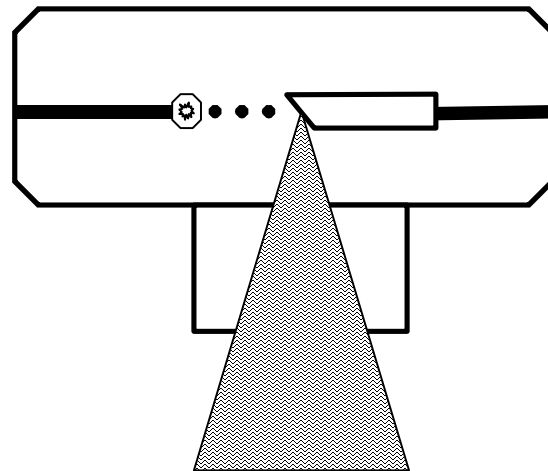
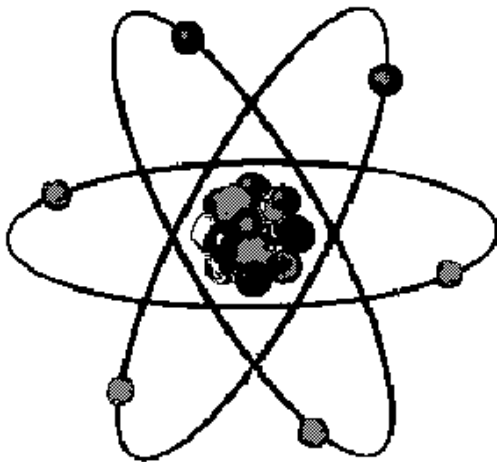


SUNY UPSTATE MEDICAL UNIVERSITY

RADIATION SAFETY MANUAL



Approved by the Radiation Safety Committee: _____

Issued To: _____ Lic. No. _____

Department: _____ Room # & Building _____

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2.0 FORWARD

This edition of the Radiation Safety Manual sets forth the requirements and recommendations governing the use of radiation sources at the SUNY Upstate Medical University at Syracuse. The general and specific policies and procedures for the safe use of radionuclides and radiation sources are set up by the Radiation Safety Committee. After approval by the President, they are reviewed by the New York State Department of Health prior to being put into effect. Where the use of radionuclides or radiation involves research on human subjects, the Institutional Committee for the Protection of Human Subjects along with the Radiation Safety Committee, review the proposed use, make recommendations, and set policies and procedures.

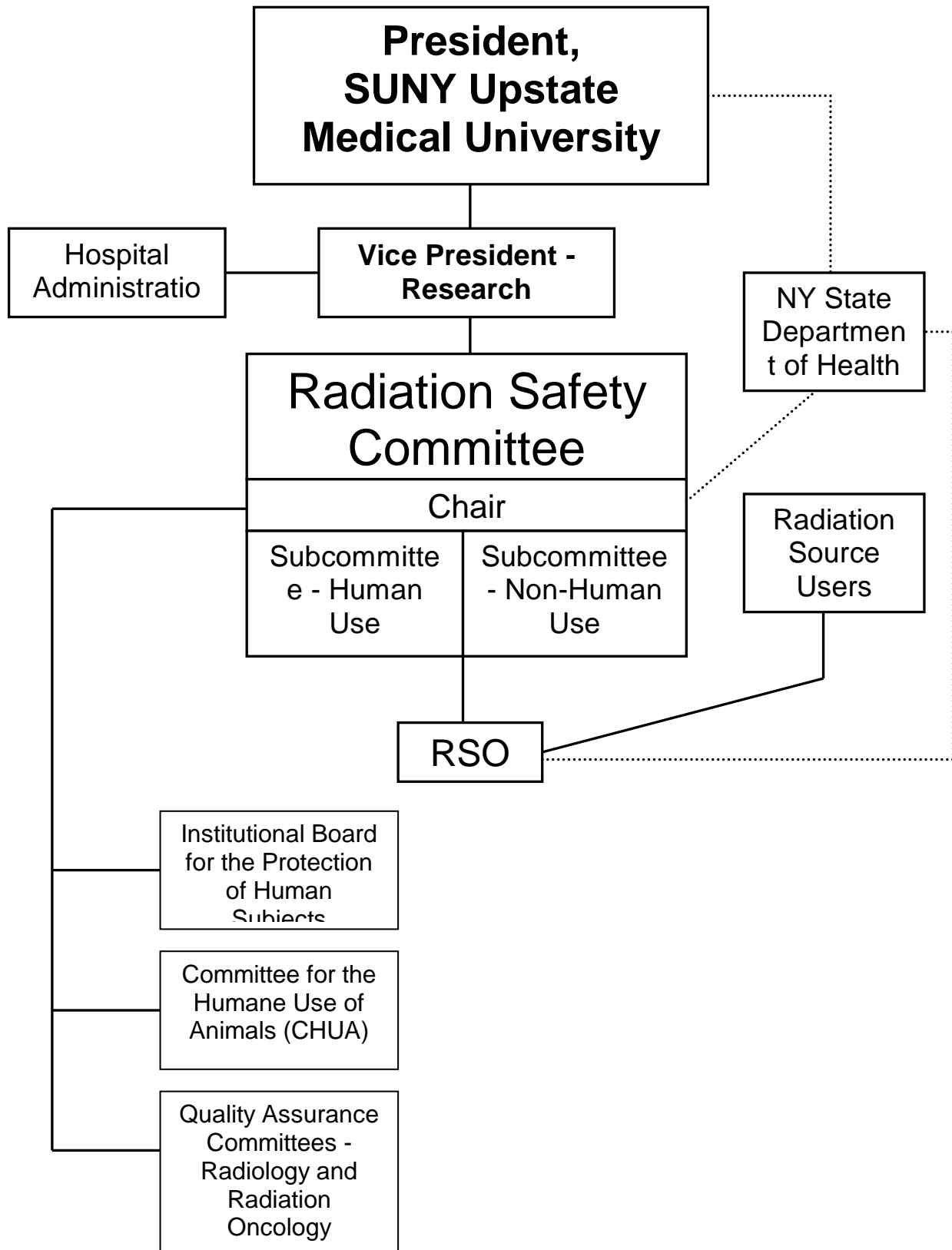
The responsibility for determining that approved procedures are carried out and that the rules and regulations of the Upstate Medical University, state and federal agencies regarding radiation safety are adhered to, has been assigned to the Radiation Safety Office under the direction of the Radiation Safety Officer (RSO). The Radiation Safety Officer, who reports through the Radiation Safety Committee to the Vice President for Research in this capacity, will interpret the procedures established by the Radiation Safety Committee, will monitor and check all use of radionuclides, and will make certain that all necessary records, information, and reports are kept. The RSO and others delegated by him will work closely with the Radiation Safety Committee, the Institutional Committee for the Protection of Human Subjects, and the Committee for the Humane Use of Animals, to ensure the maximum beneficial use of radiation with the minimum practical risk to patients, employees, and general public.

All personnel using radiation should become familiar with the procedures contained in this manual and conduct themselves in accord with them. In the event that the Radiation Safety Officer or designee detects violations or deficiencies in any part of the Upstate Medical University at Syracuse's regulations which go uncorrected after being brought to the attention of the responsible individuals, such will be reported to the Radiation Safety Committee and the President and appropriate action will be taken.

