RADIATION SAFETY MANUAL

for

WEST VIRGINIA UNIVERSITY

December 1981

TABLE OF CONTENTS

Section 1: Introduction

The use of radioactive materials is valuable in a wide variety of clinical and experimental situations. This use is not without risk. One purpose of this manual, as well as the various state and federal regulations, is to retain the benefits while minimizing the risk.

Most radioactive materials are obtained and used here under a specific license of broad scope issued to West Virginia University by the U.S. Nuclear Regulatory Commission. Large sources, source material (uranium or thorium), special nuclear materials (enriched U-235 or U-233 and plutonium in certain quantities) and medical teletherapy units are covered by separate university licenses. In no instance is an individual within the university licensed under current N.R.C. practice. In addition, all operations involving the use of ionizing radiation, whether produced by radionuclides or x-ray units, are subject to the regulations of the West Virginia State Department of Health. This manual reflects both the federal and state regulations.

This manual provides users with the information needed to safely handle radioactive material and radiation producing machines. The regulations are not intended to harass, hinder or obstruct the use of ionizing radiation at West Virginia University; but rather, to ensure that such use is in accordance with accepted standards as directed towards the protection of health and the minimization of danger to life or property. Great care has been taken in formulating these regulations to achieve a balance between convenient methods of control and individual user's convenience. However, there is no compromise on safe handling of radiation sources.

All matters related to the radiation sources such as their procurement, their use, their transfer and disposal, the design of radiation facilities, the emergency procedures, etc., as well as the working of the various committees related to the administration of the radiation safety office are described in this manual. The radiation safety office is located in Room G-210, University Hospital. All radioactive material will be received and distributed from this office.

The manual is divided into sixteen sections. Each section has page numbers designated by the number of the section. The ring binder format is chosen for the manual so that changes can be implemented by simply substituting the new page for the old.

A copy of this manual should be available to all those using radiation or radionuclides.

Section 2: Abbreviations, Definitions and Units

As used in this manual:

Agency - means the West Virginia Department of Health

Airborne Radioactive Area - means (i) any room, enclosure, or operating area in which airborne radioactive material exists in concentrations in excess of the amounts specified in Appendix B, Table I, Column 1 (Section 15.06), or (ii) any room, enclosure or operating area in which airborne radioactive material exists in concentrations which, averaged over the number of hours in any week during which, individuals are in the area, exceed 25 percent of the amounts specified in Appendix B, Table I, Column 1 (Section 15.06).

Airborne Radioactive Material - means any airborne radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases.

Aluminum Equivalent - means the thickness of aluminum affording the same attenuation, under specified conditions, as the material in question.

Attenuation - means the decrease in exposure rate of radiation caused by passage through material.

Byproduct Material - means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

Becquerel (Bq) - Radioactivity may be measured in terms of Bequerels. A Becquerel is that quantity of radioactive material which decays at the rate of 1 disintegration per second. Appropriate multiples are kiloBecquerel (kBq), megaBecquerel (MBq) and GigaBecquerel (GBq). This unit is replacing the Curie.

Calendar Quarter - means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be such that no day is included in more than one calendar quarter or omitted from inclusion within a calendar quarter. No licensee shall change the method observed by him of determining calendar quarters except at the beginning of a calendar year.

Controlled Area - means any area access to which is restricted by the registrant for purposes of protection of individuals from exposure to radiation and radioactive materials. Controlled area shall not include any areas used for residential quarters, although a separate room or rooms in a residential building may be set apart as a controlled area.

Curie - Radioactivity may be measured in terms of curies. A curie is that quantity of radioactive material which decays at the rate of 3.7×10^{10} disintegrations per second or 2.2×10^{12} disintegrations per minute. A commonly used submultiple of the curie is the microcurie (μCi), one μCi = 0.000001Ci = 3.7×10^{4} dps = 10^{6} dpm.

Dead-man Switch - means a swithch so constructed that a circuit-closing contact can only be maintained by continuous pressure by the operator.

Diagnostic-type Tube Housing - means an X-ray tube housing so constructed that the leakage radiation at a distance of 1 meter from the target cannot exceed 100 milliroentgens in 1 hour when the tube is operated at any of its specified ratings.

Dose - means the quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body. When a dose is specified during a period of time, the dose means the total quantity of radiation absorbed per unit of mass, by the body or by any portion of the body during such period of time.

Filter - means material placed in the useful beam of a radiation machine to absorb preferentially the less penetrating radiations.

Gray (Gy) - a measure of radiation absorbed by any substance in terms of the energy absorbed per unit mass of the substance (dose). One Gray corresponds to the absorbtion of 1 Joule per kilogram of mass. The Gray is replacing the rad as a unit of dose. One Gray equals one hundred rads.

Half Life - means the amount of time required for the activity of a specific radioactive material to reach one-half of its original activity.

Half-value Layer (HVL) - means the thickness of an absorber required to reduce a beam of radiation to one-half its incident exposure rate.

Healing Arts - means diagnostic and/or healing treatment of human and animal maladies including but not limited to the following which are duly licensed by the State of West Virginia for the lawful practice of: medicine and its associated specialities, dentistry, veterinary medicine, osteopathy, chiropractic, and podiatry.

High Radiation Area - means any area, accessible to individuals in which there exists radiation at such levels that the individual could receive in any one hour a dose to the whole body in excess of 100 millirems.

Human Use - means the internal or external administration of radiation or radioactive materials to an individual.

Individual - means any human being.

Inherent Filtration - means the filtration in the useful beam due to the window of the X-ray tube and any permanent tube enclosure.

Installation - means the location where one or more sources of ionizing radiation are used, operated, or stored.

Interlock - means a device for precluding access to an area of radiation hazard either by preventing entry or by automatically removing the hazard.

Kilovolts Peak (kvp) - means the crest value in kilovolts of the potential of a pulsating potential generator. When only one-half of the wave is used, the value refers to the useful half of the wave.

Lead Equivalent - means the thickness of lead affording the same attenuation, under specified conditions, as the material in question.

Leakage Radiation - means all radiation coming from within the tube housing except the useful beam.

Monitoring - means a periodic or continuous determination of the exposure rate in an area (area monitoring) or the exposure received by a person (personnel monitoring) or the measurement of contamination level.

NRC - means the U.S. Nuclear Regulatory Commission

Occupational Dose - means any dose to an individual from radiation (1) in a controlled area or (2) in the course of employment in which the individual's duties involve exposure to radiation; provided, however, that occupational

dose shall not be deemed to include an individual's radiation dose for the purpose of diagnosis or therapy of such individual.

Person - means any individual, corporation, partnership, firm, association, trust, estate, public or pribate institution, group, agency, political subdivision of West Virginia, any other State or political subdivision or agency thereof, and any legal successor, representative, agent or agency of tne foregoing, other than the United States Nuclear Regulatory Commission, or any successcr thereto, or other federal government agencies.

Personnel Monitoring Equipment - means devices designed to be worn or carried by an individual for the purpose of measuring the radiation exposure received (e.g., film badges, pocket ionization chambers, pocket dosimeters, TLD rings, etc.).

Primary Protective Barrier - means a barrier sufficient to attenuate the useful beam to the required degree.

Protective Apron - means an apron made of attenuating materials used to reduce radiation exposure.

Protective Barrier - means a barrier of attenuating materials used to reduce radiation exposure.

Protective Glove - means a glove made of attenuating materials used to reduce radiation exposure.

Qualified Expert - means an individual who has demonstrated to the satisfaction of the Agency that he possesses the knowledge and training to measure ionizing radiation, to evaluate safety techniques, and to advise regarding radiation protective needs.

Radiation - means gamma rays and X-rays, alpha and beta particles, high-speed electrons, neutrons, and other nuclear particles; but not sound or radio waves or visible, infrared, or ultraviolet light. (Same as ionizing radiation.)

Radiation Area - means any area, accessible to individuals, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirems, or in any 5 consecutive days a dose in excess of 100 millirems.

Radiation Producing Machines - means any equipment capable of

producing radiation when the association controls are operated, but excluding equipment which produces radiation only by the use of radioactive materials.

Rad - a measure of the dose of any radiation to body tissue in terms of the energy absorbed per unit mass of the tissue. One rad corresponds to the absorption of 100 ergs per gram of tissue. (One millirad (mrad) = 0.001 rad).

Radiation Safety Officer (RSO) - means a person appointed by the University President to be directly responsible for radiation protection at the West Virginia University.

Radioactive Material - means any material, solid, liquid, or gas, which emits ionizing radiation spontaneously.

Registrant - means any person in West Virginia who possess a registrable item and registers such item with the Agency in accordance with its regulations.

Registration - means the filing with the Agency by a registrant of all registrable items in accordance with these regulations. Registration is made on forms available from the Agency. Registration does not imply Agency approval or disapproval of the use of such registrable items.

Rem - a measure of the dose of any radiation to body tissue in terms of its estimated biological effect relative to a dose of one "rad" of X-rays. (One millirem (mrem) = 0.001 rem). For the purposes of regulation, any of the following is considered to be equivalent to a dose of one rem:

a. An exposure of 1 R due to X-, or gamma radiation;

b. A dose of 1 rad due to X-, gamma, or beta radiation;

c. A dose of 0.1 rad due to neutrons or high energy protons;

d. A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye;

e. If it is more convenient to measure the neutron flux, or equivalent, than to determine the neutron dose in rads, as provided in subparagraph (c) of this paragraph, one rem of neutron radiation may, for purposes of these regulations, be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body, or

f. If there exists sufficient information to estimate with

reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to one rem may be estimated from the following table:

TABLE III

Neutron Flux Dose Equivalents

Neutron Energy (Mev)	Number of Neutrons Per Square Centimeter Equivalent to a Dose of 1 Rem (neutrons/cm^2)	Average Flux to Deliver 100 Millirem in 40 hrs (neutrons/cm^2 per sec.)
Thermal	970×10^6	670
0.0001	720×10^6	500
0.005	820×10^6	570
0.02	400×10^6	280
0.1	120×10^6	80
0.5	43×10^6	30
1.0	26×10^6	18
2.5	29×10^6	20
5.0	26×10^6	18
7.5	24×10^6	17
10.0	24×10^6	17
10 to 30	14×10^6	10

Roentgen (R) - the special unit of radiation exposure equal to the production in air of ions bearing 2.58×10^{-4} coulombs of charge of either sign by electrons generated per-kilogram in air.

Scattered Radiation - means radiation that, during passage through matter, has been deviated in direction.

Sealed Source - means radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling.

Secondary Protective Barrier - means a barrier sufficient to attenuate stray radiation to the required degree.

Shutter - means a device, generally of lead, fixed to an X-ray tube housing to intercept the useful beam.

Sievert (Sv) - a measure of dose equivalent to any body tissue in terms of its relative biological effect relative to one

Gray. The Sievert is replacing the rem. See "rem" for detailed conversion information. One Sievert equals one hundred rem.

Source Material - means: (1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05 percent) or more of uranium, thorium or any combination thereof. Source material does not include special nuclear material.

Source of Radiation - means any radioactive material, or any device or equipment emitting or capable of producing radiation.

Stray Radiation - means radiation not serving any useful purpose. It includes leakage and secondary radiation.

Survey - means the evaluation of the radiation associated with the production, use, release, disposal or presence of sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and/or equipment and measurements of radiation levels or concentrations or radioactive materials.

Therapeutic-type Tube Housing - means an X-ray tube housing so constructed that the leakage radiation at a distance of 1 meter from the target cannot exceed 1 roentgen in 1 hour; and at a distance of 5 centimeters from any point on the surface of the housing accessible to the patient cannot exceed 30 roentgens in 1 hour when the tube is operated at any of its specified ratings.

Uncontrolled Area - means any area access to which is not controlled by the registrant for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

Unrefined and Unprocessed Ore - means ore in its natural form prior to any processing, such as grinding, roasting beneficiating, or refining.

Useful Beam - means that part of the radiation which passes through the windows, aperture, cone or other collimating device of the tube housing in an X-ray unit.

Whole Body - means the whole body, or head and trunk, or active

blood forming organs, or lens of eyes, or the gonads (this definition is not applicable to the phrase "skin of the whole body").

NOTE: Other terms not herein specifically defined shall be used in accordance with the definitions in the Recommendations of the National Council on Radiation Protection and Measurements, or any successor thereto, as published in Handbooks of the National Bureau of Standards.

ADDENDUM:

Shall - Shall indicates a recommendation that is necessary or essential to meet the currently adopted standards of protection.

Should - Should indicates an advisory recommendation that is to be applied when practicable.

Section 3: Responsibility of Radiation Committees and of Certain Individuals

The U.S. Nuclear Regulatory Commission has granted West Virginia University a broad license for the use of nuclear byproduct and source materials as well as several specific licenses for uses such as cobalt teletherapy, plutonium powered pacemakers, etc. In addition, a number of radionuclides, as well as all x-ray sources are operated under a system of registration with the West Virginia State Department of Health.

The use of sources of ionizing radiation, whether subject to state or federal regulation is administered by the Radiological Safety Committee and a number of other committees reporting to the Radiological Safety Committee. This is illustrated in figure 3.1.

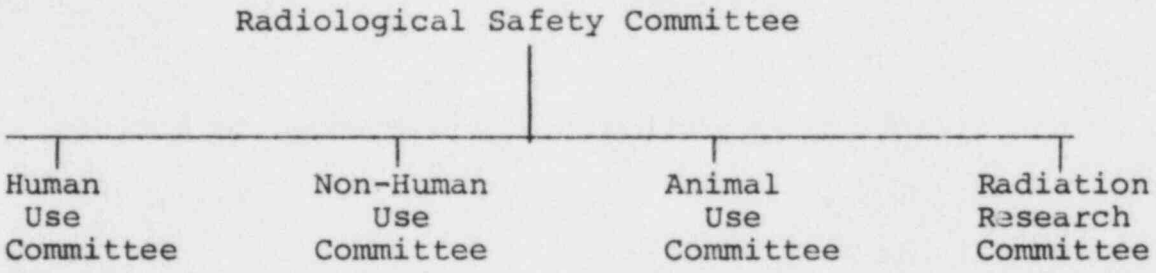


Figure 3.1 Administrative Structure

Members

Members of the Radiological Safety Committee are appointed by the president of the University. Members of the other committees are appointed by the Radiological Safety Committee after nomination by the chairman of the Radiological Safety Committee, the Radiation Safety Officer or the chairman of the individual committee. Unless the appointment is by reason of a person's status, e.g., the director of the animal quarters on the Animal Use of Radiation and Radionuclides Committee, it will be for two years, renewable once.

Section 3.1 The Radiological Safety Committee

The Radiological Safety Committee is composed of the Vice President for Health Sciences, the Vice President for Research and Graduate Studies, the Dean of The College of Medicine, and the Hospital Administrator with responsibility for the Radiology Department, the Radiation Safety Officer and the chairman of each of the committees reporting to the Radiological Safety Committee.

The committee meets at least quarterly to:

1. Adopt rules and policies on the use of ionizing radiation within the university.

2. Review plans for all new building and modifications of existing structures where ionizing radiation is to be used.

3. Review reports by the Radiation Safety Officer and the chairman of the reporting committees.

4. Approve or modify proposals for amendments to the various licenses or applications for new licenses.

5. Review the operation of the radiation safety office on at least an annual basis to insure that all license obligations and regulations of the U.S. Nuclear Regulatory Commission and the West Virginia State Department of Health are met and that regulations notwithstanding, sources of ionizing radiation are being used in a safe manner.

6. Approve changes in the radiation safety manual and recommend changes when these become necessary.

Section 3.2 Human Use of Radiation and Radionuclides Committee

The committee is composed of the chairman of the Radiology Department, the Director of Nursing Service, physicians who are experts in radiation therapy, nuclear medicine, internal medicine, hematology, a person experienced in the assay of radionuclides, and a member of the radiation safety office staff, as well as such additional members as shall be nominated by the chairman of the Radiological Safety Committee in consultation with the committee.

The committee meets at least quarterly to:

1. Adopt rules and policies pertaining to the use of ionizing radiation on humans.

2. Review and either approve or return for amendment all proposals for the use of radionuclides in humans.

3. Examine the qualifications of all persons proposing to use radionuclides in humans.

4. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used on humans and to send its recommendations to the Radiological Safety Committee.

5. Review proposed shielding and operations of all radiation producing machines and equipment used for the exposure of humans.

6. Review all instances of alleged infractions of rules and unsafe practices in the human use of ionizing radiation, and to take the steps necessary to ensure safe practice.

7. Review reports from the radiation safety office on those using ionizing radiation on humans and any changes or impending changes in regulations.

8. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the human use of ionizing radiation.

Section 3.3 Non-Human Use of Radiation and Radionuclides Committee

The committee is composed of a physician who is an expert in the use and properties of radionuclides, a person experienced in the assay of radionuclides, a member of the staff of the radiation safety office and others who may be nominated by the chairman of Radiological Safety Committee in consulation with the committee.

The committee meets at least quarterly to:

1. Adopt rules and policies on the in vitro use of sources of ionizing radiation at the Medical Center and at the Charleston Division.

2. Review and either approve or return for amendment all proposals for the in vitro use of ionizing radiation at the Medical Center or the Charleston Division.

3. Examine the qualifications of all persons proposing to use radionuclides in vitro at the Medical Center or the Charleston Division.

4. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used in vitro at the Medical Center or the Charleston Division and send its recommendations to the Radiological Safety Committee.

5. Review all instances of alleged infractions of rules and unsafe practices in the use of ionizing radiation in vitro at the Medical Center or the Charleston Division and take the steps necessary to ensure safe practice.

6. Review reports from the radiation safety office on those using ionizing radiation in vitro and any changes or impending changes in regulations.

7. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the vitro use of ionizing radiation at the Medical Center and Charleston Division.

Section 3.4 Animal Use of Radiation and Radionuclides Committee

The committee is composed of the director of the animal quarters, a person experienced in the assay of radionuclides, a member of the staff of the radiation safety office and others who may be nominated by the chairman of the Radiological Safety Committee in consultation with the committee.

The committee meets at least quarterly to:

1. Adopt rules and policies for the use of ionizing radiation in and on animals.

2. Review and either approve or return for amendment all proposals for the use of ionizing radiation on animals.

3. Examine the qualifications of all persons proposing to use radionuclides in animals.

4. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used in or on animals and send its recommendations to the Radiological Safety Committee.

5. Review all instances of alleged infractions of rules and unsafe practices in the use of ionizing radiation in or on animals and take the necessary steps to ensure safe practice.

6. Review reports from the radiation safety office on those using ionizing radiation on animals and any changes or impending changes in regulations.

7. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the use of ionizing radiation in and on animals.

Section 3.5 Radiation Research Committee

The committee is composed of physicists, chemists, and biologists experienced in the use of radionuclides, a member of the staff of the radiation safety office and others who may be nominated by the chairman of the Radiological Safety Committee in consultation with the committee.

The committee meets at least quarterly to:

1. Adopt rules and policies on the use of ionizing radiation on the Downtown and Evansdale campuses.

2. Review and either approve or return for amendment all proposals for the use of radiation or radionuclides on the Downtown or Evansdale campus.

3. Examine the qualifications of all persons proposing to use radionuclides on the Downtown or Evansdale campus.

4. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used on the Downtown or Evansdale campus and send its recommendations to the Radiological Safety Committee.

5. Review all instances of alleged infractions of rules and unsafe practices in using ionizing radiation on either the Downtown or Evansdale campus and take the necessary steps to ensure safe practice.

6. Review reports from the radiation safety office on those using ionizing radiation either Downtown or on the Evansdale campus and any changes or impending changes in regulations.

7. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the use of ionizing radiation Downtown and on the Evansdale campus.

Section 3.6: Radiation Safety Officer's Responsibility

The Radiation Safety Officer is appointed by the University President. His responsibilities include the following:

1. To furnish consulting services to any potential user of ionizing radiations and advise him on radiation safety procedures.

2. To ensure that all license obligations and regulations of the federal and state government are met.

3. To provide general surveillance of all health physics activities, including the assisting of all personnel in discharging their responsibilities.

