details of the report will be recorded in the Committee minutes.

In addition, a follow-up of the individual's exposure for the next monitoring period (one month) will be conducted and if needed, further actions will be taken. This procedure is necessary in maintaining our ALARA program quality.

B. Exposures

Exposures to radioactivity can essentially be broken down into two categories: external or internal.

1. Protection Against External and Internal Exposures

For protection against external exposures, the basic protection factors of *time, distance, and shielding* shall be employed to reduce the exposure potential to a value at least below permissible levels. Outlined below are additional rules and procedures to be followed for protection against exposures to sources of ionizing radiation.

- a. The exposure potential shall be estimated *before* placing into operation any procedures in which personnel may become exposed to radiation.
- b. The use of sources of ionizing radiation shall be subjected to programs of continuous monitoring or regularly scheduled surveys as a means of evaluating the radiation hazards.
- c. Special clothing which can be easily laundered or disposed of shall be worn and properly fastened when there is a possibility of contamination with radioisotopes. When necessary, impervious gloves, safety glasses, and shoe covers shall be worn. These items should not be worn outside the laboratory. Protective clothing should be monitored for contamination before sending to the laundry. Any protective clothing which has become contaminated should be handled as any other piece of contaminated material.

- d. Before any work is undertaken with radioisotopes, attention shall be given to precautionary measures including the use of hoods, remote handling equipment, and glove boxes. Health Physics-Radiation Control should be consulted for recommendations on specific operations. *Plan the procedure to be used, and, if possible, perform a dry run.*
- e. The situations which necessitate the wearing of impervious gloves are listed below:
 - (1) Manipulation of any radioisotope.
 - (2) The presence of an open wound on the hand.
- f. Stainless steel or equivalent type trays lined with plastic-backed absorbent paper shall be used when working with radioactive materials.
- g. Pipetting by mouth is prohibited. Use rubber bulbs, syringes or pipettors.
- h. When transporting or transferring radioactive materials, double containers with absorbent material must be used.
- i. Containers affording adequate protection and shielding shall be used to store radioactive materials.
- j. Keep the laboratory neat and clean. Keep the work area free of equipment and material not required for the immediate procedure. Eating, storing or preparation of food (including candy and beverages), and smoking is not permitted in a laboratory or rooms where work with unsealed radioactive material is taking place or where contamination may exist. Refrigerators and freezers in which radioactive material is stored shall not be used for the storage of foods or drinks.
- k. An area shall be set aside for the decontamination and cleaning of laboratory apparatus used with radioactive material. A sink in this area shall be designated by Health Physics-Radiation Control for use with radioactive material. Do not use this area for any operation which does not involve radioactive material. Isolate all laboratory apparatus and equipment which are used in operations involving radioactive material.
- l. Use of flammable liquids shall not be permitted in laboratories unless such flammables are (1) contained in U.L. approved safety cans with anti-flash-back screens and (2) used in a properly vented enclosure. Pressure bottles or tanks containing counting or laboratory gas shall not be used or stored in the laboratory unless they are securely mounted to the wall, bench or floor.

- m. Good personal hygiene practices, such as washing hands and arms thoroughly, using plenty of soap and water, before handling any object which goes to the mouth, nose, or eyes, will greatly reduce the possibility of internal exposure. Wash and monitor the hands whenever leaving the laboratory after handling radioactive material. Keep fingernails clean and short.
- n. Do not apply cosmetics in a laboratory where unsealed sources of radioactive material are in use.
- o. Monitor shoes and other clothing for contamination and remove all contamination before leaving work areas.

C. Area Controls

Areas in which sources of ionizing radiation are used or stored shall be controlled to prevent any unnecessary exposures to personnel. In order to assure good area controls, the below listed methods shall be employed.

1. Posting

Areas shall be classified for posting as follows:

- a. High Radiation Area
- b. Radiation Area
- c. Airborne Radioactivity Area
- d. Radioactive Materials

Both the Nuclear Regulatory Commission and the State of Michigan have regulations governing posting, control, and safety devices required for these areas according to: N.R.C. 10CFR20 Section 20.203(b), (c), and (d) and State of Michigan R325.5224-R325.5227. In addition rooms or areas in which radioactive material is used or stored shall be posted according to: N.R.C. 10CFR20 Section 20.203(e-1) and e-2); Section 20.204; and State of Michigan R325.5228-R325.5229 and R325.5233.

Also, Form NRC-3 and/or the State of Michigan Form RH-100 "Notice to Employees", shall be placed in a sufficient number of places in every establishment where employees are engaged in activities licensed by the Nuclear Regulatory Commission and/or registered with the State of Michigan, to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

Health Physics-Radiation Control will post the required signs in order to ensure that they meet Federal and State specifications. Such posting, or a change in posting, shall be done only under the direction of Health Physics-Radiation Control personnel.

2. Restrictions

Those areas authorized by the Radiation Safety and Radioisotope Committee for use with sources of ionizing radiation are restricted to usage by the Approved User and those personnel under his immediate supervision. Therefore, all such areas shall be locked against unauthorized admittance at all times when authorized personnel are not present in the areas.

Sealed and unsealed sources of radioactive materials shall be locked in their storage containers when not in use. Generators of ionizing radiation shall have control locks or mechanisms to prevent their unauthorized and accidental activation.

D. Monitoring and Surveying

In order to ensure satisfactory radiation safety throughout the University complex, routine and periodic monitoring and surveying of personnel, equipment, and facilities are required. The frequency of surveys will depend upon the classification of the facilities employing sources of ionizing radiation.

1. Responsibilities

- a. It becomes the responsibility of the radiation worker to see that his working environment is safe and well organized, safety devices are installed and properly working, appropriate records are being maintained, and that contamination is not to exceed levels as specified in Table No. 2.
- b. It is Health Physics-Radiation Control's responsibility to periodically monitor and survey all controlled areas.
- c. Health Physics-Radiation Control shall supply the Approved User with reports of findings in these investigations, along with recommendations for the elimination of all items of non-compliance to Federal, State, and Wayne State University regulations, and a specified time period for making the necessary corrections.
- d. Experimental work shall be monitored throughout on a periodic basis to determine the occurrence, or possibility of occurrence, of new and increased radiation hazards.

2. Leak Tests and Special Surveys

The University's Material License, as well as other N.R.C. licenses in which the University is named as licensee, has conditions regarding the testing of sealed sources for leakage and/or contamination. The State of Michigan has similar regulations governing the testing of sealed sources. It is the responsibility of the Approved User of such devices to see that each of his sealed sources, except

those simultaneously exempt from same by both the N.R.C. and the State of Michigan, is tested in the manner and at the intervals required. Copies of results of these tests shall be kept on file and made available to Health Physics-Radiation Control when necessary. These tests will be performed by Health Physics-Radiation Control upon request.

3. Personnel Monitoring

All personnel working with or around sources of ionizing radiation shall wear monitoring devices approved by Health Physics-Radiation Control.

- a. Film badges-Film badges shall be the general personnel monitoring device used throughout the University. To initiate film badge service for any individual, the form H.P.-2, "Previous Radiation Exposure and Training History", must be completed and submitted, a minimum of three weeks, in advance of the date the service is to be provided. A supply of film badges will be available for temporary use upon request.

Each individual assigned a film badge shall wear only the specific badge assigned to him. In the event of a lost badge, notify Health Physics-Radiation Control. Personnel assigned badges shall wear them at all times while they are in their working areas. Film badges may be worn comfortably on the belt line or chest. All film badges shall be kept in a radiation free area when not in use and put back at the end of the work period. They should never be taken home. Assigned film badges shall not be used for any purpose other than personnel monitoring.

Normally, new film badges shall be distributed the last three working days of each month and used film packages shall be collected the first three working days of each month. It is the responsibility of the Approved User to ensure the change of film packages. If certain operations require special badges for the wrist, fingers, etc., or special film packages, Health Physics-Radiation Control should be contacted. If a film badge is suspected of being contaminated, contact Health Physics-Radiation Control for replacement.

- b. Pocket Dosimeters — Personnel working with any source of radiation where a daily exposure of more than ten millirems is possible should wear pocket dosimeters. Two pocket dosimeters shall be worn by all personnel who enter a radiation area or a high radiation area. Pocket dosimeters may be obtained from Health Physics-Radiation Control upon request.
- c. Biological Monitoring — Special tests for determining the presence of radioactive material in the body are desirable for persons handling unsealed sources of radioactive material. Each person working with such radioactive material shall make himself available for such tests when requested by Health Physics-Radiation Control.

