RADIATION SAFETY MANUAL

University of Toledo

TOLEDO,
OHIO

RADIATION SAFETY
OFFICE

Revised October, 2015

University of Toledo/Health Science Campus

EMERGENCY TELEPHONE NUMBERS

Persons to contact in case of EMERGENCY (Principal Investigator, Technician)

		Office	Home
1.	Name_____	Phone:_____	_____
2.	Name_____	Phone:_____	_____
3.	Name_____	Phone:_____	_____

In case of EMERGENCY involving the use of Radioactive Material, the following contacts may be made.

Contact, in the following order:

Joseph Agosti RSO, CNMT	Office: Office:	419-383-4301 419-383-5161
Jen Reckner R.T. (R)(BD)	Office:	419-383-4304
Alex Reiner. CNMT PET	Office: Pager:	419-383-6333 419-218-4515
Barbara Valentine CNMT, R.T.(N)	Office:	419-383-3882
Campus Police	Office:	419-383-2600

RADIATION SAFETY

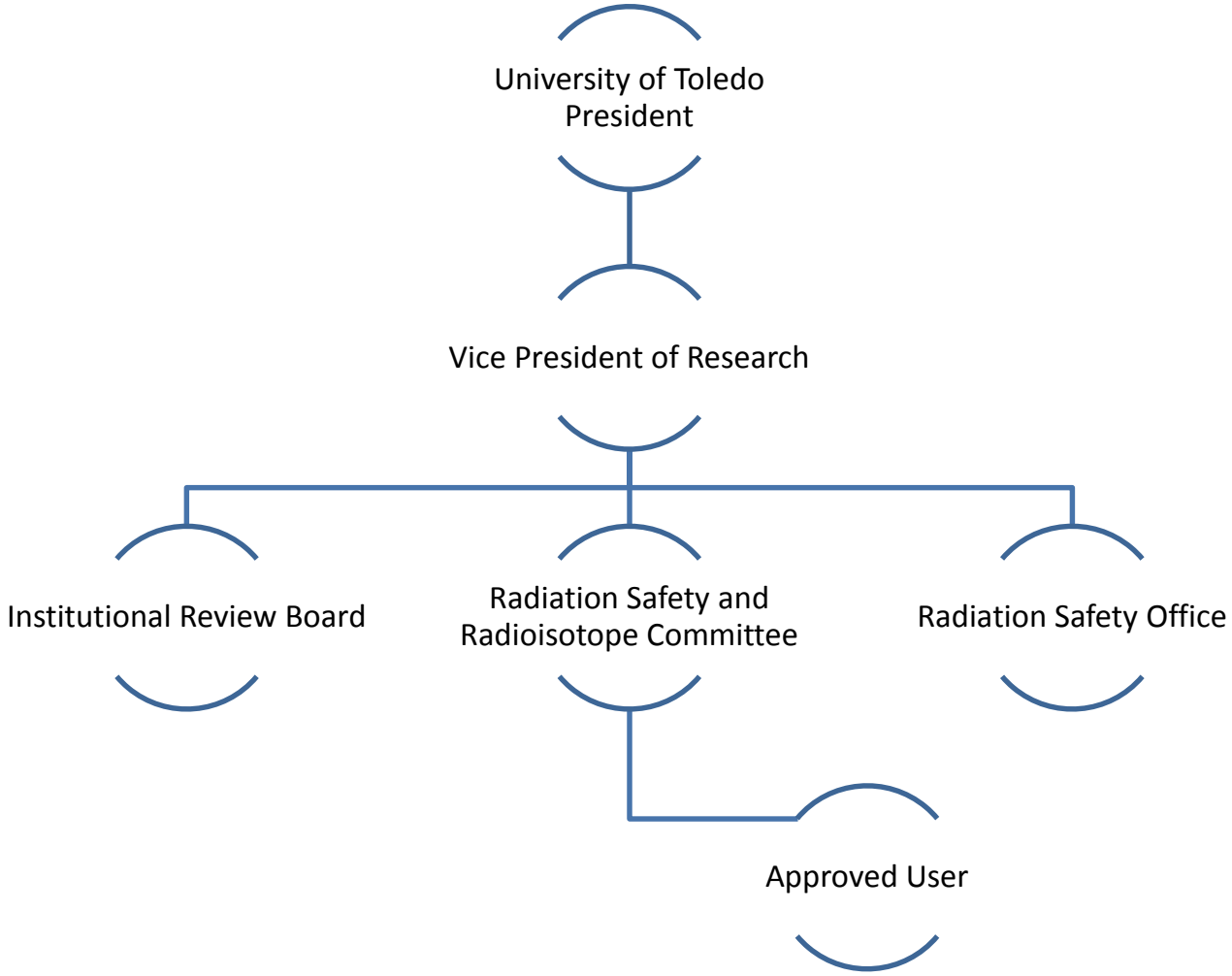
MANUAL CONTENTS

APPENDICES

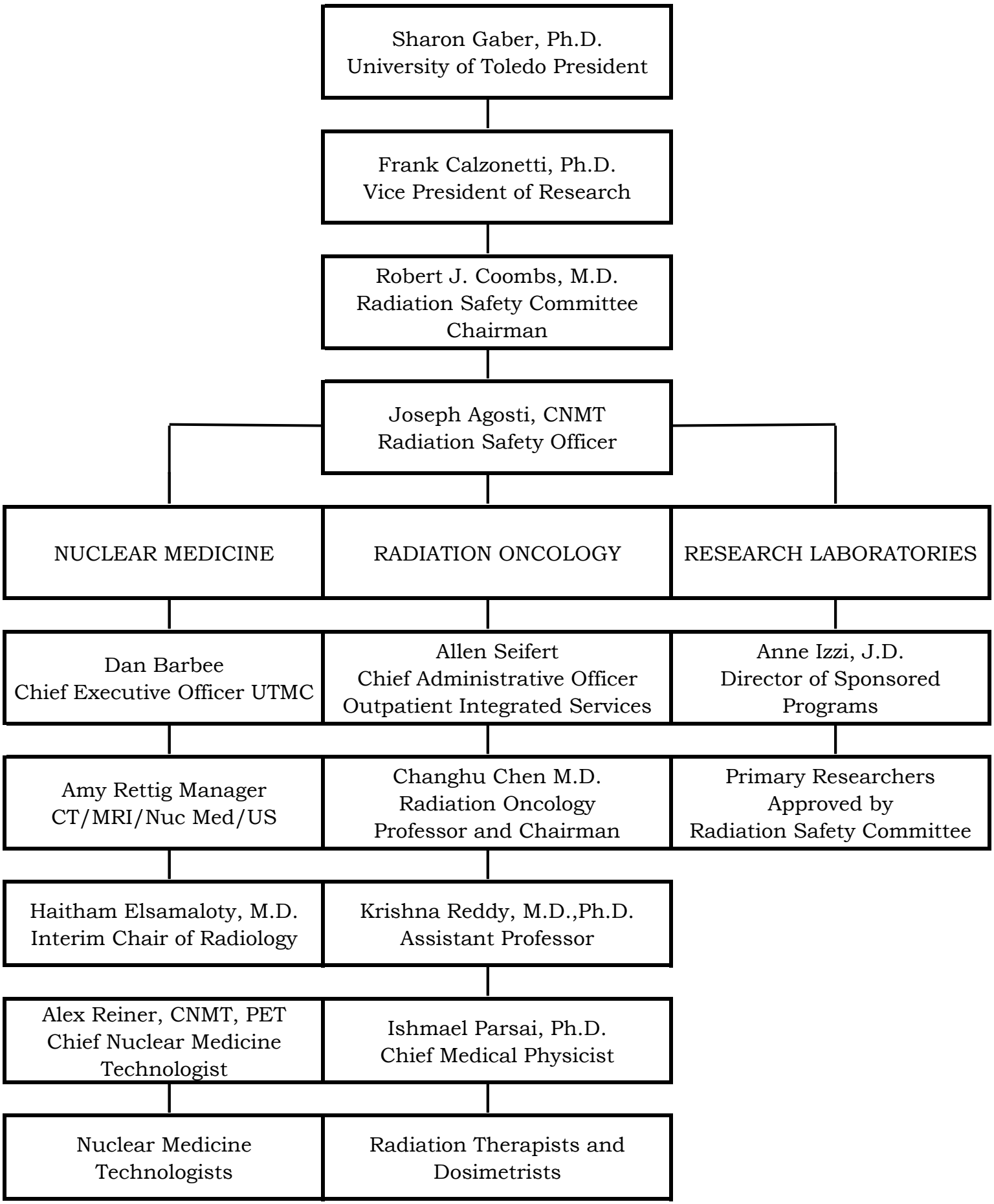
I. Administrative Controls

A. ORGANIZATION

The administrative control of the University of Toledo Radiation Safety Program is schematically represented by the chart below. There are two channels of administrative authority. The administration is for appointments and executive responsibility, the Radiation Safety Committee for review and approval of applications.



Appointments and Executive Responsibility
Application Review and Approval


Sharon Gaber, Ph.D.
University of Toledo President
Frank Calzonetti, Ph.D.
Vice President of Research
Robert J. Coombs, M.D.
Radiation Safety Committee
Chairman
Joseph Agosti, CNMT
Radiation Safety Officer
NUCLEAR MEDICINE
RADIATION ONCOLOGY
RESEARCH LABORATORIES
Dan Barbee
Chief Executive Officer UTMC
Allen Seifert
Chief Administrative Officer
Outpatient Integrated Services
Anne Izzi, J.D.
Director of Sponsored
Programs
Amy Rettig Manager
CT/MRI/Nuc Med/US
Changhu Chen M.D.
Radiation Oncology
Professor and Chairman
Primary Researchers
Approved by
Radiation Safety Committee
Haitham Elsamaloty, M.D.
Interim Chair of Radiology
Krishna Reddy, M.D.,Ph.D.
Assistant Professor
Alex Reiner, CNMT, PET
Chief Nuclear Medicine
Technologist
Ishmael Parsai, Ph.D.
Chief Medical Physicist
Nuclear Medicine
Technologists
Radiation Therapists and
Dosimetrists

B. RADIOACTIVE MATERIALS SAFETY COMMITTEE

1. Function

The Radioactive Materials Safety Committee has the responsibility of establishing and enforcing the College's Radiation Safety Program to ensure the safety and welfare of the Main Campus and Health Science Campus personnel and property as well as protecting the surrounding community from the potential hazards of all sources of ionizing radiation used at the College. The committee formulates and enforces such policies that are necessary to establish uniformly safe practice throughout the College for the procurement, use, storage and disposal of all sources of ionizing radiation.

2. Membership

The Chairman of the Committee is appointed by the Exec. Vice- President for Academic Affairs; members of the Committee are appointed upon the recommendation of the Radiation Safety Officer. Membership shall consist of at least five individuals, including the Radiation Safety Officer, management representative and technical members representing both medical uses and research uses of radioactive materials. The technical members shall have training and be a current user of radioactive materials appropriate to their areas of representation.

3. Meetings

The Committee shall meet regularly, at least once every quarter. Meetings, other than regular meetings, may be called by the Chairman or any three members of the Committee. Minutes of the proceedings shall be recorded and circulated by the secretary to the membership and to those personnel of the College having a specific interest in the proceedings.

4. Procedures

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

a. The Order of Business shall proceed as follows:

1) Review of minutes of the previous meeting

2) Old Business

3) New Business

b. 1) To establish a quorum and to conduct business, at least one-half of the Committee's membership must be present, including the Radiation Safety Officer and the management's representative.

2) For all matters considered by the Committee, a simple majority vote of a quorum shall be required for approval.

5. Duties

a. Review and act upon applications for the procurement and use of sources of ionizing radiation within the College. Applications shall be reviewed from the standpoint of radiation safety. Use of radioactive materials in humans shall be reviewed by the Radioactive Materials Safety Committee before being acted upon by the Institutional Review Board.

b. Prescribe specific conditions that may be necessary for the safe handling of any source of ionizing radiation in connection with granting approval of an application.

c. Review and take appropriate action with regard to violation of the University's Radiation Safety Program.

6. Enforcement

In the event of a failure to observe the rules and regulations governing the safe use of sources of ionizing radiation, the Radiation Safety Officer shall inform the offending investigator(s): 1) of the violations and, 2) that an unfavorable report will be made to the Committee unless they are remedied. If a remedy has not been made within a reasonable period of time, the Radiation Safety Office shall bring the violation to the attention of the Committee at its next regular meeting, or he may call a special meeting to consider the violation. After consideration of such a report, the Committee may make recommendations for mandatory remedial action with a failure to comply being just cause for withdrawal of the Committee's approval of the application. In enforcement cases, the Approved User may be present at the Committee hearing if he or she so desires.

C. RADIATION SAFETY OFFICE

1. Function

The Radiation Safety Office shall be responsible for the surveillance and maintenance of the Radiation Safety Program of the University of Toledo on a daily basis and shall be responsible for notifying the Radioactive Materials Safety Committee and the Vice-President for Academic Affairs as to the status of said program.

2. Organization

The Radiation Safety Office shall be composed of the Radiation Safety Officer plus a sufficient number of technical and secretarial personnel to carry out the functions and duties of the Radiation Safety Office.

3. Duties

The Radiation Safety Officer and Radiation Safety Office personnel shall:

a. Conduct routine monitoring and regulatory compliance surveys in all areas and facilities where sources of ionizing radiation are employed as well as those surrounding areas where the effects of radiation may be a possibility.

b. Distribute personnel monitoring devices to designated persons exposed to ionizing radiation resulting from materials or devices possessed by the University. Manage the processing, evaluation, and record keeping for the monitoring program, including advising personnel of their exposures.

c. Supervise and coordinate the institution's radioactive waste storage and disposal program.

d. Perform or arrange for the performance of leak tests on sealed sources requiring such tests.

e. Perform or arrange for the performance of instrument calibrations.

f. Approve all orders for radioactive materials to determine compliance with authorized user's possession limits.

g. Review shipments of radioactive materials; confirm their authorized use, and delivery to an approved area of use.

h. Maintain an inventory of all radioactive materials at the University and review user's records of receipt, disposition, and disposal.

i. Provide assistance, advice, and training on radiological safety procedures and regulatory requirements.

j. Supervise decontamination activities in the event of significant contamination accidents.