4. To supervise the receipt of all radioactive materials coming to the University.

5. To provide for personnel and laboratory monitoring.

6. To instruct University personnel in radiation safety.

7. To administer a radioactive waste disposal program.

8. To perform leak test on sealed sources and provide radiation surveys after installation of radiation producing machines and reactors.

9. To supervise decontamination in case of accidents.

10. To provide a continuous program of environmental radiation hazard evaluation and hazard elimination.

11. To provide advice and assistance in the acquisition of dosimetry and monitoring equipment.

12. To provide maintenance and calibration of survey equipment in the radiation safety office.

13. To maintain all centralized records pertinent to the radiation safety program.

14. To develop and refine radiation detection, shielding and health protection techniques.

15. To be responsible for the overall day-to-day administration of the radiation safety program for the University.

16. Suspend any operation causing excessive radiation hazard as rapidly and safely as possible. (In carrying out this duty the Radiation Safety Officer will report directly to the President and/or the Radiological Safety Committee Chairman).

17. To present periodic reports to the various committees on matters related to their functions.

18. To keep each department chairman informed of all Principal Investigators in his department who are conducting projects approved by the appropriate radiation safety committees.

Section 3.7: Department Chairman Responsibility

Functions:

1. To have plans for all new buidlings and modifications of existing structures, where ionizing radiation are to be used, submitted through the radiation safety office for approval by the appropriate Radiation Safety Committee prior to the construction or modification.

2. To have any area where radionuclides were previously used surveyed by the radiation safety office before workmen do any rearranging of the area. Call extension 3413.

3. To have new staff members who desire to use ionizing radiation secure a copy of this Radiation Safety Manual from the radiation safety office. In particular, his attention should initially be directed to Section 5. "Procurement of all Radiation Sources", page 5.01 for information about transferring radionuclides and equipment containing radionuclides to W.V.U. from another institution.

4. To have principal investigators who are leaving the university inform the radiation safety office of any radioactive waste and arrange for the transfer of unused radionuclides to other authorized users. This will keep any potentially hazardous material from being unsupervised when a faculty member terminates.

   Note: The radiation safety office will keep each Department Chairman informed of all Principal Investigators in his department who are conducting projects approved by any of the radiation safety committees.

Section 3.8: Principal Investigator Responsibility

The principal investigator shall be responsible for:

1. Control of employee and visitor exposure to lowest practical level and always below the Maximum Permissible Exposure.

2. Requesting proper dosimetry for laboratory personnel.

3. Providing suitable laboratory monitoring instruments and supplies for employees.

4. Following correct procedure for procurement of radioisotopes and radiation producing devices.

5. Up-to-date marking and labeling of laboratories, radioactive materials and equipment.

6. Proper disposal of radioactive wastes and accurate disposal records.

7. Immediate reporting to the radiation safety office of spills, suspected overexposure, theft of material, and other accidents.

8. Safe operation of any radiation producing device for which he is listed as the possessor.

9. Testing and care of radiation sources made by University personnel.

10. Proper administration and use of radioactivity in humans.

11. Providing employees with copies of portions of the radiation safety manual applicable to them, such as:

    a. General Procedures for Laboratory Personnel
    b. General Procedures for Nurses
    c. General Procedures for Radiation Producing Equipment Operators
    d. Emergency Procedures, Decontamination Procedures

12. Attending periodic in-service training sessions and seeing to it that students and employees attend the orientation and in-service training sessions appropriate for them.

13. Proper use of radioisotopes in animals

14. Proper use of the Co-60 Irradiator Facility.

Note: The Principal Investigator is fully responsible for adherence to these regulations and the safe use of ionizing radiations by himself and those under his direction.

Section 3.10: Individual Responsibility

An individual shall be responsible for:

1. Control of his own radiation exposure to the lowest practical level and always below the Maximum Permissible Exposure.

2. Assisting the Principal Investigator in keeping the marking and labeling of laboratories, radioactive materials and equipment up-to-date.

3. Proper disposal of radioactive wastes and accurate disposal records.

4. Immediate reporting to the RSO of spills, suspected overexposure, theft of material and other accidents.

5. Proper wearing of his radiation dosimeter.

6. Proper testing and care of radiation sources made by University personnel.

7. A working knowledge of emergency and decontamination procedures.

8. Familiarity with his specific area:

   a. General Procedures for Laboratory Personnel
   b. General Procedures for Nurses
   c. General Procedures for Radiation Producing Equipment Operators

Section 4: Requirements for Use of Radionuclides

4.01 Personnel

1. Principal Investigator
   Must submit an application giving pertinent information about himself a protocol for his proposed project, and a description of his laboratory. He must demonstrate to the pertinent radiation committee his knowledge of radionuclide procedure and safety precautions. For this purpose, the appropriate radiation committee generally requires the Principal Investigator to take and complete successfully a radiation safety course given by the University Radiation Safety Office or a test designed to cover radiation safety in general, and the investigator's area of interest in particular. The investigator is responsible for assuring adequate training, to be defined by the appropriate committee, to all of his personnel. He is responsible for all records required by the Radiation Safety Office.

2. Assistants must read the Radiation Safety Manual. They are jointly responsible with the research investigator for their training in radiation safety and radionuclide procedures and for any violation of radiation safety rules in their laboratory.

4.02 Laboratories

1. Floors - smooth and continuous surfaces are recommended; tiles, and so forth are acceptable if cracks are filled with wax.

2. Walls, ceiling and woodwork - non-porous surfaces should be washable.

3. Ventilation - labs with more than 10 microcuries of isotopes should have hoods with face velocities of at least 100 feet per minute and individual exhaust air filters.

4. Equipment - suitable equipment for the activity, type and level, must be available; use of absorbent paper and stripable paint is recommended.

5. Benches - non-porous tops with no sharp corners.

6. Monitoring - appropriate to the radionuclide(s) used will be required as a routine procedure. This will generally consist of a check of the area with a survey meter or a

counting of wipe tests taken throughout the area, either daily or following an experiment.

Section 5: Procurement of All Radiation Sources

5.1 Radionuclides

All radionuclides must be obtained by one of the following means.
All radionuclides must be ordered and received through the Radiation Safety Office.

A. Initial Request - procedure to obtain radionuclides for the first time (including human use and also for such items as gas chromatographs or balances).

B. Procedure After Initial Approval - procedure to obtain radionuclides after the first time.

C. Radionuclides for EXPERIMENTAL Human Use - as opposed to routine, non-experimental human use covered in paragraphs A and B.

D. Transfer of Radionuclides - procedure to transfer radionuclides to, from, and within W.V.U.; includes return of shipment.

5.1.1 Initial Request

1. Submit all application for use of radionuclides, including
   (a) a "Statement of Training and Experience"
   (b) a list of radiation measuring equipment available to the Radiation Safety Office, G-210, W.V.U. Medical Center. Copies of these forms are placed at the end of the manual for your use. Additional copies may be obtained by calling the RSO, extension 3413. THE PRINCIPAL INVESTIGATOR MUST BE A FACULTY OR STAFF MEMBER.

2. A Radiation Safety Committee will review the forms and accept the proposal or suggest changes necessary for approval.

3. The committee will examine the principal investigator's experience. Current policy requires that a prospective radionuclide user demonstrate his knowledge by successfully completing a short examination. However, for those with adequate training or experience, six months of temporary approval is generally granted while this requirement is being fulfilled.

4. After receipt of the approval, fill out a "Yellow Requisition for Radionuclides". A sample of this

requisition is shown at the end of the manual under "Forms". These are available from the purchasing office.

Telephone: If you wish to telephone the order to the supplier, indicate this by checking "Confirming Order." Otherwise, the order will be sent to the Purchaisng Office for routine processing. The radiation safety office will obtain the purchase order number from the purchaisng office, which you may then use in your conversation with the vendor.

In cases where a purchase order has already been obtained from the West Virginia Foundation or the Professional Fees Office, this form should be brought to the radiation safety office for approval.

Gift: If the radionuclide is a gift, free sample, etc., place the words NO CHARGE on the "Requisition for Radionuclides" in the spaces provided for:

(a) Confirming P.O. Number
(b) Budget Number

Complete the remainder of the form in the usual manner. The radiation safety office will contact the supplier and have the gift shipped as usual. If a certain person in the Vendor's place of business should be contacted to properly investigate the shipment, place this information under the space provided for Vendor.

5. The radionuclide shipment will be delivered directly to the Radiation Safety Office. The Radiation Safety Office will notify the investigator immediately upon its arrival and the investigator may send someone to pick it up.

5.1.2 Procedure After Initial Approval

1. To order additional radionuclides for use as stated in your "Proposal for Use of Radionuclides" simply fill out a "Requisition for Radionuclides" as described above and send to the Radiation Safety Office, G-210, W.V.U. Medical Center.

2. If it is desired to carry out operations not covered by

your present "Proposal" (use of greater amounts of radionuclides, different radionuclides, different procedures that present hazards not covered before, etc.), then:

(a) If the use differs significantly from the previously approved, submit a new RSO Form #6 "Proposal for Use of Radionuclides" to the Radiation Safety Office, G-210 W.V.U. Medical Center. The procedure given in the Section 5.1.1 will be followed.

(b) If the use constitutes a small change in the previously approved use, such as an increase in the approved activity by less than a factor of two, submit the proposed revision in memo form. Handling of these requests can be expedited.

5.1.3 Radionuclides for EXPERIMENTAL Human Use

The use of all experimental techniques on humans (involving radioactive material and otherwise) is governed by the Human Subjects Committee.

The procedure is exactly the same as given in Sections 5.1.1 and 5.1.2 above. The radiological safety committee will send its recommendations to the Human Subjects Committee.

5.1.4 Transfer of Radioactive Material

1. Transfer from another institution to W.V.U.

The Principal Investigator at W.V.U. must be approved by the appropriate W.V.U. Radiation Safety Committee for use of this material prior to receipt of it. The procedure to be followed for transfer is exactly the same as that for receiving a gift or free sample.

(a) Secure approval for use of the material according to Sections 5.1.1 Part 4.

(b) Fill out the"Requisition for Radionuclides" exactly as in Section 5.1.1 Part 4.

2. Transfer from W.V.U. to another institution

All radioisotope shipments from W.V.U. must be shipped by the Radiation Safety Office. The W.V.U. Radiation Safety Office must have evidence that the other institution is licensed to receive this material.

(a) Get the other institution to send their license number

and a statement from their Radiation Safety Officer that they are licensed to receive it.

(b) Bring the above information; the radionuclides and their original shipping containers, if possible. Assistance in packing and shipping will be provided.

(c) A lead pig (or other shielding) must be used to reduce the radiation to ≤ 200 millirem/hr on the surfaces of the outermost container and ≤ 10 millirem/hr at one meter from the centerline of the container. The Radiation Safety Office will supply these if available, but cannot guarantee availability.

3. Transfer within W.V.U.

This procedure is to be followed when responsibility for the radionuclides is to be transferred to another Principal Investigator.

The Principal Investigator receiving the material must be approved for use of this material prior to receipt of it. If the new Investigator is not already approved for the material he wishes to receive, then secure approval according to Section 5.1.1 or 5.1.2 above.

4. Return of Shipment to Vendor

(a) All radionuclide shipments are made through the Radiation Safety Office. Send the radionuclide, with shipping container, to the Radiation Safety Office. Include the reason for returning the shipment (this is necessary in order to get your money back). Many vendors require that you obtain an approval number from them before shipping.

(b) The Radiation Safety Office will assist in packing and shipping the radionuclide.

5.2 Radiation Producing Machines

X-ray producing machines are governed by the regulations of the West Virginia State Department of Health. An x-ray producing machine which has a beam accessible to users or others in the vicinity should be proposed to the appropriate committee before purchase, so that the adequacy of shielding and other safety precautions may be assessed. Enclosed units such as cabinet model x-ray units and x-ray spectrometers need not be approved before

purchase, but must be reported at the time of installation. The radiation safety office will then assess the adequacy of shielding and interlocks. All x-ray producing machines must be registered with the State Department of Health and inspected regularly. More frequent quality assurance testing may be specified for units used for diagnostic purposes on humans.

5.3 Reactors

The university's reactor is currently being transferred to another institution, and is held under a "possession only" license. No proposals for use of the reactor will be accepted.

Section 6: Storage of Radionuclides

6.1 Liquids and Solids

Sources of radiation shall be secured against unauthorized removal from the place of storage and shall be provided with reasonable protection against loss, leakage, or disperation by the effects of fire or water.

It is important that all stored radioactive samples be clearly labelled at all times giving radionuclide(s) chemical form, the activity and the date of activity, and the name of the responsible investigator.

Storage sites for large amounts of radioactive materials should be as remote from occupied areas as practicable. Background radiation in unrestricted areas shall be such that individuals continuously in these areas will not receive a dose in excess of 2 millirems in any one hour, or 10 millirems in any seven consecutive days. The whole body exposure in unrestricted areas shall be such that any individual will not receive a dose in excess of 0.5 rems (500 rem) in any one quarter of one calendar year.

Storage areas must be well-marked with, "Caution radioactive materials", signs. The name, address, and phone number of the responsible person, and the radiation safety officer shall be posted in a conspicuous place near the area.

6.2 Gases

The storage requirements listed above in 6.1 apply as well as the following consideration: radioactive solutions that emit gases should be labeled and kept in approved hoods which are provided with filters and have adequate ventilation. Only amounts of material necessary for immediate experiments should be stored in the laboratory. For maximum permissible concentration in air, consult Section 15.6 of this manual.

Section 7: Radiation-Producing Machines

Periodic surveys of all Radiation-Producing Machines and areas in which these machines are located will be conducted by the Radiation Safety Officer. This should in no way detract from the recommendations listed below for the use of radiation-producing machines.

1. Prior to purchase, drawings and plans for all necessary shielding must be submitted to the RSO for approval by the appropriate Radiation Safety Committee.

2. Radiation-producing machines shall be operated only by qualified personnel.

3. All radiation-producing machines should be surveyed prior to routine use and at one year intervals. A pocket chamber or film badge should be worn.

4. Radiation warning signs must be placed so as to prevent personnel from entering the radiation area. The signs should indicate clearly the type of radiation hazard present. Signs should be removed when there is no longer any need for them. In certain instances, other precautions, such as locking the entrances to the room and interlocks may be advised.

5. The operator must never expose himself to the direct beam of a radiation-producing or x-ray machine and must not stand within 4 (four) feet of the tube or irradiated target while the machine is in operation unless adequately shielded.

6. Make allowances for the range of the radiation. For example, when the beam is directed across the room, the radiation will extend into adjoining rooms. Make use of protective barriers, lead aprons, and gloves.

7. Observe any restrictions or recommendations on the use of the machines made by the Radiation Safety Officer.

8. All rules of NCRP Report 33, "Medical X-ray and Gamma-Ray Protection for Energies up to 10 MeV - Equipment Design and Use", apply. Copies are available from the Radiation Safety Officer.

Section 8: Irradiators, Reactors and Accelerators

These fall under a special category and the radiation safety guide for these facilities can be obtained from the radiation safety office.

Section 9: Radiation Protection Measures

Section 9.1: Introduction

There are two general ways in which the body may be irradiated: (1) from isotopes outside the body (external emitters); (2) from isotopes inside the body (internal emitters).

External exposure can come from gamma emitters and high energy beta emitters (such as P-32). Tritium, C-14, and S-35 are all low energy beta emitters whose maximum range in air is less than 1 foot and therefore are of negligible external hazard.

Internal exposure can come from any radioactive isotope, including the low energy beta emitters. These isotopes can get inside the body by:

(1) breathing radioactive vapor (e.g., iodine or tritiated water vapor) or dust

(2) ingesting radioactive material in food, water, or from contaminated hands

(3) entering through a cut (e.g., working with a cut hand without gloves on)

(4) absorption through the skin

Exposure limits have been set for the protection of both laboratory personnel and the general public. It must be emphasized that the following limits are maximum permissible limits. IN GENERAL, EXPOSURE IS TO BE KEPT AS LOW AS REASONABLY ACHIEVABLE (ALARA).

The radiation protection limits outlined below are set with the idea in mind that the individual is allowed to receive up to these limits each year for all of his working life. Most authorities assume that any dose of ionizing radiation, no matter how small, may produce some genetic or somatic damage; and thus, it is considered wise to avoid all unnecessary exposure to radionuclides. However, in the light of present knowledge, occupational exposure for the working life of an individual at the maximum permissible values is not expected to entail appreciable risk to the individual or to present a hazard more severe than those commonly accepted in other present day industries.

The exposures received under Sections 9.2.1, 9.2.4, and 9.2.5 are intended to be in addition to those produced by the natural background and medical exposure. Each individual receives roughly 100 millirems per year from natural background. Medical exposure may range from a few millirem to exposures measured in rems, averaging 70 millirems per year over the entire population.

Section 9.2: Radiation Protection Limits

9.2.1 External Radiation in Controlled Areas. Except as provided in 9.2.2, no user shall possess, use, receive, or transfer sources of radiation in such a manner as to cause any individual in a controlled area to receive in any period of one calendar quarter from all sources of radiation in the user's possession a dose in excess of the limits specified in Table 9.1.

TABLE 9.1
RADIATION PROTECTION LIMITS

Portion of Body	Rems per Calendar Quarter
(a) Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads	1 1/4
(b) Hands and forearms; feet and ankles	18 3/4
(c) Skin of whole body	7 1/2

9.2.2 Radiation Doses Greater Than Table 9.1. A user may permit an individual in a controlled area to receive a dose to the whole body greater than that permitted under 9.2.1 of this section, provided:

(a) During any calendar quarter the dose to the whole body from sources of radiation in the user's possession shall not exceed 3 rems; and

(b) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N-18) rems where "N" equals the individual's age in years at his last birthday; and

(c) The user has determined the individual's accumulated

occupational dose to the whole body on Form NRC-4 or on a clear and legible record containing all the information required in that form, and has otherwise complied with the requirements of 9.2.2

9.2.3 Determination of Accumulated Dose.

(a) This section contains requirements which must be satisfied by users who propose, pursuant to 9.2.2, to permit individuals in a restricted area to receive exposure to radiation in excess of the limits specified in 9.2.1.

(b) Before permitting any individual in a restricted area to receive exposure to radiation in excess of the limits specified in 9.2.1, each user shall:

(1) Obtain a certificate on Form NRC-4, or on a clear and legible record containing all the information required in that form, signed by the individual, showing each period of time after the individual attained the age of 18 in which the individual received an occupational dose of radiation; and

(2) Calculate on Form NRC-4, in accordance with the instructions appearing therein, or on a clear and legible record containing all the information required in that form, the previously accumulated occupational dose received by the individual and the additional dose allowed for that individual under Section 9.2.2.

(c) In the preparation of Form NRC-4, or a clear and legible record containing all the information required in that form, the user shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the user obtains such reports, he shall use the dose shown in the report in preparing the form.

(d) In any case where a user is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it shall be assumed that the individual has received the occupational dose specified in whichever of the following columns apply:

Part of the body	Column 1 Assumed dose in rems for calendar quarters prior to January 1, 1961	Column 2 Assumed dose in rems for calendar quarters beginning on or after January 1, 1961
Whole body, gonads active blood-forming organs, head and trunk, lens of eye	3 3/4	1 1/4

(e) The user shall retain and preserve records used in preparing Form NRC-4.

(f) If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961 yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in 9.2.2, the excess may be disregarded.

9.2.4 Exposure of Individuals to Concentration of Radioactive Material in Controlled Areas

(a) No user shall possess, use, receive, or transfer radioactive material in such a manner as to cause an individual in a controlled area to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Appendix 15.06 Table I. "Expose", as used in this section, means that the individual is present in an airborne concentration. No allowance shall be made for the use of protective clothing or equipment or particle size, except as authorized by the NRC, pursuant to paragraph (c) of this section.

(b) The limits given in Appendix 15.06, Table I, are based upon exposure to the concentrations specified for forty hours in any period of seven consecutive days. In any such period where the number of hours of exposure is less than forty, the limits specified in the table may be increased proportionately. In any such period where the number of hours of exposure is greater than forty, the limits specified in the table shall be decreased proportionately.