David R. Smith, MD

President

3.0 Radiation Safety Committee Lines of Responsibility



4.0 The Radiation Safety Committee

As required by the N.Y. State Public Health Code (10 NYCRR 16.120(b)) and the conditions of our radioactive materials license No. 47, an institutional radiation safety committee has been established by the administration of this institution. This Committee has the general responsibility to oversee the safe use of all sources of ionizing radiation within the Upstate Medical University.

The Radiation Safety Committee shall meet as often as necessary to conduct its business but not less than once each calendar quarter and shall have a quorum present to conduct official business. A quorum shall consist of at least one-half the Committee membership, including the Radiation Safety Officer and the representative from Administration.

The responsibilities and duties of the Radiation Safety Committee are detailed in Appendix A.

5.0 The Radiation Safety Officer.

A Radiation Safety Officer (RSO) shall be appointed in writing by the President of the SUNY Upstate Medical University. The Radiation Safety Office, under the direction of the Radiation Safety Officer, is responsible for the establishment of safe working conditions for all Upstate's personnel and patients as well as the general public and to maintain environmental emissions within limits set by the NY State Department of Environmental Conservation and the Environmental Protection Agency. The specific duties include:

1. Carry out the directives of the Radiation Safety Committee.
2. General surveillance and inspections of all health physics and radiation activities to insure that radiation exposure to workers, patients and the general public are kept as low as practicable.
3. Consultation with all individuals and groups concerning the safe use of radiation including protective devices, shielding and special equipment (such as clothing, respirators, etc.).
4. Investigating each case of excessive or abnormal radiation exposure or other radiation accident to determine causes and affect rectification of contributing factors.
5. Assaying and performing quality control checks or instituting such procedures when deemed appropriate for all radionuclides used in human subjects.
6. Assisting at and insuring safe practices for all radiation procedures which are unusual or carry a large risk from a health physics aspect.
7. Instituting a program of radiation surveys, inspections and wipe tests along with record keeping to monitor radiation use.
8. Instructing personnel for proper procedures for storage, use and disposal of radioactive materials.
9. Supervise and coordinate radioactive waste disposal including proper record keeping, waste handling, packaging and separation.
10. Perform New York State required leak testing of sealed sources and inspect radiation producing equipment.
11. Institute, supervise and review all personnel monitoring by film badges and other personnel dosimeters and consult on special cases such as pregnancies, children, etc.
12. Supervise decontamination in the case of radioactive contamination of persons or areas.
13. Plan, institute and utilize adequate health safeguards and practices with respect to new equipment and/or procedures using radiation in conjunction with principal investigators.
14. Maintain a continuous and developing program of radiation hazard evaluation and elimination.

15. Maintain a capability to respond to radiation emergencies originating either within the Upstate Medical University or outside where the Upstate Medical University may become involved (see Section 11.1).
16. Maintain good working relationships with the radiation-using group to insure an effective program of radiation safety.
17. Supervise the various activities of the Radiation Safety Office (the current Radiation Safety "Office" = Radiation Safety Officer, 1 T.H. Med. Instr. Spec. Sr., 1 T.H. Med. Instr. Spec., part-time use of one secretary, shared use of a two-room laboratory).
18. Maintain Calibrations of Radiation Safety survey instrumentation.

Please refer to Appendix B for minimum qualifications of the Radiation Safety Officer established by the N.Y. State Public Health Code (10NYCRR16 2(1)(42)).

6.0 Delegation Of Authority To The Radiation Safety Officer:

MEMORANDUM

TO: All Employees

FROM: David R. Smith, MD, President
SUNY Upstate Medical University, Syracuse, N.Y.

RE: Authority of the Radiation Safety Officer

_____ has been appointed Radiation Safety Officer and is responsible for ensuring the safe use of radioactive materials. The Radiation Safety Officer is responsible for managing the radiation safety program; identifying radiation safety problems; initiating, recommending, or providing corrective actions; verifying implementation of corrective actions; and ensuring compliance with regulations. The Radiation Safety Officer is hereby delegated the authority to meet those responsibilities.

When an unsafe use or condition involving a radiation source is brought to the attention of the Radiation Safety Officer, he or she shall have the authority to immediately stop usage of the source. Final disposition of the problem will be the responsibility of the Radiation Safety Committee.

The Radiation Safety Officer is also responsible for assisting the Radiation Safety Committee in the performance of its duties and serving as its secretary.

David R. Smith, MD
President

7.0 A.L.A.R.A. Program

Program for Keeping Occupational Radiation Exposures at the SUNY Upstate Medical University, Syracuse, N.Y. at Levels as Low as Reasonably Achievable (A.L.A.R.A.)

1. Management Commitment

- a. We, the management of the SUNY Upstate Medical University in Syracuse, NY, are committed to the program described below for keeping exposures as low as is reasonably achievable (ALARA). In accordance with this commitment, we hereby describe an administrative organization for radiation safety and will develop the necessary written policy, procedures, and instructions to foster the ALARA concept within our institution. The organization will include a Radiation Safety Committee (RSC) and a Radiation Safety Officer (RSO).
- b. We will perform a formal annual review of the radiation safety program, including ALARA considerations. This shall include reviews of operating procedures and past exposure records, inspections, etc., and consultations with the radiation safety staff or outside consultants.
- c. Modification to operating and maintenance procedures and to equipment and facilities will be made where they will reduce exposures if the cost, in our judgment, is considered to be unjustified. We will be able to demonstrate, if necessary, that improvements have been sought, that modifications have been considered, and that they have been implemented where reasonable. Where modifications have been recommended but not implemented, we will be prepared to describe the reasons for not implementing them.
- d. The sum of the doses received by all exposed individuals will be maintained at the lowest practicable level. It would not be desirable, for example, to hold the highest doses to individuals to some fraction of the applicable limit if this involved exposing additional people and significantly increasing the sum of radiation doses received by all involved individuals.

2. Radiation Safety Committee (RSC)

a. Review the Proposed Users and Uses

- 1) The RSC will thoroughly review the qualifications of each applicant with respect to the types and quantities of materials and uses for which he or she has applied to ensure that the applicant will be able to take appropriate measures to maintain exposure ALARA.
- 2) When considering a new use of radioactive material, the RSC will review the efforts of the applicant to maintain exposure ALARA. The user should have systematized procedures to ensure ALARA and shall have incorporated the use of special equipment such as syringe shields, rubber gloves, etc., in his or her proposed use.
- 3) The RSC will ensure that the user justifies his or her procedures and that dose will be ALARA (individual and collective).

b. Delegation of Authority

- 1) The RSC will delegate authority to the RSO for enforcement of the ALARA concept.
- 2) The RSC will support the RSO in those instances where it is necessary for the RSO to assert his/her authority. Where the RSO has been overruled, the Committee will record the basis for its action in the

minutes of the Committee's quarterly meeting.

c. Review of the ALARA Program

- 1) The RSC will encourage all users to review current procedures and develop new procedures as appropriate to implement the ALARA concept.
- 2) The RSC will regularly perform a review of occupational radiation exposure with particular attention to instances where Investigational Levels in Table 1 (below) are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA program's quality and to decide if action is warranted when Investigational Levels are exceeded (See Part 6 of the ALARA program).
- 3) The RSC will evaluate our institution's overall efforts for maintaining exposures ALARA on an annual basis. This review will include the efforts of the RSO, authorized users, and workers, as well as those of management.