4. Audit of Radioactive Material Use

Items included in the Annual Audit of the Radiation Safety Program are:

a. A review of types and quantities of RAM used clinically and in research to ensure compliance with license limits.
b. A review of surveys done in clinical and research areas.
c. An evaluation of training for users & technologists.
d. Review of results of surveys performed by the Radiation Safety Office.
e. Evaluation of compliance with regulations, the conditions of our license, certificates of use, and the University of Toledo Radiation Safety Manual.
f. Review of performance based instruction by the Radiation Safety Office for users and/or technical staff.

The frequency of audits of areas of use vary depending on the type of radioactive material used. Clinical Nuclear Medicine and Heart Station are audited by the Radiation Safety Office quarterly. Research areas that handle >1.0 mCi per procedure are formally audited at least three times per year. Areas of use that use <1.0 mCi per procedure are formally audited at least two times per year. This is not to say that the Radiation Safety Office only enters these areas during formal audits. Radiation Safety personnel informally observe areas of use during waste pick-ups, delivery of dosimetry, and informal walk-throughs. This method has proven effective and is proven by areas clean of contamination and frequent communication between the Radiation Safety Office and users.

D. APPROVED USER

1. Definition

An Approved User is any person who has been granted permission to use forms of radioactive material by the University of Toledo Radiation Safety Committee.

2. Qualifications

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

a. Be a member of the faculty of the University of Toledo with the rank of Instructor or higher.

b. Be actively engaged in work, instruction, and/or research at the University of Toledo which requires the use of radioactive materials.

c. Possess the minimum training and experience outlined in Appendix #1.

3. Function

The Approved user shall have the primary safety responsibility for those sources of radioactive materials which are listed on his/her Certificate of Use. He/she shall assure that procurement, storage and usage complies with the rules and regulations in this manual.

4. Duties

The Approved User shall:

a. Confine his possession and use of sources of radioactive materials to those limits, locations, and purposes authorized by the Radiation Safety Committee.

b. Not transfer, abandon, or dispose of such sources except as authorized by the Committee.

c. Maintain records as specified in this manual.

d. Conduct or cause to have conducted the required surveys and leak tests.

e. Limit the use of sources of radioactive materials under his/her control to those persons subject to his/her direct supervision.

f. Instruct the personnel under his supervision in the use of radiation safety procedures and equipment.

g. Assure that personnel under his/her supervision have become familiar with the University of Toledo's Radiation Safety Program and that they comply with all regulations therein.

h. Plan his/her research and use of sources of radioactive materials to assure that adequate safety precautions are taken.

i. Communicate to the Radiation Safety Officer pertinent information with respect to changes in operational procedures, new techniques and alterations in the physical facilities.

j. At all times comply with the University of Toledo's Radiation Safety Program as described in this manual.

II. General Instructions

A. APPLICATION FOR USE OF SOURCES OF RADIOACTIVE MATERIAL

1. <u>General Requirements</u>

In order to procure or use any source of radioactive materials at the University of Toledo, approval must be obtained from the Radiation Safety Committee.

a. Considerations:

Approval of any application shall be based upon its radiation safety aspects and the conditions of the radioactive materials license held by the University of Toledo.

b. Applicant Rank:

The minimum rank required for an applicant shall be that of instructor.

c. Training and Experience:

The applicant's training and experience must meet the requirements of the Radioactive Materials Safety Committee listed in Appendix #1.

2. Human Use Requirements

Authorized Users for human use must meet the requirements in 3701:1-58. Institutional Review Board (IRB) approval is required for human research.

3. Procedures

All applications for possession and use of sources of radioactive materials shall be made on appropriate forms obtainable from the Radiation Safety Office or on the University web page. (See Appendix #2)

4. Approval of Application

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

B. PROCUREMENT PROCEDURES

All sources of radioactive materials shall be procured under the direction of the Radiation Safety Office. See Appendix #4 or #5 for procurement instructions. Any questions concerning the procurement of sources of radioactive materials shall be directed to the Radiation Safety Officer.

C. TRANSFER OF SOURCES OF IONIZING RADIATION

The transfer of any source of radioactive materials from the University of Toledo or between Authorized Users must be approved by the Radiation Safety Office.

D. RECORDS

Records relating to personnel exposure, radiation surveys, leak tests, inventories, waste disposals, and calibrations must be maintained and available for inspection as directed by the ODH rules and regulations.

E. FACILITIES AND LABORATORY EQUIPMENT

All designs and plans for new facilities, or alterations to existing facilities in which sources of ionizing radiation will be stored and/or used, shall be reviewed and approved by the Radiation Safety Officer prior to the start of any construction or alteration operations.

1. Release of Facilities for Other Usage

Facilities in which radioactive material was either used or stored shall not be released for other purposes until the facility has been decommissioned under the direction of the Radiation Safety Office.

2. Transfer of Facility Responsibility

The responsibility for the operation of a facility is placed in the hands of the Approved User by the Radiation Safety Committee. Therefore, this responsibility shall not be transferred to another individual until an application for such has been approved by the Committee.

3. Laboratory Equipment

Laboratory equipment which has been used for radioactive materials purposes or located within a radioactive material facility shall not be transferred out of the lab until it has been surveyed and determined to be free of radioactive contamination. The survey and/or decontamination shall be completed by the Approved User under the direction of the Radiation Safety Office.

III. Radiation Safety

A. GENERAL

1. Objectives

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

a. To maintain as low a level of radiation exposure as is reasonably achievable. (ALARA)

b. To reduce the possibility of entry of radioactive materials into the human body by ingestion, inhalation, absorption, or through open wounds.

c. To reduce to the lowest reasonably achievable limits the amounts of radioactive materials released to the general environment.

Since these recommendations are made to cover most of the general situations and cannot possibly cover all circumstances, there may be instances in which these recommendations do not apply. In such situations the Radiation Safety Office shall be contacted for assistance or clarification. If the problem cannot then be rectified, it shall be presented to the Radiation Safety Committee for resolution.

2. Permissible Dose Limits

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

3. Safe Use of Radioactive Material

To ensure the safe use of radioactive material it is the policy of the University of Toledo to:

a. Wear a laboratory coat or other protective clothing at all times when handling radioactive materials.
b. Wear disposable gloves at all times when handling radioactive materials that can cause contamination to the skin.
c. After each procedure or before leaving the area, monitor hands, shoes, and clothing for contamination of gamma or high energy betas in a low background area.
d. Not eat, drink, smoke, or apply cosmetics in any area where licensed material is stored or used. There shall be no pipetting by mouth.
e. Not store or drink in areas where licensed material is stored or used. Special care will be used to ensure personal effects do not come in contact with licensed material.
f. Wear personnel monitoring devices, if required, at all times when in areas where licensed materials are used or stored.
g. Dispose of radioactive waste only in designated, labeled, and properly shielded receptacles.
h. Store radioactive solutions in clearly labeled containers.
i. Secure licensed materials when not under constant surveillance by the securing of the lab, or by securing the storage unit. (i.e. locking the refrigerator, freezer, or by the use of lock boxes to secure primary containers of radioactive materials).

B. EXPOSURE

Exposure to radioactivity can essentially be classed into two categories: External and Internal.

1. External

For protection against external exposure, the basis protection factors of time, distance, and shielding shall be employed to reduce the exposure potential to a value below maximum permissible levels. In every situation these three factors must be considered jointly. While shielding is desirable in reducing the exposure, it must be remembered that doing the job at twice the distance is just as effective as adding two half-value thicknesses of shielding material or doing the job in one-fourth the time. Continuous use of monitoring equipment is the best method of evaluating the hazard and reducing the exposure.

2. Internal

The prevention of internal exposure is more exacting and less easily performed than that of external exposure. The maximum permissible levels of radioactive contamination in the air or on laboratory surfaces are of such a low level that they cannot be detected with ordinary survey instruments. If a low level contamination is suspected, the Approved User in charge of the area should be notified so that a survey can be made. The general policy in the use of radioisotopes is to use such equipment and procedures which will reduce the probability of ingestion and inhalation of radioisotopes into the body.

3. Additional Rules

Outlined below are additional rules and procedures to be followed for protection against exposure to sources of ionizing radiation.

a. The exposure potential shall be estimated before placing into operation any procedure in which personnel may become exposed to radiation.
b. The use of sources of ionizing radiation shall be subjected to programs of continuous monitoring or regularly scheduled surveys as a means of evaluating the radiation hazards.

c. Special clothing (i.e. lab coats, gloves, etc.) which can be easily laundered or disposed of shall be worn and properly fastened when there is a possibility of contamination with radioactive materials. When necessary, safety glasses, and shoe covers shall be worn. These items should not be worn outside the laboratory. Protective clothing should be monitored for contamination before sending to the laundry. Any protective clothing which has become contaminated should be handled as any other piece of contaminated material.

d. Before any work is undertaken with radioactive materials, attention shall be given to precautionary measures including the use of hoods, remote handling equipment, and glove boxes. The Radiation Safety Office should be consulted for recommendations on specific operations. Plan the procedure to be used, and, if possible, perform a dry run.

e. The wearing of impervious gloves is necessary with any manipulation of unsealed radioactive materials.

f. Plastic-backed absorbent paper shall be used on bench tops when working with radioactive materials.

g. Pipetting by mouth is prohibited. Use rubber balls, syringes, or pipettors.

h. When transporting or transferring liquid radioactive materials, double containers or absorbent material should be used.

i. Containers affording adequate protection and shielding shall be used to store radioactive materials.

j. Keep the laboratory neat and clean. Keep the work area free of equipment and material not required for the procedure.

k. Eating, drinking, storing or preparation of food is strictly prohibited in laboratory areas where work with radioactive material is taking place or where contamination may exist. Refrigerators and freezers in which radioactive material is stored shall not be used for the storage of food or beverages.

l. An area shall be set aside for the decontamination and cleaning of laboratory apparatus used with radioactive material. A sink in this area shall be designated for use with radioactive material. Isolate all laboratory apparatus and equipment which are used in operations involving radioactive material.

m. Use of flammable liquids shall not be permitted in laboratories unless such flammables are: (1) contained in U.L. approved safety cans with anti-flashback screens and (2) used in a properly vented enclosure. Pressure bottles or tanks containing counting or laboratory gas shall not be used or stored in the laboratory unless they are securely mounted to the wall, bench or floor.

n. Good personal hygiene practices, such as washing hands and arms thoroughly, using plenty of soap and water, before handling any object which goes to the mouth, nose, or eyes, will greatly reduce the possibility of internal exposure. Wash and monitor the hands whenever leaving the laboratory after handling radioactive material.

o. Do not apply cosmetics in a laboratory where unsealed sources of radioactive material are in use.

p. Monitor shoes and other clothing for contamination and remove all contamination before leaving work areas.

C. AREA CONTROLS

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

1. Posting

Areas shall be classified for posting as follows:

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

State of Ohio, ODH has regulations governing posting, control, and safety devices required for these areas:

State of Ohio 3701:1-38-18

The State of Ohio has regulations governing the posting of "Notice to Employees" and other instructions to employees:

State of Ohio OAC 3701:1-38-10

2. Restrictions

a. Those areas authorized by the Radiation Safety Committee for use with sources of radioactive materials are restricted to usage by the approved user and those

personnel under his immediate supervision. Caution shall be taken to prevent unauthorized removal of radioactive material when authorized personnel are not present in the areas.

b. Sealed and unsealed sources of radioactive materials shall be kept in their labeled storage containers when not in use.

D. MONITORING AND SURVEYS

In order to ensure satisfactory radiation safety throughout the University of Toledo complex, routine and periodic monitoring and surveying of personnel, equipment, and facilities are required. The frequency of surveys will depend upon the classification of the facilities employing sources of radioactive materials. See Appendix #7.

1. Responsibilities

a. It is the responsibility of the radiation worker to see that his/her working environment is safe and well organized, safety devices are installed and properly working, appropriate records are maintained, and that contamination is not permitted to build up.

b. The Radiation Safety Office will periodically monitor and survey all controlled areas.

c. The Radiation Safety Office shall supply the Approved User with reports of findings in these investigations, along with recommendations for the elimination of all items of non-compliance to State, and University of Toledo regulations, and a specific time period for making the necessary corrections.

d. Experimental work shall be monitored throughout on a periodic basis to determine the occurrence, or possibility of occurrence, of new and increased radiation hazards.

2. Leak Tests and Special Surveys

For sealed sources that require leak testing we will use the model leak test program published in Appendix O of NMS-LIC-11. Exceptions are the brachytherapy tube and microad sources. To lessen exposure to personnel performing the leak test, each drawer housing the sources will be leak tested. This will be done by wiping the area surrounding the sources. If the leak test shows activities in excess of 0.005 uCi then

each source in the drawer will be tested individually.

The University of Toledo's ODH License has conditions regarding the testing of sealed sources for leakage and/or contamination. It is the responsibility of the Approved User of such devices to see that each of their sealed sources, except those exempt from same by the State of Ohio, (ODH) is tested in the manner and at the intervals required. Copies of results of these tests shall be kept on file in the Radiation Safety Office. These tests will be performed by the Radiation Safety Office.

3. Personnel Monitoring

All personnel working with or around sources of radioactive materials and may receive greater than 10% TEDE radiation exposure in one year shall wear monitoring devices approved by the Radiation Safety Office.

a. Radiation Monitoring Badges

Badges shall be the general personnel monitoring device used throughout the University of Toledo. To initiate badge service for any individual, contact the Radiation Safety Office. A supply of badges will be available for temporary use upon request. Each individual assigned a badge shall wear only the specific badge assigned to him or her.

In the event of a lost badge, notify the Radiation Safety Office. Personnel assigned badges shall wear them whenever they are working with or near radioactive materials. Badges may be worn comfortably between the waist and chest. All badges shall be kept in a controlled area when not in use and put back at the end of the work period. They should not be removed from the University. Assigned badges shall not be used for any purpose other than occupational monitoring.