(c) (1) Except as authorized by the NRC pursuant to this paragraph, no allowance shall be made for particle or the use of protective clothing or equipment in determining whether an individual is exposed to an airborne concentration in excess of the limits specified in Appendix 15.06, Table I.

(2) The NRC may authorize a user to expose an individual

in a controlled area to airborne concentrations in excess of the limits specified in Appendix 15.06, Table I upon receipt of an application demonstrating that the concentration is composed in whole or in part of particles of such size that such particles are not respirable and that the individual will not inhale the concentrations in excess of the limits established in Appendix 15.06, Table I. Each application under this subparagraph shall include an analysis of particle sizes in the concentrations and a description of the methods used in determining the particle sizes.

(3) The NRC may authorize a user to expose an individual in a controlled area to airborne concentrations in excess of the limits specified in Appendix 15.06, Table I upon receipt of an application demonstrating that the individual will wear appropriate protective equipment and that the individual will not inhale, ingest, or absorb quantities of radioactive material in excess of those which might otherwise be permitted under this part for individuals in controlled areas during a 40-hour week. Each application under this subparagraph shall contain the following information:

(i) A description of the protective equipment to be employed, including the efficiency of the equipment for the material involved;

(ii) Procedures for the fitting, maintenance, and cleaning of the protective equipment.

(iii) Procedures governing the use of the protective equipment, including supervisory procedures and length of time the equipment will be used by the individuals in each work week;

(iv) The average concentrations present in the area occupied by individuals.

9.2.5 Radiation Doses to Minors

(a) No user shall possess, use, or transfer sources of radiation in such a manner as to cause any individual within a controlled area, who is under 18 years of age, to receive in any period of one calendar quarter from all sources of radiation in such user's possession a dose in excess of 10 per cent of the limits specified in Table 9.1 in 9.2.1.

(b) No user shall possess, use, or transfer radioactive material in such a manner as to cause any individual within a controlled area, who is under 18 years of age, to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Appendix 15.06, Table II. For purposes of this paragraph, concentrations may be averaged over periods not greater than a week.

(c) The provisions of 9.2.4 (c) shall apply to exposure subject to paragraph (b) of this section.

9.2.6 External Radiation in Uncontrolled Areas

(a) Except as authorized by the NRC pursuant to paragraph (b) of this section, no user shall possess, use or transfer sources of radiation in such a manner as to create in any uncontrolled area from such sources of radiation in his possession:

(1) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour; or

(2) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days.

(3) Radiation levels which cause or are likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.

(b) Any user may apply to the NRC, through the Radiation Safety officer of W.V.U., for proposed limits upon levels of radiation in uncontrolled areas in excess of those specified in paragraph (a) of this section resulting from the applicant's possession or use of sources of radiation. Such applications should include information as to anticipateed average radiation levels and anticipated occupancy times for each uncontrolled area involved. The NRC will approve the proposed limits if the applicant demonstrates to the satisfaction of the NRC that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.

9.2.7 Radioactivity in Effluents to Uncontrolled Areas

(a) A user shall not possess, use, or transfer registered

material so as to release to an uncontrolled area radioactive material in concentrations which exceed the limits specified in Appendix 15.06, Table II, except as authorized pursuant to paragraph (b) of this section. For purposes of this section concentrations may be averaged over a period not greater than one year.

(b) Any person may apply to the NRC through the Radiation Safety Office of W.V.U., for proposed limits higher than those specified in paragraph (a) of this section. The NRC will approve the proposed limits if the applicant demonstrates:

(1) That the applicant has made a reasonable effort to minimize the radioactivity contained in effluents to uncontrolled areas; and

(2) That it is not likely that radioactive material discharged in the effluent would result in the exposure of an individual to concentrations of radioactive material in air or water exceeding the limits specified in Appendix 15.06, Table II.

(c) An application for higher limits pursuant to paragraph (b) of this section shall include information demonstrating that the applicant has made a reasonable effort to minimize the radioactivity discharged in effluents to uncontrolled areas, and shall include, as pertinent:

(1) Information as to flow rates, total volume of effluent, peak concentration of each radionuclide in the effluent, and concentration of each radionuclide in the effluent averaged over a period of one year at the point where the effluent leaves a stack, tube, pipe, or similar conduit.

(2) A description of the properties of the effluents, including:

(i) chemical composition;

(ii) physical characteristics, including suspended solids content in liquid effluents, and nature of gas or aerosol for air effluents;

(iii) the hydrogen ion concentrations (pH) of liquid effluents; and

(iv) the size range of particulates in effluents released into air.

(3) A description of the anticipated human occupancy in the uncontrolled area where the highest concentration of radioactive material from the effluent is expected, and, in the case of a river or stream, a description of water uses downstream from the point of release of the effluent.

(4) Information as to the highest concentration of each radionuclide in an uncontrolled area, including anticipated concentrations averaged over a period of one year:

(i) in air at any point of human occupancy; or

(ii) in water at points of use downstream from the point of release of the effluent.

(5) The background concentration of radionuclides in the receiving river or stream prior to the release of liquid effluent.

(6) A description of the environmental monitoring equipment, including sensitivity of the system, and procedures and calculations to determine concentrations of radionuclides in the uncontrolled area and possible reconcentrations of radionuclides.

(7) A description of the waste treatment facilities and procedures used to reduce the concentration of radionuclides in effluents prior to their release.

(d) For purposes of this section, the concentration limits in Appendix 15.06, Table II shall apply at the boundary of the controlled area. The concentration of radioactive material discharged through a stack, pipe or similar conduit may be determined with respect to the point where the material leaves the conduit. If the conduit discharges within the controlled area, the concentration at the boundary may be determined by applying appropriate factors for dilution, dispersion, or decay between the point of discharge and the boundary.

(e) In addition to limiting concentrations in effluent streams, the NRC may limit quantities of radioactive materials released in air or water during a specified period of time if it appears that the daily intake of radioactive material from air, water, or food by a suitable sample of an exposed population group, averaged over a period not exceeding one year, would otherwise exceed the daily intake

resulting from continuous exposure to air or water containing one-third the concentration of radioactive materials specified in Appendix 15.06, Table II.

(f) The provisions of this section do not apply to disposal of radioactive material into sanitary sewerage systems, which is governed by the Section 11.

Section 9.3: Use of Caution Signs and Labels

The following use of caution signs and labels is required by the NRC. Although these signs and labels initially will be available from the radiation safety office, each principal investigator should purchase his own if he has a continuing need. Catalogs and prices of caution signs and labels are available in the radiation safety office. Assistance in marking and labeling may be had by phoning the radiation safety office, extension 3413.

Note: The signs and labels used must describe the actual situation. For example, do not use a "Caution - Radiation Area" sign unless it really is a Radiation Area as defined below.

Keep the signs and labels up-to-date. If the situation changes, then change the marking also.

More than one sign may be required. As an example, a Radiation Area that also contains sufficient radioactive material should be posted with one sign each from Sections 9.3.2 and 9.3.3.

9.3.1 Radiation Machines. All radiation machines shall be labeled at the control panel near the energizing switch with: "Caution - Radiation; This Equipment Produces Radition When Energized."

9.3.2 Radioactive Material. The following shall be posted with a "Caution - Radioactive Material" sign or label:

(a) Each area of the laboratory in which radioactive materials are USED or STORED in an amount exceeding 10 times the quantity of radioactive material specified in Appendix 15.07.

(b) Each container in which radioactive material is TRANSPORTED, USED or STORED in amounts greater than the quantity specified in Appendix 15.07.

Exception: Laboratory containers such as beakers, flasks and test tubes are not required to be labeled if used only transiently and while the person using them is present.

(c) Where containers are used for storage, the label must also state quantity and kind of radioactivity and date of measurement of this quantity.

Note: Refrigerators used for storage should bear a "Caution - Radioactive Material" sign also.

9.3.3 Radiation Area. The following shall be posted with a "Caution - Radiation Area" sign; any area accessible to individuals, in which there exists radiation at such levels that an individual could receive a dose to the whole body:

1. in excess of 5 millirems in any 1 hour or
2. in excess of 100 millirems in any 5 consecutive days.

9.3.4 High Radiation Area. The following shall be posted with a "Caution - High Radiation Area - Personal Monitoring Equipment Required" sign: any area, accessible to individuals, in which there exists radiation at such levels that an individual could receive in any 1 hour a dose to the whole body in excess of 100 millirems.

1. Any entry into a High Radiation Area is prohibited unless the individual has on a film badge or pocket dosimeter.

2. Each High Radiation Area shall be equipped with a control device which shall either:

   (a) reduce the whole body radiation level to below 100 millirems per hour when the Area is entered.
   (b) or, energize a visible or audible alarm signal in such a manner that both the individual entering and the supervisor of the activity are made aware of the entry.

3. In the case of a High Radiation Area established for a period of $\leq$ 30 days, such a control device is not required.

9.3.5 Airborne Radioactivity Areas. The following shall be posted with a "Caution - Airborne Radioactivity Area" sign:

1. Any room, enclosure or operating area in which airborne radioactive materials exist in concentrations in excess of the amounts in Appendix 15.06, Table I.

2. Any room, enclosure or operating area in which airborne radioactive material exists in concentrations which exceed 25% of the amount in Appendix 15.6, Table I, these concentrations to be averaged over the number of hours per week during which individuals are in the area.

Section 9.4: Personnel Monitoring

9.4.1 Types and Uses of Personnel Monitoring Devices

1. Film Badge

   (a) Beta-gamma film badge:
   Used for determining external whole body exposure to gamma radiation; used for determining external whole body exposure to any beta radiation whose maximum energy is greater than 0.2 Mev. Thus, a film badge will not record beta radiation of H-3, C-14 or S-35 because these betas are too weak to penetrate the paper wrapping on the film. This acceptable, however, because these betas are too weak to penetrate the outer layer of skin.

   (b) Beta-gamma-neutron film badges:
   Same beta-gamma use as in (a) plus used for determining external whole body exposure to neutron radiation as well.

2. Ring Badge - A type of badge worn on the finger using thermoluminescent dosimeters. Used to determine external beta-gamma exposure to the fingers and hands. The 0.2 Mev cutoff for beta radiation applies here also.

3. Pocket dosimeter - An ion chamber the size of a fountain pen with a direct-reading scale showing external exposure. Therefore, your exposure can be read immediately. There are two types; one is sensitive only to beta-gamma radiation; the other to beta-gamma and neutron radiation. Pocket dosimeters are used: (1) whenever a radiation field is so high that working time is very limited. (2) whenever a person is only temporarily exposed to radiation and needs to be monitored for a few days.

9.4.2 Request for Personnel Monitoring

1. It is the responsibility of the Principal Investigator to request personnel monitoring for his laboratory personnel and himself. To request film badges, use RSO Form # 1 (see Section 16).

2. The present policy of the radiation safety office is to issue film badges, after receiving the above request, to all those working with radioactive material or exposed to radiation from machines or reactors. However, if a person works only

with H-3, C-14 or S-35 and is not exposed to any other source of radiation, then this person has no need of a film badge.

9.4.4 Exposure Report

1. Monthly exposure reports will be sent to each Department or area. These should be posted for the information of those being monitored.

2. Radiation Protection limits are given in Section 9.2.

3. An individual who has a question about his exposure should contact the radiation safety office. Normally the radiation safety office will contact anyone who receives an unexpectedly high exposure to aid in restructuring techniques to lower it in future months.

9.4.5 Classroom Use of Radiation

1. (a) The best procedure is to use radioactive material or radiation producing machines in the classroom in such a manner that the radiation protection limits for the uncontrolled areas will not be exceeded.

   (b) The radiation protection limits for the uncontrolled areas are given in Section 9.2.6 and Section 9.2.7.

   (c) Under these circumstances, personnel monitoring is not required.

2. If personnel monitoring is needed on a temporary basis, the radiation safety office will attempt to provide dosimeters. If additional dosimeters are needed, the Professor may have to assist in their purchase.

3. If personnel monitoring is needed for a full semester, film badges may be obtained as in Section 9.4.2 above. However, at present there can be a delay with the film badge company of 4 to 6 weeks after notifying them an before actual receipt of the film badges. This is the reason 1 (a) above is the best procedure to use when at all possible.

9.4.6 Off Campus Projects

There are several University groups who work for the various period at national laboratories and other facilities both in and out of the country.

1. If the U.S. Government or other agency provides personnel monitoring during this period, then it is the responsibility of the West Virginia University group leader to have a copy of the film badge and other dosimetry results sent monthly to the Radiation Safety Office.

2. If there is no agency at the facility to provide personnel monitoring, then arrangements may be made with the West Virginia University Radiation Safety Office.

3. Film badges are obtained from the Radiation Safety Office by a designated representative in each area for distribution. The radiation safety office will inform each representative each month as soon as the new badges arrive from the outside commercial firm. The old badges shall then be traded in.

4. Pocket dosimeters may be requested by calling or writing the radiation safety office which has only a few dosimeters available for temporary use. If a principal investigator has a continuing need for the pocket dosimeters, these must be purchased by him.

5. Spare film and ring badges are kept by the radiation safety office. A principal investigator may secure personnel monitoring for a vistor by having the vistor come by the radiation safety office. The principal investigator is responsible for return of the personnel monitoring device.

9.4.3 Care and Use of Film Badges

1. Wear the film badge on the chest (preferably) or waist (if necessary) with the clip toward the body. Wear the ring badge on the finger.

2. Do not remove the film from the badge. This results in errors in reading the dose.

3. At the end of the work day, leave the badge at the University in the film badge rack or other place where it will not be exposed to radiation. It is particularly important that the badge is left in the rack if a person goes out of town during the badge change period.

4. Do not deliberately expose a badge to radiation other than while being worn. This is a legal record and must reflect true exposure.

5. Wear only your own badge.

Section 9.5: Sealed Sources and Leak Tests

9.5.1 Commercially Obtained Sealed Sources

1. These sources will be given an initial leak test by the RSO when they arrive at the Radiation Safety Office.

2. Subsequent leak tests will be done by the RSO and require no action on your part except assistance, as needed, with performing the test.

3. No sealed source commercially obtained is to be opened or the contents removed.

4. Report immediately to the Radiation Safety Office all lost or deteriorating sealed sources.

9.5.2 Sources Manufactured by University Personnel

1. Sealed Sources If you wish to make your own sealed source, then:

   (a) Notify the Radiation Safety Office to test the source for contamination or leakage immediately after it is fabricated.

   (b) After initial notification to the Radiation Safety Office, no furtner action is required. The Radiation Safety Office will conduct the required periodic leak tests, which are the same as for a commercially manufactured source.

2. Unsealed Sources

   Definition: Radioactive material that is deposited on a backing but has no cover. Planchets and other transiently used items are not included.

   (a) These sources must be placed in individual boxes or other closed containers and marked with the isotope, approximate amount and date. Attach a "Caution-Radioactive Material" sticker to the box.

   (b) Once a particular source has been assigned to a certain box, do not store the source in any other box. When a flaking or decayed source is disposed of, dispose of the box also.

   These unsealed sources are susceptible to flaking of the material with age. Therefore, with the help of the laboratory personnel, the Radiation Safety Office will periodically check for deteriorating sources.

   Note: Report immediately to the RSO all lost or deteriorating sealed or unsealed sources.

Section 9.6: Survey Instruments

1. Each Principal Investigator must provide his laboratory with a survey instrument or satisfy the Radiation Safety Office that he has immediate access to one.

2. The one exception to the instrument requirement is tritium; no satisfactory survey instrument is presently available for this isotope.

3. These instruments must be appropriate for the type and level of ionizing radiation being used. The Radiation Safety Office will be glad to assist in selecting these instruments and maintains an up-to-date catalog file of currently available instrumentation and prices.

4. The Radiation Safety Office will periodically calibrate these survey instruments at no charge. First echelon maintenance will also be provided and only batteries and replacement parts will be charged for. Financial arrangements will be made directly with each laboratory or Principal Investigator.

5. A temporary replacement instrument will be provided by the Radiation Safety Office if available. However, this cannot be guaranteed.

6. Instruction of laboratory personnel in the use of survey instruments is the responsibility of the Principal Investigator. The Radiation Safety Office will assist by periodically offering instructions in use of these instruments. Notification of the classes will be given in advance.

7. Bear in mind the need for survey instruments when applying for grants and contracts. Other universities have found these items to be entirely acceptable by granting agencies.

Section 9.7 General Procedures for Laboratory

The fundamental objectives of radiation protection measures are:

1. To maintain exposure to external radiation as low as feasible and always within the set exposure limits.

2. To maintain entry of radionuclides into the human body by ingestion, inhalation, absorption, or through open wounds, when unconfined radioactive material is handled, at a minimum and always within the set limits.

An important secondary objective is to maintain the integrity of critical experiments against cross-contamination. To accomplish these objectives requires positive planning and careful execution of procedures beyond the usual care taken in work with other materials. It is necessary to (1) analyze in advance the hazards of each job. (2) provide safeguards against foreseeable accidents. (3) use protective devices and planned emergency procedures in accidents that do happen.

9.7.1 Basic Policy

1. In advance of the work, a full understanding must be reached between the Principle Investigator and the employee as to the work to be done and the safety precautions to be taken.

2. The procedure for each project should be well outlined in writing for the employee; the amount of detail commensurate with the hazard.

3. In some cases, before the procedure is actually performed with radiation, it should be given a "dry run" so as to preclude slipups or unexpected complications.

4. Each Principal Investigator must make a copy of this "Radiation Safety Manual" available to his employees where radioactive materials or machines are used, and may have copied those portions of particular importance to individual employees and students.

5. Become familiar, in detail, with the published data on the metabolism and Maximum Permissible Concentrations (Table I & II, Appendix 15.06) of the isotopes you are working with. This will give you some basis and feeling for the extent of the precautions that should be taken.

6. Visitors to a laboratory that uses radionuclides should be supervised by a responsible member of the lab.

7. Radionuclides shall not be left unattended in places where unauthorized persons may handle or take them, particularly without realizing that they are radioactive.

8. Instruction of new radiation workers in the techniques and hazards of their work is required. This instruction is the responsibility of the Principal Investigator. To assist in this area, the radiation safety office will offer periodic orientation and inservice training sessions.

9.7.2 Maintain Good Personal Hygiene

1. Keep fingernails clean and reasonably short.

2. Wash hands and arms thoroughly before handling an object which goes to the mouth, nose or eyes.

3. Avoid smoking, eating and drinking in radionuclide work areas. Do not use the same refrigerator for food and radioactive material.

4. Wear a lab coat and rubber or plastic gloves to protect personal clothing and hands from contamination. If you have a break in the skin on the hand be sure to wear protective gloves.

5. Wash the gloves before taking them off, unless they must be removed immediately because of severe contamination.

6. Do not use the telephone, handle book, open cabinets or drawers, etc., with contaminated gloves.

7. Use the laboratory survey instrument on your hands, shoes, and clothing before leaving the work area to smoke or eat, and before leaving at the end of the day.

8. Check lab coats with the survey instrument before returning them to the laundry.

   (a) Maximum Permissible Contamination is 1 mr/hr (or 1000 CPM with a GM survey meter) for radionuclides in Group I & II (see Appendix 15.13); 0.1 mr/hr (or 100 CPM) for radionuclides in Group III. If clothing reads less than these limits, it may be released directly to the laundry.

(b) If readings are over these limits, or practically the entire garmet is contaminated, then put on protective gloves and wash the garmet until it is within contamination limits.

(c) If several washings still are not able to lower the contamination, then (1) hold it for decay if the half-life is short, or (2) treat it as solid radioactive waste.

9.7.3 Preparation and Use of Working and Storage Areas

1. As a general practice, work with radioactive material should be confined to only the area necessary. This simplifies the problem of confinement and shielding, and aids in limiting the affected area in case of accident.

2. All work surfaces and storage areas (table top, hood, floor, etc.) should be properly covered. Some facilities, especially in older buildings, are very hard to decontaminate and should especially be protected.

3. Plastic or metal trays (stainless steel washes easily) should be placed on the surface when liquids are to be used. The lip of the tray serves to confine a spill.