3. Radiation Safety Officer (RSO)

a. Annual and Quarterly Review

- 1) Annual review of the radiation safety program. The RSO will perform an annual review of the radiation safety program for adherence to ALARA concepts. Reviews of specific procedures may be conducted on a more frequent basis.
- 2) Quarterly review of occupational exposures. The RSO will review, at least quarterly, the external radiation exposures of authorized users and workers to determine that their exposures are ALARA in accordance with the provisions of Part 6 of the ALARA program.
- 3) Quarterly review of records of radiation level surveys. The RSO will review radiation levels in unrestricted and restricted areas to determine that they were at ALARA levels during the previous quarter.

b. Education Responsibilities for ALARA Program

- 1) The RSO will schedule briefings and educational sessions to inform workers of ALARA program efforts.
- 2) The RSO will ensure that authorized users, workers and ancillary personnel who may be exposed to radiation will be instructed in the ALARA philosophy and informed that management, the RSC and the RSO are committed to implementing the ALARA concept.

c. Cooperative Efforts for Development of ALARA Procedures. Radiation workers will be given opportunities to participate in formulation of the procedures that they will be required to follow.

- 1) The RSO will be in close contact with all users and workers in order to develop ALARA procedures for working with radioactive materials.
- 2) The RSO will establish procedures for receiving and evaluating the suggestions of individual workers for improving radiation safety practices and will encourage the use of those procedures.

4. Authorized Users

a. New Procedures Involving Potential Radiation Exposures

- 1) The authorized user will consult with, and receive the approval of,

- the RSO and/or RSC during the planning stage before using radioactive materials for a new procedure.
- 2) The RSO will evaluate all procedures before using radioactive materials to ensure that exposures will be kept ALARA. This may be enhanced through the application of trial runs.
- b. Responsibility of Authorized User to Persons Under His/Her Supervision
- 1) The authorized user will explain the ALARA concept and his/her commitment to maintain exposures ALARA to all persons under his/her supervision.
 - 2) The authorized user will ensure that persons under his/her supervision who are subject to occupational radiation exposure are trained and educated in good radiation safety practices and in maintaining exposures ALARA.
5. Persons Who Receive Occupational Radiation Exposure
- a. The worker will be instructed in the ALARA concept and its relationship to working procedures and work conditions.
 - b. The worker will know what recourse is available if he/she feels that ALARA is not being promoted on the job.
6. Establishment of Investigational Levels in Order to Monitor Individual Occupational External Radiation Exposures. This institution hereby establishes Investigational Levels for occupational external radiation exposure which, when exceeded, will initiate review or investigation by the RSC and/or the RSO. The Investigational Levels that we have adopted are listed in Table 1 below. These levels apply to the exposure of individual workers.

Table 1

	Investigational Levels (mRems per calendar quarter)	
	Level I	Level II
	<hr/>	
1. Whole body; head and trunk; active blood forming organs; lens of eyes; or gonad	125	375
2. Hands and forearms; feet and ankles	1875	5625
3. Skin of whole body*	750	2250

* Not normally applicable to nuclear medicine operators except those using significant quantities of beta-emitting isotopes.

NOTE: Not dose limits, but, checkpoints above which investigation into cause is necessary.

The Radiation Safety Officer will maintain and review results of personnel monitoring.

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

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

Investigational Level I.

- b. Personnel exposures equal to or greater than Investigational Level I, but less than Investigation Level II. The RSO will review the exposure of each individual whose quarterly exposures equal or exceed Investigational Level I and will report the results of the reviews at the first RSC meeting following the quarter when the exposure was recorded. If the exposure does not equal or exceed Investigational Level II, no action related specifically to the exposure is required unless deemed appropriate by the Committee. The Committee will, however, consider each such exposure in comparison with those of others performing similar tasks as an index of ALARA program quality and will record the review in the Committee minutes.
- c. Exposure equal to or greater than Investigational Level II The RSO will investigate in a timely manner the cause(s) of all personnel exposures equaling or exceeding Investigational Level II and, if warranted, will take action. A report of the investigation, actions taken, if any, and a copy of the individual's exposure record will be presented to the RSC at the first RSC meeting following completion of the investigation. The details of these reports will be recorded in the RSC minutes. Committee minutes will be sent to the management of this institution for review. The minutes, containing details of the investigation, will be made available to N.Y. State Health Department inspectors for review at the time of the next inspection.
- d. Reestablishment of an individual occupational worker's Investigational Level II to a level above that listed in Table 1. In cases where a worker's or a group of workers' exposures need to exceed Investigational Level II, a new, higher Investigational Level II may be established on the basis that it is consistent with good ALARA practices for that individual or group. Justification for a new Investigational Level II will be documented. The RSO will review the justification for, and will approve, all revisions of Investigational Level II. These revisions will be reported to the Radiation Safety Committee at it's next regular meeting. In such cases, when the exposure equals or exceeds the newly established Investigational Level II, those actions listed in paragraph c will be followed.

Signature of Certifying Official:

I hereby certify that the SUNY Upstate Medical University, Syracuse, N.Y. has implemented the ALARA Program set forth above:

President

SUNY Upstate Medical University

750 East Adams Street

Syracuse, New York 13210

8.0 Authorization to Use Radioactive Materials (Sealed and Unsealed Sources) or Radiation-Producing Equipment.

8.1 The possession and use of radioactive materials at the Upstate Medical University is authorized by License No. 47, issued by the N.Y. State Department of Health. New York is an "agreement state" in that it has entered into a formal agreement with the U.S. Nuclear Regulatory Commission to carry out state licensing and regulatory functions for certain categories of uses of radioactive materials.

All use of radioactive materials at this institution must conform to the limits and conditions of License No. 47 and to conditions set forth in this manual. A copy of License No. 47 is provided in Appendix No. C.

In addition, persons wishing to purchase, use and dispose of radioactive materials at SUNY Upstate must obtain approval from the Radiation Safety Officer and the Radiation Safety Committee. An example of the application form is shown in Appendix D. Approval of the application by the Radiation Safety Committee will result in the issuance of a permit to the applicant stating possession limits and use conditions.

8.2 Human use of radioactive materials at SUNY Upstate

Only persons holding an active N. Y. State license to practice medicine may administer radiation or radioactive materials to humans. Application to the RSC for such use will be made using the standard application form and the human use supplement (see Appendix D).

License No. 47 is termed a "broad medical license" which authorizes use

of radioactive materials for diagnosis and treatment of human disease, for research involving humans and animals, and for general biomedical research. The license limits the amounts of radioactive materials which can be present at the Upstate at any given time and geographically limits such use to the SUNY-Upstate campus. Use of radioactive materials at another facility, such as the Veterans Administration Medical Center, by persons holding a permit at the Upstate, is not authorized. However, radioactive material can be transferred to an individual at the second facility provided that individual an authorized user at the facility and completes a Transfer Form issued by the Upstate Radiation Safety Office.