New badge packets shall be distributed by the Radiation Safety Office or designated department within three working days of the beginning of the wear period and used badges shall be collected within the first ten working days of the start of the wear period. It is the responsibility of the Approved User to ensure the change of badge. If certain operations require special badges for the wrist, fingers, etc., or special dosimeter devices, contact the Radiation Safety Office. If a badge is suspected of being contaminated, contact the Radiation Safety Office for replacement.

b. Bioassay

Special tests for determining the presence of radioactive material in the body are desirable for persons handling intermediate or high levels of unconfined radioactive material. All persons working with such radioactive material shall make themselves available for such tests when requested by the Radiation Safety Office. See Appendix #12.

c. Medical Examination

When deemed necessary by the Radiation Safety Office, a medical examination may be required for individuals working with radioactive materials. The Radiation Safety Office shall notify those workers who are to receive an examination.

d. Survey Meters

Facility's utilizing certain sources of radioactive materials shall have appropriate survey instruments available.These instruments shall be used by the laboratory personnel to measure possible radiation fields, check for contamination of hands, shoes, clothing, and work areas.A survey meter shall only be shared by a maximum of two adjacent labs.

E. CALIBRATION OF EQUIPMENT

1. Radiation Monitors: All instruments utilized as radiation monitors must be calibrated at appropriate intervals to assure the validity and integrity of results. It is the responsibility of each Approved User to see that his instruments are properly functioning and in calibration. All survey meters used to quantitate radiation exposure or contamination must be calibrated at least annually or whenever such instruments have been repaired. The calibrations can be performed by the Radiation Safety Office (We will follow the procedure in Appendix J of NMS-LIC-11 "Model Instrument Calibration Program" for survey meters used for exposure rate readings) or sent out for calibration by an external company. Instruments used in the research labs will be calibrated using disc sealed sources appropriate for the type of radioactive materials used. Documentation will be done and retained for the appropriate time interval.

2. Dose Calibrator Tests – Nuclear Medicine/PET/Heart Station:
   Equipment used to measure dosages will be calibrated in accordance with nationally recognized standards or the manufacturer's instructions.

F. CONTAMINATION

No amounts of radioactivity shall be released into unrestricted areas in any manner which will cause the limits specified in the following regulations to be exceeded:

Ohio Radiation Protection Standards,
Rules 3701:38-19.

G. DECONTAMINATION

Successful decontamination calls for planned action. Decontamination shall be accomplished by the approved User and/or his laboratory personnel. Decontamination procedures depend upon source type, strength, chemical and physical properties, and total area contaminated. The trigger level for initiating decontamination is 500dpm/cm^2.

1. Procedures
   a. Decontamination of any area shall be accomplished by working from the outer edges towards the center.
   b. Make full use of protective clothing (gloves & lab coat minimum), footwear, masks, etc. to reduce the possibilities of personnel contamination for those conducting the decontamination.
   c. Do not wear protective clothing, etc. outside of a designated change area.
   d. Handle all equipment used in decontamination and all run-off solutions as ones which are potentially contaminated.
   e. Make provisions for the disposal of all used cleaning materials and equipment as well as other contaminated articles in the area. Therefore, always bring the necessary collection receptacles to the area in question, not vice versa.
   f. Suggested agents for removal of contamination from various surfaces can be found in Radiation Safety Lab Manual.

g. Make full use of available instrumentation for monitoring, choosing the most effective for your purposes.

h. Make a complete record of the decontamination operations. (Utilize survey diagram).

i. After decontamination has been completed, do not permit any work or occupancy within the area(s) until a survey it has been done to verify there is no contamination.

j. All decontamination events must be recorded and kept on file for 3 years.

IV. Radioactive Waste

All radioactive waste shall be disposed of via procedures approved by the Radiation Safety Office. Accumulation and storage of radioactive waste shall be in containers labeled Radioactive Materials. The containers must be lined with yellow bags marked Radioactive Materials. These bags are obtained from the Radiation Safety Office. The containers are to be kept either in a secured central storage area or within the approved users' laboratory. Proper disposal or transfer of radioactive waste is the responsibility of the Approved User.

A. METHOD OF DISPOSAL

The following methods of disposal will be utilized at the University of Toledo.

1. <u>Storage for Decay</u>

This process will be performed by the Radiation Safety Office. Waste contaminated with radionuclides having a half- life of less than 120 days will be stored for decay. The material may be discharged into the sewer or through normal waste disposal when the material has been surveyed with a suitable survey instrument, and found not to be above background. Proper documentation of this process must be kept.

2. <u>Disposal into the Municipal Sewer System</u>

Radioactive waste which is water soluble and readily dispersible may be disposed of through the municipal sewer system. This shall be done in accordance with State regulations. Contact the Radiation Safety Office for limits. Records of sink disposal shall be forwarded to the RSO at the end of each month.

3. Shipment to Commercial Disposal Facilities

Radioactive waste materials which cannot be disposed of by other designated means shall be disposed of through a licensed commercial facility, via the Radiation Safety Office

B. RESPONSIBILITIES

1. Approved User's Responsibility

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

a. Radioactive waste material shall be segregated per instruction from the Radiation Safety Office.

b. Radioactive waste shall be stored in a separate designated area within the individual laboratories. The waste shall be removed from the individual laboratories by calling the Radiation Safety Office. The appropriate information including the radioactive material; the quantity of each radioactive material; the Approved User's name; and other pertinent information shall be available on the waste log when picked up. The containers provided for the accumulation and storage of radioactive waste material shall not be used for any other purposes.

c. The Approved User shall use due care in the selection of containers for the transfer and storage of liquid waste. In case of organic solvents, containers of a capacity not exceeding five gallons shall be used for accumulation and storage purposes.

d. Acids and bases shall be neutralized to approximately pH7 before depositing them in waste containers.

e. Liquid waste shall be stored in such a manner that there will be no possibility of a chemical reaction which might cause an explosion or cause the release of radioactive or toxic gas or vapors.

f. The Approved User shall not dispose of radioactive waste into the sewer system in excess of amounts listed in the sink disposal log.

g. The material must be water soluble and readily dispersible in water. The release of gaseous waste to the air effluent shall be accomplished only through hoods designated for this purpose and with approval from the Radiation Safety Office.

2. Radiation Safety Office's Responsibilities

The Radiation Safety Office has the responsibility for the ultimate disposal of radioactive materials. The Radiation Safety Office shall maintain the central storage areas. Radioactive waste shall be removed periodically from the individual laboratories by the Radiation Safety Office and be placed in appropriate containers within the central storage area.

C. ANIMAL CARCASSES AND EXCRETA CONTAINING RADIOACTIVE MATERIAL

Instructions:

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

1. All objects which can inflict a wound shall be removed from animal carcasses.

2. Animal carcasses shall be double packaged in plastic bags in a manner which will ensure against the leakage of body fluids.

3. Each package shall be labeled using a radioactive material string tag with the radioisotope, amount of radioisotope, date of injection or treatment, weight in kilograms and the Approved User's name.

4. Animal carcasses shall be stored only in freezers designated by the Radiation Safety Office.

5. All excreta shall be collected and placed in appropriate containers. Solids, including liquids mixed with absorbent material, etc., shall be placed in plastic bags and then stored in appropriate containers. Liquids shall be placed in one-gallon plastic containers.

6. An estimate of the activity that is expected to be eliminated by the animal shall be made and recorded.

7. The containers shall be labeled with the name of the Approved User, the radioisotope(s), the estimated activity, and the date of collection.

V. Classification of Facilities and Sources of Ionizing Radiation

A. LABORATORY AREAS

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

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

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

Type 0: Laboratories in which the use of radioactive materials is limited to small tracer amounts. Here the activity shall not exceed the limits specified for Type 0 laboratories.

B. RADIOACTIVE MATERIALS

Type 3: Activities greater than 500 milliCuries

Type 2: Activities >100 milliCuries but <500 milliCuries

Type 1: Activities <100 milliCuries but >100 microCuries

Type 0: Activities <100 microCuries

VI. Emergencies

Any circumstance or event which has caused or threatens to cause abnormal exposure of persons to ionizing radiation, or a loss of radioactive materials, shall be termed a radiological emergency. Emergencies may arise from a variety of situations; therefore, procedures cannot be established to cover all situations. Lifesaving procedures shall be the primary concern in any emergency. Following this shall be the protection of all personnel from exposure to ionizing radiation and then the confinement of contamination to the local area of the accident if this is possible.

A. NOTIFICATION

All emergencies shall be reported to:

1. Radiation Safety Office
2. Approved User responsible for the source of ionizing radiation.

B. EMERGENCY PROCEDURES

1. <u>Accidents involving Release of Radioactive Material</u>
   a. Notify all persons in the area at once and isolate those involved. Simultaneously forestall further spillage and initiate isolation and decontamination procedures.
   b. Keep the number of persons dealing with the spill to a minimum.
   c. Notify the Radiation Safety Office.
   d. Monitor all persons involved in the spill and clean-up operations, paying particular attention to the shoe soles.

e. Decontamination of personnel and the area involved shall be undertaken only under the direction of the Radiation Safety Office.

f. Occupancy of, or work in the area shall not be resumed until approved by the Radiation Safety Office.

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

a. Notify all persons to vacate the room immediately.

b. If time permits all windows should be closed, fans or air conditioners should be shut off, the door and all other openings should be sealed with wide masking or adhesive tape.

c. Notify the Radiation Safety Office.

d. Restrict the movement of potentially contaminated persons to a local zone just outside the spill areas until the extent of contamination is ascertained.

e. If no means are available for monitoring, it should be assumed that all personnel involved are contaminated.

f. Decontamination of the area shall be done only under the direction of the Radiation Safety Office.

g. Occupancy of, or work in, the area shall not be resumed until approved by the Radiation Safety Office.

3. Injuries to Personnel Complicated by Radioactive Contamination

a. All life-saving procedures should be carried out immediately; contact a physician at once if needed.

b. Report all radiation accidents involving personnel (contaminated wounds, ingestion, inhalation) to the Radiation Safety Office as soon as possible.

c. Wash minor wounds under running water immediately, while spreading the edge of the wound.

d. Permit no person who has sustained a radiation injury to return to work without the approval of the Radiation Safety Office and the attending physician.

e. A report shall be prepared by the individual injured and the Approved User in charge.

f. In the event of a radioactive contaminated injured victim reports to the UTMC Emergency Department the "Code Orange – Radioactive" procedure is to be initiated.

4. Overexposure and/or Suspected Overexposure

a. Contact the Radiation Safety Office at once.

b. A report shall be prepared by the individual exposed and the Approved User in charge.

c. It is the responsibility of the Radiation Safety Office to report any exposure greater than the limits set forth in the regulations by the State of Ohio/Bureau of Radiation Protection or the Nuclear Regulatory Commission.

5. Emergencies Involving Fires in Restricted Areas and Their Adjacent Locations

a. Notify, in order: all persons in the area, UT Campus Police (Dial 2600), and the Radiation Safety Office immediately. The caller must relate his name, location, and degree of any radiation hazard involved.

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

Because of the nature of this kind of emergency, the following set of instructions shall be carried in every vehicle used while transporting radioactive substances. These instructions are to be read and followed by all personnel in the event of an emergency.

a. Immediate notification is to be given by telephoning, in the following order: local Police and/or Highway Patrol, and the Radiation Safety Office at the University of Toledo. Caller must state his or her name, location, what happened, when, where, who was involved, and what has been done to control or contain the radioactive materials.

Someone must maintain the security of the vehicle and radioactive material and keep bystanders away while calls are being made.

b. All traffic should be detoured around the scene of the accident. If this is not possible, vehicles should be moved the shortest distance necessary to clear the right of way. If radioactive material is spilled, passage through the area should be prevented unless absolutely necessary. If right of way must be cleared before radiological assistance has arrived, the spillage should be washed to shoulders with minimum dispersal of wash water, or cover with at least four inches of earth or sand.

c. The Radiation Safety Office will notify the Ohio Department of Health/Bureau of radiation Protection as soon as possible

d. If the accident involves wreckage and a person is believed to be alive and entrapped, every possible effort should be made to rescue him or her.

e. The area of the accident should be restricted. The public should be kept as far from the scene as practical. Local authorities should make only necessary entries and investigations in the accident area. No attempt should be made to clean up any debris or material involved in the accident prior to the arrival of an emergency monitoring team.

f. Persons who have had possible contact with the radioactive material should be segregated and confined until they can be examined further. The names and addresses of those involved should be obtained and recorded.

g. The injured should be removed from the area of the accident with as little contact as possible and held at a transfer point. All life-saving measures should be performed promptly, but elective first aid and surgical procedures should be delayed until advice or help can be obtained from a physician familiar with radiation medicine. Except in extreme emergency, patients should not be moved to local hospitals or doctors' offices before a radiological survey has been made.

h. If the accident involves fire, attempts to extinguish it should be made from as great a distance as possible. The fire should be treated as one involving toxic chemicals. Suspected material

should not be handled until it has been monitored and released by monitoring personnel. Clothing and tools used at the fire should be segregated until they can be checked by emergency monitoring teams.

i. Eating, drinking or smoking in the area of the accident should be prohibited. Food or drinking water which may have been in contact with material from the accident should not be used.

j. Careful attention and consideration should be given in matters of public relations to:

(1) transmission of information to the public by press, radio, and television. Shall be referred to UT Public Relations Office

(2) tactful handling of volunteers and curious onlookers

7. Lost Sources

a. If a source is lost notify all personnel in the area, monitor each individual, and evacuate the area

b. Restrict movement of personnel involved to a known and controlled area.

c. Do not remove any articles such as waste containers, laundry bags, soiled linens from the areas involved.

d. Notify the Radiation Safety Office

8. Other Emergencies

If any questions exist, call the Radiation Safety Office.

VII. Transporting of Radioactive Material

Transporting of radioactive material by personnel of the University of Toledo must be done in full compliance with State and Federal Regulations and specifications. All questions pertaining to transporting of radioactive material must be directed to the Radiation Safety Office.

A. INSTRUCTIONS

1. On-campus Transport

a. Transport shall be in unbreakable, spill proof, double containers which are free from loose, external contaminating.

b. Gamma radiation, or equivalent, shall not exceed 10 mR/hr at one-meter distance.

c. Containers shall be labeled in accordance with Federal and State regulations.