4. Absorbent mats or paper may also be used. Incontinent mats having a plastic back and absorbent paper front are especially useful. (see Appendix 15.14). If contaminated, they may simply be discarded in the Radioactive Waste Can.

5. Floors made out of wood, stone, or concrete are very porous and hard to decontaminate. A plastic or asphalt tile covering is recommended. Some type of covering, even if just disposable absorbent paper, should always be used in areas where contamination is likely.

6. (a) Experiments involving any procedures which might produce airborne contamination (volatile isotopes, dust or gases) shall be conducted in a hood, dry box or other suitable closed system.
   (b) Radioactive gases or material with radioactive gaseous daughters must be stored in gas tight containers and kept in areas having good ventilation.
   (c) An approved hood should have an air flow of about 125 linear FPM. This should be checked by a representative of the radiation safety office before being put into use.

7. Practice good housekeeping. If an area is kept neat and clean and free from equipment and materials not required for the immediate procedure, the likelihood of accidental contamination or exposure is reduced.

8. Be your own monitor. Periodically (at least daily) check the work area and yourself with the laboratory survey instrument.

9. Radionuclides received in shipment must be opened in a properly equipped laboratory only by the Principal Investigator or someone under his immediate supervision. It is advisable to open vials containing liquids in the hood, because the air space in the vial is likely to be saturated with the radionuclide.

10. (a) Whenever feasible, radioactive material, and particularly liquids, should be kept in unbreakable (i.e., plastic) containers. If kept in glass, a larger secondary container should be provided in which to place the glass container. Then, if breakage did occur, the radioactive material would still be confined by the secondary container.

    (b) See Section 9.3.2, about proper marking of the storage container.

11. Vacuum pumps attached to contaminated systems should exhause into a hood.

12. Provisions for radioactive waste disposal must be made. See Sections 11, "Radioactive Waste Disposal", for instructions and required disposal material such as plastic bags, separate trash can for solid radioactive waste, etc.

9.7.4 Survey of Working Area

1. At least once a day, check the work areas for contamination with the laboratory survey instrument. Remove any contamination found. In many cases, the measures necessary to avoid contamination of experiments are more stringent than the measures required for protection of people. In addition to the daily routine check, these areas should be surveyed whenever there is a reason for concern about contamination.

2. If the radioactive material is a gamma or high energy beta emitter, survey the radiation level. Shield the material when necessary according to Appendix 15.12, "Shielding".

3. Before using the survey instrument, check the:

   (a) battery condition
   (b) response to the check source

If difficulty is encountered, call the RSO for assistance.

4. (a) If an instrument shows little or no radiation, and experience indicates that there should be radiation present, secure another instrument and check your initial finding. (b) If an instrument indicates the presence of radiation but seems to be erratic, take the reading at face value, then secure another instrument and check your initial finding.

5. Upon request, the RSO will monitor any lab or experimental setup.

6. Laboratories using only low energy beta emitters like tritium and carbon-14 should conduct the survey by swabbing work areas with damp filter paper and counting it in a liquid scintillation counter.

7. Construction or repair in a laboratory that is using or has used radioactive materials should not be done until the area has been surveyed by the RSO. Call extension 3413 for the survey.

9.7.5 Proper Use of Equipment

1. The use of tongs or other long-handled devices greatly reduces hand exposure by increasing the distance between your hand and the isotope. A general rule of thumb is that sources of strength greater than 10 microcuries should be handled with tweezers or tongs and not directly. Of course, this doesn't apply to the low energy beta emitters such as H-3, C-14, or S-35.

2. Use pipette filling devices. DO NOT PIPETTE RADIOACTIVE SOLUTIONS BY MOUTH.

3. Equipment such as glassware that is used with radioactive material should be kept separate from non-contaminated items. It is recommended that a marked storage cabinet or other marked container or area be provided for glassware and tools used in radioactive work.

4. All reusable glassware and tools should be cleaned after use. Contamination by trace quantities of material might seriously affect future low level experiments, even though the personnel hazards were negligible.

5. No equipment used with radioactive material shall be removed from the laboratory or repaired until the radiation safety office has surveyed it for possible contamination.

It is the responsibility of the laboratory personnel request this survey.

6. Heavy rubber gloves can be used to significantly reduce the beta dose to the hands from high energy betas. Of course, this won't change the gamma exposure.

7. Safety glasses, regular optical glasses, or goggles offer significant protection to the eyes from high energy beta emitters.

9.7.6 Transportation of Radionuclides On Campus

1. When transporting radionuclides from one part of a building to another, it is important to both minimize the dose to yourself and others, and avoid the possibility of spills. Therefore, you should always use a tightly closed container on a cart. For high energy beta emitters and for gamma emitters additional lead shielding may be necessary. If the original shipping container contained s shielded container, this may be suitable; otherwise, lead pigs in a variety of sizes and shapes are available from the radiation safety office and from commercial suppliers.

When going from one floor to another, use a service elevator when possible. If the dose rate where other passengers might be standing is greater than 2 m rem per hour, encourage them to try another elevator. Carrying a survey meter is very effective for this.

2. Transportation of radionuclides from one building to another, unless they are immediately adjacent, will present greater difficulties. In this case the radiation safety office should be contacted for advice.

3. Unopened orders of radionuclides in their original shipping containers may be transported to any location where their use has been authorized without further restriction. All shipping containers must be approved by the Nuclear Regulatory Commission for a variety of safety factors.

Section 9.8: General Procedures for Physicians

9.8.1 Sealed Source Implants

1. It is the physician's responsibility to request a private room for all sealed source therapy patients (radium, cesium, etc.).

2. The radiation safety office must be informed of all implants so that the necessary warning signs and labels can be posted. These will be removed by radiation safety office personnel after the sources are removed, and counted and the patient surveyed.

3. Each patient must be restricted to his room during the therapy treatment. An exception may be made of prostate patients treated with I-125 seeds.

4. Each patient must remain hospitalized until the sources are removed, or in the case of permanent implants the radiation level is low enough to be no hazard to those in the home.

5. The Chief of Radiation Therapy has complete responsibility for insertion, removal, and inventory of the sources.

6. A log book of issue and return must be maintained as a part of the inventory procedure. The inventory must be performed directly after removal of the sources. Therefore, sources will either be in the patient or in inventory, and not temporarily stored somewhere in between.

7. The following information must be in the patient's chart:

   (a) radionuclide
   (b) total number of millicuries and number of sealed sources
   (c) location in body
   (d) date of insertion, and anticipated date of removal

9.8.2 Radionuclide Administration

1. It is the physician's responsibility to place all patients administered more than 20mCi of radionuclide, who stay in the hopsital, in a private room. Check with the radiation safety office beforehand; the limit may be lower in some cases. It is not permitted to expose other patients to radiation levels of 2 mrem per hour or more.

2. When the patient has a private room, radionuclides should be administered in the patient's room; otherwise, a treatment room is preferable.

3. The physician, and those directly assisting, must wear disposable gloves and lab coat to prevent contamination of their hands and street clothes.

4. The patient, if wearing street clothes, must be suitably protected from accidental contamination with a lab coat, sheet, etc.

5. If contamination of the floor or table top is likely, absorbent mats should be used to reduce decontamination work.

6. It is strongly recommended that disposable syringes and needles be used whenever possible.

7. Contact the radiation safety office before administration so that arrangements can be made to provide absorbent paper for the room or any other precautions which may be necessary, as well as to survey the patient and provide the necessary warning signs and labels.

8. The physician is responsible for safe disposal of all radioactive solutions and contaminated equipment. Such solutions and equipment are not to be left on the nursing unit or disposal responsibility relegated to the nursing staff.

   (a) Waste from Patients who have received radioactive iodine: feces, may be disposed of via the toilet; urine and vomitus should be considered radioactive waste, and will be collected and saved for disposal by radiation safety office personnel.

   (b) Wastes from patients who have received other radionuclides may be disposed of via the toilet.

   (c) Other Wastes - such as unused radionuclide contaminated syringe, ets. must be bagged and marked as described in Section 11, "Radioactive Waste Disposal".

   (d) Contaminated Return Items -

      (1) Decontaminate these in your laboratory and return directly to Central Supply Room.

      (2) Or bag separately from the waste, hold for decay in your laboratory, then return to Central Supply Room.

Note: It is more convenient to use disposable items when possible.

9. The following information must be on the patient's chart:

   (a) Radionuclide and number of millicuries.
   (b) Location in Body.
   (c) Date administered.

10. Each patient must be restricted to his room during the therapy treatment.

11. Each patient must remain hospitalized until the residual activity is 30 millicuries or less. Consideration should be given to possible exposure of other family members at home, especially children and pregnant women.

12. The "Radiotherapy Patient" sign and sticker will be removed by the radiation safety office. When

    (a) the patient is descharged or
    (b) the residual activity is below 5 millicuries.

13. When a patient containing residual activity leaves the hospital, the physician must give appropriate instructions so that exposure or contamination of other individuals is minimized. The radiation safety office will assist in this upon request.

14. The physician is responsible for:

    (a) having any tissue samples, blood, excreta, etc. that is contaminated marked with a "Caution-Radioactive Material" sticker and

    (b) forwarding any special handling instructions to the analysing laboratory.

    Assistance in determining the above is available from the radiation safety office.

9.9.3 Emergency Operation

The physician or resident must:

1. Inform the surgeon of:

   (a) date of radionuclide therapy
   (b) amount and kind of radionuclide
   (c) location of the radionuclide in the patient

2 Inform the radiation safety office before the surgery of

(a) the above information
(b) time and place of surgery

The radiation safety office will necessary monitoring and advice on exposure.

9.8.4 Cadavers

If a patient who has received a therapeutic dose of any radionuclide dies in the hospital within a three week period after administration, the physician must:

(a) Notify the Radiation Safety Office, night or day. The radiation safety office will give suitable instruction to the pathologist and funeral director.

(b) Notify the pathologist, if an autopsy is to be performed, that the cadaver contains radioactive material and that the radiation safety office will provide necessary monitoring during autopsy.

9.9. General Procedures for Nurses

9.9.1 Definition: Radiotherapy Patient

Defined to mean patients who have been given radioisotopes orally or intravenously or have received sealed source implants. Specifically excluded are patients who have been irradiated only by x-ray, Cobalt-60 teletherapy, or accelerator machines. These latter patients will not contain any residual radioactivity from the x-ray, Cobalt-60 teletherapy, or accelerator treatments. Consequently no special precautions are necessary as they do not present any radiation hazard.

9.9.2 Purpose

The following procedures are given in order to prevent overexposure of nursing personnel and, additionally, to keep this exposure as low as practical.

9.9.3 Procedure

1. It is the doctor's responsibility to have all therapy patients housed in a private room if they have received sealed source implants or have been administered more that 20 millicuries of radioisotope. These rooms must not be adjacent to the nurses' station. The most desirable location is with the patient's bed placed against the outside wall and as far from neighboring patients as possible. The room best suited for I-131 patients should have a private bath. Iodine patients void large quantities of radioactive iodine the first couple of days and also tend to leave radioactive perspiration on whatever they touch.

2. A patient who has been administered radioisotopes of sealed sources can be identified by:

   (a) a "Radiotherapy Patient" sticker on the front cover of the patient's chart and information in the chart.
   (b) a "Radiotherapy Patient" sign on the patients door.

3. The information on the sticker in 2 (a) above are the doctor's responsibility. The "Radiotherapy Patient" sign is to be placed there by someone from the radiation safety office. Neither may be removed except by a resprensentative of the radiation safety office.

4. If film badges or other radiation dosimeters are provided, these must be worn during the entire shift.

5. Line the trash can in the radiotherapy patient's room with a plastic bag. This will facilitate the radiation survey of the trash.

6. Limit each vistor to the length of time indicated on the instructions for that procedure. Arrange the vistor's chair to be beyond the yellow tape line; bedside visiting is not allowed with these patients.

7. For additional information, see Section 9.8 "General Procedures for Physicians".

9.9.4 Types of Hazards

Radiation hazards may arise from 3 sources:

(a) External irradiation due to radioisotopes in the patient.
(b) Contamination of the skin in the course of patient care.
(c) Ingestion of radioactive material (probably from contaminated hands).

9.9.5 Prevention of unnecessary External Irradiation

1. Nursing personnel should be rotated among radiotherapy patients in order to keep individual exposure at a minimum. Nurses who become pregnant must be assigned to non-radiotherapy patients.

2. (a) Keep as much distance as possible between the patient and yourself while working in the room; the further away the patient is, the less the exposure rate will be. If a bedside shield is provided, work behind it as much as possible.

   (b) Do not neglect the patient, but do not linger unnecessarily either.

3. Unless specifically ordered by the doctor, the patient's bath should be postponed for the first 48 hours. Baths should thereafter be given every second day for the first week. However, the patient may bathe himself as often as desired unless restricted by the doctor.

4. For patients with sealed source implants (radium, cesium, etc.):

   (a) Linen, trash, etc. should be left in the patient's room until surveyed by someone from the radiation safety office.

If a sealed source becomes displaced, contain the source in a pan WITHOUT TOUCHING IT. Use forceps or other handling devices to keep the source at least 6 - 12 inches from your hands and body. Notify the Therapist and the radiation safety office at once.

(b) The room is not to be released for other patients, or even for cleaning by housekeeping until it has been surveyed by someone from the radiation safety office, and all warning signs removed.

(c) Gynecological patients are restricted to bed during the therapy treatment. Others should be either in bed or on the far side of the bed when staff or visitors are in the room.
Exception: Patients who have been implanted with iodine-125 seeds in the prostate represent minimal threat from external radiation. The radiation from the seeds is so weak that the patient is occasionally allowed to walk the corridor before his room is declared safe. This is because the seeds themselves may be excreted in the urine, and these should not be handled.

(d) Surgical dressings and bandages should be changed only as directed by the radiologist or physician designated by him.

(e) Barring a rupture of one of the sealed sources, instruments and containers used to handle them do not become radioactive.

(f) Perineal care is not normally given during the treatment, but the perineal pad may be changed when necessary. If the pad is changed, be sure the radioactive sources are not disturbed. Should a bowel movement necessitate perineal care, it should be given with due consideration to distance, time and shielding.

9.9.6 Prevention of Contamination and Ingestion

1. This is normally only a problem for patients administered radionuclides like iodine-131 and is not a problem in sealed source therapy unless one of the sources has ruptured.

2. If there is leakage from an intracavity injection or spillage of vomits or urine, put on surgical gloves and mask contain the liquid without touching it. Keep the gloves with other contaminated material for monitoring. Notify the responsible physician and the radiation safety office at once. In the meantime, keep those not involved away from the area so as to prevent spread of the contamination.

3. Feces may be disposed of in the toilet, as may urine except for iodine-131 therapy patients. The radiation safety office will provide suitable containers for the urine of these patients. If a bedpan is used, it must be handled by hospital personnel wearing gloves and mask; a gown or lab coat is desirable but not essential. Pour the urine into the container provided and rinse the bedpan. Rinse water may be disposed of via the toilet. Keep the same bedpan for use until the treatment is completed; it will be checked for contamination at that time.

4. Disposable dished and utensils should be used for the patient's meals. No linen or trash should leave the room until it has been checked by someone from radiation safety.

5. Radioactive material should not be allowed to touch the skin. Wear disposable gloves whenever contact is possible.

6. Practice good housekeeping when working with radiotherapy patients. Wash hands thoroughly before eating or smoking.

7. When a patient is first administered I-131, practically anything he touches will be contaminated by radioactive perspiration. Also, as much as 80% of the iodine may appear in the urine during the first 48 hours. Therefore, disposable gloves when changing the bed linen, touching the patient or other activities. Put a plastic or rubber cover on the pillow and materials at least during the first 48 hours to prevent contamination of these items.

9.9.7 Summary

1. Wear your film badge.

2. Keep as much distance as possible from the patient; perform the necessary duties in a little time as possible.

3. Nothing should be removed from the patient's room unless it has been monitored by someone from radiation safety.

4. Use disposable gloves when handling any items that might be contaminated. Call the physician in charge and the radiation safety office if a spill occurs or a loose source is found.

Section 9.10: General Procedures for Radiation Producing Equipment Operators

9.10.1 Diagnostic and Therapeutic X-ray Units

1. Notify the RSO whenever there is any change in the setup; i.e., new equipment, change in output of radiation, change in shielding, etc.

2. Always wear your film badge.

3. Keep exposure as low as possible. The operator must never expose himself to the useful beams. Make full use of protective barriers, lead aprons, and gloves.

4. Clear the area of all non-essential personnel. The operator shall insist that all non-essential personnel leave the exposure area before operating the unit, and that all essential personnel be adequately shielded.

   Notify the supervisor and the RSO immediately of any accidental exposures of radiation.

5. Keep the unit disconnected or locked when not in actual use.

6. No person shall be regularly employed to hold patients during exposure, nor shall any x-ray technician or student technician ever be permitted to perform such service. The person holding the patient should wear protective gloves and apron. No part of this person's body should be in the useful beam.

7. All protective devices that may become defective with use, such as lead aprons or gloves, must be periodically inspected for radiation leakage.

9.10.2 Holding Patients for X-ray

No person shall be regularly employed to hold patients during x-ray exposures. A parent or other relative should always hold the patient when they are available. At other times, however, a nurse may be asked to hold a patient for an x-ray. The following things must be done:

1. Always wear the film badge or pocket chamber if provided.

2. Always wear the lead apron and gloves if gloves are provided.

3. Never place any part of your body in the direct beam of the x-ray machine.

Section 9.11 Bioassays

9.11.1 Rationale

The prime motivation of any laboratory radiation safety program is to prevent the ingestion, inhalation or absorption by laboratory personnel of any of the radionuclides used. Sources which are of minimal danger externally may be extremely hazardous once inside the body.

Radioactive iodine is of particular concern because of iodine's concentration in the thyroid. Tritiated and iodinated nucleic acid precursors and analogs, if ingested, will show up selectively in the DNA of dividing cell populations. Furthermore, tritium in any form is difficult to detect, and if volitalized may contaminate the area without the worker being aware of it.

A bioassay program is not a substitute for good practice in the laboratory. It is, rather, an after the fact check on whether or not a significant amount of the radionuclide entered the body despite what were thought to have been safe procedures. Should such an amount be found, it will signal the need for additional monitoring and a change in procedures so that the laboratory's program can be carried out without undue risk.

9.11.2 Conditions for a Bioassay

The need for a bioassay will depend on the radionuclide used, the circumstances under which it is used, the volatility of substance and the amount of activity involved- in brief, the likelihood of the spread of contamination. Table 9.11-1 indicates the quantities and circumstances which warrant attention.

Table 9.11-1

Activities which warrant bioassay.

	Activity used at one time or in one day.			
	Volatile or Dispersible		Bound to Nonvolatile Agent	
Location of use	^{3}H	^{125}I or ^{131}I	^{3}H *	^{125}I or ^{131}I
Open room or bench	10 mCi	0.1 mCi	1 mCi	1 mCi
Fume hood	30 mCi	1 mCi	10 mCi	10 mCi
Closed glove box	30 mCi	10 mCi	100 mCi	10 mCi

*The figures in this column presume the nonvolatile substance is a nucleotide precursor. If it is not, these numbers may be multiplied by a factor of ten.

9.11.3 When to have a bioassay

A crucial part of monitoring any physiological function is to establish a baseline. Thus it is important to have a routine bioassay, whether urinalysis or thyroid scan, before exposure to the radionuclides, but no over one month before.

A bioassay should be conducted between 6 and 48 hours after exposure to an activity listed in Table 9.11-1. Should exposure to this activity be frequent, it is sufficient to repeat the test every two weeks.

Persons working in a laboratory which has on hand or has used in a calendar quarter an activity equal to that listed in the "closed glove box" entry for Table 9.11-1 should have a bioassay at least quarterly.

9.11.4 Bioassay Procedure

If a thyroid scan is the proposed method of bioassay, simply call Nuclear Medicine and arrange an appointment. If a scan will be needed over a weekend, call the radiation safety office for assistance.

Analysis of urine samples is the responsibility of the individual investigator. If assistance is needed call the radiation safety office.