8.3 Possession and use of radiation-producing equipment.

All persons possessing equipment capable of producing significant amounts of ionizing radiation, e.g., x-ray imaging devices, cabinet x-ray units, x-ray diffraction units, electron microscopes, etc., must inform the Radiation Safety Officer of possession and intended use of the equipment.

Permission to use this equipment shall be given by the Radiation Safety Committee upon formal application to that Committee with indication of awareness of potential hazards in its use and knowledge of appropriate radiation safety procedures.

8.4 Responsibilities of persons authorized to use radioactive materials or radiation sources at SUNY Upstate

Each is responsible for:

1. Providing adequate facilities, equipment, counting and survey

instruments, supervision and instructions to control radiation hazards and to comply with the requirements of this manual and/or the Radiation Safety Committee.

2. Maintaining an up-to-date listing with the Radiation Safety Officer of areas where radioactive material is stored or handled and where radiation-producing equipment is operated.
3. Maintaining an up-to-date listing with the Radiation Safety Officer of personnel who may be handling radioactive material or operating radiation equipment, or who may be occupationally exposed to ionizing radiation.
4. Keeping an accurate inventory of the amounts of radioactive materials possessed.
5. Keeping accurate records of use and disposal of any radioactive material.
6. Making periodic radiation safety surveys of each area in which radiation or radioactive materials are used as required by the Radiation Safety Committee. "Periodic" shall mean monthly for use of unsealed sources of radioactive material and biannually for sealed sources and radiation-producing equipment. See Appendix E for suggestions on making the periodic surveys.
7. Controlling the entry to areas specified as "controlled areas" for reasons of radiation protection. Radiation warning signs on entries and locks on storage areas are appropriate.
8. Informing the Radiation Safety Officer of changes in existing procedures which might increase radiation exposure or volume of radioactive waste produced.
9. Ensuring that all radiation workers under their supervision wear

appropriate radiation monitoring devices during periods when radiation exposure is possible, and, are properly instructed in radiation safety prior to performing any procedure which may involve possible exposure to ionizing radiation.

10. Providing security at all times against unauthorized removal of radioactive material under their control. "At all times" includes normal working hours when the area in question is not occupied.
11. Providing, in writing to the Radiation Safety Officer, notice of intent to stop usage and/or vacate a controlled area at least 30 days in advance of the expected date to vacate.
12. Becoming familiar with all applicable areas of the Radiation Safety Manual and Part 16 of the N.Y. Sanitary Code. A copy of Part 16 is found in Appendix F.

8.5 Responsibilities of All Radiation Workers.

Radiation workers are individuals authorized by the Radiation Safety Officer to work with radioactive materials and operate radiation-producing equipment or frequent controlled areas.

Each person working in an area where the possibility of radiation exposure or contact with radioactive materials exists has a responsibility to become informed of possible radiation hazards.

Each worker must act in accordance with the requirements of this handbook and those established by the Radiation Safety Committee and his or her supervisor.

General Instructions

1. Prior to performing an operation with quantities of radioactive material which may produce significant external or internal exposure, the user shall

consider precautionary measures including the use of remote handling devices, hoods, shielding, etc. The Radiation Safety Officer must be consulted before beginning any new use of radioactive material.

2. There shall be no eating, drinking, smoking, or application of cosmetics or preparation of food in any location where radioactive materials are used or stored.

3. Food, drink or personal effects shall not be stored with radioactive materials.

4. Pipetting of radioactive materials by mouth is prohibited.

5. Lab coats and disposable gloves shall be worn during operations involving the handling of unsealed sources of radioactive material. The lab coat and gloves should be removed before leaving the laboratory. Care must be taken such that other items (i.e., pens, pencils, notebooks, doorknobs, telephones, etc.) are not handled with gloves used during work with radioactive materials.

6. Work which may result in contamination of work surfaces shall be performed in such a manner so as to minimize any low-level radioactive waste generated and still provide for ease of decontamination. Trays made of impervious material (i.e., stainless steel, porcelain-coated, etc.) provide excellent work arrangements to help prevent the spread of contamination.

Work surfaces and personnel should be monitored after working with radioactive materials

Where there has been a spill of radioactive material (see posted Spill Procedures) which may have produced contamination of the person or clothing, both the person and the clothing shall be monitored. Personnel shall be decontaminated as soon as possible.

7. Where contamination above the limits established for area surveys is discovered during a laboratory survey, decontamination must be initiated immediately by the user.

8. After working with unsealed sources of radioactive material, hands should be monitored and washed before leaving the laboratory, eating or smoking.

9. Objects and equipment that may have been contaminated with radioactive material shall be surveyed and demonstrated to be free of contamination prior to their removal from the laboratory, or transferred to other laboratories, repair shops, surplus, etc. If found to be contaminated, such items must be decontaminated as soon as practical.

10. If personnel monitoring devices (whole-body or ring badge) have been issued to you for your work with radioactive materials, they must be worn at all times when in areas where these materials are stored or used. A whole-body badge should be worn at chest or waist level and a ring badge should be worn on the dominant hand, with the detector turned to the palm side of your hand. When personnel monitoring devices are not being worn to monitor occupational exposures, they should be stored in a designated low background area.

11. Dispose of radioactive waste only in the manner designated by the Radiation Safety Officer and maintain records as instructed.

12. Store radioactive materials in covered containers plainly identified and labeled with the name of the compound, radionuclide, date, activity and radiation level (if applicable).

13. Always transport radioactive material in shielded containers.

8.6 Training in Radiation Safety.

No radioactive material or radiation-producing source will be used without the user being properly trained. Training in possible hazards associated with a particular use of radioactive materials or radiation-producing equipment shall be provided by the individual or individuals authorized to possess and use the radiation source in question. General radiation safety instruction can be provided by the authorized user or the Radiation Safety Office.

The Radiation Safety Officer shall make the final decision as to the proper amount of training in radiation safety. Experience in handling radioactive materials and/or radiation-producing equipment may be substituted for partial fulfillment of training requirements. The amount of training and/or experience required will be based on the training requirements set forth in Part 16, N.Y. State Public Health Code (see Appendix F) and additional requirements set forth by the Radiation Safety Committee.

8.7 Application To Use Radioactive Materials. (Principal Users Only)

Persons wishing to become principal users of unsealed sources of

radioactive materials at the Upstate Medical University must make formal application to the Radiation Safety Committee using the "Application for Permission to Use Radioactive Materials" and, if appropriate, the Human Use Supplement. Copies can be obtained by contacting the Radiation Safety Office.

The completed application is then sent to the Radiation Safety Officer (RSO) for evaluation.

The evaluation process consists of a review of the application, an interview with the applicant, and a visit to the user's laboratory. The RSO will then produce a detailed evaluation of the application, interview and laboratory visit for submission to the Radiation Safety Committee with the RSO's recommendation. Depending on the type of application, i.e., human use or non-human use, the application will be sent to either the human use or non-human use subcommittee of the Radiation Safety Committee and its chairman for comment, approval, conditional approval or disapproval.

Approval of the application must be unanimous by the three members of the appropriate subcommittee and the chairman.

8.7.1 Amendments.

Radioactive material/radiation producing device permit holders are required to conduct their programs in accordance with statements, representations, and procedures contained in the permit application and supporting documents. The permit must therefore be amended if the permit holder plans to make any changes in the facilities, equipment (including types of monitoring and survey instruments), procedures, authorized users, radiation therapy physicist, or radioactive material to be used.