2. Transport Via Motor Vehicle – Campus to campus & other facilities

The transport of radioactive material to/from UT Main and or University of Toledo or other facilities via motor vehicle shall be performed under the following conditions.

a. All radioactive material shall be packaged in Department of Transportation specification containers. All containers shall be free of loose contamination on the outside.

b. The gamma radiation or equivalent shall not exceed 200 mR/hr at the surface of the container and shall not exceed 10 mR/hr at one meter with appropriate DOT diamond label.

c. There must not be any loose radioactive material in the motor vehicle and all containers shall be placed securely in the vehicle to prevent leakage or shift of loading under conditions normally incident to transportation. There shall not be more than 40 units per vehicle (one unit equals 1 milliroentgen per hour at one meter for hard gamma radiation or the amount of radiation which has the same effect on film as one mR/hr of hard gamma rays of radium filtered by one-half inch of lead)

d. All shipments must meet regulations and general packaging requirements of 49 CFR Parts 170-180.

e. The motor vehicle shall be placarded in conformity with Department of Transportation regulations, 49 CFR Part 177.

f. Shipping orders, bills of lading and other forms of shipping papers shall be prepared in conformity with transportation regulations.

g. The motor vehicle shall be attended at all times. For transportation of high levels of unsealed radioactive materials, two people shall accompany the shipments.

h. Emergency instructions and an appropriate survey instrument shall accompany the driver of the motor vehicle.

i. Cars, buildings, area, or equipment in which radioactive material has been spilled shall not be placed in service or occupied until decontaminated by qualified persons and released by the Radiation Safety Office.

VIII Additional Procedures and Instructions

A. TESTING OF SEALED SOURCES

Before any sealed source greater than 100 microCuries Beta/Gamma or 10 microCuries Alpha is put into useful service for the first time, and at intervals not to exceed six months beta/gamma or three months alpha, the Approved User shall conduct or have conducted a leak test to determine its integrity.

The presence of radioactive material which exceed the limits set for in 3701:1-38-24, by license condition or the Radioactive Materials Safety Committee the source must be removed from service.

B. INSTRUCTION REGARDING THE USE OF ANIMALS EXPOSED TO RADIOACTIVE MATERIAL

1. Approved User's Responsibilities

The Approved User of radioactive materials in charge of a research project involving animals must obtain prior approval from the Institutional Animal Care and Use Committee. The Approved User is responsible for the radioisotopes and radiation safety involved while the animals are confined in the animal facilities.

a. Division of Laboratory Animal Medicine technicians must be notified of animals containing radioactive material and given specific information in regard to the care and management of these animals, their biological waste, required equipment, and necessary radiation safety instructions.

b. All cages containing food or that contain radioactive material shall be tagged with the following information (using a "Caution-Radioactive Material" string tag):

(1) Name of radioactive materials.
(2) Activity of radioactive material injected per animal.
(3) Date of injection.
(4) Principal investigator's name and phone number.

c. Animals containing radioactive materials shall be kept in cages apart from other animals.

d. All procedures, including injection of radioisotopes and preservation of carcasses, carried on outside of cages shall be done on steel trays with absorbent paper. The investigator shall make any necessary surveys of the area to verify that there is no contamination of the facilities.

e. Animals which have been injected with radioactive material that may be volatilized and dispersed into the room shall be kept in an area with adequate ventilation and air cleaning facilities.

f. Exercise of animals containing radioactive material normally will be restricted to their cages or primary enclosure. If some type of activity outside the cage or primary enclosure is required, it will be carried out by the authorized user or a person directly responsible to him. The authorized user shall be responsible for any emergency or contamination which may arise.

g. Appropriate surveys, by the Authorized User, during and at the end of a project, of the facilities used by an authorized user shall be made and results of these surveys shall be recorded and kept on file. Any pertinent information arising from these surveys which imply a health hazard shall be given immediately to the Radiation Safety Officer.

h. No animals from outside the University of Toledo and containing

radioactive material shall be placed in animal quarters without prior written approval of the Radiation Safety Officer, and the Director of Division of Laboratory Animal Medicine.

i. The cages will be monitored by the authorized user with equipment and methods appropriate to the radioisotope involved to determine the level of contamination. If contamination is found, it shall be reported to the Radiation Safety Office and decontamination of the cages will be performed under the direction of the authorized user.

C. SUPPORT PERSONNEL

Support personnel shall constitute the members of maintenance, Environmental Services and Campus Police.

1. Emergencies

If a question exists regarding a possible radiation hazard, the Radiation Safety Office, as well as the staff member in charge of the facility shall be called. No attempt should be made to enter an area where a real or suspected radiation hazard exists.

2. Requested Maintenance and Environmental Services Maintenance and custodial personnel shall request the Approved User to conduct a radiation survey of the area where the services are required. This survey shall be conducted prior to, or simultaneously with, the service being rendered.

3. Routine Maintenance and Environmental Services

Routine services shall be established in those areas where arrangements have been made with the Approved User. These arrangements shall be approved by the Radiation Safety Officer and may contain certain requirements and/or restrictions, depending upon the type of facility involved and the type of service desired.

4. Training Program for Support Personnel

Training programs for support personnel shall be conducted periodically by Radiation Safety Office for purposes of familiarizing personnel with those aspects of radiation safety relevant in the discharge of their duties.

Participation of support personnel in these programs shall be mandatory upon notification from the Radiation Safety Officer. In general, the topics covered in these programs shall consist of:

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

IX. Medical Use of Radioactive Material

A. Approval of Authorized Users (AU) for Medical Use

Primary approval for Authorized Medical use of radioactive material at the University of Toledo Medical Center is contingent on board certification by an appropriate board and/or being listed on an NRC/agreement state license for the same type of use. If the applicant does not meet the above requirements the steps listed in Appendix D of NMS-LIC-09 will be followed. Applicants for routine medical use of byproduct material should also provide The following documents:

1. Application Form for Approved Users (See Appendix #2)
2. Verification of Training and Experience
3. Certification by a board listed in 3701:1-58
4. Name listed on an NRC or Agreement State license

B. Experimental or Non-Routine Medical Uses

Applicants for experimental or non-routine medical uses of radioactive material must furnish additional information to the Radioactive Materials Safety Committee in addition to the above forms. This supportive information may be completed in one of two methods.

1. Research Protocol, which includes the information requested in the attached Appendix F, Non-Routine Medical Uses of Byproduct Material. (See Appendix #15)

2. Investigational New Drug Application (Form 1571)

It is the applicant's responsibility to provide the necessary supportive information in the above applications to the Radioactive Materials Safety Committee. The committee's review of the application may be delayed if the appropriate information is not furnished.

If there are any questions pertaining to the application for Medical Use of Radioactive Material, please contact the Radiation Safety Office.

X. Training and Experience for Medical Uses of Byproduct Material

A. The ODH regulations define six types of medical use for byproduct material.

1. Use of radiopharmaceuticals for uptake, dilution and excretion studies 3701:1-58-32). (3701:1-58-32)
2. Use of unsealed radioactive materials for imaging and localization studies for which a written directive is not required. (3701:1-58-34).
3. Use of unsealed radioactive material for which a written directive is required. (3701:1-58-37).
4. Use of sources for manual brachytherapy (3701:1-58-43).
5. Use of sealed sources for diagnosis. (3701:1-58-53)
6. Use of a sealed source in a remote after loader unit, teletherapy unit, or gamma stereotactic radiosurgery unit. (3701:1-58-55).

For further information concerning specific radiopharmaceuticals or sources listed under the preceding six categories, consult the Radiation Safety Office.

B. TRAINING FOR IMAGING AND LOCALIZATION STUDIES

To qualify as adequately trained to use or directly supervise the use of a radiopharmaceutical, generator or reagent kit for imaging and localization studies, an Approved User must be a physician who:

1. Is certified in:
   a. Nuclear medicine by the American Board of Nuclear Medicine;
   b. Diagnostic radiology by the American Board of Radiology; or
   c. Diagnostic radiology or radiology by the American Osteopathic Board of Radiology; or

2. Has had classroom and laboratory training in basic radioisotope handling techniques applicable to the use of prepared radiopharmaceuticals, generators, and reagent kits, supervised work experience, and supervised clinical experience as follows:

a. 200 hours of classroom and laboratory training that includes:

(1) Radiation physics and instrumentation:

(2) Radiation protection;

(3) Mathematics pertaining to the use and measurements of radioactivity;

(4) Radiopharmaceutical chemistry; and

(5) Radiation biology; and

b. 500 hours of supervised work experience under the supervision of an authorized user that includes:

(1) Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

(2) Calibrating dose calibrators and diagnostic instruments and performing checks for proper operation of survey meters;

(3) Calculating and safely preparing patient dosages;

(4) Using administrative controls to prevent the misadministration of by product material;

(5) Using procedures to contain spilled byproduct material safety and using proper decontamination procedures; and

(6) Eluting technetium-99m from generator systems, measuring and testing the eluate for molybdenum-99

c. 500 hours of supervised clinical experience under the supervision of an authorized user that includes:

(1) Examining patients and reviewing their case histories to determine their suitability for radioisotope diagnosis, limitations, or contraindications;

(2) Selecting the suitable radiopharmaceuticals and calculating and measuring the dosages;

(3) Administering dosages to patients and using syringe radiation shields;

(4) Collaborating with the authorized user in the interpretation of radioisotope test results; and

(5) Patient follow-up; or;

3. Has successfully completed a six-month training program in nuclear medicine that has been approved by the Accreditation Council for Graduate medical Education and that included classroom and laboratory training, work experience, and supervised clinical experience in all the topics identified in paragraph 2 of this section.

C. TRAINING FOR USE OF BRACHYTHERAPY SOURCES (3701:1-58-51, 71)
To qualify as adequately trained to use a brachytherapy source for therapy, an approved user must be a physician who:

1. Is certified in:
   a. Radiology or therapeutic radiology by the American Board of Radiology;
   b. Radiation oncology by the American Osteopathic Board of Radiology;
   c. Radiology, with specialization in radiotherapy, as a British "Fellow of the Faculty of Radiology: or "Fellow of the Royal College of Radiology"; or
   d. Therapeutic radiology by the Canadian Royal College of Physicians and Surgeons; or

2. Is in the active practice of therapeutic radiology, has had classroom and laboratory training in radioisotope handling techniques applicable to the therapeutic use of brachytherapy sources, supervised work experience, and supervised clinical experience as follows:

   a. 200 hours of classroom and laboratory training that includes:

      (1) Radiation physics and instrumentation; (2) Radiation protection;

      (3) Mathematics pertaining to the use and measurements of radioactivity; and

(4) Radiation biology;

b. 500 hours of supervised work experience under the supervision of an authorized user at a medical institution that includes:

(1) Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;
(2) Checking survey meters for proper operation;
(3) Preparing, implanting, and removing sealed sources;
(4) Maintaining running inventories of material on hand;
(5) Using administrative controls to prevent the misadministration of byproduct material; and
(6) Using emergency procedures to control byproduct material; and

c. Three years of supervised clinical experience that includes one year in a formal training program approved by the Residency Review Committee for Radiology of the Accreditation Council for Graduate Medical Education or the Committee on Postdoctoral Training of the American Osteopathic Association, and an additional two years of clinical experience in therapeutic radiology under the supervision of an authorized user at a medical institution that includes:

(1) Examining individuals and reviewing their case histories to determine their suitability for brachytherapy treatment, and any limitations or contraindications;
(2) Selecting the proper brachytherapy sources and dose and method of administration; (3) Calculating the dose; and
(4) Post-administration follow-up and review of case histories in collaboration with the authorized user.
(5) For High Dose Remote After loading use verification of a minimum of 40 hours specific training in the set-up, dose calculation, operation and emergency procedures.

D. TRAINING FOR THERAPEUTIC USE OF RADIOPHARMACEUTICALS (3701:1-58-40,41,42)

To qualify as adequately trained to use radiopharmaceuticals for therapy, an approved user must be a physician who:

1. Is certified by:
   a. The American Board of Nuclear Medicine; or
   b. The American Board of Radiology in radiology or therapeutic radiology; or

2. Has had classroom and laboratory training in basic radionuclide handling techniques applicable to the use of therapeutic radiopharmaceuticals, and supervised clinical experience as follows:
   a. 200 hours of classroom and laboratory training that includes:
      (1) Radiation physics and instrumentation;
      (2) Radiation protection;
      (3) Mathematics pertaining to the use and measurement of radioactivity; and
      (4) Chemistry of radioactive material for medical use
      (5) Radiation biology.

E. Training for the Treatment of Hyperthyroidism (3701:1-58-41)

The requirements listed in the ODH shall be followed. Regulation (3701:1-58-41).

F. Training for the Treatment of Thyroid Carcinoma (3701:158-42)

The requirements listed in the ODH regulation shall be followed. (3701:1-58-42).

XI. Use of Brachytherapy Sources

A. RESPONSIBILITIES OF THE RADIATION ONCOLOGIST

1. The attending radiation oncologist shall be solely responsible for all aspects of prescription, use, and return of sources of brachytherapy storage area at UTMC. The UTMC Quality Management Program must be followed.

2. Prior to insertion and following removal, brachytherapy sources shall be in possession of the radiation oncologist or locked in appropriately shielded designated areas for which he is responsible.

3. Sources shall be brought to the patient in the operating room or at the patient's bedside by the radiation oncologist or his designee. A physicist, dosimetrist or radiological technologist qualified in brachytherapy source handling may assist the radiation oncologist and, in so doing, shall remain with the sources until the radiation oncologist takes charge of the sources.

4. When brachytherapy sources are removed from a patient, the radiation oncologist or his designee shall see that a source count and a radiation survey are performed before discharge. The radiation oncologist shall also see that the sources are returned to a designated safe storage area. His designee may assist the radiation oncologist by receiving the brachytherapy sources and returning them immediately to safe storage area.

5. The Radiation oncologist shall maintain a current copy of standing orders for patients undergoing brachytherapy with the Radiation Safety Office for review by the Radioactive Materials Safety Committee.