- d. Medical Examinations - When deemed necessary by the Radiation Safety Officer or Health Physics-Radiation Control, a medical examination may be ordered for individuals who will be working with materials or equipment producing ionizing radiation. Health Physics-Radiation Control shall notify those workers who are to receive the examination.
- e. Survey Meters - Every facility utilizing sources of ionizing radiation shall have appropriate survey instruments. These instruments shall be used by the laboratory personnel to measure possible radiation fields, check for contamination of hands, shoes, clothing, and work areas.

E. Calibration of Equipment

All instruments utilized as radiation monitors must be calibrated at appropriate intervals to assure the validity and integrity of results. It becomes the responsibility of each Approved User to see that his instruments are properly functioning and in calibration. All survey meters must be calibrated annually or whenever such instruments have been repaired. Survey instruments may be made available for short term loan as deemed necessary by Health Physics-Radiation Control, but not to exceed sixty days.

F. Contamination

No amount of radioactivity shall be released into unrestricted areas in any manner which will cause the limits specified in the following regulations to be exceeded: N.R.C. 10CFR20, Sections 20.105 and 20.106, and State of Michigan R325.5211 and R325.5212.

The significance of contamination levels in restricted areas can be found in the Appendix.

G. Decontamination

Successful decontamination calls for planned action. Decontamination shall be accomplished by the Approved User and/or his laboratory personnel under the direction of Health Physics-Radiation Control. Decontamination procedures depend upon source type, strength, chemical and physical properties, and total area contaminated.

1. Procedures

- a. Decontamination of any area shall be accomplished by working from the outside towards the center.
- b. Make full use of protective clothing, footwear, gloves, masks, etc. to reduce the possibilities of personnel contamination for those conducting the decontamination procedures.

- c. Do not wear protective clothing, etc., outside of a designated change area.
- d. Handle all equipment used in decontamination and all run-off solutions as ones which are potentially contaminated.
- e. Make provisions for the disposal of all used cleaning materials and equipment as well as other contaminated articles in the area. Therefore, always bring the necessary collection receptacles to the area in question, not vice versa.
- f. Make full use of available instrumentation for monitoring, choosing the most effective for your purposes.
- g. Make a complete record of the decontamination operations.
- h. After decontamination has been completed, do not permit any work or occupancy within the area(s) until approval has been obtained from Health Physics-Radiation Control.
- i. Monitor each step of the decontamination operations just as if it was a separate, unrelated incident.
- j. Suggested agents for removal of contamination from various surfaces can be found in the Appendix.

IV. RADIOACTIVE WASTE DISPOSAL

All radioactive waste shall be disposed of via Health Physics-Radiation Control or with their approval. Accumulation and storage shall be in designated containers, kept either in central storage areas or within approved individual laboratories. The radioactive waste disposal program is divided into the responsibilities of Health Physics-Radiation Control and those of the Approved User.

A. Responsibilities

1. Approved User's Responsibilities

The proper storage and disposal of radioactive waste within the laboratory is the responsibility of the Approved User. He shall ensure compliance with applicable regulations and maintain positive control over all such wastes in his area until it is removed. The Approved User shall ensure that the following procedures are complied with in the proper storage of radioactive waste in his facilities.

- a. Radioactive waste materials shall be segregated per instructions from Health Physics-Radiation Control.

- b. Radioactive waste shall be stored in a separate, designated area within the individual laboratories. Where a central storage area is available, the waste shall be removed from the individual laboratories at the end of each working day and be placed in designated containers within said central storage area.
- c. The approved user shall include the following information on all radioactive waste containers: the radionuclide(s), the activity of each radionuclide, the chemical form, quantity and hazard, the date on which the waste was placed in the container, the Approved User's name, and other pertinent information. The containers provided for the accumulation and storage of radioactive waste material shall not be used for any other purpose.
- d. The Approved User shall utilize approved liquid waste containers as provided by Health Physics-Radiation Control for liquid waste. In case of organic solvents, containers of capacity not exceeding five gallons shall be used for accumulation and storage purposes.
- e. Liquid waste shall be stored in such a manner that there will be no possibility of a chemical reaction which might cause an explosion or cause the release of radioactive or toxic gases or vapors.
- f. Liquids shall be neutralized before depositing them in waste containers.
- g. Health Physics-Radiation Control shall be notified if waste material needs to be removed from his facilities.
- h. The Approved User shall *not* dispose of radioactive waste into the sewer system without written approval from Health Physics-Radiation Control. In addition, the release of gaseous waste to the air effluent shall be accomplished *only* through hoods designated for this purpose and with written approval from Health Physics-Radiation Control.

2. Health Physics-Radiation Control's Responsibilities

Health Physics-Radiation Control has the responsibility for the collection, storage, and ultimate disposal of radioactive waste. Waste shall be collected upon special request from an Approved User.

- a. Health Physics-Radiation Control shall provide the following types of containers for storage of low level radioactive waste:
 - (1) Poly-lined Drums of 28-Gallon Capacity. These are to be used in individual laboratories or in central storage areas for the accumulation of dry solid waste.
 - (2) Poly-lined Liquid Containers. These containers are to be used

in individual laboratories for contaminated objects which may inflict a wound or as an outer container for the disposal of radioisotopes.

- (3) Plastic Jugs of One-Gallon Capacity. These are to be used in the individual laboratories for the accumulation of inorganic, aqueous liquids.
 - (4) Metal Drums of 55-Gallon Capacity with a Poly-liner. These are to be used in central storage areas for the accumulation of solid waste.
 - (5) Freezers, Chest Type. These are to be used in central storage areas for the accumulation of organic, solid waste.
- b. Health Physics-Radiation Control shall provide the necessary labels and tags for the above containers. Health Physics-Radiation Control shall also provide the forms which are required for attachment to these containers.
 - c. Health Physics-Radiation Control shall maintain central storage areas in those places where the use of radioactive material warrants them. These storage areas shall be used for the accumulation and storage of radioactive material. Where such areas are available, radioactive waste normally shall be removed from the individual laboratories at the end of each working day and be placed in appropriate containers within said central storage areas. A key to the storage area will be issued to each Approved User who has a need to use the facility.
 - d. Health Physics-Radiation Control shall operate and maintain the University Waste Center located at 5959 Cass Avenue. The Waste Center shall be used for storage, preparation, and disposal of radioactive waste. Facilities are also available for decontamination of laboratory equipment and apparatus.
 - e. The following methods of ultimate disposal will be utilized by Health Physics-Radiation Control:
 - (1) Storage for Decay - waste contaminated with radionuclides having a half-life of less than 65 days may be stored for decay.
 - (2) Disposal into the Municipal Sewer System - radioactive waste which can be conveniently disposed of through the municipal sewer system shall be processed for same in accordance with Federal and State regulations.
 - (3) Disposal as a chemical - Tritium and Carbon-14 wastes as defined and not exceeding the Nuclear Regulatory Commission's Title 10CFR Part 20.306 may be disposed as non-radioactive waste. However, nothing in this section relieves the licensee from complying with other applicable federal, state and local regulations governing any other toxic or hazardous property of these materials.

- (4) Disposal by Release to Air Effluent - radioactive gaseous volatile wastes shall be released as air effluent in concentrations less than those specified by Federal and State regulations.
- (5) Shipment to Commercial Disposal Facilities - radioactive waste materials which cannot be disposed of by other designated means shall be disposed of through a licensed commercial facility. Health Physics-Radiation Control shall be responsible for the management of all such shipments, in accordance with all applicable regulations.
- f. Ultimate disposals shall be made in full compliance with Federal and State regulations and the records of disposal shall be maintained on appropriate forms.

B. Animal Carcasses Containing Radioactive Material

1. Instructions

Listed below are the instructions to be followed when working with animals containing radioactive materials.

- a. All objects which can inflict a wound shall be removed from animal carcasses.
- b. Animal carcasses shall be packaged in plastic bags in a manner which will ensure against the leakage of body fluids.
- c. Each package shall be labelled with the isotope, amount of isotope, date of injection or treatment, and the Approved User's name.
- d. Animal carcasses shall be stored in facilities designated by Health Physics-Radiation Control.
- e. All excreta shall be collected and placed in appropriate containers. Solids, including liquids mixed with sawdust, shavings, etc., shall be placed in plastic bags and then stored in either 55-gallon metal drums or 28-gallon fiber drums. Liquids shall be placed in one-gallon plastic jugs.
- f. An estimate of the activity that is expected to be eliminated by the animal shall be made and recorded.
- g. The containers shall be labelled with the name of the Approved User, the isotope(s), the estimated activity, and the date of collection.

V. CLASSIFICATION OF FACILITIES AND SOURCES OF IONIZING RADIATION

A. Laboratory Areas

Type 3: Laboratories which are specifically designated for handling high levels or highly toxic radioactive materials. They incorporate special apparatus, equipment, materials of construction and construction design to limit the spread of contamination and to assist in maintaining high standards of laboratory hygiene.