Applications for permit amendments may be filed either in letter form or via E-mail. The application should identify the license by number and should clearly describe the exact nature of the changes, additions, or deletions.

References to previously submitted information and documents should be clear and specific and should identify the pertinent information by date, page and paragraph.

Amendment applications must be signed or contain the E-mail signature block of the permit holder and dated.

8.8 Training.

8.8.1 Radiation Worker Training.

Each individual who works with ionizing radiation at SUNY Upstate Medical University must complete a training program prior to commencing work. Also, all workers must attend an annual refresher program to retain approved radiation worker status. The training program consists of two stages.

STAGE ONE (directed by the Radiation Safety Office). --Training in the following areas:

1. Applicable regulations and license conditions.
2. Radiation hazards and risks.
3. Basic radiation safety procedures, work rules, exposure monitoring, survey instrument use and contamination monitoring.
4. Reporting unsafe working conditions.
5. Emergency procedures.
6. Exposure monitoring and bioassay, workers' right to be informed of results.
7. Meaning of posted warning signs, etc.
8. Examination in the above.

Items 1-8 must be obtained and documented. At the completion of this stage,

conditional approval to work in radiation areas will be given by the R.S.O.

STAGE TWO (Directed and documented by the authorized user).

Training in the following areas:

1. Areas where radioactive materials are stored, used and disposed.
2. Location and use of records for use, inventory and disposal of radioactive materials.
3. Location and use of personnel radiation safety equipment such as survey meters, lab coats, gloves, etc.
4. Location and use of radiation safety-related documents, in animals, etc.
5. Location and use of emergency eye wash, safety shower, and emergency contact list.
6. Hazards of radioactive materials and related compounds specific to the laboratory and precautions to be taken.
7. Document direct supervision and instruction by the authorized user in techniques and use of equipment specific to the use of radioactive materials in the laboratory.

Items 1-6 must be completed, documented and returned to the RSO upon starting work.

Item 7 must be completed, documented and returned to the RSO within two months of starting work.

A sign-off form for documentation of the above training is found on the next page.

Statement Of Training In Safe Use Of Ionizing Radiation.

_____ has successfully completed stage one of the mandatory training in the safe use of radiation or radioactive materials on _____. The above named individual has conditional approval from the Radiation Safety Officer to work with:

(Radiation Safety Officer) (Date)

I certify that _____ has been trained in item Nos. 1-6, under "Stage Two" for Radiation Worker training.

(Authorized User) (Date)

I certify that _____ has received direct instruction and work supervision in use of techniques and equipment for safe handling of radionuclides or radiation equipment specific to my laboratory.

(Authorized User) (Date)

8.8.2 The Individual Worker

Individual User

Much of the work with radiation, either in research or in clinical situations, is done by individuals other than the authorized user. Therefore, it is his or her responsibility to be familiar with this manual and proper procedures.

Their adherence to good practice will facilitate radiation safety, perhaps more than any other single factor. The following regulations and work practices should be conscientiously adhered to:

1. The individual's exposure rate should be kept as low as practicable by utilizing short working times, appropriate shielding and protective devices and judicious use of distance as a protection factor.
2. Wearing radiation monitoring dosimeters when appropriate. The Radiation Safety Office should be consulted about the proper use and storage of the dosimeters. People exclusively using low energy Beta emitters (^3H , ^{14}C , ^{35}S , ^{45}Ca) are not issued dosimeters.
3. Using appropriate protective clothing and devices such as:
 - a. appropriate protective gloves and gowns when handling
 - b. respiratory protective devices when indicated
 - c. protective barriers
 - d. tongs and other mechanical devices for remote handling
 - e. pipette filling devices (NEVER PIPETTE BY MOUTH!).
 - f. use of air hoods, exhaust devices, etc. as specified by the
Radiation Safety Office
4. Smoking, drinking, eating, applying cosmetics, or storing food or drinks in radiation laboratories are prohibited. In certain cases where the

laboratory area is large, areas may be designated where these activities may be permitted. This approval will be at the discretion of the Radiation Safety Officer. Also, each laboratory area designated for eating, etc. will be delineated by appropriate warning signs and/or lines on the floor as found appropriate by the Radiation Safety Officer.

5. Washing hands after use of radionuclides.
6. Proper labeling and storing of radioactive materials.
7. General good housekeeping. Keeping work areas and storage areas organized and neat. Unbreakable and non-leaking containers should be used. Absorbent and/or disposable chucks should be used to contain any spillage. Non-porous surfaces such as glass or stainless steel should be used for work surfaces. Fiberglass trays can be substituted for these stainless steel or glass work surfaces.
8. The individual worker shall be thoroughly familiar with the physical, chemical and biological characteristics such as half life, energy, biological pathways, chemical reactions, toxicity, volatility, permeability, etc. He or she should request more information, if necessary, from the authorized user or from Radiation Safety personnel.
9. All individuals working with radioactive materials must have authorization from the Radiation Safety Officer to conduct such work. In particular, no one under 18 shall be regularly employed in an area where their radiation dose may exceed those levels permitted for the general public. See Section 10.2 for the SUNY Upstate policy for pregnant workers.

8.8.3 Instruction And Training Of Ancillary Personnel

Ancillary personnel whose duties may require them to work in the vicinity of radioactive materials or radiation-producing equipment must also be informed of radiation hazards and receive basic instruction in radiation safety (radiation risks, identification of signs and symbols, emergency contacts and action).

Persons associated with the laboratory, e.g., clerical and certain laboratory staff, will be instructed by the authorized user. All others will receive instruction through the Radiation Safety Office.

8.9 PROCEDURES FOR ORDERING AND RECEIVING RADIOACTIVE MATERIALS.

All purchases, gifts or transfers from or to other Institutions or authorized users of radioactive materials must be approved by the Radiation Safety Office. The Radiation Safety Officer must assure that receipt of any radioactive material within SUNY Upstate be for authorized radioactive materials and within the possession limits of our license and those set for the individual authorized user. To ensure this requirement, the following purchasing procedure must be followed:

1. All purchase orders for radioactive materials shall be accompanied by a completed "Radioactive Materials Purchase Order Clearance Form" signed by the authorized user. The authorized user cannot delegate the signing of the card.
2. The purchase order and clearance form shall then be sent to the Radiation Safety Office for approval and signing. The approved order will be sent by the Radiation Safety Office to the Campus Purchasing Department.

Note: The Purchasing Department will not accept any order for radioactive material without the completed Clearance Form.

3. The ordering process can be expedited somewhat, by hand-carrying the forms to the Radiation Safety Office and carrying or FAXing the forms to the Purchasing Department. Orders should be placed to arrive on normal work days, not holiday or weekends; as there is no one in receiving or the Radiation Safety Office to receive or deliver them.
4. All radioactive materials are delivered to the Radiation Safety Office. Upon arrival, the shipments are checked for damage, accuracy of contents, in some cases wipe tested, and logged in the Receipt Book. Should a radioactive material (RAM) package be inadvertently delivered to a laboratory during normal business hours, after hours or on a weekend; do not open it, contact the Radiation Safety Office for instructions.
5. The laboratory ordering the material is then contacted and informed of its

arrival. The RAM shipment is picked up at the Radiation Safety Office. Upon returning to the laboratory the radioactive material shipment should be opened immediately. Inspect the contents for possible damage or leakage, check the label for correspondence with the shipping papers (radionuclide, chemical form, activity, assay date must match). Conduct a smear survey of the exterior of the radioisotope container and analyze the smear for removable contamination. If free of contamination transfer it to an authorized storage area.