6. The High Dose Rate Remote Afterloading unit shall be used in accordance with the Quality Management Program for HDR.

B. ADDITIONAL REQUIREMENTS

1. Use of Outside Sources

If radioactive sources other than those available at the University of Toledo Medical Center are brought to the UTMC, prior approval by the Radioactive Materials Safety Committee shall be obtained. The Radiation Safety Office will provide the necessary forms for preparing a protocol. Since human use is involved, the request for use should be prepared well in advance so that review by the Radioactive Materials Safety Committee may be completed prior to the need for patient care. In case of an emergency, one should contact the Radiation Safety Office or a physician member of the Radioactive Materials Safety Committee.

2. Accountability

a. A log of each source shall be kept in the brachytherapy storage area so that the location of all sources can be determined. For sources removed from the safe, the log should indicate the type and strength of the sources, the patient's name, the date of removal, the date of return and the initials of the persons removing and returning the sources.

b. The person preparing brachytherapy sources for implantation or applicator loading will do so as prescribed by the radiation oncologist on the Radiation Oncology Brachytherapy Source Record. He will then sign the Brachytherapy Source Record and Source Log. Before the sources leave the brachytherapy storage area, another qualified person will check the prepared loading, verify it with the prescription on the Brachytherapy Source Record and sign the source log.

3. Accident or Incident: Immediate Notification

In the event of any type of accident, incident, or loss of a brachytherapy source, radiation oncology personnel shall immediately notify the Radiation Safety Office.

C. GENERAL BRACHYTHERAPY PROCEDURES

1. Patients receiving permanent implants shall be assigned a room on a nursing floor. These patients do not require a private room.

2. Patients receiving temporary brachytherapy shall be assigned to private rooms on nursing floor 4 AB UTMC hospital. If because of medical complications it is required that the patient be placed in another unit the Radiation Safety Office must be notified prior to the placement.

3. A radiation survey of the patient's room shall be performed as soon as possible after the insertion of the sources.

4. During the period of temporary brachytherapy treatment, the patient's room shall be posted with appropriate signs indicating:
   a. Source type, strength, and site of application
   b. Radiation exposure levels at bedside, and 1 meter and 6 feet from the source of radiation
   c. Instructions to nursing personnel and visitors indicating any restrictions.

5. The patient's chart will also be posted with a Radioactive Materials label and will contain physician's orders regarding radiation protection.

6. All nursing personnel and other staff at UTMC Hospital who attend a patient while radioactive sources are in place shall be issued personal dosimeters supplied by the Radiation Safety Office. Nurses should observe the time limits (maximum time for 100 millirems exposure) and enforce the prescribed limits for pregnant women, minors and visitors. Any nurse who is pregnant, or suspects she may be pregnant, shall not tend to the patient. Nurses and other assistants should employ the principles of minimum time, maximum distance and shielding as protection measures.

D. GUIDELINE FOR TEMPORARY BRACHYTHERAPY IMPLANTS

These procedures are in addition to the General Brachytherapy Procedures listed under XI. C. 1-6 of this manual.

1. Immediately preceding the insertion of radioactive sources in a patient, the radiation oncologist will visually check the radioactive source loading to insure that the sources loaded are exactly as prescribed. After inserting the brachytherapy sources in the patient, the radiation oncologist will sign the Radiation Oncology Brachytherapy Source Record under "Certificate of Receipt." This entry will include the number and type of sources and the time and date of insertion.

2. A Radiation survey will be performed at locations within the patient's room sufficient to provide time limits for staff and visitors.

3. The radiation survey after insertion will include the rooms above, below and adjacent to the patient's room. These exposure readings will be entered on the Brachytherapy Source Record. No room will remain occupied if an exposure rate greater than 2.0 mR/hr is measured.

E. GUIDELINES FOR PERMANENT BRACHYTHERAPY IMPLANTS

These procedures are in addition to the General Brachytherapy Procedures listed under XI. C. 1-5 of this manual:

1. Following implantation, a radiation survey shall be performed in the operating room before the room is cleaned. The survey will specifically include all suction fluids, sponges, trays and linens which might contain a source.

2. (a) In cases where there is a possibility of brachytherapy sources being discharged through surgical wounds or body orifices, linens and appropriate waste materials will be kept in the room, e.g. urine, drainage, stool. The patient’s room will be surveyed daily to check for the presence of dislodged sources. A Radiation survey log will be posted on the door to the patient's room and a notation will be made daily indicating that waste materials and linens have been checked, are not contaminated with radioactive material and may be discarded in the normal manner.

(b) If after 3 days no dislodged sources have been found and, in the opinion of the radiation oncologist, there is negligible change of a source becoming dislodged, the Radiation Safety Officer may authorize the discontinuance of daily radiation contamination surveys.

3. A final radiation survey shall be performed after the patient is discharged, but before linens and waste have been removed and the room cleaned.

4. Upon discharge from the hospital, patients at risk of discharging a radioactive source (e.g. prostate) will be given instructions for handling any sources that may be recovered.

XII. Guidelines for the Therapeutic Administration of Iodine-131 for Thyroid Cancer:

A. ROOM SELECTION (Admitted patients)

1. The therapy room should be a corner room in a low traffic section of hallway.
2. No carpeting on floor.
3. Private toilet facilities must be available since urine and perspiration will be contaminated with iodine-131.
4. Adequate ventilation is necessary since iodine is volatile and levels of airborne iodine-131 can build up.

B. ROOM PREPARATION (Admitted patients)

1. Determine if urine is to be stored in room. If so, select area and provide shielding if necessary.
2. Remove unnecessary furniture from room. Arrange coverings for floor, tabletops, telephone, and television, as necessary to aid in decontamination.
3. Arrange for meals to be brought on disposable trays if possible.
4. Provide two labeled waste containers. All disposable items go in one; gowns and linens go in the other.
5. Central Service must be contacted to provide an Isolation cart to hold the following items:
   a. Exam Gloves
   b. Isolation gowns
   c. Foot coverings

This cart is to be kept in the hall immediately outside patient's room.

C. IODINE-131 DOSE PREPARATION AND ADMINISTRATION

1. The dose should be corrected for decay from the manufacturer's assay.
2. The dose must be assayed in the dose calibrator and compared to the manufacturer's assay. Values must agree within 10% in order to proceed with administration of the iodine-131.
3. The dose should be placed on a tray having absorbent coverings and appropriate shielding to reduce external radiation levels below 10 mR/hr at 12 inches from the container.
4. For inpatients the dose must be administered to the patient in the patient's room (for iodine-131 cancer therapy).
5. The administration of the dose and the time period immediately thereafter represent the period of greatest radiation safety concern. If liquid iodine-131 is used then volatile iodine can represent an exposure to personnel therefore only experienced personnel should handle the dose. The patient may regurgitate the iodine dose immediately after administration and cause elevated air concentrations as well as gamma levels. The Radiation Safety Office is to be notified immediately if the patient regurgitates. Decontamination supplies should be readily available during the time period following the administration of the iodine-131.
6. The usual safety procedures such as wearing a lab coat, ring dosimeter, whole body monitors, and gloves are required.

Guidelines for the Therapeutic Administration of Iodine-131 for Thyroid Cancer (out-patients)

Patients that are authorized to be released; and isolated to, their homes on an outpatient contingent basis must complete appropriate documentation to ensure the safety of family and visitors who may come into contact with the patient after treatment.

A questionnaire regarding their living arrangements, the number and ages of cohabitants, suitability of sleeping/restroom facilities, and other pertinent living conditions must be completed and assessed by the appropriate authority. The "Calculations for Immediate Patient Release following I-131 Therapy" (See Section K, Form 4) must also be completed per U.S. NRC Regulatory Guide 8 to ensure that anyone who lives with, or comes into contact with, the patient will not receive a dose >0.5rem during the isolation period.

After the treatment and prior to release from the medical facility, staff will perform a survey of the patient at one (1) meter and record the value. After the isolation period, the patient will return to the medical facility for another survey at one (1) meter and will then be released from the isolation state. Readings will be assessed with the Radiologist and/or Radiation Oncologist to determine if the patient may be released from isolation.

D. ROOM SELECTION (out-patients)

1. Either a PET/CT injection room or the HDR room will be utilized for the administration of the iodine-131, depending on room availability.

E. ROOM PREPARATION (out-patients)

1. Arrange coverings for floor and chair.

2. Provide a labeled waste container for all disposable items. Gowns and linens will be surveyed for contamination. If contamination is present Radiation Safety will store for decay.

3. Provide an Isolation cart to hold the following items:
   a. Exam Gloves
   b. Isolation gowns

This cart is to be kept in the hall immediately outside patient's room.

F. PERSONNEL SAFETY

1. Radiologist and/or Radiation Oncologist

The training of the radiologist or radiation oncologist includes the procedures to be carried out during an iodine-131 therapy administration. It is the responsibility of the radiologist or radiation oncologist to insure that his staff reviews the applicable procedures just prior to any administration. A QMP form must be filled out by the Authorized User prior to the administration of the I-131. The administration must conform to the QMP form. Any deviation greater than 10% of the prescribed dose or the route of administration must be confirmed, recorded and signed on the QMP form by an Authorized User.

2. Personnel Present at the Administration

This group includes the radiologist or radiation oncologist and may include any or all of the following: other physicians, physicist, dosimetrist, nuclear medicine technologist, nurse.

The administration of iodine-131 will occur in pill form whenever possible. The use of iodine-131 in pill form greatly reduces the risk of contamination to support personnel during administration process. No bioassay will be required on personnel present at the time of the administration when an iodine-131 capsule is administered. Bioassays are required if iodine-131 is used in liquid form.

The administration of large quantities of liquid iodine-131 present a radiation safety problem not normally encountered. Namely, it is quite possible for a small thyroid uptake of iodine-131 by personnel to occur if standard safety practices are not followed. All doses must be opened only inside the hood. Once the dose has been administered, the next most likely site for possible thyroid uptake is in the patient's room where elevated air concentration of iodine-131 might be found. Should the room be poorly ventilated, the limits of occupancy by visitors, nurses, and other staff may be limited by the air concentration, instead of the external gamma levels. This can be determined by the Radiation Safety Office through the use of air sampling. A thyroid uptake measurement must be performed on all personnel in the room at the time of administration within **72 hours** of the administration of iodone-131 in liquid form.

3. Nursing Personnel

Due to the extremely low number of iodone-131 inpatients nursing personnel are educated on radiation safety (including iodine-131 therapy) only when an inpatient treatment will be done, in addition an instruction form is handed out. (See Section K, Form 5). Questions regarding the administration of an iodine-131 therapy dose and care of the patient should be referred to Radiation Safety.

Personnel monitoring as required by Radiation Safety will be provided. Thyroid uptake counts may also be required at the discretion of the Radiation Safety Office.

4. Environmental Services

Personnel are not to enter the patient's room without the permission of the Radiation Safety Office. The Radiation Safety Office will post a green sign in the door to notify personnel that the room has been decontaminated and is ready to be put back into service.

5. Visitors

Visitors for inpatients are not to enter the I-131 patient's room unless authorized by the Radiation Safety Office. When authorized, visitors are subject to the posted time limits. Visitors may visit from outside the room. There is to be no contact between the patient and visitors.

G. ROOM SURVEY

1. The radiation survey of the patient's room must be performed immediately after the dose has been administered to the patient and before any bedside nursing care is given.

2. A calibrated survey meter must be used to determine the Radiation levels at bedside, at six feet from patient, in adjoining patient rooms, and in the hallway. (See Section K, Form 1) - The form titled "Iodine-131 Therapy Administration Limits of Exposure" (Section K, Form 2) is to be posted at the entrance to the patient's room.

3. The frequency of surveys is to be determined by the Radiation Safety Office. Physical decay of iodine-131 and biological elimination from the patient may decrease radiation levels sufficiently to permit more lenient time limits for nurses.

4. Air sampling must be performed when a patient's urine is stored in the room in unsealed containers. Sampling must be done with a low volume air sampler using charcoal-activated filters. (See Section K, Form 3)

H. PATIENT DISCHARGE

The patient will be discharged in accordance with Regulatory Guide 8.39, Release of Patients Administered Radioactive Materials. Restrictions for household members are given in the form titled "Instructions for Family of Released Patient" which should be given to the appropriate household members before the patient is discharged. (See Section K, Form 7) The patient will be presented with an "*Attention: Security Personnel and Law Enforcement"* card stating the patient has had a medical procedure and may still have small amounts of radiation capable of being protected by radiation monitoring equipment.

I. ROOM DECONTAMINATION, WASTE DISPOSAL

The Radiation Safety Office must survey all areas likely to have been contaminated prior to their release for unrestricted use. Door signs must remain until decontamination is completed. The room must be cleaned to less than 500 dpm per 100 cm^2 removable contamination. Standard procedures for decontamination are to be followed. Some items (e.g., telephone) may require removal for radioactive decay in storage. When the decontamination is complete the Radioactive Materials posting will be removed and a green sign will be posted indicating that the room has been released for unrestricted use.

Although the patient's urine will likely contain large quantities of radioactive iodine-131, disposal of the material in the sanitary sewer system is permitted because of the large dilution factor. If space doesn't present a problem, the urine can be stored until the activity decays to background level. All other waste materials (such as food, trays, paper, plastic and bedding) must be stored for decay in plastic bags for ten half-lives and background readings are obtained. These plastic bags must have the "Caution--Radioactive Materials" tag, identifying the date of collection and the radioisotope present. A record shall be kept showing that items were monitored prior to return for use or disposal. The patient's room cannot be released to nursing service without the approval of the Radiation Safety Office.

J. RECORD KEEPING REQUIREMENTS

The following seven forms are to be filled out for each iodine-131 therapy administration for cancer. The purpose of each form is discussed below.

1. Radiation Safety Survey Form

This form is to be used to record the radiation levels in and around the patient's room. The measurements may be made by anyone experienced with the survey meter (physicist, dosimetrist, technologist, or physician). This form will be saved in the patients file. It will also be the source of the calculated values to be placed on the "Limits of Exposure" form.