Type 2: Laboratories which handle intermediate levels of activity or radioactive material of intermediate toxicity. This type of laboratory incorporates many features of the Type 3 laboratory but with some of the more specialized features being omitted.

Type 1: Laboratories intended for use with only low levels of toxicity or activity. This type of laboratory is usually one which has a few special features to accommodate work with radioactive materials.

Type 0: Laboratories in which the use of radioactive materials is limited to small tracer amounts. Here the activity shall not exceed the limits specified for Type 0 laboratories as contained in the Appendix. These laboratories shall not be used for regular isotope projects or studies.

B. Generator Areas

Class A: Those areas which contain high energy accelerators, x-ray generators, and radioisotopic teletherapy devices housed in specially designed facilities.

Class B: Those areas which contain generators rated below 250 KV that are housed in specially designed facilities.

Class C: Those areas which contain generator equipment such as mobile x-ray machines, mobile isotopic devices, fixed installations such as x-ray diffraction units and other analytical equipment utilizing ionizing radiation.

Class D: Those areas which contain devices not ordinarily considered as emitting ionizing radiation.

C. Radioactive Materials

See Appendix.

VI. EMERGENCIES

Emergencies involving ionizing radiations may arise from a variety of situations; therefore, procedures cannot be established to cover all situations. Life saving procedures shall be the primary concern in any emergency. Following this shall be the protection of all personnel from exposure to ionizing radiation. All other deliberations shall be subsequent to these two major considerations.

A. General Responsibilities

1. Approved User

The Approved User shall:

- a. Report the details of the emergency situation immediately to Health Physics-Radiation Control.
- b. Utilize the emergency telephone numbers which are posted in all approved areas.

2. Health Physics-Radiation Control

In the event of any radiation emergencies occurring within the University complex, Health Physics-Radiation Control shall encompass all responsibilities not designated to the Approved Users. Health Physics-Radiation Control shall have the prime authority for all decisions regarding the handling of said emergencies.

B. Emergency Procedures

1. Accidents Involving the Release of Radioactive Materials

- a. Notify Health Physics-Radiation Control at once.
- b. Notify all persons in the area and isolate those involved. Simultaneously forestall further spillage and initiate isolation and decontamination procedures.
- c. Keep the number of persons dealing with the spill to a minimum.
- d. Monitor all persons involved in the spill and the clean-up operations, paying particular attention to the shoe soles.
- e. Decontamination of personnel and the area involved shall be undertaken only under the direction of Health Physics-Radiation Control.
- f. Occupancy of, or work in, the area shall not be resumed until approved by Health Physics-Radiation Control.

2. Sealed Source Rupture (also, Accidents Involving Radioactive Dusts, Mists, Fumes, Organic Vapor, or Gases)

- a. Notify Health Physics-Radiation Control at once.
- b. Notify all persons to vacate the room immediately.
- c. If time permits, all windows should be closed, fans and air conditioners should be shut off, the door and all other openings should be sealed with wide masking or adhesive tape.
- d. Restrict the movements of potentially contaminated persons to a local zone just outside the spill area until the extent of contamination is ascertained.
- e. If no means are available for monitoring, it should be assumed that all personnel involved are contaminated.
- f. Decontamination of the area will be done only under the direction of Health Physics-Radiation Control.
- g. Occupancy of, or work in, the area shall not be resumed until approved by Health Physics-Radiation Control.

3. Injuries to Personnel Complicated by Radioactive Contamination

- a. All life-saving procedures should be carried out immediately; contact a physician at once if needed.
- b. Report all radiation accidents involving personnel (contaminated wounds, ingestion, inhalation) to Health Physics-Radiation Control as soon as possible.
- c. Wash minor wounds under running water immediately, while spreading the edges of the wound.
- d. Permit no person who has sustained a radiation injury to return to work without the approval of Health Physics-Radiation Control and the attending physician.
- e. A report shall be prepared by the individual injured and the Approved User in charge.

4. Overexposures and/or Suspected Overexposures

- a. Contact Health Physics-Radiation Control at once.
- b. A report shall be prepared by the individual exposed and the Approved User in charge.

5. Emergencies Involving Fires in Approved Areas and Adjacent Locations

- a. Notify, in order: all persons in the area, the Fire Department, Public Safety, and Health Physics-Radiation Control immediately. The caller must relate his name, location, and degree of any radiation hazard involved.

6. Emergencies Involving Motor Vehicles Acting as Carriers of Radioactive Materials

Because of the nature of these kinds of emergencies, the following is a completely self-contained set of instructions which shall be carried in every vehicle used while transporting radioactive substances. These instructions are to be read and followed by all personnel in the event of an emergency.

- a. Immediate notification is to be given by telephoning the following in order: Local Police and/or Highway Patrol, Local Health Authorities, Health Physics-Radiation Control, Wayne State University, at 577-1255. Caller must relate his name, location, what happened, when, where, who was involved, and what has been done to control or confine the radioactive materials. Have someone maintain security over the vehicle and radioactive material and keep by-standers away, while calls are being made.
- b. All traffic should be detoured around the scene of the accident. If this is not possible, vehicles should be moved the shortest distance necessary to clear right of way. If radioactive material is spilled, passage through area should be prevented unless absolutely necessary. If right of way must be cleared before radiological assistance has arrived, the spillage should be washed to shoulder of right of way with minimum dispersal of wash water, or covered with at least four inches of earth or sand.
- c. The nearest Nuclear Regulatory Commission Office should be notified as soon as possible.
- d. If the accident involves wreckage and a person is believed to be alive and entrapped, every possible effort should be made to rescue him.
- e. The area of the accident should be restricted. The public should be kept as far from the scene as is practical. Local authorities should make only necessary entries and investigations in the accident area. No attempt should be made to open or examine contained material. No attempt should be made to clean up any debris or material involved in the accident prior to the arrival of an Emergency Monitoring Team.

- f. Any persons who have had possible contact with the radioactive material should be segregated and confined until they can be examined further. The names and addresses of those involved should be obtained.
- g. The injured should be removed from the area of the accident with as little contact as possible and held at a transfer point. All life-saving measures should be performed promptly, but elective first aid and surgical procedures should be delayed until advice or help can be obtained from a physician familiar with radiation medicine. Except in extreme emergency, patients should not be moved to local hospital or doctor's office before a radiological survey has been made.
- h. If the accident involves fire, attempts to extinguish it should be made from as great a distance as possible. The fire should be treated as one involving toxic chemicals. Suspected material should not be handled until it has been monitored and released by monitoring personnel. Clothing and tools used at the fire should be segregated until they can be checked by emergency monitoring teams.
- i. Eating, drinking, or smoking in the area of the accident should be prohibited. Food or drinking water which may have been in contact with material from the accident should not be used.
- j. Careful attention and consideration should be given in matters of public relations to tactful handling of volunteers and crowds of curious onlookers. Transmission of information to the public by press, radio, and television shall be by the Radiation Safety Officer or designated individual from Health Physics.

7. Lost Sources

- a. Notify Health Physics-Radiation Control at once.
- b. If a source is lost, notify all personnel in the area, monitor each individual and evacuate the area.
- c. Restrict movement of personnel involved to a known and controlled area.
- d. Do not remove any articles, such as waste containers, laundry bags, soiled linens, from the areas involved.

8. Other Emergencies

If any question exists, call Health Physics-Radiation Control at 577-1255.

VII. TRANSPORTING OF RADIOACTIVE MATERIAL

Transporting of radioactive material by personnel of Wayne State University must be done in full compliance with regulations and specifications as stated in 10CFR30 by the Nuclear Regulatory Commission, and the Dangerous Articles Tariff by the Department of Transportation (D.O.T.). All questions pertaining to transporting of radioactive material must be directed to Health Physics-Radiation Control. Proper labels, placards, Health Physics-Radiation Control's "Transfer of Radioactive Material" form, and some types of shipping containers may be obtained from Health Physics-Radiation Control.

Prior approval for transporting of radioactive material must be obtained from Health Physics-Radiation Control, situations per A.1. and A.2. excepted.

A. Instructions

1. Intra-Facility Transport

- a. Transport shall be in unbreakable, spill-proof, double containers which are free from loose, external contamination.
- b. Gamma radiation, or equivalent, shall not exceed 200 mr/hr at the surface of the container nor exceed 10 mr/hr at one meter distance.
- c. Containers shall be labeled in accordance with the provisions of Michigan Department of Public Health, Rule R325.5230.