NOTE: When opening a shipment of radioactive material, wear disposable gloves.

- a. To avoid possible confusion and oversight in adherence to the required procedures for radioisotope shipment receipt and inspection, one person in each radioisotope permit holder's group should be assigned the responsibility of receipt, opening, inspection and surveying of radioisotope shipments. In his/her absence, this assigned person is responsible for appointing an alternate person to assume responsibility for these duties. The alternate is responsible for opening, inspecting and transferring the radioactive material to an authorized storage area as soon as possible.
 - b. Shipments that are potentially volatile, gaseous, or could be released into the air should be opened in a radioisotope hood, and to further ensure the safety of personnel, a smear survey should be taken of the inner container to determine possible radioactive contamination. Notify the Radiation Safety Office at 464-6510 in the event of any contamination, improper packaging, leaking, damaged vials, etc.
6. Again as a reminder, procedures listed below must be followed when a radioisotope shipment is received:
- a. Remove shipping papers and supplier's instructions and retain for receipt records.
 - b. Remove inner packing materials and place into an appropriate receptacle (packing material must be surveyed for possible radioisotope contamination and shown to be free of contamination before being disposed of as non-radioactive trash or returned for recycling).

8.10 Storage of Radioactive Materials.

All storage areas for radioactive materials must meet the following conditions.

1. Provide adequate radiation protection. The amount and type of protection required will depend on a number of factors: quantity of radioactive material (activity), types of radiations emitted, proximity of workers, etc. The amount of shielding shall be such that radiation

exposure levels in adjacent accessible areas shall be as low as reasonably achievable with a maximum of 2 mRem in any one hour.

2. Have appropriate radiation warning signs conspicuously displayed.
3. Have provision for locking the storage area. Cupboards and cabinets can be fitted with key locks or padlocks. Refrigerators and freezers should be purchased with door locks.

Note that the N.Y. State Department of Health requires radioactive materials to be secured when, for example, a laboratory room is unlocked and no laboratory personnel are present.

4. Food, drink or personal use items must not be stored with radioactive materials.
5. All storage containers must be appropriate for the type of radioactive material being stored and shall be labeled with the amount (activity) and name of the radioactive material and the universal radiation symbol. Please contact the Radiation Safety Office (x46510), for assistance in meeting the above conditions.

8.11 Transfer of Radioactive Materials

An authorized user may transfer control of radioactive material to another authorized user either on or off campus. Transfer may occur only upon notification to and approval of the Radiation Safety Officer (RSO). Notification to the RSO is made using the "Radioactive Materials Transfer Form." See Appendix K for an example of the current form.

Radioactive materials can only be transferred to individuals who are authorized users as designated by the appropriate institutional, state or federal agency having jurisdiction. The following conditions shall be met:

1. The person receiving the nuclides must be an authorized user and have authorization to use the radioactive materials in question.
2. If the person receiving the nuclides is at another institution, he/she must have the appropriate Federal, State or institutional permits for possession of the radioactive material.
3. The amount of radioactivity transferred shall be such that possession limits are not exceeded.
4. The "Record of Radioactive Materials Transfer," obtainable at the Radiation Safety Office, shall be filled out.
5. A copy of the transfer record shall be sent to the Radiation Safety Office.

Please contact the Radiation Safety Office (x46510), for assistance in meeting the above conditions. We will also provide guidance assistance in packaging the material for shipment and filling out of the proper forms, in order to insure that all state and federal regulations are met.

8.12 Utilization of Radioactive Material in Experimental Animals

1. All radioactive preparations and procedures involving the use of experimental animals will be performed in the laboratory's approved radionuclide preparation and use areas. All radiation safety precautions and procedures described in the Radiation Safety Manual will be observed.
2. Animals containing radioactive material will be housed in the Department of Laboratory Animal Resources (DLAR) or in the laboratory. Housing of radioactive animals in the laboratory is subject to prior approval of

the Committee for the Humane Use of Animals and the Radiation Safety Officer (RSO). The animals will be housed in appropriately identified cages until their excretions contain only background amounts of radioactivity or until they are euthanized. Personnel from DLAR will be trained in proper safety procedures by the investigator(s) responsible for the experimental procedure(s) and the Radiation Safety Office. The investigator (authorized user) is responsible for the instruction and proper care and handling of radioactive animals in DLAR. Trained DLAR personnel will insure that proper methods are used for handling radioactive animals and for disposing of the carcasses and waste. The primary animal enclosure (e.g. cage, pen, or run) will be properly identified as containing animals that have been given radioactive material (i.e., radioactive material caution label, the radionuclide type and activity, and the principal investigator's name and phone extension.)

3. Animal excreta will be collected and placed in sealed plastic bags which contain sufficient absorbent material to absorb all free "biological waste" via the Medical Center's radioactive waste disposal program.
4. The primary enclosure will be lined with an absorbent bottom pad. Absorbent material will be used in and around the enclosure to prevent spills of urine contaminated with radioactive material. Upon removal of the experimental animal, the enclosure will be decontaminated by washing with detergent and hot water while wearing appropriate apparel. Contaminated water will be flushed down an approved hot sink or drain.
5. All cleaning equipment will be surveyed by the investigator or their

designee to ensure no excessive contamination exists. The animal room or laboratory will be surveyed for contamination following decontamination procedures and contamination levels reduced to <1000 dpm/100 cm² at the direction of the RSO. Additional surveys may be required if the animals are kept in areas other than those on the laboratory's protocol. The laboratory responsible for the animal is required to ensure any room where an animal containing radioactive material is housed is properly posted and controlled.

6. The animal housing room will be locked unless attended by authorized personnel.

7. Additional information regarding care of radioactive animals can be obtained from the Radiation Safety Office.

8.13 Decommissioning or Vacating Radioactive Use Laboratories or Cessation of RAM Use.

The Authorized User may terminate his/her permit at any time by notifying the RSO in writing, thirty (30) days in advance of the intended termination date. The notice must include how he/she will transfer the radioactive material currently in his/her possession. The Authorized User must transfer all radioactive material (RAM) in his/her possession to either the RSO or another Authorized User prior to termination of his/her permit. The Authorized User must schedule an exit inspection to be conducted by a member of the RSO staff after all radioactive material has been removed from the room(s) and other required actions are completed. The Authorized User must submit their exit wipe test survey to the Radiation Safety Office before the room is cleared and permit terminated.

The Authorized User must inform the RSO in writing should they plan to stop using RAM for a period longer than six (6) months. The Authorized User is not required to provide details about a new location, however all the following will apply to include submitting an exit/cessation inspection and submitting an exit/cessation wipe test survey.

Once an area has been designated as a controlled area for the use of radioactive material by the Radiation Safety Committee, it shall remain so until it has been found suitable for non-radioactive uses and released by Radiation Safety staff.