2. Limits of Exposure

This form will provide the nursing personnel and visitors with specific limits of time of patient visit. This form is to be posted at the entrance to the patient's room.

3. Air Sampling Worksheet

This form will be useful to the Radiation Safety Office when calculating air concentrations that may exist.

4. Radioactivity Precautions for Nursing Personnel

This is a list of precautions to be taken by all nursing personnel to provide exposures as low as reasonably achievable.

5. Patient In-Hospital Instructions

This is a list of precautions to be taken by the patient to provide for minimum contamination and exposures as low as reasonably achievable.

6. Permanent Implant or Internal Dose

This is a sticker to be attached to the outside of the patient's chart. This helps indicate the fact that the patient contains radioactive materials

7. Instructions for Family of Released Patient

This form is the set of written instructions given to patient's family. A copy of this should be maintained in Radiation Therapy.

XIII. RECORD KEEPING REQUIREMENTS
IODINE-131 CANCER THERAPY

	Form Title	Kept During Rx In/On	Permanent Disposition
1.	Radiation Safety Survey Form	Patients Room Entrance	Radiation Therapy Files
2.	Limits of Exposure	Patient's Room Entrance	Radiation Therapy Files
3.	Air Sampling Worksheet	Radiation Safety Files	Radiation Safety Files
4.	Radioactivity Precautions for Nursing Personnel	In Patient's Chart	Patients Chart
5.	Patient In-Hospital Instructions	Patient's Room	Patients Chart
6.	Permanent Implant or Internal Dose	Cover of Patient's Chart	Discard
7.	Instructions for Family of Released Patient	In Patient's Chart	Original to Family Copy to Radiation Therapy
8.	Quality Management Program	Radiation Therapy Files	Radiation Therapy Files

The University of Toledo Medical Center

Radiation Safety Room Survey

Post I-131 Treatment

Patient:_____ Room: _____ Date: _____

Administered Dose: _____ mCi Meter Model/SN: _____ Cal. Date: _____

Survey Performed by: _____

1. Sketch room, including furniture and storage (urine).
2. Indicate with numbers those locations to be surveyed.
3. Record values below.
4. Limit nurses and visitors to 2.5mR in any one hour.
5. Limit other patients to 100mRem total – note time of scheduled discharge.
6. Make sure some diagnostic exam isn't interfering with the survey.
7. Rooms above, below, and adjacent should also be surveyed.

Date_____	Date_____	Date_____	Date_____
Time _____	Time _____	Time _____	Time _____
mR/hr _____	mR/hr _____	mR/hr _____	mR/hr_____
Note:_____	Note:_____	Note:_____	Note:_____

Location:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

THE UNIVERSITY OF TOLEDO
MEDICAL CENTER

I^{131} THERAPY ADMINISTRATION

LIMITS OF EXPOSURE

Patient_____ Room_____ Date_____

Administered Dose_____mCi

All medical staff and visitors should stay behind the shield while visiting the patient.

NURSES

1. Not more than _____ minutes in any one day at bedside.
2. Not more than _____ minutes in any one day behind shield.
3. Not more than _____ minutes in any one day at six (6) feet.

VISITORS

1. Not more than_____minutes in any one day at six (6) feet (in chair).
2. Do not eat, smoke, drink or apply cosmetics in patient's room.
3. Pregnant women or minors (under 18 years of age) should not visit the patient.
4. Visitors should remain at a distance of six (6) feet or more from the patient.

THE UNIVERSITY OF TOLEDO
MEDICAL CENTER

IODINE-131 THERAPY

ADMINISTRATION AIR SAMPLING

WORKSHEET

PATIENT_____Room_____Date_____

AIR SAMPLER_____

TIME OF SAMPLE START_____

TIME OF SAMPLE STOP_____

TIME OF SAMPLE COUNT START_____

TIME OF SAMPLE COUNT STOP_____

CFM X TOTAL MIN = TOTAL VOL (V)

$$\frac{\text{TOT, COUNT - BKG}}{C \times F} = \text{DPM} \times \frac{\text{uCi}}{2.22 \times 10^6 \text{ dpm}} = \text{uCi}$$

$$\frac{\text{uCi}}{\text{ml}} = \text{concentration} \times \text{time in room} = \text{mPCa - hrs}$$

Table I, Col 1 MPC_a (sol. restricted area) = 9×10^{-9} uCi/ml

Table II, Col 1, MPC_a (col. unrestricted area) = 1×10^{-10} uCi/ml

THE UNIVERSITY OF TOLEDO
MEDICAL CENTER

Calculations for Immediate Patient Release Following I-131 Therapy

Patient-specific factors for post-thyroidectomy I-131 therapy are based on assumed uptake, effective half-life and occupancy factors recommended by NRC*.

Patient Name_____ Date_____

Authorized Physician_____ Time of Administration_____

Calculation By_____ I-131 Activity_____mCi

Assumptions:

Extrathyroid Uptake Fraction,	$F_1 = 0.95$
Thyroid Uptake Fraction	$F_2 = 0.05$
Extrathyroid Effective Half-Life,	$T_{l\text{-eff}} = 0.32$ days
Thyroid Effective Half-Life,	$T_{2\text{-eff}} = 7.3$ days
Occupancy Factor (First 8 hrs),	$E_1 = 0.75$
Occupancy Factor (After 8 hrs),	$E_2 = 0.25$
I-131 Physical Half-Life,	$T_\rho = 8.04$ days
I-131 Gamma Ray Constant,	$\Gamma = 2.2$ R cm^2/mCi hr

$$D(\infty) = \frac{34.6\,\Gamma\,Q_0}{(100\text{ cm})^2}\left\{E_1 T_\rho (0.8)\left(1 - e^{-0.693(0.33)/T_\rho}\right) + e^{-0.693(0.33)/T_\rho} E_2 F_1 T_{1\text{-eff}} + e^{-0.693(0.33)/T_\rho} E_2 F_2 T_{2\text{-eff}}\right\}$$

$D(\infty) = (0.00227)(Q_0) =$ _____ rem (Must be <0.5 rem)

Occupancy factors based upon patient receiving instructions and agreeing to restrictions contained in the University of Toledo Medical Center – Outpatient I-131 Release Instructions.

*U.S. Nuclear Regulatory Commission Regulatory Guide 8.39, April 1997.

THE UNIVERSITY OF TOLEDO
MEDICAL CENTER

RADIOACTIVITY PRECAUTIONS FOR NURSING PERSONNEL DURING IODINE-131 THERAPY APPLICATIONS

1. Permissible time limits at bedside and at six (6) feet for nurses will be posted at the entrance to the patient's room.

2. Gloves, gowns and shoe covers must be worn when entering the patient's room.

3. Visitors are **not** to enter the patient's room without prior authorization from the Radiation Safety Office. There is to be no physical contact between the I-131 patient and visitors.

4. Utensils, bedding, and clothing of attendants and nurses, etc., that may be contaminated by the patient should be kept in the container provided. They will be checked by the Radiation Safety Office.

5. Unless otherwise notified, all excreta can be disposed of in the normal manner. When other precautions are required, specific orders will be written in the patient's chart.

6. When permitted, urinals, bedpans, and urine collection bottles; may be used by the patient. These will be "hot" and should be handled only by the patient or radiation safety, unless otherwise instructed.

7. Personal dosimeters may be necessary for personnel monitoring when specified by Radiation Safety.

8. If any emergency should arise with regard to radiation safety, the Radiation Safety Office must be called promptly.

THE UNIVERSITY OF TOLEDO
MEDICAL CENTER

PATIENT IN-HOSPITAL INSTRUCTIONS

1. You may eat three (3) hours after treatment and your diet need not be altered.

2. Prior to urination, place three [3] caps full of Radiacwash cleaning solution in toilet bowl water. If you need assistance, call the nurse.

3. Urinate directly into the toilet taking care so that the area around the toilet is not soiled with urine.

4. Flush the toilet three (3) times.

5. Always wash hands thoroughly after urinating

6. Prior to showering place 3 caps full of Radiacwash in the shower. After showering let the water run for 3 to 5 minutes.

7. You should limit physical contact with patient care workers and have no physical contact with visitors.

THE UNIVERSITY OF TOLEDO
MEDICAL CENTER

INSTRUCTIONS FOR FAMILY OF RELEASED PATIENT

Home precautions to be taken by patient after receiving a therapeutic dose of radioiodine (Iodine-131):

1. The patient should sleep alone and except for brief periods, other persons should remain at a distance greater than six (6) feet. This is especially important for children and other persons under 45 years of age.
2. Whenever possible, use separate toilet facilities, that is, a toilet not used by other members of the family.
3. Before urinating, always place 3 caps full of Radioiodine cleaning solution into the toilet bowl. Then flush the toilet three (3) times.
4. Use care so that the area around the toilet is not soiled with urine.
5. If you return to work within two weeks, take a 3 ounce bottle of Radiacwash cleaning solution with you and use as above each time.
6. Bed linen and clothing need no special precautions, except when there are young children in the family, in which case your linen and clothing should be washed separately with soap or detergent, after the other clothing has been washed. Then the tub or washing machine should be rinsed three (3) times.
7. Wash out bathtub or shower with soap or cleanser after use.
8. Use stringent contraceptive measures to avoid pregnancy during the three (3) months after treatment. Do not breast feed during this time.
9. If any questions arise regarding these instructions, please feel free to call 383-4301 or 383-5114 and ask to discuss them.

* * *

The above instructions have been explained to me. I understand that these recommendations are being made to minimize any risk of radiation exposure to my family members.

Patient _____ Date_____

Witness _____ Date_____

GLOSSARY

Activity: The number of nuclear transformations occurring in a given quantity of material per unit time. (See Curie)

Bacquerel: The SI unit of activity. One bacquerel equals 1 nuclear transformation per second.

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

Controlled Area: A defined area in which the occupational exposure of personnel to radiation or to radioactive material is under the supervision of an individual in charge of radiation protection. (This implies that a controlled area is one that requires control of access, occupancy, and working conditions for radiation protection purposes.)

Curie: In physics, unit of activity of a quantity of a radioactive substance, named in honor of the French physicist Marie Curie. One curie (1 Ci) is equal to 3.7 × 1010 becquerel (Bq). In 1975 the becquerel replaced the curie as the official radiation unit in the International System of Units (SI).
Several fractions of the curie are in common usage:

millicurie (mCi) = 10^{-3} curies

microcurie (uCi) = 10^{-6} curies

Decay, radioactive: Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles and/or photons.

Dose: A general form denoting the quantity of radiation or energy absorbed. For special purposes, it must be appropriately qualified. If unqualified, it refers to absorbed dose.

Dose, absorbed: The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The unit of absorbed dose is the rad. One rad equals 100 ergs per gram (See rad and gray)

Dose, cumulative: (Radiation) The total dose resulting from repeated exposures to radiation.

Dose, equivalent (DE): A quantity used in radiation protection. It expresses all radiation on a common scale for calculating the effective absorbed dose. It is defined as the product of the absorbed dose in rads and certain modifying factors. (The unit of dose equivalent is the rem).

Dosimeter: Device used to detect and measure an accumulated dosage of radiation.

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

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

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

Gray: The unit of absorbed dose equal to 1 J/kg in any medium.
1 gray = 100 rad.

Half-life, Biological: The time required for the body to eliminate one-half of an administered dosage of any substance by regular processes of elimination. Approximately the same for both stable and radioactive isotopes of a particular element.

Half-life, Effective: Time required for a radioactive element in an animal body to be diminished 50 percent as a result of the combined action of radioactive decay and biological elimination.

$$\frac{\text{Biological half-life x Radioactive half-life}}{\text{Biological half-life + Radioactive half-life}}$$

Half-life, Radioactive: Time required for a radioactive substance to lose 50 percent of its activity by decay. Each radionuclide has a unique half-life.

Ionization: The process by which a neutral atom or molecule acquires a positive or negative charge.

Maximum Permissible Dose (MPD): The maximum RBE dose that the body of a person or specific parts thereof shall be permitted to receive in a stated period of time.

Nuclide: Any individual nuclear species such as 14C, 32P, 131I, etc. irrespective of whether or not the nuclide has other isotopes. The term isotope is frequently misused for nuclide, but the strict meaning of the former as originally defined by Soddy (1914) is of the same place, i.e. in the same position in the periodic table. Thus, one may say that the nuclide phosphorus-32 is an isotope of phosphorus, or even more specifically of, say, phosphorus-32. A radioactive nuclide is often referred to as a radionuclide.

Occupationally Exposed Population: All persons who are designated as being specifically engaged in a task which subject them to possible exposures of ionizing radiation.

Rad: The unit of absorbed dose equal to 0.01 J/kg in any medium.
1 rad = 0.01 gray

Rem: A special unit of dose equivalent. The dose equivalent in rems is numerically equal to the absorbed dose in rads multiplied by the quality factor, the distribution factor, and any other necessary modifying factors.

Roentgen: An exposure dose of x- or gamma radiation such that the associated corpuscular emission per .001293 gm. of air produces, in air, ions carrying 1 electricity of either sign.

Sealed Source: A radioactive source sealed in an impervious container which has sufficient mechanical strength to prevent contact with a dispersion of the radioactive material under the conditions of use and wear for which it was designed.

Shall: Denotes that the ensuing recommendation is necessary or essential to meet the currently accepted standards of protection.

Should: Indicates advisory recommendations that are to be applied when practicable.

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

APPENDIX #1

Minimum Training and Experience Required for Authorized Users

(Non-Human)

The minimum training and experience required for approval of authorized users is forty (40) hours of training in basic radioisotope technique.

The training may be obtained in a formal course or incorporated in a program using byproduct materials. The training should include general training in basic radioisotope handling technique including:

a) A working knowledge of principles and practice of radiological health safety; radioactivity measurements; standardization of monitoring techniques and instruments; mathematics and calculations basic to the use and measurements of radioactivity; and biological effects of radiation.

b) Experience in the use of byproduct material for the type and quantities for which the application is being made or equivalent experience.