2. Inter-University Transport

The transport of radioactive material from one facility to another within the University complex shall be performed under the following conditions:

- a. Transport will be in a motor vehicle.
- b. All radioactive material shall be packaged in D.O.T. specification containers. All containers shall be free of loose contamination on the outside.
- c. The gamma radiation, or equivalent, shall not exceed 200 mr/hr at the surface of the container and shall not exceed 10 mr/hr at one meter.
- d. There must not be any loose radioactive material in the motor vehicle and all containers shall be securely blocked and braced to prevent leakage or shift of lading under conditions normally incident to transportation. There shall not be more than 40 units per vehicle (One unit equals 1 milliroentgen per hour at one meter for hard gamma radiation or the amount of radiation which has the same effect on film as one mrhm of hard gamma rays of radium filtered by one-half inch of lead).

- e. Containers must be labeled according to the specifications set forth by D.O.T.
- f. The motor vehicle shall be placarded in conformity with D.O.T. regulations.
- g. Shipping orders, bills of lading, Health Physics-Radiation Control's Form H.P.-7, "Transfer of Radioactive Materials", or other shipping papers shall be prepared in conformity with D O.T. regulations.
- h. Loading shall be done under the direction of Health Physics-Radiation Control unless prior arrangements have been made.
- i. The motor vehicle shall be attended at all times. For transportation of high levels of unsealed radioactive material, two people shall accompany the shipment.
- j. Emergency instructions and an appropriate survey instrument shall accompany the driver of the motor vehicle.
- k. Cars, buildings, area, or equipment in which radioactive material has been spilled shall not be placed in service or occupied until decontaminated by qualified persons.

3. Transport from the University to Outside Facilities

This type of transport shall have the same requirements as those provided in Section A.2.

VIII. ADDITIONAL PROCEDURES AND INSTRUCTIONS

A. Testing of Sealed Sources

Before any sealed source is put into useful service for the first time, and at other intervals, the Approved User shall conduct tests or have the following tests conducted to determine its integrity.

- a. Initial measurement of activity.
- b. Dry wipe.
- c. Wet wipe.
- d. Emersion tests when applicable.
- e. Other applicable non-destructive procedures.

The presence of radioactive material which exceeds the limits set forth by the U.S. Nuclear Regulatory Commission, and/or the State of Michigan, and/or specific license agreement in any of the above tests shall be cause for removal of the source from use.

B. Support Personnel

Support personnel shall constitute the members of the Building Services and Public Safety Departments.

1. Emergencies

If a question exists regarding a possible radiation hazard, Health Physics-Radiation Control, as well as the staff member in charge of the facility, shall be called. No attempt should be made to enter an area where a radiation hazard exists unless life-saving procedures are necessary.

2. Non-Routine Maintenance and Custodial Services

Maintenance and custodial personnel, or the Approved User, shall request Health Physics-Radiation Control to conduct a radiation survey of the area where services are required. This survey shall be conducted prior to, or simultaneously with, the service being rendered. Requests for surveys shall be made at least 48 hours prior to the need for same.

3. Routine Maintenance and Custodial Services

Routine services shall be in accordance with procedures as established by Health Physics-Radiation Control.

4. Training Programs for Maintenance and Custodial Personnel

Training programs for support personnel shall be conducted periodically by Health Physics-Radiation Control for purposes of familiarizing personnel with those aspects of radiation safety relevant in the discharge of their duties. Participation of support personnel in these programs shall be mandatory upon notification from Health Physics-Radiation Control.

In general, the topics covered in these programs shall consist of:

- a. Types of sources of ionizing radiation.
- b. Description of posting placards, signs, and labels.
- c. Instructions regarding services in posted areas.
- d. Special instructions regarding emergencies or suspected incidents.

C. Instructions Regarding the Use of Animals Exposed to Radioactive Materials

I. Approved User's Responsibilities

The Approved User of radioisotopes in charge of a research project involving animals is responsible for the radioisotopes and radiation safety involved while the animals are being maintained by the Division of Laboratory Animal Resources (DLAR).

- a. DLAR personnel must be notified of animals containing radioactive material and given any specific precautions necessary in regard to radiation safety prior to using DLAR facilities.
- b. All cages housing animals injected with radioactive material must be tagged with the following information (using a "Caution - Radioactive Material" tag):
 - (1) Name of isotope.
 - (2) Amount of radioactive material injected per animal (in units of microcuries).
 - (3) Date of injection.
 - (4) Principal investigator's name and phone number.
- c. Animals containing radioactive material will be kept in cages apart from other animals.
- d. All procedures, including injection of radioisotopes and preservation of carcasses, carried on outside of cages will be done on steel trays with absorbent paper. The investigator will make any necessary surveys of the area to verify that there is no contamination of the facilities.
- e. Animals which have been injected with radioactive material that may be volatilized and dispersed into the room will be kept in an area with adequate ventilation and air cleaning facilities.
- f. Exercising of animals containing radioactive material will not normally be done. If investigator desires such, he will designate the task to someone directly responsible to him. The investigator will be responsible for any emergency or contamination problems which may arise.
- g. Appropriate surveys, during and at the end of a project, of the facilities used by an investigator will be made and results of these surveys will be recorded and kept on file. Any pertinent information arising from these surveys which imply a health hazard will be given to Health Physics-Radiation Control immediately.

- h. No animals from outside Wayne State University containing radioactive material will be housed by DLAR without prior approval of Health Physics-Radiation Control.
- i. The cages will be monitored by the investigator with a survey method appropriate to the radioisotope involved to determine the level of contamination. If contamination is found, decontamination of the cages will be performed under the direction of Health Physics-Radiation Control.

APPENDIX

Table No. 1 — Radioisotope Procurement Instructions

Table No. 2 — Contamination Levels in Restricted Areas

Table No. 3 — Suggested Agents for Removal of Contamination

Table No. 4 — Radioactive Materials Classification

Table No. 5 — Classification of Laboratories for Handling Radionuclides

Table No. 1

Radioisotope Procurement Instructions

A computer program has been established for the inventory of radioisotopes for Wayne State University. Each new Approved Buyer of radioisotopes will be issued pre-punched IBM cards for use in this program. A data sheet listing the inventory of isotopes will be forwarded to each Approved Buyer on a quarterly basis.

The Purchasing Department will not honor a routine requisition for a radioisotope unless a "Radioisotope Requisition" card accompanies the purchase requisition.

The procedure for ordering a radioisotope on a routine requisition will be as follows:

1. Information on the left hand portion of the "Radioisotope Requisition" card is to be filled out by the Approved Buyer or his representative and forwarded to Purchasing with the purchase requisition.
2. Purchasing will then contact Health Physics-Radiation Control for approval to order the isotope.
3. Upon receipt of approval, the card will be sent back to the Approved Buyer, whereupon he will retain the card until the isotope is received.
4. Upon receipt of the isotope, the Approved Buyer will complete the right hand portion of the requisition card and forward the card to Health Physics-Radiation Control.

The procedure to be followed in ordering isotopes on an *emergency* basis under this Inventory Control system is as follows:

1. The Approved Buyer shall contact the Purchasing Department and indicate that he desires to order a radioisotope on an emergency basis.
2. Purchasing will then contact Health Physics-Radiation Control for approval to order the isotope.
3. Upon receiving approval, Purchasing will contact the Approved Buyer and issue the Purchase Order number.
4. The Approved Buyer shall retain the blue "Radioisotope Requisition" card until the radioisotope is received, at which time he shall complete the right hand portion of the card and forward the card to Health Physics-Radiation Control.

The procedure for recording radioisotope usage will be as follows:

1. Upon use of a specific quantity of an isotope, or upon use or disposal of an entire batch of an isotope, the Approved Buyer will fill in the required information on an Isotope Usage card and forward this card to Health Physics-Radiation Control.

2. If isotope usage occurs frequently during the course of a week, these cards may be retained for forwarding to Health Physics-Radiation Control on a weekly basis.

Any questions concerning the procurement of radioisotopes under this system should be directed to Health Physics-Radiation Control.

Table No. 2

Contamination Levels in Controlled Areas

For Beta and Gamma loose contamination:

- Considerations: Collection efficiency = 10%.
Total area wiped per test = 100 cm^2 .
Recommended permissible contamination level is $10^{-4} \mu\text{Ci/cm}^2$.
Assume a safety factor of 1/10 recommended permissible contamination level.
- Action Levels: $< 220 \text{ dpm/wipe } (100 \text{ cm}^2)$ —Decontamination not necessary.
 $220 \text{ dpm/wipe } (100 \text{ cm}^2)$ or above—Decontamination necessary.

For Alpha loose contamination:

- Action Levels: $< 22 \text{ dpm/wipe } (100 \text{ cm}^2)$ —Decontamination not necessary.
 $22 \text{ dpm/wipe } (100 \text{ cm}^2)$ or above—Decontamination necessary.