Instructions for Decommissioning and Vacating Radioactive Use Laboratories.

If equipment and other items are to be moved from your laboratory, certain actions **must** be taken first in order to properly prepare for the move. Laboratories that are relocating from one campus building to another campus building (i.e., from the Institute for Human Performance (IHP) to Weiskotten Hall (WH) or from University Hospital to WH, etc.) **must turn in all radioactive material** prior to completing any of the following steps or have made other arrangements with the RSO. RAM which you intend to use in your new lab should be specifically identified and distinguished from RAM that you are turning in as radwaste. Arrangements will be made to transfer that material to your new laboratory once you have set it up and it has been inspected by the RSO. Laboratories that are simply relocating to space within the same building will be allowed to transport their RAM to their new laboratory, after **first** notifying the RSO and receiving permission. **All radioactive waste (liquid and dry) will be turned into the waste room prior to any release being given by the RSO.** Because some of your equipment has been used to store

and/or process RAM it will be necessary that we assure the movers, construction workers, and new occupants that the area is contamination free. Laboratories given up for unrestricted use may require different release and clearance limit certification.

At least one (1) week prior to the date of your scheduled decommissioning or vacation and after your last use of RAM and turn in of radwaste; you will need to accomplish the following mandatory actions:

1. The outside surface of any piece of equipment used to store or process radioactive material that is to be moved from its present position must be wipe tested. This includes refrigerators, microfuges, laminar flow hoods, waste cans, bench tops and floors, shields, etc.
2. All fume hoods used for work with radioactive materials must have all items removed and the inside and outside surfaces of the fume hoods wipe tested.
3. Floor tiles located around and in front of equipment, fume hoods and work benches used to store or work with radioactive material must also be wipe tested.
4. Any equipment not being moved to a new lab, which has the potential to have been used to store or process RAM; must be wipe tested inside and out (e.g., refrigerators, freezers, centrifuges, etc.).
5. All workbench counter surfaces as well as floor areas below

refrigerators and freezers must be wiped tested after all equipment, protective pads or trays, and lab materials have been removed even though RAM may not have been used on them. The initial wiping of large areas using a single wipe is acceptable to minimize the number of wipes used.

All wipe tests must be completed at least one (1) week prior to the move/closure date, unless cleared with the RSO to allow for any decontamination to be completed. Use your monthly wipe test diagram sheets and add additional information as necessary to specifically identify tested equipment and locations. Use separate wipes for floor locations and inside and outside fume hood surfaces. **Write in large letters across the top of the form "Laboratory Closure/Vacating". For the quickest results bring the wipes to the RSO,** do not send through campus mail. After all wipes have been evaluated and have been found to be clean, you are required to remove all radiation stickers and signs from within the room and from the outside of the entrance door.

If you are relocating within the Medical Center, let us know your new location in writing and provide a new room diagram of your use areas, as soon as possible, so that we can develop a new survey sheet for you.

9.0 The Disposal of Radioactive Waste.

9.1. General

The disposal of radioactive waste is governed by state and federal regulations and rules established by the low level radioactive disposal sites. Unfortunately, the complexity of these regulations require the waste generator to separate radioactive waste in a rather complex manner. We hope this section of the Radiation Safety Manual will "ease the pain" somewhat and aid you, as a generator of low level radioactive waste, in the proper management of this waste.

9.2. Some General Rules

1. Approved radioactive waste containers must be located in the vicinity of work areas. Each container must be conspicuously marked with approved radioactive warning signs and symbols. Contact the Radiation Safety Office for supplies, signs, etc.
2. Waste containers must be lined with the required bags to aid in handling, please fill plastic bags only ~ ½ full. Containers and bags are available at the Waste Room (Rm. 227, WH).
3. Non-radioactive items must not be placed in containers with radioactive material. It is essential that we keep our volume of radioactive waste as small as possible (see 9.2.6, "Decreasing Volume of Radioactive Waste").
4. Waste containers should be brought to the Waste Room, Room 227, WH at the scheduled day and hour. Each must be accompanied by a completed green (3"x5") "Record of Carcass and Waste Disposal." Supplies of the disposal cards are available at the Radiation Safety Office or by contacting the

Radiation Safety Office. Contact this Office, also, for the Waste Room schedule.

5. Each waste generator is required to keep an accurate record of all radioactive waste in each container brought to the Waste Room for disposal. The record must indicate: type of radioactive material, the activity in microcuries, date of disposal and name of generator. It is recommended that tally sheets be maintained for each container.

6. All radioactive waste will be delivered to Room 227, Weiskotten Hall for disposal. Contact the Radiation Safety Office at x46510 for current operating hours.

7. In general, waste will be separated by half-life according to the following schedule:

Radioactive Group I: Half-life 20 days or less (I-131, P-32, P-33 etc.)

Radioactive Group II: Half-life greater than 20 days but less than 90 days
(Cr-51, Fe-59, S-35 etc.)

Radioactive Group III: Half-life 90 days or greater (H-3, C-14, Ca-45, etc.)

8. Lead and other hazardous materials, as defined by the U.S. Environmental Protection Agency (EPA) must not be mixed with radioactive waste. At the present time, "mixed" waste (radioactive and hazardous material) cannot be accepted for disposal at any site in the U.S. Mixed wastes having short radioactive half-lives may be stored on site for decay and then disposed of as a "simple" hazardous material. Please inform Radiation Safety (x46510) and the Environmental Health and Safety (X45782) offices before generating any mixed hazardous waste.

A copy of the EPA list of hazardous waste is found in Appendix I.

9.2.1 Dry Waste. Dry waste will include items such as paper, plastic gloves, etc. Not included are animals and/or tissue, scintillation vials and liquids. Sharps (broken glass, needles, etc.) must be collected separately. Dry waste receptacles must be doubly lined with 4-mil plastic bags. Waste should be

separated by isotope, however, isotopes with similar half-lives may be placed together.

9.2.2 Liquid Waste. All liquid waste must be segregated into the following categories:

- Aqueous Waste
- Non-aqueous Waste

Please indicate, for each, the approximate pH and type of compound. Do not mix compounds that may create release of gases or become reactive.

Liquid waste must be stored in sturdy plastic containers only. Appropriate containers will be supplied by the Radiation Safety Office. Each container must also be equipped with a leak-proof screw cap.

Sewer disposal of liquids is not allowed unless written authorization is received from the Radiation Safety Officer (see 9.2.3).

9.2.3 Sewer Disposal. All releases of liquid radioactive waste to the sanitary sewer must comply with the following requirements:

1. Written permission from the Radiation Safety Officer after submission of a written request by the authorized user.
2. Designation and proper labeling of one disposal sink per authorized user. Appropriate labels are available at the Radiation Safety Office.
3. All liquid waste must be readily soluble in water. No exceptions.
4. The total annual release allowed will be set by the Radiation Safety Officer. Releases into the sewer must be spread evenly over the calendar year.
5. Radioactivity concentrations should be diluted to one microcurie or less per liter at the time of disposal.
6. An accurate log, indicating the date, radionuclide and activity, of each disposal must be kept.