Procedure: Use an external handling system to pipette 2 millileters of urine into 10 ml of a cocktail, such as Instagel of Aquasol, which is capable of counting aqueoud solutions with a reasonable effeciency. Count the sample for 10 minutes in a liquid scintillation counter using the setting appropriate to the radionuclide. Quench correction may be made by internal standard, external standard or channel's ratio method. For background count, use an equivalent sample without radioactivity, such as the previously collected baseline sample.

9.11.5 Reporting Results

Should a thyroid scan show more than 0.12μCi of ^{125}I or more than 0.04 μCi of ^{131}I, notify the radiation safety office immediately so that additional monitoring can be begun and corrective actions initiated.

Should a urine sample show more than 0.003 μCi/liter of ^{131}I or more than 0.01 μCi/liter of ^{125}I or more than 5 μCi/liter of ^{3}H, the radiation safety office should be notified. A second sample will normally be tested 24 hours later, and if this still indicates high activity, additional monitoring and corrective action will be initiated.

If activity is greater than ten times the above numbers it may be necessary to report this as an "incident, as described in section14.

If minimal activity levels are found, the results of the bioassay should be reported in the quarterly report. This should include the person's name, date, radionuclide tested for, background, disintegrations per minute, efficiency and activity per liter for urinalysis, and total thyroid activity for thyroid scans.

9.12 Air Sampling

Any person working with radionuclides or in an area near where radionuclides are being used may request that the radiation safety office monitor the air in the room or their work area.

The radiation safety office will normally initate air sampling only if the results of film badge or bio-assay monitoring indicate contamination of the work area or if a previously untried iodination procedure is to be used, or if the description of proposed experiments indicates a high amount of volatiles or aerosols.

Those doing iodination should use a special iodination box with a 100 FPM air flow which has been purchased for this purpose. This apparatus fits within the fume hood, but draws air through an activated charcoal filter and exhausts it through the hood exhaust.

Section 10: Radionuclides In Animals

10.1 Animal Care Area

Investigators wishing to use radionuclides in the Animal Care Area (Animal Quarters) on any campus must submit their requests to the director of Animal Care. All requests must be made on the regular form prepared for this purpose and must include all the information required in order that proper procedures for handling of animals, excreta, and for decontamination can be established. A copy of this form is located at the end of the manual under "Forms". The Director also has a supply of these forms.

The information will transmitted to the Animal Use of Radiation and Radionuclides Committee for recommendations or approval.

The general regulations for the radionuclide area in the Animal Quarters are;

1. All excreta are to be disposed of by the investigator, using procedures given in "Radioactive Waste Disposal", Section 11.

2. Feeding and watering of the animals given radionuclides are responsibilites of the investigator unless specific arrangements have been made with the Director.

3. All Animal Care equipment used with animals given radionuclides must be washed, rinsed and monitored by the investigator before being turned over to the Animal Care personnel for routine cleaning.

   Radioactivity must be non-detectable with an ordinary beta-gamma survey meter. A suitable meter is available in the Animal Care Radionuclide area. For beta energies less than 0.3 MeV, damp filter paper and a liquid scintillation counter should be used. Do not return the equipment until the results of this count are known.

4. The investigator is responsible for monitoring the following areas at leat once each week:

   (a) Floor of the room housing the animals
   (b) Sink at which excreta are disposed
   (c) Sink at which equipment is washed

5. A record of all monitoring must be kept by the investigator.

6. The radiation safety office should be notified at the start of the experiment. A respresentative of the radiation safety office will also monitor the portion of the animal quarters where radionuclides are being used once each week.

7. The area occupied by animals and equipment must be monitored at the termination of the experiment by a representative of the radiation safety Office.

8. There must be posted by the investigator at the area in which his animals are housed appropriate radiation signs.

9. Radiation emitted at cage surfaces must in no case exceed 5 mr/hour unless adequate shielding is provided by the investigator to reduce the amount of radiation received by the neighboring animals to less than 5 mr/hour. See appendix 15.12, "Shielding". Assistance may also be obtained from the radiation safety office.

10.2 Investigator's Laboratory

Investigators who wish to keep radionuclide animals administered in their own laboratory must observe the following requirements:

1. All excreta are to be disposed of by the investigator using procedures given in Section11, "Radioactive Waste Disposal".

2. The laboratory area and equipment must be monitored daily during the course of the experiment and at the termination of it to prevent spread of contamination and unnecessary exposure to personnel.

3. The investigator must post appropriate radiation signs.

4. Proper ventilation must be provided if the animals are given radionuclides which are exhaled in significant amounts.

5. If the radiation level at the point of access to the cage exceeds 5 mr/hr or at a normally used work area exceeds 2.5 mr/hr, shielding must be provided. See Appendix 15.12, "Shielding". Assistance may also be obtained from the radiation safety office.

Section 11: Radioactive Waste Disposal

Normally a charge is made to a principal investigator for disposing of his radioactive wastes. However, if unusually large volumes or specials procedures become necessary, the principal investigator must bear any additional cost.

Note that virtually all radioactive waste disposal is through the radioactive waste disposal barrels provided by the radiation safety office. These barrels are periodically sent by the radiation safety office to the commercial waste disposal centers. Thus there is NO radioactive waste disposal on any of the University campuses by burial or incineration.

For purposes of disposal, radioactive wastes will be divided into the following three catergories:

1. Biological Radioactive Waste

2. Solid Radioactive Waste (non-biological)

3. Liquid Radioactive Waste

Radioactive waste must not be disposed of in any manner other than as outlined below.

11.1 Disposal of Biological Radioactive Waste

11.1.1 Introduction

All biological waste (animal carcasses, tissue samples, etc.), both radioactive and non-radioactive, must be properly bagged. No liquied must be able to leak out. Waste material contained inside must be prepared so that it cannot pierce the bag. This may entail padding parts of the biological waste with gauze pads or other material to keep the plastic bags from being torn and punctured.

Proper Bagging

A. Radioactive biological material

1. Place radioactive biological material in temporary storage in YELLOW plastic bags. Make sure the material will not puncture or tear the bag. Seal the bag with masking tape as described below.

Sealing Instructions

a. Twist top of bag into short "rope". Wrap tape tightly two or three times, then stop but don't cut the tape yet.

b. Bend top portion of twisted bag down along the taped section and wrap the tape two or three more turns. Bag is now sealed.

2. If more than one bag needs to be place around original bag in order to insure against leakage or puncture, do so and seal each additional bag according to the Sealing Instructions above.

3. If a bag tears, then re-bag it before putting it in the shipping barrel.

B. All other biological material

Place any biological material that is not contaminated with radioactivity in any color plastic bags other than yellow. YELLOW IS USED ONLY FOR RADIOACTIVE MATERIAL; seal with masking tape according to Sealing Instructions. Follow paragraph A-2 if needed.

11.01.2 Protocol and Instruction for Biological Radioactive Waste Disposal

A. Each of the campuses will have an Animal and Plant Waste Coordinator. The Coordinator will be a member of the Animal Use of Radiation and Radionuclides Committee or a member of the staff of the radiation safety office.

B. Waste inventory control and indentification will be done by means of a 4 copy, 4" x 6" card. A card will be used for each animal (plant) or small group of animals (plants) used.

1st copy = Radiation Safety Office File
2nd copy = Campus Coordinator File
3rd copy = Attach to plastic container
4th copy = Investigator File

C. Each Campus will have a site (s) for animal and plant storage. (A cold room, refrigerator, freezer, or other container for material not requiring refrigeration)

D. Place animals (or plants) in approved plastic bags and seal securely.

E. Attach copy 3 of the Isotope Identification Card. (Be sure that you have completed it.) Give copies 1 and 2 to the Waste Coordinator. Retain copy 4 for your records. Be sure to make an entry on your quarterly report sheet under Barrel.

F. Deposit bag with attached card in the temporary storage container. (Do not put it into the shipping container.)

G. Periodically, the Plant and Animal Waste Coordinator will monitor and transfer bags to the 55 gallon shipping barrels.

H. When a shipping barrel is filled, the coordinator will pour Vermiculite into the interstices within the barrel, tie the large plastic barrel liner at the top, and clamp the lid on the barrel.

I. When a shipping barrel is filled, the coordinator will send copy 1 from each bag which was placed in the barrel to the radiation safety office.

J. The coordinators will be responsible for advising the radiation safety office of their needs for barrels, plastic bags, vermiculite, and Radionuclide Identification Cards.

Materials Covered by Protocol

1. Radioactive animal carcasses, feces, and bedding.
2. Radioactive plants.

Material containing radionuclides of a short half-life will usually be stored for 10 half-lives and treated as nonradioactive materials for routine disposal.

Each investigator or research group will receive from the radiation safety office the following:

1) Radionuclide Identification Cards
2) 55 gallon barrels with plastic liners
3) Vermiculite for liquid absorption
4) Small plastic bags for animal and tissue holding

11.2 Disposal of Solid Radioactive Waste (non-biological)

The general procedure is as follows:

1. Line trash can marked "Radioactive Waste" with YELLOW plastic bag and fold top of bag down over side of can.

Note: The radiation safety office, extension 3413, will mark a trash can with a "Radioactive Waste" sign for you.

2. Place solid waste inside YELLOW bag.

3. When can is full, close plastic bag and seal up the top with masking tape. OR, if can reads greater than 2 mr/hr at one yard from the can, close plastic bag and tape up the top whether the bag is full yet or not. Always tape according to Sealing Instructions (paragraph 11.01, A-1 above).

4. With a magic marker, write on the plastic bag the following:

   (a) Investigator's name
   (b) Department name
   (c) Radionuclides present and estimated number of microcuries of each.

   Note: Referring to your quarterly report sheets might help. Always make an entry under the Barrel column when discarding solid waste.

5. Transfer the closed and marked plastic bags to the shipping barrel provided to the department. Complete the pertinent entries on the form attached on the outside of the barrel.

   Note: (1) Please place plastic cover over syringe needles before discarding into plastic bag.

   (2) Wrap broken glassware in paper towels to prevent the plastic bag (and someone's hand) from being punctured.

   (3) Place only radioactive materials in these cans. Other materials only increase volume and raises cost of disposal.

11.3 Disposal of Liquid Radioactive Waste

It is contrary to University policy to dispose of radionuclides via the sewage system. We are at the top of the watershed, and our waste water will be used an average of three times before it reaches the Gulf of Mexico.

11.3.1 Liquid Waste Barrels

Special liquid waste barrels are available from the radiation safety office. These consist of a small barrel containing vermiculite inside a larger barrel, with vermiculite in between.

Carry liquid wastes in a closed container to a liquid waste barrel and pour it directly into the inner barrel.

Enter the pertment information on the form attached to the outside of the barrel. Notify the radiation safety office when the inner barrel reaches its capacity.

11.3.2 Wash Water

It is not generally necessary to dispose of wash water in the liquid waste barrels. This may be disposed of via the sewage system provided:

1. You designate a sink in the laboratory as a "radioactive waste sink" and have the radiation safety office mark it as such. Do not use an unmarked sink for washing contaminated glassware and disposing of wash water.

2. This sink may be used routinely for disposal of non-radioactive waste just as any other sink. Restrictions on its use are only those dictated by common sense.

3. Rinse the sink with copious amounts of water after washing contaminated materials in it. This will both reduce the contamination in the sink and further dilute the small amount of radionuclide released into the sewage system.

11.3.3 Liquid Scintillation Vials

It is a false economy to try to use reusable liquid scintillation vials. The saving in money is more than offset by the difficulty in cleaning them and the hazard from their contents, both chemical and radionuclide.

The safest and most effecient way to dispose of liquid scintillation vials is in a barrel normally used for solid waste. Put a layer of vermiculite, then a layer of intact liquid scintillation vials, then another layer of vermiculite, etc., until the barrel is full. In this way there will be virtually no breakage of the vials, and more than adequate amounts of absorbant material to contain any spilled contents.

Section 12: Emergency Procedures

12.1 Introduction

Emergencies resulting from accidents in laboratories working with radioactive materials will range from simple spills of small amounts of radioactive materials, where no serious contamination problem results, to major disasters occurring from explosions, fires or natural pheonomena. Correspondingly, the hazards resulting from such accidents will cover the range of situations from no hazard whatsoever to very serious situations involving extreme radiation hazards and bodily injury or both. In view of the complicating factors that may arise during such emergencies, simple rules of procedure cannot be set down covering all situations of radiation danger. However, in any emergency primary concern must always be the protection of laboratory personnel from radiation hazards. Second should be the confinement of the contamination to the local area of the accident, if this is possible.

12.2.1 Spills - No Airborne Contamination

1. Notify all other persons in the room at once.

2. Monitor the skin and clothing of persons near the spill.

   (a) If spill is on skin, flush thoroughly. Proceed according to "Decontamination of Personnel", Section 13.1.

   (b) If spill is on clothing, discard outer or protective clothing.

3. Block off the contaminated area. Permit only the minimum number of persons necessary to deal with the spill into the area. This prevents spread of the contamination. In case the spill causes high radiation hazard ($\geq$ 100 millirems/hr to the whole body), vacate the room immediately, close all doors and keep everyone out until someone from the radiation safety office arrives.

4. Confine the spill.

   (a) Put on protective gloves and lab coat. Use shoe covers if floor is contaminated.
   (b) Drop absorbent paper on a liquid spill.
   (c) Dampen a dry spill; take care not to spread the contamination.
   (d) See "Decontamination of Laboratory," Section 13.2.

5. Notify the radiation safety office, extension 3413 or the University CENTREX Operator; the radiation safety office will provide supervision and monitoring of the cleanup.

6. DO NOT CALL HOUSEKEEPING TO CLEAN UP RADIOACTIVE SPILLS. The person involved is responsible for the cleanups.

12.2.2. Airborne Contamination (Dust, Vapors, Gases)

1. Evacute the laboratory immediately. If time permits, hold your breath and shut off the source of contamination. (Example: If radioactive gas is leaking from a cylinder, close the cylinder valve if you can.)

2. Shut all doors to the laboratory.

3. Call Physical Plant and have the air conditioning shut down in your area. Notify the radiation safety office, extension 3413 or the University CENTREX Operator. The radiation safety office will supervise re-entry into the contaminated area.

4. Post a guard to insure that no one re-enters the laboratory and to keep the area clear of spectators.

5. Assemble and monitor all persons who were in the laboratory at the time of accident. The place of assembly should be near the contaminated area in order to reduce the spread of contamination. Proceed as in "Decontamination of Personnel", Section 13.1.

12.2.3 Injury to Personnel

1. Wounds

   (a) If contamination is found in open wounds, flush the wound immediately with running water while spreading the edges of the gash.

   (b) In cases where isotopes have accidentally been released into a finger of other extremity by a hyperdermic, induce the wound to bleed by "milking" it as a cleansing action in addition to the running water.

   (c) If contamination is found in the eyes, flush the eyes with running water.

2. Ingestion of material

   (a) If radioactive material has been taken into the mouth, it should be assumed that some of the material has been ingested.

   (b) Induce vomiting by placing a finger well back in the throat.

   (c) Have person drink a pint of water and induce vomiting again.

3. Of course, if the injury is serious, take the person to the Emergency Room of the hospital at once.

4. Report ALL radiation accidents (wounds, overexposure, ingestions, inhalation) to the radiation safety office as soon as possible.

12.2.4. Fire

1. Notify all persons in immediate area.

2. Activate nearest fire alarm signal.

3. Notify University telephone operator, give location of fire of smoke.

4. Attempt to put out fires if radiation hazard is not serious.

5. Notify the radiation safety office, extension 3413.

6. Follow instructions given by University fire emergency plans.

Section 13: Decontamination Procedures

13.1 Decontamination of Personnel

The objective of personnel decontamination is to reduce radiation exposure promptly, minimize absorption of radionuclides into the body, and keep localized contamination from spreading. A survey instrument is absolutely necessary.

If a person is found to have radioactive contamination on their clothing or bodies, the following steps should be taken:

13.1.1 Skin

1. Remove any clothing found to be contaminated before determing levels of skin contamination. Generally, levels below 0.1 mrem/hr present a minimal hazard, but still should be removed if possible.

2. Specific hot spots or areas on the skin should be located with a survey meter. These should be cleaned up so as to prevent the spread of contamination to clean areas of the body.

3. Ordinarily, soap and lukewarm water (or detergent) will remove most of the contamination.

   (a) Wash for 1-2 minutes, rinse and dry the areas. Pay particular attention to the hands and fingernails. Monitor with a survey meter. Repeat if contamination still present.
   (b) If contamination still present, wash again using plenty of soap and a soft brush. Apply only light pressure to the brush. Rinse, dry and resurvey. Repeat if contamination still present.
   (c) Take care to keep radioactivity from being washed into any skin breaks with a sterile bandage will help.
   (d) Even if contamination still persists, these efforts should be halted before the skin becomes reddened and irritated.
   (e) ALWAYS contact the radiation safety office , extension 3413 for advice and final monitoring.

4. If contamination is widespread over the body, shower with soap and water, dry and repeat survey. If contamination is still widespread, shower with scrubbing, dry and resurvey. If contamination still exists, select the most highly contaminated areas and proceed as in 3 (a) and 3 (b). Never let the skin become irritated.

5. DO NOT use organic solvents. These may only increase the probability of radioactive material penetrating the skin.

6. When decomtamination is completed, apply lanolin or hand cream to prevent chapping.

7. Notify the radiation safety office if any difficulty is encountered in removing the contamination or if assistance or monitoring is desired. The radiation safety office should provide final monitoring.

13.1.2 Hair

1. If the hair is contaminated, try up to three washings with liquid soap and rinse water. Use towels to keep water from running onto the face and shoulders.

2. Notify the radiation safety office if any difficulty is encountered in removing the contamination of if assistance or monitoring is desired. The radiation safety office should provide final monitoring.

13.1.3 Clothes

1. Contaminated clothes (or shoes) should be removed from the body to prevent further spread of the contamination. Place these items in plastic bags or containers.

2. After necessary body decontamination has been accomplished, put on protective gloves and lab coat (or surgical gown) and rinse the clothing in a Radioactive Waste Sink (providing the sink is less contaminated than the clothing).

3. Recheck the surface of the garments with a survey meter. Maximum Permissible Contamination is:

   (a) 1 millirem/hour (or 1000 CPM with a GM survey meter) for isotopes in Group I and II Appendix 15.13;

   (b) 0.1 millirem/hour (or 100 CPM) for isotopes in Group III (Appendix 15.13). If clothing reads less than these limits it may be released directly to the laundry.

4. If several washing still are not able to lower the contamination then either hold it for decay if the half-life is short, or treat it as solid radioactive waste (see Section11, "Radioactive Waste Disposal").

5. The radiation safety office will provide final monitoring and advice.

13.2 Decontamination of Laboratories

This job will be much easier if appropriate planning and precaution (see Section 9.7, "General Procedures for Laboratory Personnel",) are made ahead of time.

1. The general procedure is to confine the radioactive material as much as possible and prevent spread to other areas.

2. Prepare yourself for this job by putting on protective gloves, lab coat or surgical gown, and shoe covers if the floor is contaminated.

3. A survey instrument is a must; otherwise you are only guessing where the contamination lies.

4. First remove the gross contamination caused by the spill; start at the edges of the contaminated area and work inward. If a large amount of gamma or high energy beta emitter has been spilled (example: a patient vomits shortly after receiving an oral therapy dose of 150 mc I-131) manipulate the cleaning rags or towels with long forceps or tongs; this will significantly reduce hand exposure. Once a cleaning rag has become contaminated, it should be disposed of rather than reused.

5. After removing spilled liquids or other material, soap and water should usually be tried first to remove the remainder of the contamination.

6. All waste material should be placed in a plastic bag or other container to prevent recontaminating the area. The waste must eventually be sealed in plastic bags as described in Section 11, "Radioactive Waste Disposal".

7. The individual involved in the spill is responsible for the clean up. DO NOT CALL HOUSEKEEPING TO CLEAN UP RADIOACTIVE SPILLS.

8. The radiation safety office will advise in the clean-up procedures and will provide final monitoring. Call extension 3413 or the University CENTREX Operator.

Section 14: Notification of Incidents

14:01

The following must be reported by telephone to the RSO. The RSO can then advise in the decontamination, if necessary, and provide final monitoring.