For fixed contamination:

- Considerations: Maximum permissible dose to any individual in a controlled area is 100 mrem per 40 hour work week.
Assume a safety factor of 1/10 MPD.
- Action levels: $< 0.25 \text{ mr/hr}$ - No action necessary. 0.25 mr/hr or above - Appropriate action should be taken to reduce exposure.

*John R. Prince and Chih H. Wang, A Method for Evaluating Surface Contamination of Soft Beta Emitters. In: *Surface Contamination*, Ed. B. R. Fish, Pergamon Press, 1967.

Table No. 3

Suggested Agents for Removal of Contamination

Contaminated Area	Decontaminating Agent	Remarks
Skin and hands	Mild soap and water.	Wash 2 to 3 minutes and monitor. Do not wash over 3 to 4 times.
	If necessary, follow by soft brush, heavy lather, and tepid water.	Use light pressure with heavy lather. Wash for 2 minutes, 3 times. Rinse and monitor. Use care not to scratch or erode skin. Apply lanolin or hand cream to prevent chapping.
	<i>Other Procedures</i> A mixture of 50% Tide and 50% corn meal	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to scratch or erode the skin.
	A 5% water solution of a mixture of 30% Tide, 65% Calgon, and 5% Carbose (Carboxymethyl Cellulose)	Use with water. Rub for a minute and rinse.
	A preparation of 8% Carbose, 3% Tide, 1% Versene, and 88% water homogenized into a cream	Use without any additional water. Rub for one minute and wipe off. Follow with lanolin or hand cream.
	<i>Chemical Procedures</i>	(As a last resort)
	Titanium dioxide paste. Prepare paste by mixing precipitated titanium dioxide with a small amount of lanolin.	Work the paste into affected area for 2 minutes. Rinse and wash with soap, brush, and warm water. Monitor.
	Mix equal volumes of a saturated solution of potassium permanganate and 0.2 N sulfuric acid. Continue	Pour over wet hands, rubbing the surface and using hand brush for not more than 2 minutes. (Note: Will

Table No. 3 (continued)

Contaminated Area	Decontaminating Agent	Remarks
Skin and hands (continued)	with the next step also. (Saturated solution KMnO_4 is 6.4 gms. per 100 ml of water.) Apply a freshly prepared 5% solution of sodium acid sulfite (NaHSO_3).	remove a layer of skin if in contact with the skin for more than 2 minutes.) Rinse with water. Apply in the same manner as above. Apply for not more than 2 minutes. The above procedure may be repeated. Apply lanolin or hand cream when completed.
Hair	Liquid soap and rinse water.	Make repeated applications of liquid soap with water rinses, using towels to keep water from running onto the face and shoulders. Acid goggles can be used to protect the eyes. Thoroughly dry the hair before surveying. Apply lanolin or cream conditioner.
Wounds (cuts and breaks in the skin)	Running tap water. Report to Medical Officer and Radiation Safety Officer as soon as possible.	Wash the wound with large volumes of running water immediately (within 15 seconds). Spread the edges of wound to permit flushing action by the water.
Ingestion by swallowing	Report to Medical Officer and Radiation Safety Officer as soon as possible.	Urine and fecal analysis will be necessary to determine amount of radionuclides in the body.
Clothing	Wash, if levels permit.	Use standard laundering procedures. Three percent versene or citric acid may be added to wash water. Wash water must be below the MPL for sewer disposal.

Table No. 3 (continued)

Contaminated Area	Decontaminating Agent	Remarks
Glassware	Soap or detergent and water. Chromic acid cleaning solution or conc. nitric acid.	Monitor wash water and plan disposal of it.
	<i>Suggested Agents</i>	<i>Elements Removed</i>
	Oxalic acid 5% (Caution-poison)	Zr, Nb, Hf.
	Versene (EDTA) 5% conc. NH ₄ OH 3%	Alkaline Earth Metals: Be, Mg, Ca, Sr, Ba, Ra, P as PO ₄ .
	HCl 10% by volume	Alkali Metals, Na, K, Rb, Cs, and strongly absorbed metals like Po.
	To make, dissolve in order: (1) Versene (EDTA) 5% (2) Conc. NH ₄ OH, 3% by volume (3) Glacial acetic acid 5% by volume	Trivalent metals, Al, Sc, Y, La, Ce, Pr, Nd, Pm, Sa, Eu. Rare Earths, Ac, Ga, In, Ti, B. Transition metals, Cu, Zn, Fe, Co, Ni, Cd, Sn, Hg, Pb, Th, U, Ag. (Always consider the radioactivity of the cleaning solution when disposing of it).
Laboratory tools	Detergents and water, steam cleaning.	Use mechanical scrubbing action.
Metal tools	Dilute nitric acid, 10% solution of sodium citrate or ammonium bifluoride.	As a last resort, use HCl on stainless steel.
	Metal polish, sandblasting, other abrasives.	Such as brass polish on brass. Use caution as these procedures may spread contamination.

Table No. 3 (continued)

Contaminated Area	Decontaminating Agent	Remarks
Plastic items	Ammonium citrates, dilute acids, organic solvents	
Walls, floors, benches	Vacuum cleaning.	The exhaust of the cleaner must be filtered to prevent escape of contamination with a filter having a pore size of 0.2 microns. Central vacuum systems shall not be used.
	Detergents and water with mechanical action.	
	Water from high pressure source. Steam cleaning.	This may spread contamination.
<i>Specific Materials</i>		
Rubber	Washing or dilute HNO_3 .	
Leather	Very difficult to decontaminate	
Linoleum	CCl_4 , kerosene, Ammonium citrate, dilute mineral acids.	
Ceramic tile	Mineral acids, Ammonium citrate, trisodium phosphate.	Scrub hot 10% solution into surface and flush thoroughly with hot water.
Paint	CCl_4 , 10% HCl	Usually best to remove the paint.
Brick and concrete	32% HCl	If this is not successful, concrete must be removed.
Wood	Hot citric acid, remove the wood with a plane or floor chippers and grinders.	
Traps and drains	(1) Flush with water (2) Scour with rust remover. (3) Soak in 1 solution of citric acid. (4) Flush again.	Follow all four steps.

Table No. 4

Classification of Isotopes According to Relative Toxicity per Unit Activity

*Group 1**

Pb-210	Po-210	Ra-223	Ra-226	Ra-228	Ac-227	Th-227	Th-228	Th-230
Pa-231	U-230	U-232	U-233	U-234	Np-237	Pu-238	Pu-239	Pu-240
Pu-241	Pu-242	Am-241	Am-243	Cm-242	Cm-243	Cm-244	Cm-245	Cm-246
Cf-249	Cf-250	Cf-252						

*Group 2**

Na-22	Cl-36	Ca-45	Sc-46	Mn-54	Co-56	Co-60	Sr-89	Sr-90
Y-91	Zr-95	Ru-106	Ag-110m	Cd-115m	In-114m	Sb-124	Sb-125	Te-127m
Tc-129m	I-124	I-126	I-131	I-133	Cs-134	Cs-137	Ba-140	Ce-144
Eu-152(13y)		Eu-154	Tb-160	Tm-170	Hf-181	Ta-182	Ir-192	Tl-204
Bi-207	Bi-210	At-211	Pb-212	Ra-224	Ac-228	Pa-230	Th-234	U-236
Bk-249								

*Group 3**

Be-7	C-14	F-18	Na-24	Cl-38	Si-31	P-32	S-35	A-41
K-42	K-43	Ca-47	Sc-47	Sc-48	V-48	Cr-51	Mn-52	Mn-56
Fe-52	Fe-55	Fe-59	Co-57	Co-58	Ni-63	Ni-65	Cu-64	Zn-65
Zn-69m	Ga-72	As-73	As-74	As-76	As-77	Se-75	Br-82	Kr-85m
Kr-87	Rb-86	Sr-85	Sr-91	Y-90	Y-92	Y-93	Zr-97	Nb-93m
Nb-95	Mo-99	Tc-96	Tc-97m	Tc-97	Tc-99	Ru-97	Ru-103	Ru-105
Rh-105	Pd-103	Pd-109	Ag-105	Ag-111	Cd-109	Cd-115	In-115m	Sn-113
Sn-125	Sb-122	Te-125m	Te-127	Te-129	Te-131m	Te-132	I-130	I-132
I-134	I-135	Xe-135	Cs-131	Cs-136	Ba-131	La-140	Ce-141	Ce-143
Pr-142	Pr-143	Nd-147	Nd-149	Pm-147	Pm-149	Sm-151	Sm-153	Eu-152
Eu-155	Gd-153	Gd-159	Dy-165	Dy-166	Ho-166	Er-169	Er-171	(9.2 hr)
Tm-171	Yb-175	Lu-177	W-181	W-185	W-187	Re-183	Re-186	Re-188
Os-185	Os-191	Os-193	Ir-190	Ir-194	Pt-191	Pt-193	Pt-197	Au-196
Au-198	Au-199	Hg-197	Hg-197m	Hg-203	Tl-200	Tl-201	Tl-202	Pb-203
Bi-206	Bi-212	Rn-220	Rn-222	Th-231	Pa-233	Np-239		

*Group 4**

H-3	O-15	A-37	Co-58m	Ni-59	Zn-69	Ge-71	Kr-85	Sr-85m
Rb-87	Y-91m	Zr-93	Nb-97	Tc-96m	Tc-99m	Rh-103m	In-113m	I-129
Xe-131m	Xe-133	Cs-134m	Cs-135	Sm-147	Re-187	Os-191m	Pt-193m	Pt-197m
Th-232	Th-Nat	U-235	U-238	U-Nat				

* International Atomic Energy Agency (Venezia). Technical Reports Series No. 15 - A Basic Toxicity Classification of Radionuclides (1963).