APPENDIX #2

University of Toledo Application for Use of

Radiation Sources

Applicant_____
Last Name Degree First Name Initial

Department_____ Academic Rank_____

Office Bldg._____ Room_____ Office Phone_____ Lab Phone_____

APPLICANT'S TRAINING:

COURSES IN RADIATION SAFETY/RADIOACTIVE MATERIAL METHODOLOGY

Course Title	Place Where Taken	When (Month & Year)	Contact Hours

EXPERIENCE WITH RADIONUCLIDES

Type	Place of Experience	When (Month & Year)

Persons who will routinely use sources:

Name	Position	Date of Birth	Soc. Sec. Number

In the event of an emergency in your area, who can be contacted?

Name _____ Office Phone _____

Address _____ Home Phone _____

Name _____ Office Phone _____

Address _____ Home Phone _____

1. UNSEALED SOURCES - RADIONUCLIDES

X-A*	SOLID, LIQUID, OR GAS	CHEMICAL FORM	SOLUBLE OR NONSOLUBLE IN WATER?	VOLATILE OR TOXIC OR COMBUSTIBLE?	MAXIMUM ACTIVITY (Spell Out Millicurie or Microcurie) PER ORDER	TOTAL IN YOUR LAB

2. SEALED SOURCES (Encapsulated or Otherwise Sealed to Prevent Removal of Activity)

RADIONUCLIDE	MANUFACTURER	ACTIVITY/DATE	SERIAL AND MODEL NUMBER

* e.g., H-3, C-14, P-32, etc.

COMPLETE SEPARATE PAGE FOR EACH PROJECT

1. Radionuclide and form to be used: _____

2. Activity to be used per procedure (uCi or mCi):_____

3. Number of procedures to be done per month:_____

4. Duration of the project:_____

5. What type(s) and quantity(ies) of radioactive waste will you generate?

   _____

6. Will you dispose of radioactive waste via sewer (sink)?_____

7. If animals are to be used, indicate: Type _____

   Number_____

   Maximum Activity (Microcuries/gram)_____

   IACUC Approved Project Number _____

8. Use of volatile radionuclides requires an approved fume hood.

   Indicate room and hood to be used. _____

9. Use of high energy beta emitters and all gamma emitters requires a survey meter. No more than two approved users may share a meter.

   Indicate: Make _____

   Model _____

   Probe Type _____

10. Use of high energy beta emitters at levels greater than 1 millicurie/procedure requires a brem shield. Confirm that a shield is available. _____(Initial)

11. Confirm that your staff has been properly instructed in project protocols and radiation safety procedures. _____(Initial)

12. Attach a brief project description.

*IMPORTANT! READ AND SIGN THE FOLLOWING STATEMENT:

I, the undersigned, have read and understand the applicable N.R.C., State of Ohio, and University of Toledo Radiation Safety regulations, and agree to comply with same in the handling and using of all sources of ionizing radiation.

SIGNATURE_____ DATE_____

APPENDIX #4

Procurement of Radioisotopes
Health Science Campus

The Purchasing Department will not honor a requisition for radioisotopes unless it is approved by the Radiation Safety Office.

A. Procedure for Routine Requisitions

1. Fill out a standard purchase requisition. Mark it "RADIOACTIVE MATERIAL".
2. On Purchase Requisitions, spell out clearly whether quantities are MILLICURIES or MICROCURIES.
3. The Purchase Requisition must be signed by the Approved User.
4. Forward the requisition to the Radiation Safety Office for approval. After approval, the Radiation Safety Office will email the approved requisition to Purchasing and copy the approved user on the email.
5. The Receiving Department will automatically forward all shipments of radioactive material that are received to the Radiation Safety Office, unless prior arrangements are made and approved.
6. The Radiation Safety Office will notify the Approved User of the arrival of a shipment. The Approved User will pick up the shipment and sign a copy of the packing slip to indicate that it has been received. This copy remains on file in the Radiation Safety Office. A Receipt and Disposition Log will be given with each package.
7. Packages containing radioactive material should be opened according to rules given in Appendix #6 (printed on the back of the Receipt & Disposition Log). The radioisotope receipt & disposition form provides an area for this documentation.

B. Procedure for Blanket Orders (Called in with follow-up purchase req.)

1. Follow steps 1, 2 and 3 in Section A.
2. Each isotope on a Blanket Order must be specified individually and include a listing of each radionuclide, the chemical form, maximum activity per order, estimate of total activity and signed by an Authorized User. The requisition must be approved by the Radiation Safety Office.
3. All persons permitted to call in orders must be specified on the purchase order.
4. Only persons with specific knowledge of radioisotopes will be approved to call in orders, e.g., physicians, physicists, technologists.
5. Individual releases against the Blanket Order **DO NOT** require the approval of the Radiation Safety Office.
6. All shipments must be delivered through the Radiation Safety Office and picked up by an authorized lab person or user.

C. Replacement Orders

1. You must notify the Radiation Safety Office immediately when a replacement orders are required. The Radiation Safety Office needs to know the purchase order number and estimated date of arrival.
2. All replacement orders must be delivered through the Radiation Safety Office and picked up by an authorized lab person or user.

D. Procedure for No-Charge Shipments or Shipment from another Institute

1. All no-charge shipments or shipments from another institute must have the prior approval of the Radiation Safety Office. Written notification (email is acceptable) shall include the anticipated date of arrival of the shipment, the isotope, the amount in millicuries or microcuries and the chemical form.

2. All shipments must be delivered through the Radiation Safety Office and picked by authorized personnel.

APPENDIX #5

Procedures for Ordering and Receiving Radioactive Materials

Main Campus

Only Approved Users or the Radiation Safety Officer (RSO) may purchase or receive as gifts any radioactive materials. A copy of each purchase requisition or documentation of acceptance of a gift must be counter-signed by the Radiation Safety Officer or other person as designated by the Radiation Safety Committee. A copy of each requisition or documentation shall be maintained by the RSO.

All Main Campus purchases of radioactive material are to be shipped to the University's Central Receiving Department or Department of Chemistry Stockroom. The receipt of each incoming package of radioactive material is to be recorded into a log book. Included in this log is the purchase order number of the material, the name of the Approved User purchasing the material, and the results of a visual inspection for obvious damage of the package.

If damage to the package is suspected, Central Receiving or the Chemistry Stockroom is to attempt to detain the deliverer of the package and is immediately to place the package into a secure storage area where no unauthorized person has access, and notify the RSO or the Vice Provost for Research who will then determine appropriate action. The action will include monitoring of the package for contamination and surface radiation levels within 3 hours of the beginning of the next working day.

If no damage is suspected, Central Receiving or the Chemistry Stockroom is to promptly notify the Approved User receiving the package. The Approved User or designated laboratory worker is to wipe test the surface of the package as well as the package's contents immediately after it is taken to the laboratory. A record of this wipe test is to be maintained in the laboratory.

APPENDIX #6

Procedure for Safely Opening Packages Containing Radioactive Materials

Shipping packages received known to contain radioactive material, will be monitored for radioactive contamination and radiation levels if the package is labeled according to U.S. Department of Transportation rules(i.e. labeled with Yellow II or Yellow III) as containing radioactive material or if there is evidence of damage to the package. Such packages will be monitored within 3 hours of receipt if received during normal working hours or within 3 hours of the beginning of the next working day if received after normal working hours. The ODH/BRH will be notified if removable contamination exceeds 6600 dpm/300 cm^2.

The following procedure for opening each package will be followed:

1. Put on Gloves to prevent hand contamination.

2. Visually inspect the package for any sign of damage (e.g. wetness, crushed). If damage is noted, stop the procedure and notify the Radiation Safety Officer.

3. Measure the exposure rate at 1 meter from the package and then at the package surface. If the exposure exceeds 10 mr/hr at 1 meter or 200 mr/hr at the surface, stop and notify the Radiation Safety Officer.

4. Wipe the external surface of the package at several locations and count the wipe sample in the wipe counter for a time sufficient to provide adequate sensitivity. Employ the detection efficiency factor and wiped area to determine the dpm/100cm^2. If the contamination exceeds 2200dpm/100cm^2, take precautions against the spread of contamination and contact the Radiation Safety Officer.

Open the package with the following precautionary steps:

1. Open the outer package following the supplier's instructions, if provided, and remove the packing slip.

2. Open the inner package and verify that the contents agree with the packing slip. Verify that the material received was the material ordered.

3. Check the integrity of the final source container. Look for broken seals or vials, loss of liquid, moisture or stains on packing material.

4. If there is any reason to suspect contamination, wipe the surface of the final source container and count the wipe sample as above.

5. Monitor any packing material and empty packages for contamination with a appropriate survey before discarding.

If contaminated, treat the material as radioactive waste.

If not contaminated, remove or deface the radiation labels before discarding.

For Clinical Areas UTMC

<u>Unit Dosage Records</u>

We will establish and implement the model procedure for unit dose record system that was published in the latest version to Regulatory Guide 10.8, Appendix M.1.

APPENDIX #7

Area Survey Procedures

The following frequency for Radiation surveys in radionuclide laboratories shall be followed and is the responsibility of the Approved User.

In all laboratories, consideration should be given to the possibility of cross-contamination. Therefore, it may be necessary to monitor before and after each procedure for experimental accuracy.

1. All elution, preparation, and injection areas will be surveyed daily with a low-range thin-window G-M survey meter and decontaminated if necessary (Nuclear Medicine Areas). These areas will also be monitored for contamination using a wipe test weekly.
2. Laboratories using greater than one millicurie activities per procedure will monitor the lab for contamination at least once every two weeks (research labs).
3. Laboratories using less than one millicurie activities per procedure will monitor the lab for contamination at least once per month (research labs).
4. Laboratories using higher activity or volatile radioactive materials will be considered on an individual basis.
5. The laboratory survey will consist of:

    a. A series of wipe tests to measure contamination levels. The method for performing wipe tests will be sufficiently sensitive to detect 100 dpm/100 cm^2 for the contaminant involved.
    b. Action Levels for radioactive contamination is 500 dpm/100 cm^2.

6. A permanent record will be kept of all survey results, including negative results. The record will include:
   a. Location, date, and type of equipment used.
   b. Name of person conducting the survey.
   c. Drawing of area surveys, identifying relevant features such as active storage areas, active waste areas, etc.
   d. Detected contamination levels, keyed to locations on drawing.
   e. Corrective action taken in the case of contamination or excessive exposure rates; reduced contamination levels or exposure rates after corrective action; and any appropriate comments.

7. Area will be cleaned (decontaminated) if the contamination (trigger) level exceeds 500 dpm/100 cm^2.
8. These records must be kept for a period of three years.

APPENDIX #8

Dose Equivalent to an Embryo / Fetus – Declared Pregnant Women
3701:1-38-12 (H)

A woman that desires to have her occupational radiation exposure limited to the values listed in 3701:1-38-12(H) must declare her pregnancy in writing to the Radiation Safety Officer as soon as possible after discovering she is pregnant. The Radiation Safety Office will council her according to Reg. Guide 8.13 "Instruction Concerning Prenatal Radiation Exposure." The written declaration should be made on the "Control of Radiation Exposure during Pregnancy" form (Addendum #5).

The Radiation Safety Office will monitor the radiation exposure of the participant to ensure the exposures to the embryo/fetus are maintained below the 0.5 Rem for the term of the pregnancy. If the exposure to the woman has exceeded the 0.5 Rem limit before the declaration the limit her limit will be set at no greater than 50 mRem per month for the rest of the pregnancy.

APPENDIX #9

Contamination Levels in Controlled Area

Loose Contamination on surfaces:

Beta and Gamma Emitters	2000dpm/cm^2
Alpha Emitters	1000dpm/cm^2

Loose contamination is **not** acceptable and is to be removed if over 500 dpm.

Fixed Contamination on Surfaces:

(wipe survey = negative, meter survey = positive)

Radiation levels such that anyone present for a 40- hour work week will not receive an exposure in excess of 1/120th of the maximum permissible dose specified per calendar year in 3701:1-38-12.

APPENDIX #10

Suggested Agents for Removal of Contamination

Contaminated Area	Decontaminating Agent	Remarks
Skin and Hands	Mild soap and water	Wash 2 to 3 minutes and monitor Do not wash more than 3 to 4 times
	If necessary, follow by soft Brush, heavy lather, and tepid water.	Use light pressure with heavy lather. Wash for two minutes, 3 times. Rinse and monitor. Use care not to scratch or erode the skin. Apply lanolin or hand cream to prevent chapping.
	Other procedures: A Mixture of 30% Tide and 50% corn meal.	Make into a paste. Use with additional water with a mild Scrubbing action. Use care Not to scratch or erode the skin.
	A 5% water solution of a mixture of 30% Tide, 65% Calgon, and 5% Carbose (Carboxymethyl Cellulose)	Use with water. Rub for a minute and rinse.
	CHEMICAL PROCEDURES	(AS A LAST RESORT)
	Titanium Dioxide paste. Prepare paste by mixing precipitated titanium dioxide with a small amount of lanolin.	Work the paste into affected area for 2 minutes. Rinse and wash with soap, brush, and warm water. Monitor.
	Mix equal volumes of a saturated solution of potassium permanganate and 0.2 N sulfuric acid.	Pour over wet hands, rubbing the surface and using hand brush for not more than 2 minutes.

Contaminated Area	Decontaminating Agent	Remarks
Hair	Liquid soap and rinse water.	Make repeated applications of liquid soap with water rinses, using towels to keep water from running onto the face and shoulders. Acid goggles can be used to protect the eyes. Thoroughly dry the hair before surveying. Apply lanolin or cream conditioner.