1. Any contamination or suspected contamination of personnel.

2. Any uncontained spill (example: radioisotopes spilled out onto the floor or onto areas of a bench top not covered with disposable, absorbent material or confining tray.)

14.02

The Nuclear Regulatory Commission requires <u>immediate reporting</u> of the following incidents. Therefore, each Principal Investigator or individual involved shall immediately notify the RSO by telephone of an incident and the RSO will directly communicate with the NRC.

1. Theft or loss of radioactive material in such quantities and under such circumstances that it appears to the Principal Investigator that a substantial hazard may result to persons in unrestricted areas.

2. Exposure or suspected exposure of any individual to:

   (a) 25 rems or more to the whole body
   (b) 150 rems or more to the skin of the whole body
   (c) 375 rems or more to the hands, forearms, feet or ankles

3. Release or suspected release into the air or water of radioactive material in concentrations greater than 5000 times the limits specified in Table II, Appendix 15.06, averaged over 24 hours.

4. A loss of one working week or more of the operation of any facilities due to any incident involving any radiation source.

5. Damage to property in excess of $100,000 due to any incident involving any radiation source.

14.03

The NRC requires twenty-four hour notification of the following incidents. Therefore, each Principal Investigator or individual involved shall immediately notify the RSO by telephone of the following incidents.

1. Exposure or suspected exposure of any individual to

   (a) 5 rems or more to the whole body
   (b) 30 rems or more to the skin of the whole body
   (c) 75 rems or more to the hands, forearms, feet or ankles

2. Release or suspected release into the air or water of radioactive material in concentrations greater than 500 times the limits specified in Table II, Apendix 15.06, averaged over 24 hours.

3. A loss of one working day or more of the operation of any facilities affected.

4. Damage to property in excess of $1000.

14.04

The NRC requires a written report within 30 days of the following incidents. Each Principal Investigator or individual involved shall immediately notify the RSO of the incident and the RSO will provide assistance in preparing the report.

1. Exposure of an individual to

   (a) radiation in excess of, or
   (b) concentrations of radioactive material in excess of any applicable limit set forth in Section 9.02.

2. Any of the incidents listed in Sections 14.02 and 14.03.

3. Levels of radiation or concentrations of radioactive materials (not involving excessive exposure of an individual) in an unrestricted area in excess of 10 times any applicable limit as set forth in Section 9.02.

Each report required under this paragraph shall describe:

(a) the extent of exposure of individuals to radiation or radioactive materials.

(b) levels of radiation and concentrations of radioactive material involved.

(c) the cause of the exposure, levels or concentrations.

(d) corrective steps taken or planned to assure against a recurrence.

Note: Most of the problems at West Virginia University will probably be of the type described in Section 14.01. Few, if any, should involve the exposures and concentrations listed in Sections 14.02 and 14.03.

14.05

Radiation reports or inquiries from members of the public shall be referred to the RSO.

APPENDICES

1) University Radiological Safety Committee — PHONE

Ray Koppelman, Ph.D., Chairman Vice President for Energy Studies, Graduate Programs and Research	2021
W. Robert Biddington, D.D.S. Acting Vice President for Health Services	2321
John Jones, M.D. Dean, School of Medicine	4511
G. Lansing Blackshaw, Ph.D. Associate Dean, College of Engineering	4821
Knox Van Dyke, Ph.D. Professor, Pharmacology/Toxicology	5449
C.E. Flink, M.B.A. Associate Hospital Administrator	2909
Orlando F. Gabriele, M.D. Chairman, Radiology Department	3091
Atam Arya, Ph.D. Professor, Physics Department	3498
Stephen T. Slack, Ph.D. Section Chief, Medical Physics and Radiation Safety	3413

2) Human Use of Radiation and Radionuclides

Orlando F. Gabriele, M.D., Chairman Professor and Chairman, Department of Radiology	3091
James G. Thomas, D.D.S. Professor Oral Diagnosis and Roentgenology	4659
Peter C. Raich, M.D. Professor and Section Chief, Department of Medicine	4229
Anna Moson Associate Hospital Administrator, Nursing Services	4931
Barbara Jones, M.D. Professor and Associate Chairman, Department of Pediatrics	4451
Jin Chul Kim, M.D. Associate Professor of Radiology	4106
Knox Van Dyke, Ph.D. Professor Pharmacology/Toxicology	5449

2) Human Use of Radiation and Radionuclides (continued)	PHONE
Herbert A. Thompson, Ph.D. Associate Professor Microbiology	3951
Frank Dennis O'Connell, Ph.D. Assistant Dean and Professor Pharmacy	5211
James Lai, Ph.D. Associate Professor of Radiology	3570
Stephen T. Slack, Ph.D. Chief, Medical Physics and Radiation Safety	3413
3) Non-Human Use of Radiation and Radionuclides	
Knox Van Dyke, Ph.D., Chairman Associate Professor Pharmacology/Toxicology	5449
Stanley R. Shane, M.D. Professor and Associate Chairman, Department of Medicine	4125
Carl J. Malanga, Ph.D. Professor Pharmacy	5101
David B. Yelton, Ph.D. Associate Professor Microbiology	2649
James Lai, Ph.D. Associate Professor of Radiology	3570
Ping Lee, Ph.D. Professor Physiology	4991
Stephen T. Slack Ph.D. Chief, Medical Physics and Radiation Safety	3413
4) University Radiation Research	
Atam Arya, Ph.D., Chairman Professor Physics Department	3498
Ramsey H. Frist, Ph.D. Associate Professor Biology	2491
Robert A. Dailey, Ph.D. Associate Professor Animal Sciences	2406
Gale Rafter, Ph.D. Professor Biochemistry	2494
Nar S. Dalal, Ph.D. Assistant Professor Chemistry	3435

4) University Radiation Research (continued)	PHONE
Stephen T. Slack, Ph.D. Chief, Medical Physics and Radiation Safety	3413
5) Radiological Studies with Animals	
Ramsey H. Frist, Ph.D. Associate Professor Biology	2491
E. Keith Inskeep, Ph.D. Professor Animal Sciences	2406
Thomas K. Shehan, D.V.M. Associate Professor and Department Division Coordinator Comparative Pathology	2721
Stephen T. Slack, Ph.D. Chief, Medical Physics and Radiation Safety	3413

Program for Maintaining Occupational
Radiation Exposures ALARA

West Virginia University
15 August 1980

I. Management Commitment

a. We, as representatives of the administration and faculty of West Virginia University, are committed to the program described in this paper for keeping exposures (individual and collective) as low as reasonably achievable (ALARA). We have established an administrative organization for radiation safety and will develop the necessary written policy procedures and instructions to foster the ALARA concept within our institution. The organization includes several radiation safety committees, the chief of which is the Radiological Safety Committee (RSC), as described in our broad license application, and a radiation safety officer (RSO). We are also committed to following the guidance provided by U.S. Nuclear Regulatory Guides 8.10 and 8.18.

b. We will perform a formal annual review of the radiation safety program including ALARA considerations. This shall include reviews of operating procedures and past exposure records, inspections, etc., and consultations with the radiation protection staff or outside consultants.

c. Modification to operating and maintenance procedures and to equipment and facilities will be made where they will significantly reduce exposures at reasonable costs. We will be able to demonstrate that improvements have been sought, that modifications have been considered, and that they have been implemented where practicable. Where modifications have been considered but not implemented, we will be prepared to describe the reasons for not implementing them.

d. In addition to maintaining doses to individuals as far below the limits as is reasonably achievable, the sum of the doses received by all exposed individuals will also be maintained at the lowest practicable level.

It would not be desireable, for example, to hold the highest doses to individuals to some fraction of the applicable limit if this involved exposing additional people and significantly increasing the sum of radiation doses received by all involved individuals.

II. Radiation Safety Committees

a. Review of Proposed Users and Uses

1. The appropriate radiation safety committee will thoroughly review the qualifications of each potential authorized user with respect to the types and quantities of materials and uses for which he has applied to assure that the user will be able to take appropriate measures to maintain exposure ALARA.

2. When considering a new use of byproduct material, the appropriate committee will review the efforts of the authorized user to maintain exposure ALARA. The user should have systemized procedures to ensure ALARA, and should have considered the use of special equipment such as syringe shields, rubber gloves, etc., in his proposed use.

3. The appropriate committee will ensure that the user justifies his procedures and that they will result in ALARA doses (individual and collective).

b. Delegation of Authority

1. The duties, responsibilities and authority of the radiation safety officer are outlined in the university radiation safety manual, and they are sufficient for enforcement of the ALARA concept.

2. The Radiological Safety Committee will support the RSO in those instances where it is necessary for the RSO to assert his authority. Where the RSO has been overruled, the Committee will record the basis for its action.

c. Review of ALARA Program

The Radiological Safety Committee of the university will perform an annual review of all radiation safety programs.

1. The Radiological Safety Committee will encourage all users to review current procedures and develop new procedures as appropriate for ways to implement the ALARA concept.

2. The radiation safety office will perform a quarterly review of occupational radiation exposure. Any unusual exposures or trends in exposures, particularly those which exceed the Investigational Levels in Table I below, will be discussed at the next meeting of the appropriate committee. The principle purpose of this review is to assess trends in occupational exposure as an index of the ALARA program quality and to decide if action is warrented when investigational levels are exceeded.

3. The Radiological Safety Committee will evaluate our institution's overall efforts for maintaining exposures ALARA annually. This review will include the efforts of the RSO, authorized users, and workers as well as those of management.

III. Radiation Safety Officer (RSO)

a. Annual and Quarterly Review

1. The RSO will review the radiation safety program on an annual basis for adherence to ALARA concepts.

2. The RSO will review at least quarterly the exposures of authorized users and occupational workers to determine that their exposures are ALARA.

3. The RSO will review at least quarterly the radiation levels in unrestricted and restricted areas and releases of effluents to unrestricted areas to determine that they are at ALARA level.

b. The RSO's Educational Responsibilities for an ALARA Program

1. The RSO will schedule briefings and educational sessions to inform workers of ALARA program efforts.

2. The RSO will assure that authorized users, occupational workers and ancillary personnel understand the ALARA philosophy and know that management, the Radiological Safety Committee and the RSO are committed to implementing the ALARA concept.

c. Cooperative Efforts for Development of ALARA Procedures

Radiation workers will be given opportunities to

participate in formulation of the procedures that they will be required to follow.

1. The RSO will maintain close contact with all users and workers in order to develop ALARA procedures for working with radioactive materials.

2. The RSO will establish procedures for receiving and evaluating the suggestions of individual workers for improving health physics practices and encourage the use of these procedures.

d. Reporting and Reviewing Instances of Deviation from Good ALARA Practices

The RSO will investigate all instances of deviation from good ALARA practices; and, if possible, determine the causes. When the cause is known, the RSO will propose changes in the program to maintain exposures ALARA.

IV. Authorized Users

a. New Procedures Involving Potential Radiation Exposures

1. The authorized user will consult the RSO and the appropriate committee before using radioactive materials for a new procedure.

2. The authorized user will consider all procedures thoroughly before using radioactive materials to ensure that exposures will be kept ALARA. This may be enhanced through the application of trial runs.

b. Responsibility of the Authorized User to those he supervises

1. The authorized user will explain the ALARA concept and his commitment to maintain exposures ALARA to all of those he supervises.

2. The authorized user will ensure that those under his supervision are trained and educated in good helath physics practices and in maintaining exposures ALARA.

c. Continuing Review of ALARA Concepts by the Authorized User

1. The authorized user will continuously review his procedures to ensure that his ALARA program is optimal.

2. The authorized user will maintain contact with the RSO to ensure that he is aware of and employs the most current methods to maintain exposures ALARA.

V. Persons Who Receive Occupational Radiation Exposure

a. The worker will be instructed in the ALARA concept and its relationship to his working procedures and work conditions.

b. The worker will know what recourses are available if he feels that ALARA is not being promoted on the job.

VI. Establishment of Investigational Levels in Order to Monitor Individual Occupational Exposures

This university hereby establishes Investigational Levels for specific kinds or classes of operations which, when exceeded, will initiate review or investigation by the radiation safety office. Reports of these investigations will be reviewed by the appropriate committees. The exposure levels that we have established are listed in Section VII below. These levels apply to the exposure of individual workers.

VII. Investigational Levels

Table 1

		mrems per calendar quarter	
		LEVEL I	LEVEL II
1.	Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads	125	375
2.	Hands and forearms; feet and ankles	1875	5625
3.	Skin of whole body*	750	2250

* Applicable to operations using significant quantities of beta emitting radionuclides.

The Radiation Safety Officer will review and record on

Form NRC-5, Current Occupational External Radiation Exposures, or an equivalent form, results of personnel monitoring, not less than once in any calendar quarter, as is required by 10 CFR 20, §20.401. The following actions will be taken at the Investigational Levels as stated in Table 1:

a. Quarterly exposure of individuals to less than Investigational Level I.

   Except when deemed appropriate by the RSO, no further action will be taken in those cases where an individual's exposure is less than Table 1 values for the Investigational Level I.

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

   The RSO will review the exposure of each individual whose quarterly exposures equal or exceed Investigational Level I. He will report the results of his reviews at the first meeting of the committees responsible for oversight of radiation safety in the areas involved 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. The committee will, however, consider each such exposure in comparison with those of others performing similar tasks as an index of ALARA program quality and will record the review in the committee minutes to be reviewed by the Radiological Safety Committee.

c. Exposure equal to or greater than Investigational Level II.

   The RSO will investigate in a timely manner the cause(s) of all personnel exposures equaling or exceeding Investigational Level II and, if warranted, take action. A report of the investigation, actions taken, if any, and a copy of the individual's Form NRC-5 or its equivalent will be presented to the appropriate committee at the first meeting following completion of the investigation. The details of these reports will be recorded in the committee minutes. Committee minutes will be reviewed by the Radiological Safety Committee, and if necessary passed on to appropriate administrators. The minutes

containing details of the investigation, will be made available to NRC inspectors for review at the time of the next inspection.

d. Re-establishment of an individual occupational worker's Investigational Level II Above That Listed In Table I.

In cases where a worker's or a group of workers' exposures need to exceed Investigational Level II, a new, higher Investigational Level II may be established on the basis that it is consistent with good ALARA practices for that individual or group. Justification for a new Investigational Level II will be documented.

The Radiation Safety Committee will review the justification for, and will approve, all revisions of Investigational Levels II. In such cases, when the exposure equals or exceeds the newly established Investigational Level II, those actions listed in paragraph c above will be followed.

VIII. Signature of Certifying Official

We hereby certify that this institution (or private practice), has implemented the ALARA Program set forth above.

Ray Koppelman

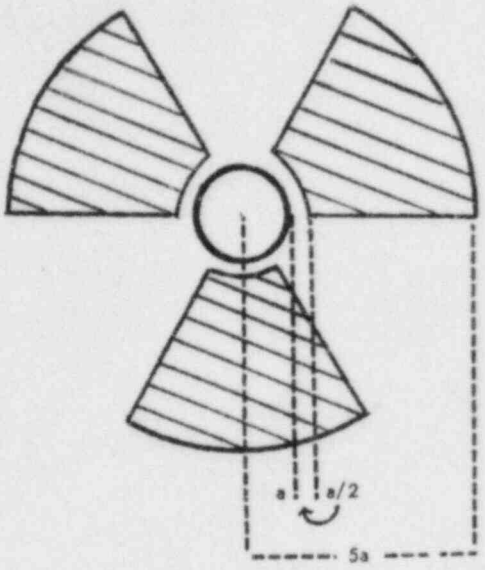
Ray Koppelman, Ph. D.
Vice President for Energy Studies, Graduate Programs and Research

Stephen T. Slack

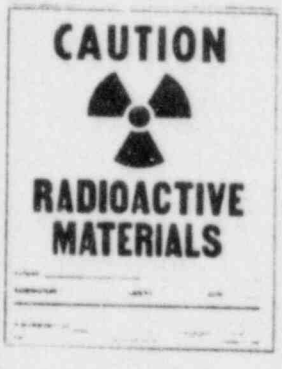
Stephen T. Slack, Ph. D.
Radiation Safety Officer

15.02 Radiation Symbol

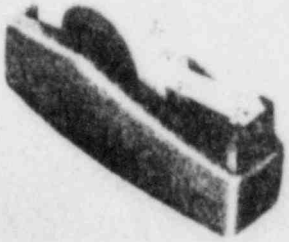
1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.

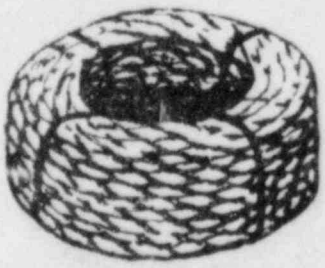


15.03 Radiation Warning Signs



15.04 Radiation Labels, Tapes, Rope





Form NRC-3
(9-78)
10 CFR 19
10 CFR 20

UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19)

Copies of all NRC Licenses held by WVU, amendments, notices of violations, personnel exposure records, and other records pertinent to Radiation Safety at WVU are available in the Radiation Safety Office - Room G-210 University Hospital.

In Part 20 of its Rules and Regulations, the Nuclear Regulatory Commission has established standards for your protection against radiation hazards from radioactive material under license issued by the Nuclear Regulatory Commission. In Part 19 of its Rules and Regulations, the Nuclear Regulatory Commission has established certain provisions for the options of workers engaged in NRC-licensed activities.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply there NRC regulations and the conditions of his NRC license to all work under the license.
2. Post or otherwise make available to you a copy of the NRC regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post Notices of Violation involving radiological working conditions, proposed imposition of civil penalties and orders.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the NRC regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE NRC REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels, and safety interlock equipment;
5. Exposure records and reports;
6. Options for workers regarding NRC inspections; and
7. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The NRC regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Sections 20.101, 20.103, and 20.104 of the Part 20 regulations. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air.
2. If you work where personnel monitoring is required pursuant to Section 20.202:
   (a) your employer must give you a written report of your radiation exposures upon the termination of your employment, if you request it, and
   (b) your employer must advise you annually of your exposure to radiation, if you request it.

INSPECTIONS

All activities under the license are subject to inspection by representatives of the NRC. In addition, any worker or representative of workers who believes that there is a violation of the Atomic Energy Act of 1954, the regulations issued thereunder, or the terms of the employer's license with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the appropriate United States Nuclear Regulatory Commission Inspection and Enforcement Regional Office (shown on map at right). The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. During inspections, NRC inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

POSTING REQUIREMENTS

Copies of this notice must be posted in a sufficient number of places in every establishment where activities licensed by the NRC are conducted, 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.

UNITED STATES NUCLEAR REGULATORY COMMISSION

A representative of the Nuclear Regulatory Commission can be contacted at the following addresses and telephone numbers. The Regional Office will accept collect telephone calls from employees who wish to register complaints or concerns about radiological working conditions or other matters regarding compliance with Commission rules and regulations.