† An alternative classification has been suggested by K. Z. Morgan, W. S. Snyder and M. R. Ford, *Health Physics*, 10 (3), 151, 1964.

*The International Atomic Energy Agency refers to Groups 1 to 4 as "High Toxicity", "Medium-Toxicity - Upper Sub-Group A", "Medium Toxicity - Lower Sub-Group B" and "Low Toxicity" respectively.

Table No. 5

Classification of Laboratories for Handling Radionuclides

Group of Radionuclide	Type of Laboratory			
	Type 3	Type 2	Type 1	Type 0
1	>1 mCi	10 μ Ci to 1 mCi	<10 μ Ci	0.1 μ Ci*
2	>100 mCi	1 mCi to 100 mCi	<1 mCi	1 μ Ci*
3	>10 Ci	100 mCi to 10 Ci	<100 mCi	10 μ Ci*
4	>1000 Ci	10 Ci to 1000 Ci	<10 Ci	100 μ Ci*

*Excluding any alpha emitters.

Note: Modifying factors for activities listed in above Table:

Procedure	Factor
Storage (Stock solutions)	100
Very simple wet operations	10
Normal chemical operations	1
Complex wet operations with risk of spill	0.1
Simple dry operations and work with volatile radioactive compounds	0.1
Dry and dusty operations	0.01

RADIATION SAFETY MANUAL FOR NURSES

**Wayne State University
Radiation Safety Program**

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PREFACE

With the rapid increase in the diagnostic and therapeutic use of radioactive isotopes, there should be no uncertainty or confusion concerning their hazards and the precautions to be observed. The information which follows is brought to the attention of all whose duties bring them into contact with patients who have received radioisotopes for diagnosis or treatment. The procedures outlined will assure safe, efficient nursing care.

I. INTRODUCTION

The use of radioactive sources in medicine began with the treatment of tumors and sarcomas with radium. Since the advent of nuclear technology there has been an increase in the use of radioactive sources in medicine. Radionuclides like iodine-131, cobalt-60, phosphorus-32, etc., which are by-products of nuclear technology, are used extensively in diagnostic and therapeutic medicine. For example, iodine-131 is used as a diagnostic aid in the evaluation of thyroid function and also as a therapeutic agent in the destruction of malignant thyroid tissue. It can be expected that in the future many new uses for radioactive material will be found in medicine.

Because radioactive materials have the property of penetrating and damaging tissue, exposure of the tissue to radiation may produce certain biological effects. Animal experimentation and some observations of humans indicate that exposure to low levels of radiation over a period of years may lead to an increase in the incidence of cancer and leukemia. Exposures to high levels of radiation produce the same effects in a shorter interval of time, plus such effects as epilation, skin burns, and general radiation sickness. To compound the above hazards, a genetic effect may result from changes in reproductive organs upon exposure to both low and high levels of radiation. These genetic effects may be observed in the increased frequency of mutations in coming generations.

The amount of radiation received by persons as a part of their normal duties should not exceed the dosage shown in Table I.

TABLE I*

Type of Exposure to Radiation Worker and Environs

Permissible total weekly doses in significant volumes
of critical organs under various conditions of exposure

Conditions of Exposure		Dose in Critical Organs (mrem per week)				Maximum Yearly Dose
Part of Body	Radiation	Skin at Basal Layer of Epidermis	Blood Forming Organs	Gonads	Lens of Eye	
Whole Body	Any radiation with half-value-layer greater than 1 mm of soft tissue.	600 ^a	100 av.	100 av.	5 rem.	
Hands and Forearms or Feet and Ankles or Head and Neck	Any radiation	1500 ^b				75 rem.
Environs Any Part of Body			10	10	10	0.5 rem.

*Regulations governing the use of radioactive isotopes, x-radiation and all other forms of ionizing radiation; Feb., 1967 - Michigan Department of Public Health, Division of Occupational Health, Lansing, Michigan.

The limiting value of 5 rems per year whole body exposure is the accepted yearly exposure. However, in case of an emergency, an individual can be exposed to whole body dosage of 25 rems once, and only once, during his lifetime. Females who are capable of reproduction shall not be exposed to the emergency dose. In general, radiation exposures are not to exceed the levels in Table I for the listed time intervals.

To minimize radiation exposures consistent with good nursing practice, several general rules can be followed:

1. Stay away from the source of the radiation. By doubling one's distance from the source, the exposure is reduced to one-quarter of its original intensity.
2. Reduce the amount of time which is spent near a radiation source.
3. To minimize individual exposure, rotate nursing care among nursing personnel.
4. Follow any special instructions issued by Health Physics-Radiation Control.
5. Whenever film badges are furnished, wear them at all times while on duty. Film badges will be issued *only* upon the recommendation of Health Physics-Radiation Control.

Whenever a patient has radium implants, plaques, or therapeutic doses of radioisotopes, such individuals are considered as radioactive sources. Any questions concerning possible hazards or biological effects associated with the nursing care of such patients should be directed to Health Physics-Radiation Control.

II. GENERAL INSTRUCTIONS

A. Avoidance of Hazards

To avoid the hazards which can result from the improper handling of radioactive patients, the following general instructions should be followed:

1. All patients receiving therapeutic radioactive material shall be identified by the use of a wrist band.
2. Special instructions indicating any special procedures, and identifying the radioactive material as to quantity and type, shall be made a part of the patient's chart.
3. All personnel involved in the nursing care of a patient who has received therapeutic radioactive material shall be informed of this fact and issued appropriate personnel monitoring equipment.
4. Any questions concerning radiation safety shall be directed to Health Physics-Radiation Control.
5. Any emergency involving radioactive material shall be reported immediately to Health Physics-Radiation Control.

III. SEALED SOURCES

A. Type and Probable Site

Sealed sources are usually in the form of needles, tubes, plaques, molds and special applicators and are used only in therapeutic procedures.

PROBABLE SITE AND SOURCE TYPE FOR SEALED SOURCES

Site	Type
Skin	Radium needle, radon seed, cobalt plaque, mold (Ra or Co)
Tongue, palate, floor of mouth	Radium needle, radon seed, mold
Vagina (cervix)	Special applicators with radium or cobalt-60 source
Bladder	Radon seeds
Rectum	Special applicator with radium or cobalt-60 source.

B. Five Operational Stages During Which Radiation Hazards Exist

In the application of sealed sources for medical therapy treatment, there are five operation stages during which radiation hazards exist:

1. Transfer of sources from storage and preparation for use on patients.
2. Transfer from preparation bench and application to patient.
3. Irradiation of patient.
4. Removal of sources from patient and transfer to preparation bench.
5. Removal of sources from applicators, cleaning and transfer from preparation bench to storage space.

C. Nursing Care

1. Nursing care shall be planned so as to avoid spending unnecessary time in close proximity to the patient. Nurses shall work with speed and efficiency.
2. Private duty nurses shall be instructed by Health Physics-Radiation Control concerning the minimum distance to remain from the patient's bed except during actual nursing care.

3. Pregnant females shall not attend the patient.
4. To minimize individual exposure, nursing care shall be rotated among nursing personnel.

D. Monitoring of Nursing Personnel Exposure

1. If a nurse's exposure is expected to approach 25 per cent of acceptable limits (25 mr/week average per calendar quarter), a film badge shall be assigned with exposure records kept on an available permanent file. Indirect or direct reading electroscope pocket dosimeters may be used for occasional monitoring provided a permanent record is kept of daily exposures by Health Physics-Radiation Control or some designated person other than the nurse being monitored.

E. Patient Room Assignment

1. Any patient receiving radium implant therapy shall be assigned to a room in a ward monitored by Health Physics-Radiation Control.
2. The room shall not be shared with other patients unless adequate shielding is provided and the exception is noted by the Radiation Safety Officer or his Deputy.