Contaminated Area	Decontaminating Agent	Remarks
Wounds (cuts and breaks in the skin)	Running tap water. Report to Medical Officer and Radiation Safety Officer as soon as possible	Urine and fecal analysis will be necessary to determine the amount of radionuclides in the body

Contaminated Area	Decontaminating Agent	Remarks
Ingestion by Swallowing	Report to Medical Officer and Radiation Safety Officer as soon as possible	Urine and fecal analysis will be necessary to determine the amount of radionuclides in the body

Contaminated Area	Decontaminating Agent	Remarks
Clothing	Wash, if levels permit	Use standard laundering procedures. Three percent versene or citric acid may be added to wash water. Wash water must be below

Contaminated Area	Decontaminating Agent	Remarks
Glassware	Soap or detergent and water. Chromic acid cleaning solution or conc. nitric acid.	Monitor wash water and plan disposal of it.
	Suggested Agents:	Elements removed
	Oxalic acid 5% (Caution-poison)	Zr, Nb, Hf
	Versene (EDTA) 5% conc. NH4OH3%	Alkaline Earth Metals: Be, Mg, CA, Sr, Ba, Ra, P as PO4.
	To make, dissolve in order: (1) Versene (EDTA) 5% (2) Conc. NH4OH, by volume (3) Glacial acetic acid 5% by volume.	Tribalent metals, Al, Sc Y, La, Ce, Pr, Nd, Pm, Sa, Eu. Rare Earths, Ac, Ga, 3% In, Ti, B. Transition metals, Cu, Zn, Fe, Co, Ni Cd, Sn, Hg, Pb, Th, U, Ag.

Contaminated Area	Decontaminating Agent	Remarks
Laboratory Tools	Detergents and water, steam cleaning	Using mechanical scrubbing action.
Metal Tools	Dilute nitric acid, 10% solution of sodium citrate or ammonium bifluoride.	As a last resort, use HCl on stainless steel.
	Metal polish, sand-blasting, other abrasives.	Such as brass polish on brass. Use caution as these procedures may spread contamination.
Plastic Items	Ammonium citrates, dilute acids, organic solvents.	
Walls, Floors, Benches	Vacuum Cleaning	The exhaust of the cleaner must be filtered to prevent the escape of contamination with a pore size of 0.2 microns. Central vacuum systems shall not be used.
	Detergents and water with mechanical action.	
	Water from high pressure Source. Steam cleaning.	This may spread contamination.
Specific Materials		
Rubber	Washing or dilute HNO_3	
Linoleum	CCl4, kerosene, ammonium citrate,	
Ceramic Tile	mineral acids, ammonium citrate, trisodium phosphate	Scrub hot 10% solution into surface and flush thoroughly with hot water.
Traps and Drains	(1) Flush with water (2) Scour with rust remover (3) Soak in a solution of citric acid. (4) Flush again.	Follow all four steps.

APPENDIX #11

Disposal of Liquid Waste to Sewage System

Liquid waste may be disposed via the sanitary sewer system at University of Toledo provided that the following conditions are met:

1. Each Approved User of radionuclides must use only one sink for the disposal of liquid waste, unless an exception is given by the Radiation Safety Office.
2. Each sink must be identified as being a radioactive sink with the appropriate caution sign displayed.
3. The daily limits of radioactive material released must not be exceeded. These limits are listed on the Sink Disposal Log form.
4. All releases of radioactive material must be followed by flushing the sink with copious amount of water.
5. The liquid waste must be **readily soluble or dispersible** in water.
6. Flammable solvents that are not miscible with water should not be flushed down the drain.
7. Radioactive material that can be conveniently decayed in storage should not be disposed via the sewer.
8. The Sink Disposal Log **must** be returned to the Radiation Safety Office at the end of each month.

APPENDIX #12

Bioassay

The intent of bioassay is to monitor the radiation worker from the standpoint of possible INTERNAL exposure (as the dosimeter monitors possible EXTERNAL exposure). Inherently, however, bioassay is fraught with assumptions and unknowns and is relatively expensive. Therefore, it is unrealistic to use as a routine tool for those radiation workers using relatively low biohazard radionuclides.

For work with low levels of radiation, the control of possible internal radiation exposure is best accomplished by the education and enforcement of the standard laboratory rules.

There are occasions, however, when the quantity of radionuclides are such that, should an ingestion or inhalation occur, it is likely that the bioassay procedure would determine that internal dose with some degree of accuracy.

The first column in the following table is a "threshold" quantity of radionuclide which, if exceeded, mandates the use of the bioassay schedule as presented.

Other forms of bioassay (whole body counts) could become necessary should this examination be performed and some activity be found.

Quantity/Use Necessitating Bioassay	Type of Bioassay	Frequency of Exam
Single use of:		
1 Ci Tc-99m	Thyroid	Immediate
100 mCi Tl-201	Urine	Immediate
100 mCi S-35	Urine	Within 14 days
100 mCi P-32	Urine	Within 14 days
100 mCi Cr-51	Urine	Within 14 days
10 mCi I-125	Thyroid	Within 24-48 hours
>30 mCi I-131	Thyroid	Within 18-72 hours
100 mCi Co-57	Urine	Within 14 days
100 mCi Hg-203	Urine	Within 14 days
100 mCi H-3	Urine	Within 14 days
100 mCi C-14	Urine	Within 14 days
Multiple use of:		
>10 mCi I-125 per Quarter	Thyroid	Quarterly
Continuous use of:		
10 mCi H-3 organic	Urine	Weekly
10 mCi C-14 organic	Urine	Weekly
10 mCi H-3	Urine	Weekly
10 mCi C-14	Urine	Weekly

APPENDIX 13

GUIDELINES FOR THE HANDLING
OF RADIOACTIVE CADAVERS

All uses of radiation are carried out under the direction of the Radioactive Materials Safety Committee which has the administrative responsibility of insuring the safe use of ionizing radiation within the hospital. The radioactive patient who expires and presents a radiation safety problem is a rare one, since therapeutic quantities of radioactive materials are seldom administered and then not to the moribund patient. It is possible for a radiation safety problem to occur in this manner, however. In radiation safety, any reduction in personnel exposure that can be affected should be used, and to this policy is presented.

The following table lists all sources of use of ionizing radiation within the hospital and whether or not safety procedures are needed

Sources of Ionizing Radiation Within the Hospital	In Case of Death Are Safety Procedures Needed?
Diagnostic Sources	
X-Rays	No
Nuclear Medicine Scans	No
Therapeutic Sources	
External Beam Therapy	No
Temporary Implant or Application of Sealed Sources That Do Not Decay away and Must be Removed	No, Once the Sources are Removed
Permanent Implant of Sealed Sources that Decay Away and Need Not be Removed	Yes
Liquid or Capsule Dose(s) or Therapeutic Amounts of Radioactive Material	Yes

General Procedures

1. Patients who had received diagnostic quantities of radioactive material need no special procedures.
2. Patients who had received external beam therapy are not radioactive and no procedures are needed.
3. Patients who expire during a temporary intercavitary or interstitial implant present no safety problem once all the sources are removed! If during autopsy a small piece of metal is found, this may be a missing sealed source. Stand away from this source a minimum distance of ten feet. Call the Radiation Safety Officer.
4. Expired patients who had received either permanent implants or liquid or capsule doses of radioactive material do require special handling. The range of doses a patient might receive is large. The patient may have received a very small amount of radioactivity and the procedure may simply be to treat the expired patient in normal fashion. On the other hand, the dose and type of radiation may be such that the Radiation Safety Officer may have to monitor the pathologist during the entire procedure.
5. If a patient who is known to contain radioactive material dies outside of the hospital, the Radiation Safety Office should be contacted. Knowing the radionuclide present, the initial activity and chronology of application, specific instructions can be given to reduce personnel exposure during autopsy or preparation for burial or cremation.
6. The physician who pronounces the patient dead is responsible for notifying the Radiation Safety Office so that a radioactivity tag may be attached to the body (See Addendum #1). The physician in charge must also be notified at once.
7. If an autopsy is not performed, the Radiation Safety Office will fill out the radioactivity report to be attached to the death certificate and forwarded to the funeral director (See Addendum #2).
8. If an autopsy is to be performed, the Radiation Safety Office will provide specific instructions to reduce personnel exposure during autopsy (See Addendum #3 and #4).
9. Cremation of an expired radioactive patient <u>cannot</u> occur without the written permission of the Radiation Safety Office.
10. Nothing in these procedures is to be taken as the proper procedure to follow in the event of a death due to radiation accident at a radiation facility. In this case, the prevention of contamination is the overriding concern.

ADDENDUM
#1

Radioactivity Tag

(To be filled out by the Radiation Safety Office
after being contacted by the physician
who pronounced the patient as dead.)

ADDENDUM
#2

Specific Instructions to Reduce Radiation
Exposure During Embalment

Follow procedure A or B below during the embalming of

_____.

A. This body does not contain significant amount of radioactive material. No special precautions are necessary if standard embalming procedures are employed.

B. This body contains radioactive material. The following procedures should be observed:

A closed system should be used to drain fluids. Use suction if necessary. Fluid can be disposed of via sewer, flush with copious amounts of water.

Blood and urine should be removed via closed systems. Dispose via sewer with copious amounts of water.

Other_____

_____

_____

Signed_____
Radiation Safety Officer

Date:_____

A copy of this report is maintained in Radiation Safety Office files.

ADDENDUM
#3

Radiation Hazard Evaluation Form

(To be filled out by Radiation Safety Officer for his use)

Name_____ Date and Time of Death _____

Radioisotope_____ Amount Administered_____ Route of Administration_____ Amount Present Distribution within Body

_____

_____

_____

_____

Indicate Distances _____

Suggest ring badges if exposure
>0.25 R/hr @ 25 cm
See NCRP #37 p. 27.

Limit Hand Exposure to 1.5 Rems

Date of Survey_____

Instrument Used_____

Signed_____
Radiation Safety Officer

Date: _____

ADDENDUM
#4

Specific Instructions for Autopsy

(To be filled out by Radiation Safety Officer)

The following procedures should be followed if so indicated:

_____ Wear Safety Glasses.

_____ Wear Plastic (non-absorbent) Gown.

_____ Cover Floor with Bench Liner.

_____ Wear Double Thickness Autopsy Gloves.

_____ Wear Whole Body Film Badge.

_____ Wear Ring Badge.

_____ Remove the _____ area or tissue first before proceeding further. Identify it as radioactive.

_____ Leave the _____ area or tissue untouched until last.

_____ Cover the _____ area or tissue with shielding as provided.

_____ Use only long instruments--8" or greater.

_____ Fluids, Blood, Urine should be removed via closed system. Flush with copious amounts of water.

_____ Small specimens need--need not--be handled with special precautions.

_____ Waste Container needs to be provided for contaminated sponges, gowns, and instruments.

_____ Organs are to be kept in storage for _____ days before processing for disposal.

Autopsy Performed by_____Patient Name_____

Whole Body or Ring Badge No._____Exposure_____

Signed_____
Radiation Safety Officer

Date_____

THIS REPORT MUST BE FILED IN THE RADIATION SAFETY OFFICE

ADDENDUM
#5

Control of Radiation Exposure During Pregnancy

Name (Print) _____

Last First Middle Initial

Department _____

Other Employment as Radiation Worker. If none, initial here _____

Institution: _____

Address: _____

_____

Contact Person: _____

Telephone: _____

In signing this form, it is acknowledged that:

1. I voluntarily declare my pregnancy. My estimated date of conception is _____

2. I have received oral instruction and have read and understood the material presented in U.S. Nuclear Regulatory Commission Guide 8.13, Revision 3 (June 1999).

3. The University of Toledo Radiation Safety Officer or his designate provided a discussion period following the above instruction, during which my questions, if any were answered satisfactorily.

4. I understand that NCRP recommendations and ODH Regulation 3701:1-38 limit the radiation dose to the embryo/fetus to 0.5 rem during the term of the pregnancy. The primary method of monitoring exposure from external radiation sources will be a dosimeter badge properly worn by me near the waist and under any protective device.

5. I acknowledge that my personal dosimetry records indicate a whole body exposure of_____ mrem from the time of conception through the date of my declaration of pregnancy.

Signed _____ Date _____

APPENDIX #14

Radiation Exposure to Individuals
Less than Eighteen Years of Age

The exposure of individuals less than eighteen years of age must be limited in all instances to 3701:1-38-12(G) regulations. These regulations can be considered to be met if all of the guidelines below are followed:

1. Each Approved User is responsible for the immediate supervision of individuals less than eighteen years of age working in their laboratory.
2. Under no circumstances may such individuals work with radiation sources without approval of the Radiation Safety Office.
3. Individuals less then eighteen years of age must be denied access to laboratories or experiments or environments which could result in their receiving greater than one-tenth of the maximum permissible dose for a radiation worker (3701:1-38-12).
4. Individuals less than eighteen years of age must be provided with appropriate dosimeters as necessary to evaluate any possible exposure.
5. Individuals less than eighteen years of age must have explained to them the extent of any radiation hazards associated with the work intended.
6. The Radiation Safety Office must be notified of the intent on the part of the Approved User to permit individuals less than eighteen years of age to engage with radiation or radioactive materials under their supervision. Requests must be made prior to any actual work done by individuals less than eighteen years of age. The purpose of this request is to permit the Radiation Safety Office to evaluate the conditions of intended work in light of the above guidelines and to grant approval for such individuals to work in a radiation laboratory.
7. Individuals less than eighteen years of age must be denied access to laboratories or areas or experiments which have a bioassay, Dosimeter badge, or TLD immediate history greater than the ALARA action levels.
8. Individuals less than eighteen years of age must be instructed in basic laboratory safety rules as required by University of Toledo regulations.

ALL APPROVED USERS MUST RECEIVE APPROVAL FROM THE RADIATION SAFETY OFFICE PRIOR TO PERMITTING INDIVIDUALS LESS THAN EIGHTEEN YEARS OF AGE TO ENTER RADIATION AREAS.

TABLE I

Critical Area	Max Permissible Annual Dose Adult	Max Permissible Annual Dose Minor
Whole Body Total Effective Dose Equivalent		
(External)	5 Rem	0.5 Rem
(DDE +CDE)	5 Rem	0.5 Rem
Shallow Dose Equivalent (Skin)	50 Rem	5.0 Rem
Lens of the Eye	15 Rem	1.5 Rem

APPENDIX #15

Three Methods of Security of Radioactive Materials in Labs

Method 1 Lock the door.

When no one is present in the lab the lab door to the main entrance of the lab is to be secured.

Method 2

If the main door is not secured when on one is present the storage unit for the radioactive material must be secured by a locking mechanism.

Method 3

If it is not practicable to keep the storage unit locked when no one is present in the lab a lock box approved by the Radiation Safety Office may be used. The box must be secured and locked when no one is present in the lab.