Regional Offices

REGION	ADDRESS	TELEPHONE	
		DAYTIME	NIGHTS AND HOLIDAYS
I	Region I, Office of Inspection and Enforcement, USNRC 631 Park Avenue King of Prussia, Pennsylvania 19406	215 337-5000	215 337-5000
II	Region II, Office of Inspection and Enforcement, USNRC 101 Marietta St., N.W., Suite 3100 Atlanta, Georgia 30303	404 221-4503	404 221-4503
III	Region III, Office of Inspection and Enforcement, USNRC 799 Roosevelt Road Glen Ellyn, Illinois 60137	312 932-2500	312 932-2500
IV	Region IV, Office of Inspection and Enforcement, USNRC 611 Ryan Plaza Drive, Suite 1000 Arlington, Texas 76012	817 465-8100	817 465-8100
V	Region V, Office of Inspection and Enforcement, USNRC 1990 N. California Boulevard, Suite 202, Walnut Creek Plaza Walnut Creek, California 94596	415 943-3700	415 943-3700

Appendix 15.07

QUANTITY BASES FOR POSTING AND LABELING

Material	Microcuries	Material	Microcuries
Ag^{105}	1	P^{32}	10
Ag^{111}	10	Pd^{103} + Rh^{103}	50
As^{76}, As^{77}	10	Pd^{109}	10
Au^{198}	10	Pm^{147}	10
Au^{199}	10	Po^{210}	0.1
Ba^{140} + La^{140}	1	Pr^{143}	10
Be^{7}	50	Pu^{239}	1
C^{14}	50	Ra^{226}	0.1
Ca^{45}	10	Rb^{86}	10
Cd^{109} + Ag^{109}	10	Re^{186}	10
Ce^{144} + Pr^{144}	1	Rh^{105}	10
Cl^{36}	1	Ru^{106} + Rh^{106}	1
Co^{60}	1	S^{35}	50
Cr^{51}	50	Sb^{124}	1
Cs^{137} + Ba^{137}	1	Sc^{46}	1
Cu^{64}	50	Se^{75}	10
Eu^{154}	1	Sm^{153}	10
F^{18}	50	Sn^{113}	10
Fe^{55}	50	Sr^{89}	1
Fe^{59}	1	Sr^{90} + Y^{90}	0.1
Ga^{72}	10	Ta^{182}	10
Ge^{71}	50	Tc^{96}	1
H^{3} (HTO or $H^{3}_{2}0$)	250	Tc^{99}	1
I^{131}	10	Te^{127}	10
In^{114}	1	Te^{129}	1
Ir^{192}	10	Th (natural)	500
K^{42}	10	Tl^{204}	50
La^{140}	10	Tritium. See H^{3}	250
Mn^{52}	1	U (natural)	500
Mn^{56}	50	U^{233}	1
Mo^{99}	10	U^{234}-U^{235}	50
Na^{22}	10	V^{48}	1
Na^{24}	10	W^{185}	10
Nb^{95}	10	Y^{90}	1
Ni^{59}	1	Y^{91}	1
Ni^{63}	1	Zn^{65}	10
		Unidentified radioactive materials or any of the above in unknown mixture	0.1

15.08 EMERGENCY SURGERY OR DEATH OF PATIENT CONTAINING RADIOACTIVE MATERIAL

Emergency Surgery

If the patient does not contain more than 5 mc. of any isotope, surgery may be performed with no attention to the radioactivity. Larger quantities may be present in patients with radioactive colloid in a cavity or injected into tissues, with radioactive iodine for a thyroid condition, or with metallic radioactive implants; in these cases certain precautions may be necessary.

1. Radioactive Iodine. It is highly unlikely that emergency surgery will be essential within 24 hours after the administration of a dose. After this period, if the surgeon can avoid actual manipulation of the thyroid gland or of regions containing active metastases, he will not receive an undue exposure during the period of any likely emergency operation.

2. Radioactive Colloidal Chromic Phosphate in Pleural or Abdominal Cavity. The isotope will be desposited more or less uniformly over all the serous surfaces, and the exposure more or less to the hands working within the cavity, or possibly to the face if the cavity is opened widely. With the doses usually given for treatment of ascites, a period of half an hour for the hands actually in the cavity appears reasonable.* If the operation involves any other part of the body, so that hands need not be in the contaminated cavity, no precautions are necessary.

3. Radioactive Colloidal Gold in Pleural or Abdominal Cavity. For this isotope doses are larger than for phosphorus, and the radiation, being both beta and gamma, is more penetrating. If the cavity containing the material need not be opened, no special precautions are necessary. However, if the work must be carried out within the radioactive cavity, speed is essential, and a skilled surgeon who is a rapid worker should be selected if at all possible. Since such an operation will probably be a very rare occurrence, it is reasonable to set the surgeon's permissible exposure at the 13-week level. With 100 mc. of Au-198 in the abdominal cavity of the patient, or rather mostly deposited on its serous surfaces, the surgeon's gloved hands in this cavity would be exposed to a dose-rate of about 40 r per hour. If the permissible dose to the hands in three months is 25 rads, he will receive this in about half an hour. It is truly unlikely that the hands will actually be in the cavity for this length of time; the intervals when they are outside need not be considered. Glasses or goggles should be worn by the surgeon and his assistants to prevent a possible splash of radioactive material into the eyes.

4. Colloidal or Metallic Radioactive Implants in Tissues. It is usually possible to avoid direct contact with the implanted region. There is little use in trying to block the radiation by shielding. For gamma-emitting isotopes lead rubber sheets are of very little value;

*National Bureau of Standards Handbook 65. "Safe Handling of Bodies Containing Radioactive Isotopes."

1.2 cm. (1/2 in.) of lead is necessary to reduce the intensity of radium radiations to half. It is more important for everyone on the surgical team to stand as far as practicable from the radioactive material.

Death

The doctor who pronounces the patient dead and sends the body to the morgue must make sure that the radioactivity label remained affixed to the history and accompanies the body if this contains more than 5 mc. of an isotope. He should also attach blank copies of a suitable radioactivity form to the death certificate, to the patient's chart, and to the autopsy permission slip if there is one. Copies of the following sample form are available at each Nursing Station and in the Isotope Department.

WEST VIRGINIA UNIVERSITY HOSPITAL

Radioactivity Form to Accompany Body of Individual
Who Died While Containing Radioactive Material

This form is to be attached to the death certificate, to the patient's history, and to the autopsy permission slip, if there is one.

Notice to Autopsy Surgeon and to Funeral Director:

☐ This body contains between 5 and 30 mc. of radioactive material. If an autopsy is to be done, the radiation protection officer should be consulted as to any precautions. If the funeral director is to employ only standard embalming procedures, no special precautions are necessary.

☐ This body contains more than 30 mc. of radioactive material. If an autopsy is to be performed the radiation protection officer or his deputy should be present.
The funeral director should observe the following precautions:

_____

_____

_____

(Check the appropriate box.)

Signed _____

Date _____

The physician in charge or the radiation protection officer must check the appropriate box before any further procedure is carried out. The administered dose must have been entered on the original radioactivity label, and the National Bureau of Standards Handbook 65 gives a convenient table for determining how much isotope is left at any particular time. Copies of this table are on page 4 of these instructions.

To set down here details of procedure for autopsy or embalming would be simply to copy the Handbook. It is evident that if the isotope content is above 5 mc. the radiation protection officer will have to be involved in autopsy procedure, and if more than 30 mc., he must be present for either embalming or autopsy. He must be familiar with the contents of the Handbook, and copies of it should be available within the institution.

Accident or Injury during Surgery or Autopsy

In case of an injury occurring during surgery or autopsy whereby the rubber gloves are cut or torn and radioactive material may have been introduced into the wound, the gloves should be removed and the wound washed with large quantities of running water, the edges being spread to facilitate flushing action. The radiation protection officer should be notified at once, and should check for residual contamination.

Contaminated Clothing or Instruments

Clothing or instruments that become contaminated during surgery or autopsy should be turned over to the radioisotope laboratory for decontamination or disposal. Disposable waste should be cared for in the same manner as in the hot laboratory.

Special care should be taken to prevent the floor of the operating room or the autopsy room from being contaminated. Such contamination is inevitably transferred to the shoes and thereby spread all over the institution. In addition, the floors of autopsy rooms are often of rough concrete or other material that is difficult to decontaminate, and flushing them or scrubbing them with water may only spread the contamination. Therefore, great care should be taken that all body fluids are properly discharged down the drain. In the case of accidental overflow, the fluid should immediately be taken up as completely as possible, with dry waste held in tongs or forceps, and put promptly into a suitable receptacle.

Probable radioactive content of body at various times after various doses*

A guide for consideration before autopsy or surgery. For values below heavy lines no precautions are necessary except wearing surgical rubber gloves. For values above lines, consultation with radiation protection officer is indicated.

Millicuries administered	Days elapsed since administration --										
	1	2	3	4	6	8	10	15	20	25	30
Au^{198} or Y^{90}	Millicuries of isotope remaining in injected cavity or injected tissues, assuming no physiological elimination.										
150	115	90	69	52	32	20	12	3			
125	96	75	58	44	27	16	10	3			
100	77	60	46	33	21	13	8	2			
75	58	45	35	26	16	10	6	2			
50	38	30	23	18	11	7	4	1			
40	31	24	18	14	9	5	3	1			
30	23	18	14	10	6	4	2	1			
20	16	12	9	7	5	3	2	1			
I^{131}	Millicuries of isotope remaining in functioning thyroid tissue or metastases following administration for thyroid ablation or cancer treatment. Assumed 50% uptake and 6-day effective half life. (These doses are maximal; usually residuals will be smaller.)										
200	89	78	71	63	50	40	32	18	10	6	3
150	67	58	53	47	38	30	24	14	8	5	3
125	56	49	44	39	31	25	20	11	6	3	2
100	45	39	36	32	25	20	16	9	5	3	2
80	36	31	28	25	20	16	13	7	4	2	1
60	27	23	21	19	15	12	10	5	3	2	1
50	22	20	18	16	13	10	8	4	2	1	
40	18	16	14	13	10	8	6	3	2		
30	13	12	11	9	8	6	5	3	2		
20	9	8	7	6	5	4	3	2	1		
10	5	4	4	3	3	2	2	1	1		
P^{32}	Millicuries of isotope remaining in injected cavity or injected tissues, assuming no physiological elimination.										
30	29	27	26	25	22	20	18	15	11	10	7
25	24	23	22	21	19	17	15	12	9	8	6
20	19	18	17	16	15	14	12	10	8	7	5
16	15	15	14	13	12	11	10	8	6	5	4
12	11	11	10	10	9	8	7	6	5	4	3
10	10	9	9	8	7	7	6	5	4	3	2
8	8	7	7	7	6	5	5	4	3	3	2
6	6	5	5	5	4	4	4	3	2	2	1
4	4	4	3	3	3	3	2	2	2	1	1

*Reprinted from NBS Handbook 65, Safe Handling of Bodies Containing Radioactive Isotopes (A Guide for Surgeons, Pathologists, and Funeral Directors), dated May 1958.

Appendix 15.12: Shielding

Radioactive material shall be shielded in such a manner that will keep personnel exposure to the lowest practical level and always below the Radiation Protection Limits (See Section 9.02).

If radiation levels in certain areas do not cause personnel exposure but do interfere with a neighbor's experiment or counting equipment, the levels may have to be lowered.

A very brief discussion of shielding against beta emitters and gamma emitters will be given below. More complete data and assistance is available from the RSO.

A. Beta Shielding

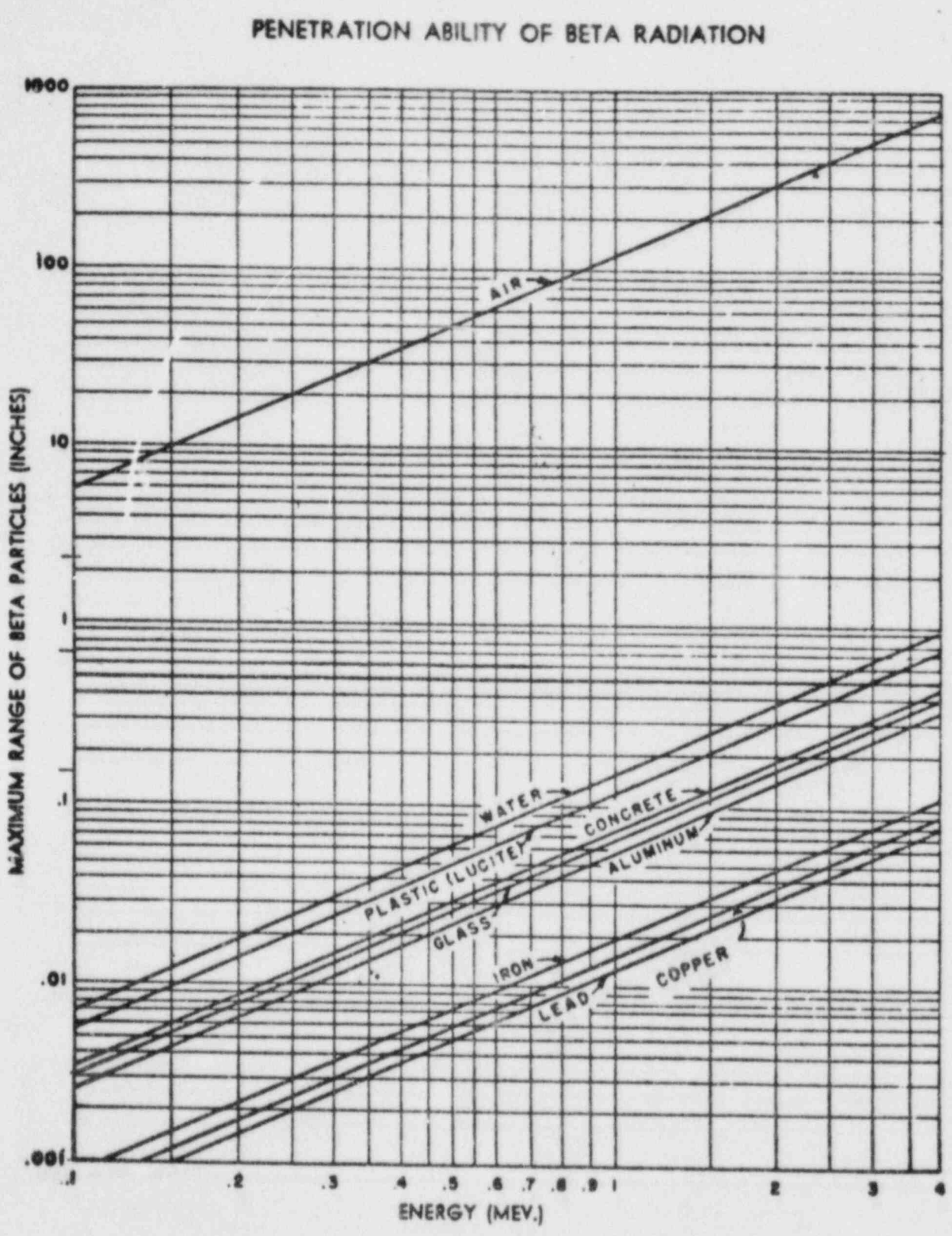
Every beta emitter gives off betas (electrons) from zero kinetic energy up to its maximum energy (Example: P-32 gives off electrons from zero up to 1.7 Mev. of kinetic energy). The electrons of maximum energy penetrate farther into a material than electrons of lower energy. Thus, the maximum energy electron is said to have the greatest range (or penetration) into the material. Therefore, if you pick a shield thick enough to stop the maximum energy electrons, then all lower energy betas will be completely stopped also.

Figure 15.12.1 shows that a 1.7 Mev. electron has a maximum range in plastic (lucite) of 0.26" which is about 1/4 of an inch. A piece of plastic 1/4" thick should provide good shielding for P-32, which has a maximum energy beta of 1.7 Mev.

C-14 has a maximum beta energy of 0.15 Mev. Figure 15.12.1 shows that a 0.15 Mev. beta is stopped by less than 10" of air, so no additional shielding is needed.

If shielding must be provided for a large amount of a high energy beta emitter then x-rays produced in the shield when the electrons are stopped (called bremsstrahlung) must be taken into account. As an example, 1/4 inch of lucite (which stops all betas from P-32) will produce an exposure rate, at one foot from the lucite, of 70 mr/hr for 1 curie and 0.07 mr/hr for 1 millicurie of P-32. Thus, bremsstrahlung is a problem only for large amounts of high energy beta emitters. The procedure is to place lucite (or other low atomic number material) close to the emitter and then place lead (or other high atomic number material) on the outside of the lucite to attenuate the x-rays (or bremsstrahlung). Any metal (or other high Z material) placed between the lucite and emitter will cause the production of higher exposure rates.

Figure 15.12.1



The maximum range of beta particles as a function of energy in the various materials indicated.

B. Gamma Shielding

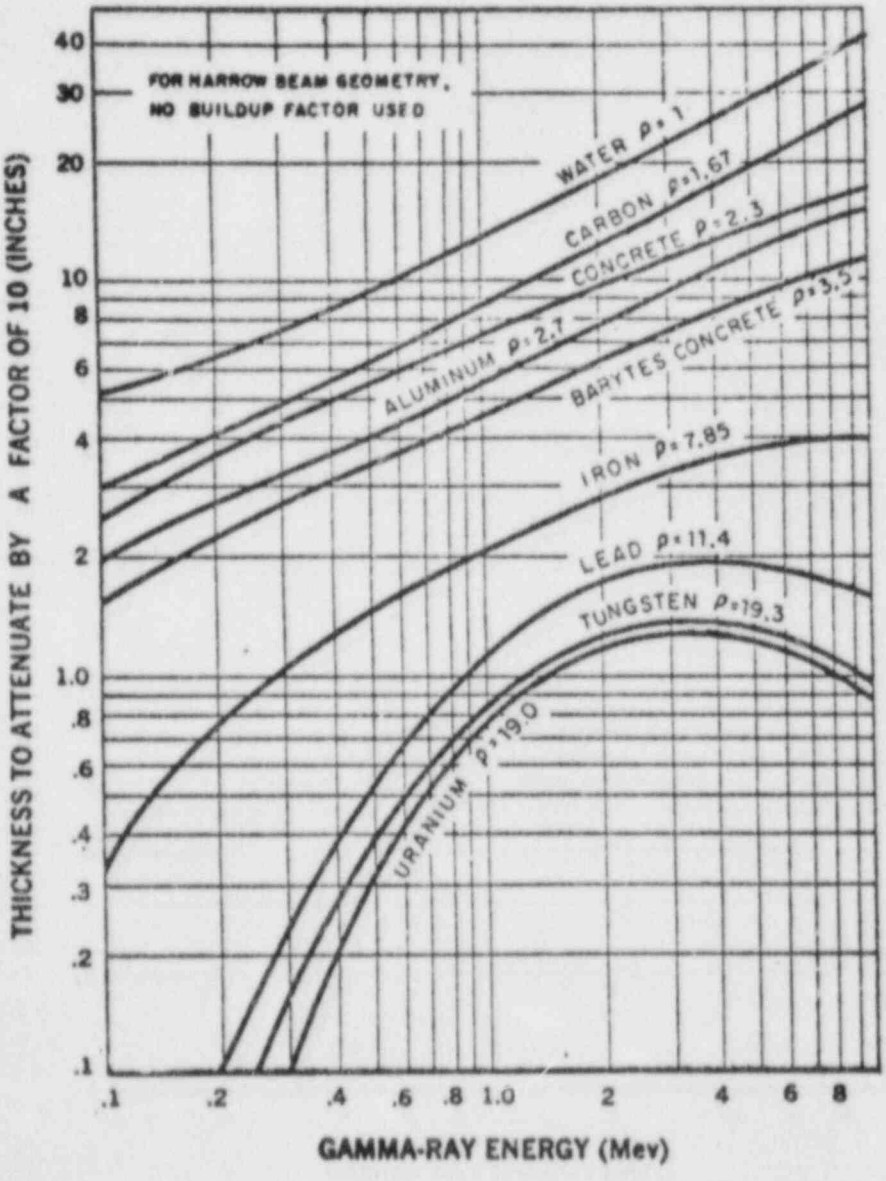
Gamma rays cannot be stopped completely in a certain thickness of shield material like betas can. Instead gammas are attenuated exponentially. This may be seen in the following example. Suppose, for example, you had a 0.9 Mev. gamma emitter that read 100 mr/hr on a survey instrument and you wanted to reduce the reading to 1 mr/hr by using shielding. Figure 15.12.2 shows that it takes approximately 1" of lead to attenuate a 0.9 Mev. gamma by a factor of 10. Therefore, placing 1" of lead between the gamma source and your meter will reduce the reading by 1/10, or 1/10 (100 mr/hr) = 10 mr/hr. Adding another 1" piece of lead (2" of lead total now) will again reduce the reading 1/10, 1/10 (10 mr/hr) = 1 mr/hr. The next 1" of lead (3" total) would reduce the reading to 0.1 mr/hr and so on.