F. Bed Restrictions

1. The patient shall be restricted to bed rest during the entire period of treatment.

G. Perineal Implants

1. No lavatory privileges shall be given during the entire period of treatment.
2. The bedpan shall be visually checked by the nurse before emptying for dislodged radium sources on applicators. Bandages and dressings shall be changed only on the order of the radiologist or physician in charge.
3. The foot of the patient's bed shall be placed toward an outside wall.

H. Surgical Dressing, Bandages, and Linens

1. Surgical dressings and bandages should be changed only as directed by the radiologist.
2. Dressings, excreta soiled dressings, linens and other laundry used in connection with this patient shall not be removed from this patient's room until it has been monitored by radiation safety personnel for accidentally displaced radioactive material.

I. Posting and Placement of Instruction Sheets

1. The person authorized to treat a patient, with a sealed source, or the head nurse shall place in the patient's file an instruction sheet, on distinctively colored paper, containing the following information:
 - a. Caution label with source indicated
 - b. Visitors statement
 - c. Statement of hospital personnel.
 - d. Room assignment instructions
 - e. Statement on dressings, etc.
 - f. Emergency statement (displacement of source)
 - g. Statement of termination
 - h. Special instructions

The person authorized to treat a patient with a sealed source, or the head nurse shall post on all entrance doors to the patient's room a conspicuous sign in magenta lettering on a yellow background with the radiation hazard symbol and the legend "Caution - Radiation Area. Unauthorized persons keep out. In case of emergency, call the Radiation Safety Officer."

J. Visitors and Other Patients

1. No visitors under 18 years of age are allowed.
2. Pregnant persons are to be excluded from the patient's room.
3. Visitors must stay at least three feet from the patient and visiting time is limited to one hour per day.
4. Other patients are to be excluded from the patient's room unless adequate shielding is provided and the exception is noted by the Radiation Safety Officer or his Deputy.

K. Termination of Treatment

1. Upon termination of treatment, the person removing the radioactive material shall indicate the radiation safety status, date, time, and that further radiation safety precautions are no longer required in connection with the patient undergoing treatment on the appropriate form.
2. Nurses shall not take, nor be given responsibility for the handling and storing of removed applicators.
3. Upon termination of treatment, the person removing the radioactive material shall determine that the number of sources implanted are accounted for before removing the transport container to the radium storage room.

L. Instruments, Containers, and Utensils

1. Instruments and containers used to handle sealed sources do not ordinarily become radioactive.
2. No special precautions are needed for sputum, vomitus, dishes, utensils, or instruments unless noted by the Radiation Safety Officer or his Deputy.

M. Emergencies

1. If the source is displaced or disturbed accidentally, the x-ray therapy department must be notified immediately. At night or on weekends the radiology resident on duty should be contacted and/or the attending physician.
2. If a source should fall out, *do not pick it up*. Notify the x-ray therapy department and move to a safe distance (at least six feet) from the source until personnel from Health Physics-Radiation Control or x-ray therapy arrive.
3. In the event of any other untoward incident involving radioactive material, the Radiation Safety Officer or Health Physics-Radiation Control shall be notified immediately.
4. Nurses shall not be responsible for manipulating or removing dislodged sources.

IV. NON-SEALED SOURCES

A. Type and Probable Site

Non-sealed sources may be used either in a diagnostic or in a therapeutic procedure, and are usually in liquid form.

PROBABLE SITE AND SOURCE TYPES FOR NON-SEALED SOURCES

Site	Type
Thyroid tissue	Iodine-131 as a liquid, administered orally or intravenously
Abdominal cavity	Phosphorus-32 or gold-198 administered as colloid in liquid
Pleural cavity	Phosphorus-32 or gold-198 administered as colloid in liquid
Brain	Technecium-99m
Blood	Chromium-51
Liver	Cobalt-60 or Cobalt-57 tagged B-12

B. Instructions for the Nursing Care of Patients Receiving Therapeutic Doses

Since non-sealed sources are introduced as liquids into the blood, the gastrointestinal tract, or the body cavity, they may be found in the urine, feces, saliva, vomitus and perspiration.

1. Iodine-131

- a. Read the patient's chart for any specific instructions.
- b. All linen and other articles (including dressings) used in conjunction with the care of the patient within the first 48 hours shall be turned over to the Isotope Department.
- c. Whoever changes dressings or linen, or is likely to come into contact with other articles contaminated by the patient, should wear rubber gloves during the first 48 hours.
- d. All personnel (including visitors) entering the patient's room within the first 48 hours shall wear a covering gown.
- e. All waste generated in the patient's room should be stored in a waterproof bag in the room until removed by authorized personnel.
- f. Plastic or rubber coverings shall be used on the pillow and mattress.
- g. Isolation trays shall be used unless an exception is noted by the Radiation Safety Officer or his Deputy.
- h. If any body fluids are to be collected, all necessary equipment for the collection with appropriate shielding shall be furnished by the Isotope Laboratory.
- i. After a patient is discharged, the area shall not be released for further use until approval has been given by the Radiation Safety Officer or his Deputy.
- j. During the first 48 hours only those housekeeping procedures approved by the Radiation Safety Officer or his Deputy shall be carried out.

2. Phosphorus-32

- a. In the use of radioactive chromic phosphate in the body cavities, the dressing over the site of the injection will always be contaminated. Gloves must be used in handling the dressing or any material which has made contact with fluid oozing from the injection site.
- b. All linens must be checked by the Isotope Laboratory before releasing them to the laundry.
- c. If phosphorus is given orally, and the patient vomits within the first 24 hours, isolation procedures should be used to carry out appropriate nursing procedures. The vomitus and the soiled bedding, clothing or utensils shall be saved for the Isotope Department.

3. Radioactive Gold

- a. During the first 24 hours, any occupancy of the room shall be controlled as authorized by the Radiation Safety Officer or his Deputy. Generally, anyone occupying the patient's room should stay about six feet away from the bed except during actual nursing procedures.
- b. For the first 48 hours visitors should sit at least three feet away from the bed. Visitors under 18 years of age and pregnant females should not be permitted.
- c. No special precautions need be taken for dishes, instruments or utensils.
- d. No precautions need be taken for vomitus, urine, stools or sputum.
- e. Dressings should be changed by the doctor. Dressings over the puncture wound, during the first 48 hours, should be saved for the Isotope Department if they show staining. (radioactive gold will stain red or purple.) If there is no drainage from the puncture wound after the first 48 hours, the dressing may be handled in the usual manner.
- f. If the surgical dressing becomes damp, stained, or bloody because of drainage or leakage from the puncture wound, *do not touch the dressing*. Call the Isotope Laboratory or the Radiation Safety Officer or his Deputy.
- g. If bed clothes become contaminated by drainage or leakage from the puncture wound, save the linen in a special bag for the Isotope Laboratory.
- h. If colloidal gold-198 is used in prostate treatment, the urine will be collected once and given to personnel in the Isotope Laboratory for safe disposal.

4. Other Isotopes

Individual written instructions will be issued by the Isotope Laboratory or the Radiation Safety Officer or his Deputy.

C. Nursing Care for Patients Receiving Tracer Doses of Radioactive Isotopes

1. General

- a. There is no danger in carrying out normal nursing care.
- b. There are no restrictions on visitors other than usual hospital rules.
- c. There are no special precautions for dishes, utensils or instruments.
- d. Special precautions may be necessary if urine or stools are to be saved for isotope studies. The Isotope Department will issue specific instructions if stool and urine collections are necessary.

- e. If a patient should contaminate the bed with urine or feces during the first 24 hours, save the linen in a special bag for the Isotope Department.
- f. If the patient should vomit during the first 24 hours, collect the vomitus in a cardboard container and save it for the Isotope Department.

2. After-Care of the Equipment

- a. Rinse the bed pan, urinal, bath basin, and similar equipment with tap water. Discard the rinsings into the hopper. Wash the equipment thoroughly with a detergent and water; rinse and dry.
- b. Wash rubber gloves with detergent and water *before* removing them from the hands.
- c. Put contaminated gowns in a soiled linen container.
- d. Wash hands thoroughly under running water after removing the gloves.

3. Records

- a. In the "medication" column of the nurse's notes, the radioactive substance and the amount should be recorded.
- b. In the "observation" column of the nurse's notes, any immediate effect upon the patient should be noted.

D. Emergencies and Emergency Guide Sheet

Emergency situations can arise from the following:

- 1. Vomiting within six hours after the administration of a non-sealed source.
- 2. Spilling of excretions from a non-sealed source administration.
- 3. Detachment or accidental removal of a sealed source.
- 4. Involuntary micturition or defecation from a non-sealed source administration.