The foregoing example is based on ideal attenuation where the beam of radiation is narrow and the thickness of the shield is small compared with its transverse dimensions. When a thick shield is necessary the actual attenuation is less than that shown in Figure 15.12.2 due to what is termed "buildup". In this case, the actual amount of shielding required will be somewhat greater than indicated in the figure. If accurate shielding calculations are necessary, see Radiological Health Handbook. (Copy available in Radiation Safety Office)

Figure 15.12.2 gives the thickness of various materials to attenuate gamma rays by a factor of 10 and is useful in making quick estimations of shielding requirements. Detailed procedures for determining necessary thickness of material to attenuate by any factor are contained in the Radiological Health Handbook.

Figure 15.12.2

THICKNESS FOR ATTENUATING GAMMA RAYS



Thickness to attenuate narrow beam of gamma rays by a factor of 10.

RELATIVE HAZARDS OF INTERNAL EMITTERS

Selected radioisotopes grouped according to relative radiotoxicity, with the amounts considered as low, intermediate, or high level in laboratory practice.

I. Slight Hazard

$^{*}Na^{24}$, K^{42}, Cu^{64}, $^{*}Mn^{52}$, $^{*}As^{76}$, As^{77}, Kr^{85}, $^{*}Hg^{197}$

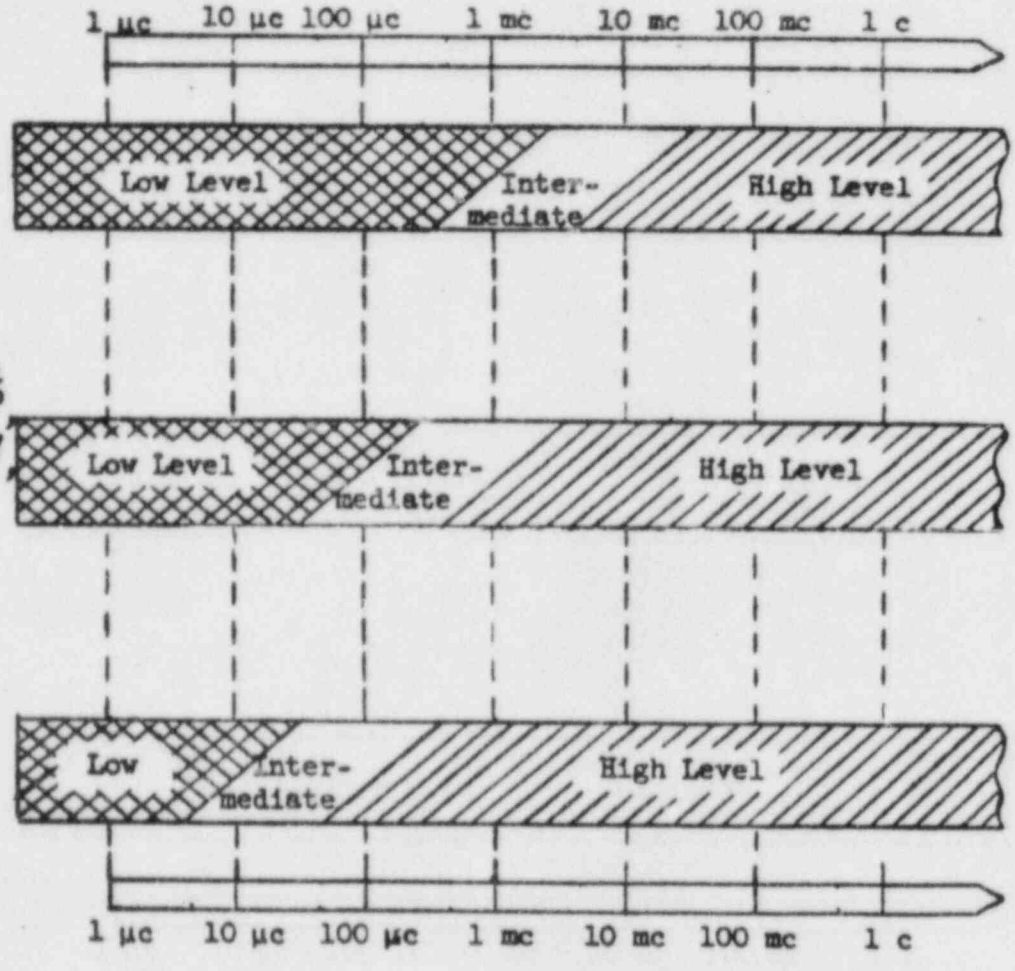
II. Moderately Dangerous

H^{3}, C^{14}, $^{*}Na^{22}$, P^{32}, S^{35}, Cl^{36}, $^{*}Mn^{54}$, $^{*}Fe^{59}$, $^{*}Co^{60}$, Sr^{89}, $^{*}Cb^{95}$, $^{*}Ru^{103}$, Ru^{106}, Te^{127}, Te^{129}, I^{131}, $^{*}Cs^{137}$, $^{*}Ba^{140}$, $^{*}La^{140}$, Ce^{141}, Pr^{143}, $^{*}Nd^{147}$, $^{*}Au^{198}$, $^{*}Au^{199}$, $Hg^{203,205}$

III. Very Dangerous

Ca^{45}, Fe^{55}, Sr^{90}, Y^{91}, $^{*}Zr^{95}$, Ce^{144}, Pm^{147}, Bi^{210}

ACTIVITY SCALE



ACTIVITY TO BE HANDLED IN THE LABORATORY

From: K. Z. Morgan ORNL

Notes: 1. Effective radiotoxicity is obtained from a weighting of the following factors:

(a) Half-life,
(b) Energy and character of radiations,
(c) Degree of selective localization in the body,
(d) Rates of elimination,
(e) Quantities involved and modes of handling in typical experiments.

2. The slant boundaries between levels indicate borderline zones and emphasize that there is no sharp transition between the levels and the associated protection techniques.

3. The principal gamma emitters are indicated by asterisk (e.g., $^{*}Na^{24}$). The above system does not apply to the hazards of external irradiation.

FORMS

Return this form to: RADIATION SAFETY OFFICE

To be filled out by applicant. Please type or print.

1. Name _____
(Last) (First) (Middle or Maiden)

2. Present Age _____ Sex: M F

3. Date of Birth _____

4. Social Security Number _____

5. Have you ever been occupationally exposed to radiation at an institution where exposure records were maintained ?
Yes ( ) No ( )
If so where ?
Name of the most recent such institution _____
_____
Address: _____
_____
Dates: _____ _____
(beginning) (ending)
List any other previous employers who have exposure records on the back of this form.

6. West Virginia University has my permission to secure my past exposure history ? Yes ( ) No ( )

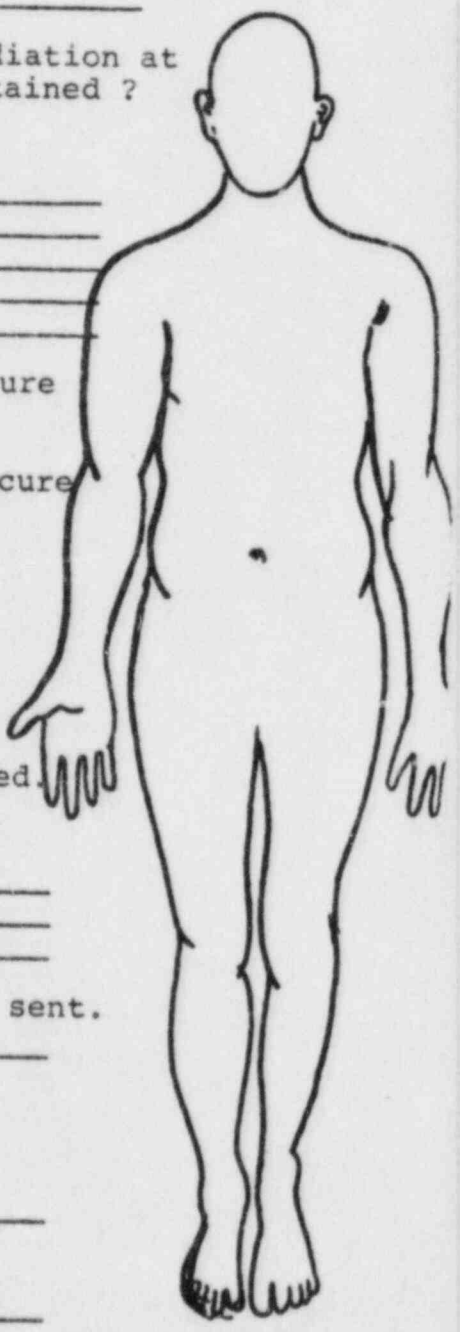
7. Have you ever been issued a film badge at West Virginia University ? Yes ( ) No ( )

8. I will wear my badge as I have indicated on the diagram at the right. (Mark on diagram)

9. Type(s) of radiation to which applicant is exposed. Circle appropriate types: A B Y X Other

10. List of radionuclides and or machines. _____
_____
_____

11. Department to which film badge results should be sent.
_____



Date: _____

Applicant's Signature _____

Signature of Supervisor
or Principal Investigator _____

West Virginia University
MEDICAL CENTER
MORGANTOWN, WEST VIRGINIA 26506

School of Medicine
Department of Radiology
Division of Medical Physics and Radiation Safety
Telephone: 304-293-3413

Dear Radiation Safety Officer,

Please furnish all pertinent occupational radiation exposure data on _____.

This information is necessary to the maintenance of a continuous radiation exposure history as required by Title 10, Code of Federal Regulations, Part-20.

Sincerely,

Stephen T. Slack
Radiation Safety Officer

Authorization for release of my radiation exposure history to the Medical Physics and Radiation Safety Office of West Virginia University is hereby given.

Period of Association _____
Period of Exposure _____
S.S. Number _____

Signature _____

West Virginia University | MEDICAL CENTER
MORGANTOWN, WEST VIRGINIA 26506

School of Medicine
Department of Radiology

In order to complete the radiation exposure history of the following individual, a record of (his, her) radiation exposure is needed from your institution.

Full name _____

S.S. Number _____

Period of Employment _____

Department _____

Authorization for release: "I, _____
do hereby authorize _____
to provide the West Virginia University Medical Center
with a record of my radiation exposure.

Please send the requested information to:

Radiation Safety Officer
Department of Radiology
West Virginia University Medical Center
Morgantown, W. Va. 26505

lb:

WEST VIRGINIA UNIVERSITY
QUARTERLY RADIONUCLIDE REPORT

This report must be filed with the Radiation Safety Office by January 15, April 15, July 15, and October 15 of each year. Upon change of employment, a radionuclide user must file a complete report with the Radiation Safety Office.

I. Radionuclide User: _____

Department: _____

Report Period: ____/1/____ through ____/____/____

Date of application for radionuclide use;(or most recent amendment thereto): _____. Has your usage changed since then? YES NO

II. Please provide the following information:

Persons Using Radioactive Material

Name	Radionuclides Used	Badged	Urine Analysis Performed	Uptake Measured
1.		YES NO	YES NO	YES NO
2.		YES NO	YES NO	YES NO
3.		YES NO	YES NO	YES NO
4.		YES NO	YES NO	YES NO
5.		YES NO	YES NO	YES NO
6.		YES NO	YES NO	YES NO
7.		YES NO	YES NO	YES NO

Please attach a xerox copy of the records of bioassays performed during the quarter.

III. 1. Do you have a copy of CFR10.19 and CFR10.20 readily available for use of everyone in your laboratory? YES NO

2. Do you have a copy of NRC-3 posted as specified thereon? YES NO

3. Do you have a copy of NRC license number 47-01163-20 with attached letters and amendments? YES NO

4. Do you have Radiation Area and/or Radioactive Materials signs posted as required by Part 20 of the regulations? YES NO

WEST VIRGINIA UNIVERSITY
Radionuclide Disposal Form

Name(s) of the radionuclide user:

Laboratory where the isotope was used (room number):

Radionuclide: Half-Life:

Chemical Form:

Date	Activity Disposed						
	Solid	Liquid	L.S. Vials	Sewer	Carcasses	Held for Decay	Total
Total							

To be returned with quarterly Radionuclide Report to:
Radiation Safety Office
Room G-210
University Hospital

Radionuclide (Mass Number and Chemical Symbol)	Chemical Form	Activity on hand at end of previous quarter	Quantity received this quarter	Total decayed this quarter	Activity disposed of this quarter	Activi on hand

DATE

SIGNATURE

APPLICATION FOR USE OF RADIONUCLIDES

Radiological Safety Committee
West Virginia University
(Please print or type)*

1) (a) Applicant's Name_____ (b) Division or Dept._____

(c) Office or Lab_____ (d) Extension_____

( ) Faculty ( ) Staff ( ) Other_____

2) Qualifications and training: Complete the RSO form titled 'Statement of Training and Experience'

3) (a) Byproduct material, element and mass number_____

(b) Chemical or physical form_____

(c) Maximum quantity in millicuries possessed at one time_____

(d) Quantity expected to be used during any 3 month period_____

4) Describe purpose for which byproduct material will be used. Give details of the procedure. Attach a reprint if similar work has been published elsewhere.

5) If the byproduct material is for human use, give details of the dosimetry. Show calculations. Specifically, give total dose as well as the target organ dose.

* If additional space is required, attach extra sheets.

6) I. Radiation Equipment: Complete the RSO form titled "Radiation Equipment"

II. Facilities: (Give brief description of the facilities and attach a floor plan of the laboratory)

7) Radiation Protection Program: (Describe method and location of storage, monitoring, location of labels, caution signs, "notice to employees" - form NRC 3, location of animal housing, etc.)

8) Waste Disposal (Give the estimate of amounts that will be disposed of by different methods)

Method	Quantity	Time Period
Injected to patients/animals		
Dry Solid Barrel		
Liquid Scintillation Vial waste		
Organic and Aqueous Bottled waste		
Sanitary Sewage System		
Effluents through hoods and exhausts		

9) Date you wish to place the first order for the radionuclide_____

I am aware of NRC rules and regulations regarding use of radionuclides and I will abide by them.

_____ _____
Date Signature

Return to: Radiation Safety Office
Department of Radiology, Medical Campus

For Use of Radiation Safety Office Only:

Approval No._____ Date_____

Name:

Department:

Radionuclide:

Quantity:

Use:

Comments:

WEST VIRGINIA UNIVERSITY

STATEMENT OF TRAINING & EXPERIENCE
(Please type or Print)*

NAME_____ OFFICE OR LAB_____

DEPARTMENT_____ EXTENSION_____

	TYPE OF TRAINING	WHERE TRAINED	DATES & DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
A)	Principles and practices of radiation protection			Yes No	Yes No
B)	Radioactive measurement, standardization and monitoring techniques and instruments			Yes No	Yes No
C)	Biological effects of radiation			Yes No	Yes No
D)	Mathematics and calculations basic to use & measurement of radioactivity			Yes No	Yes No

RADIOISOTOPE HANDLING EXPERIENCE

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DATES & DURATION OF EXPERIENCE	TYPE OF USE

Date_____ Signature_____

Return to: Radiation Safety Office
* If additional space is required, attach extra sheets

RSO Form # 7

WEST VIRGINIA UNIVERSITY

Radiation Equipment
(Please print or type)*

Type	Equipment	Manufacturer, Model, Year	Location	Known Users
Measurement and Calibration				
Continous Monitoring				
Survey				
Imaging or Counting				

* If additional space is required, attach extra sheets.

West Virginia University MEDICAL CENTER
MORGANTOWN, WEST VIRGINIA 26506

School of Medicine
Department of Radiology
Division of Medical Physics and Radiation Safety
Telephone: 304-293-3413

MEMO

TO:

FROM:

DATE:

RE: Recent Radiation Exposure

The primary objective of personnel radiation monitoring is to provide information which can aid in the reduction of radiation exposure. Since your film badge, which, according to our records was worn between approximately __/__/_____ and __/__/__, indicated that you received a dose-equivalent of _____ millirems, we would like to determine the cause.

Please answer the questions below, add any pertiment comments and return the form via your supervisor. Please feel free to contact me directly about your personnel monitoring records at any time.

1. How do you believe that the exposure occurred?

2. What has been done to prevent recurrence of such an exposure?

3. What do you recommend be done to reduce your exposure in the future?

4. Comments:

Signed _____ _____
(Person Exposed) (Date)

Signed _____ _____
(Supervisor) (Date)

TO: Funeral Director

FROM: Radiation Safety Office, W.Va University

RE: _____

( ) This body does not contain significant amounts of radioactive materials. No special precautions are required if standard embalming procedures are employed.

( ) This body contains a significant amount of radioactive material. The following precautions are to be observed.

_____

_____

_____

_____

Signed _____

Radiation Protection
Supervisor or Delegate

Date _____

LAB INSPECTIONS

SWIPE TESTING RESULTS

MONTHLY

MONTH: ______________

LS DATE SENT: ________

LS RECEIVED: ________

DATE TESTED:	LSV #:	INVESTIGATOR:	AREA TESTED:	CPM RESULTS:		FOLLOW UP NEEDED:
				Low E	High E	

REQUEST FOR USE OF LABORATORY ANIMAL FACILITIES

The following information is requested for compliance with the Animal Welfare Act P.L. 91-579 and DHEW Guidelines governing the care and use of Laboratory Animals. It also provides the investigator and/or granting agencies assurance that the animal facilities has the capability to provide the animal resource and care support for the proposed project.

Instructions: This form should be completed and submitted in triplicate to the Division of Comparative Pathology for new, renewal and/or expansion of grant applications. Two copies will be returned. The original should be submitted with the grant application to the responsible institutional administrative authority; one copy should be retained in the investigator's file; and one copy will be retained by the Division of Comparative Pathology.

1. Title of Proposal _____

2. Proposed Grant Source _____

3. Duration of Project: From _____ To _____

4. Proposed Location: ( ) Medical Center, ( ) Brooks Hall, ( ) Oglebay Hall
( ) Deahl Hall, ( ) Agriculture Sciences, ( ) Other.

5. Proposed Animal Purchase, Maintenance and Care.

Animal Species*	No. of Animals	Budget for Purchased	Budget for Care**	Duration each animal is to be held

* If dogs or cats specify acute of chronic
** In addition to boarding costs, it is recommended that allowance be made for medication and treatment charges, diagnostic laboratory services fees, etc.

6. Will procedure involve surgical manipulation? Yes _____ No _____
If yes, location of Animal Surgical area:

7. If Anesthetic, Analgesic and tranquilizers drugs are to be used during experimentation, list:

8. Will experiments involving necessary pain or distress to animals be required in which the use of appropriate anesthetic, analgesic or tranquilizing drugs cannot be used? Yes _____ No _____

If yes, briefly explain reason:

9. Method of Euthanasia:

10. This project will entail the following type of requirements:

Housing and Care	Standard ( )	Special ( )
Diet and Water	Standard ( )	Special ( )

If special explain requirements:

11. Are any of the following to be utilized?

Agents infectious or potentially infectious to humans and/or animals.	No ( )	Yes ( )
Radionuclides	No ( )	Yes ( )
Oncogenic or potentially oncogenic agents	No ( )	Yes ( )
Highly toxic chemicals or known chemical carcinogens	No ( )	Yes ( )

If yes, briefly describe:

Has their use been approved by the appropriate University committee, (eg. Radiation Safety Committee, Biohazard Committee)

12. I certify that the use of all animals involved in this project will be carried out within the provisions of the Animal Welfare Act 91-579 and DHEW Publication "Guide for the Care and Use of Laboratory Animals" if funded by NIH; and related animal welfare rules and regulations issued by the Secretary of Agriculture and/or other Federal or State agencies.

_____ _____

Signature: Principal Investigator — Date

_____ _____

Type name of Principal Investigator — Dept. and Phone No.

Proposed Request Approved ( ) Disapproved ( )

Remarks:

Date_____

_____

Director, Division of Comparative Pathology

Request For Space For Use Of Radionuclides In Animal Quarters

Date_____

Name of Investigator Making Request_____

Investigator's Department_____

Do You Have Clearnace From Radiation Safety Office To Use Radionuclides

_____

Species Of Animals To Be Housed_____

Number Of Animals To Be Housed_____

Amount Of Radionuclide To Be Used_____

Type of Radionuclide To Be Used - Element _____Compound_____

Amount Of Space Required_____

Type Of Space - Is Hood Required_____

Type Of Cage Required_____

Time Required Per Animal_____

Time Required Per Project_____