In any of the above situations take precautions that no one enters the contaminated area and immediately notify the group which is listed on the emergency guide chart.

If emergency care of the patient is required, the contaminated area may be covered by absorbent material such as paper, cotton, or old linen. Wear a gown, gloves, and shoe protection while administering to the patient.

Do not attempt to dispose of vomitus and other materials. Place contaminated materials in the receptacles furnished by the Isotope Laboratory.

Health Physics-Radiation Control or isotope personnel will monitor nursing personnel for contamination. In the event of extensive contamination of nursing personnel, the contaminated individual should wash the affected parts thoroughly with a detergent or soap, then shower and change clothes. All contaminated clothing shall be put in separate containers for monitoring. All decontamination procedures will be carried out under the direction of Health Physics-Radiation Control or Isotope Laboratory personnel.

V. SPECIAL INSTRUCTIONS FOR Ra HANDLING AND STORAGE

A. Five Operational Stages During Which Radiation Hazards Exist

In the application of radium for medical therapy treatment, there are five operational stages during which radiation hazards exist.

1. Transfer of sources from storage and preparation for use on patients.
2. Transfer from preparation bench and application to patient.
3. Irradiation of patient.
4. Removal of sources from patient and transfer to preparation bench.
5. Removal of sources from applicators, cleaning and transfer from preparation bench to storage space.

B. Leak Test

1. No sealed source shall be used unless a satisfactory leak test was performed on it and recorded within the six month interval immediately preceding such use.
2. All sources shall be leak tested at intervals not exceeding six months with a permanent record of leak test results entered in the inventory log. The leak test method shall be capable of detecting the presence of 0.005 microcuries of removable contamination and should be capable of detecting minute quantities of radon leakage.

Any source revealing the presence of 0.005 microcuries of removable contamination will be considered as a leaking source and shall not be used until it is repaired. Sources indicating slight radon leakage should be tested at more frequent intervals to circumvent the possibility of eventual rupture and gross contamination problems.

C. Treatment Scheduling and Termination

1. Whenever possible, treatments shall be scheduled to start and end during normal dayshift hours.

2. The person who administers treatment to a patient using a sealed source of radioactivity shall be responsible for terminating the treatment and for the prompt return to storage of all sources used. When possible, a second radiation therapist shall be present to observe and be thoroughly familiar with the procedures in the event that the person who initiates the treatment is unavailable to terminate it. The radiation protection officer shall be notified immediately upon determining that a person other than a radiation therapist in observance during start of treatment will be used to terminate it.
3. Certification of radiation hazard status must be completed upon termination of treatment.

D. Records and Accountability of Sources

1. For accurate accountability of sources, the Radiation Safety Officer or his Deputy shall make or cause to be made an entry in a permanent log each time sources are removed from or returned to the storage container. Such entries shall include date, time, name of patient, number of sources removed and sources remaining in storage. In addition, a periodic inventory of the contents of the safe or storage container shall be made with a permanent record kept and signed by the Radiation Safety Officer or his Deputy.
2. The following information shall be *promptly* recorded *during* use of sealed sources:
 - a. Patient's number and name.
 - b. Date source was received, or date and finding of latest leak test, whichever is most recent.
 - c. Date and time of removal from storage.
 - d. Amount of radioactivity in each source and number of sources used.
 - e. Number and type of applicator(s) used. (Indicate "needles", etc.).
 - f. Maximum radiation intensity at three feet from loaded applicator before treatment.
 - g. Date and time treatment started.
 - h. Maximum radiation intensity at three feet from loaded applicator during treatment.
 - i. Date and time treatment ended.
 - j. Maximum radiation intensity at three feet from loaded applicator on removal from patient.
 - k. Maximum radiation intensity at three feet from loaded applicator on return to "L-Block" (or to storage if applicators are not unloaded.)
 - l. Number of sources removed from applicator and returned to storage (or number of loaded applicators returned to storage).
 - m. Date and time of return to storage.
 - n. Names of persons performing each of the preceding steps.

E. Loading, Transport, and Unloading

1. General Precautions:

- a. Excessive use of over-long, too heavy, or cumbersome instruments will often increase the time of operation to a point where the total exposure exceeds that obtainable with less physical protection and correspondingly less time.
 - b. Applicators should be carefully designed for ease of handling. Each type of applicator should have its special tool for the manipulation of screw caps and plugs, without the necessity of holding either the applicator or the cap or plug in the hands.
 - c. All steps possible in the preparation and assembly of an applicator should be carried out before the insertion of the source.
 - d. Any dismantling of an applicator shall be limited to the removal of the source from the applicator. The removal of radioactive material from the source should be done only by trained qualified personnel.
 - e. Personnel should be allowed to do this work only after a period of training. No physician should be engaged in this work unless he is familiar with the hazards involved and the techniques of minimizing them.
2. All loading and unloading of applicators, as well as assembly and disassembly of loaded applicators shall be performed behind the "L-Block" shield.
 3. All manipulation of sealed sources should be performed with long-handled tools (12" to 24") designed for the purpose. Choice of tools shall be based on avoidance of damage to sources while minimizing unnecessary radiation exposure as much as possible.
 4. Each source shall be examined for visible defects during loading and unloading of applicators, and shall only be used if there is no reason to question the integrity of the source containment.
 5. Loaded applicators shall be placed immediately in the leaded carrying pig or transport cart pending removal to the operating room when the operating staff is ready for the implant.
 6. Transport containers shall be used only for transport, and not for storage of sealed sources, either temporarily or permanently.
 7. The transport cart will be posted with the radiation symbol and the words "Caution - Radioactive Material" when loaded.
 8. Every user of a radiation source in any part of the hospital shall observe such precautions as are necessary to minimize unnecessary radiation exposure to himself, the patient, other hospital personnel, visitors, and other persons.
 9. After treatment time is completed, the sources shall be removed by the individual who made the initial implant and returned immediately to the leaded transport container. The same precautions of speed and minimum attendant personnel will be observed as during the implant.

10. It shall be determined that the number of sources implanted are accounted for before removing the transport container to the radium storage room.
11. Removal of the applicator from the transport cart to the loading block will be accomplished prior to unloading applicator or sterilizing same.
12. All procedures involving sealed sources, including transfers between storage, L-Block, transport container, operating suite and the patient, shall be planned and executed, so as to be accomplished quickly, safely, and with the least exposure to personnel that is consistent with the purpose of the procedure.

F. Patient Implant and Recovery

1. When the patient is prepared for the radium, the transport container shall be taken quickly to the O.R. where insertion of implant shall be done by the attending physician or radiotherapist only.
2. Insertion shall be done with utmost speed and with minimum personnel required for assistance, to reduce personnel exposure.
3. Localization films, if required, will be done with portable x-ray equipment in the operating room.
4. The patient shall be taken quickly from the operating room or recovery room to a private room where *Radium Implant Patient Care Procedures* will be rigidly followed.

G. Safety of Adjacent Areas

1. Safety of the room adjacent to, including above and below, the radium patient's room shall be determined by calculation or monitoring with a suitable radiation survey instrument by the radiotherapist or Radiation Safety Officer. For uncontrolled occupancy except for nurseries on a 24-hour basis, a radiation dose rate of two mr/hr maximum is allowed. Radium usage shall be such that dose rate in nurseries is unchanged from background levels. All areas not determined safe for uncontrolled occupancy shall be restricted as necessary.

H. Sterilizing

1. If sterilizing the sources requires standing in sterile solution for an extended length of time, the sterilizing container shall be adequately shielded and placed in a remote location with the necessary warning signs attached.

2. After cleaning or sterilizing, the sources shall be returned to the safe or permanent storage container.

I. Storage

1. The radium shall be kept in the radium safe or radium storage container at all times when not in use.
2. The radium room should remain locked when unattended to prevent unauthorized entrance. If the radium room is not kept locked, the radium container must be provided with a lock with access to the key under the supervision of the Radiation Safety Officer.
3. All material shall be stored in appropriate compartments.
4. No user shall leave any radiation source unattended without taking appropriate measures to protect it against misuse or other misadventure. Every radioactive material container shall be properly labeled and its contents identified whenever left unattended.

J. Monitoring and Safety Devices

1. A personal monitoring device (calibrated film badge and/or equivalent dosimeter), appropriate to the exposure involved, shall be worn during all working hours by each person authorized to use and/or handle any source of ionizing radiation in the hospital, unless specifically exempted by the radiation protection officer.
2. Fluoroscopic type radiation protective garments shall not be worn during procedures involving high energy gamma radiation sources such as radium or cobalt-60 because of the tendency of such garments to increase the dose which is absorbed by the wearer when exposed to such high energy sources.