9.2.4 Liquid scintillation waste. This waste should be stored in the scintillation vials. Please do not combine into larger volumes. We require

the use of the newer "Biodegradable" solutions which have a flash point above 180 degrees F. In preparing liquid scintillation fluids for disposal, please do the following:

1. Separate vials at background or containing 0.05 microcuries or less of Carbon-14 or Hydrogen-3 per milliliter. This waste is not regulated and can be disposed of with regard only to its chemical composition.

2. Separate the vials into two groups:

Group 1: Flash point greater than 180 degrees F and activity greater than 0.05 microcuries per milliliter.

Group 2: Flash point equal to or less than 180 degrees F and activity greater than 0.05 microcurie per milliliter.

3. Place vials in a 4-mil plastic bag. Fill only $\frac{1}{2}$ full. Seal bag by twisting top of bag and taping with duct or masking tape. Repeat with two additional 4-mil bags so that the vials are enclosed with a triple layer of plastic, each with a separate end closure. Place the radioactive waste tag on the outside of the completed package.

9.2.5 Biomedical Waste (includes animal carcasses and tissues, cultures such as cell, viral and bacteriological). Please follow these guidelines exactly:

1. Place larger animals singly into 4-mil plastic bags and seal. Smaller animals may be grouped together provided they contain the same radioactive materials.

2. Free liquid must be absorbed using paper towels, on absorbent pads or other absorbent material approved by the Radiation Safety Office. Please do not include any other items with this waste.

3. Whenever possible, separate by similar half-life.

4. Biomedical waste containing known pathogens must be treated by an approved method such that the pathogens are rendered inactive-before delivery for disposal.

5. All non-sterile biomedical waste should be kept frozen in the authorized users laboratory and delivered frozen to the Waste Room. If space becomes a problem, contact the Radiation Safety Office.

6. Animal carcasses containing 0.05 microcuries or less per gram of C14 and/or H3 may be disposed of as nonradioactive. However, records must be maintained indicating the activity per gram and how this was determined, the method and date of disposal.

9.2.6 Reduction of Radioactive Waste Volume

As you may know, generators of low-level radioactive waste (LLRW) in New York State have and continue to face a critical situation when dealing with the disposal of radioactive waste. All LLRW that is to be buried at designated special LLRW landfills is assessed a surcharge per cubic foot, in addition to the transportation and disposal charges. A 55-gallon drum has a volume of 7.5 cubic feet. Additionally, at sometime in the future we may have to store all LLRW generated at Upstate Medical University for many years to come or until a suitable facility is created within the state.

In light of the above situation, it is extremely important that all persons working with radioactive materials, and producing LLRW, reduce the volume of such waste as much as possible. We should begin immediately to address the problem.

A number of general suggestions are listed below. We recognize each laboratory may have unique waste problems and we will work with you individually as needed.

1. Where possible, replace current analytical techniques using radioactive materials with those that do not.
2. Substitute short-lived radionuclides for longer-lived ones now in use. This would allow for more use of in-house decay.
3. Consolidate radioactive work areas, reduce the size of and carefully delineate boundaries of such areas. This would tend to reduce the amount of protective covering, etc., needed to protect work surfaces.
4. Review procedures in order to look for areas where LLRW production might be reduced.
5. Purchase only the amount of radionuclide you need.
6. Implement a careful monitoring program where all waste items are checked for contamination. Only waste items actually containing radioactive material are to be considered LLRW.
7. Count Phosphorous-32 without scintillation fluid by the Cherenkov method

on the Hydrogen-3 setting of a liquid scintillation counter. This method has an efficiency of approximately 40%. The material can then be held for decay and eventually discarded in the sewer.

8. Count Iodine-125 without scintillation fluid in a gamma scintillation counter, hold for decay and discard.

9. When using Liquid Scintillation Counting (LSC), change to "biodegradable" or "drain disposable" LSC fluids.

10. Convert to 1.5 or 2.0 ml microcentrifuge tubes in order to reduce total volume of scintillation fluid.

Please note that the Radiation Safety Office is currently working in a number of areas to decrease LLRW volume, e.g., compaction, crushing, storage-for-decay.

NOTE: Items 7, 8, 9 and 10 will reduce the volume of mixed hazardous waste, which is very difficult or impossible to dispose of.

10.0 General Radiation Monitoring of Personnel

10.1 General Policy

It is the general policy of this Medical Center that radiation exposure to all employees shall be kept as low as reasonably achievable (A.L.A.R.A.) regardless of gender. See Section 7.0 for the details of the ALARA Policy. Exposure of either the male or female reproductive systems to ionizing radiation before conception may introduce a degree of reproductive risk. The amount of risk depends upon total radiation dose, dose rate and the time between exposure and conception. Careful adherence to the A.L.A.R.A. Policy for all employees should reduce the reproductive risk to an insignificant level.

After conception, continued adherence to the A.L.A.R.A. Policy should also assure minimal radiation exposure to the embryo/fetus during the gestational period. However, since both the NCRP and Nuclear Regulatory Commission (NRC) have made recommendations concerning the radiation exposure to the embryo/fetus and since the embryo/fetus is a member of a different exposure group (general public vs. occupationally exposed), SUNY-Upstate has developed a specific policy to cover this.

10.1.1 SUNY Upstate Medical University policy concerning occupationally exposed women who are or could be pregnant:

The current recommendations of the National Council on Radiation Protection and Measurements (NCRP)¹ are that as a result of occupational exposure to the mother by ionizing radiation, the total dose to the embryo/fetus during the entire period of gestation not exceed 5 millisieverts (0.5 Rem). Although the mother is considered a radiation worker, the unborn child is held to be a member of the general public and is limited to 1/10 the dose of the occupationally exposed worker. The exposure should be received at a rate as constant as possible over the period of gestation.

Complicating this issue is the Pregnancy Discrimination Act (Amendment of Civil Rights Act of 1964, PL95055, October 31, 1978), which states: "Women affected by pregnancy, childbirth or related medical conditions shall be treated the same for all employee-related purposes as other individuals not so affected, but similar in their ability or inability to work."

Also, a recent (1991) U.S. Supreme Court decision stated that businesses "...cannot bar women of child-bearing age from certain jobs because of potential risk to their fetuses."

10.1.2 POLICY

The employee working with or around radiation sources, should notify² her supervisor or other appropriate representative of the administration as soon as she finds she is pregnant or has the intention of becoming pregnant.

The supervisor or administrator will notify the Radiation Safety Officer

¹ See NCRP Report No. 91, "Recommendations on Limits for Exposure to Ionizing Radiation.

The NCRP (not a regulatory agency) is the primary body in the United State which develops recommendations on radiation safety. Most federal and state regulations are patterned after NCRP guidelines. See Nuclear Regulatory (NRC) Guide 8.13, 1987 in Appendix G for current federal guidelines. The current NY State Public Health Code addressing ionizing radiation makes no recommendation concerning the embryo/fetus.

² Note: This notification is voluntary.

(RSO) who will then investigate and document the nature of the employee's work and the radiation levels in the working area. If a reasonable possibility exists that the embryo/fetus could receive a dose of 5 millisieverts (0.5 Rem) before birth, the employee will be given the following options³:

- (a) modification of work assignments to reduce her exposure,
- (b) reassignment of the worker to an area involving less radiation exposure with no loss of pay or other employee benefits.
- (c) continuing her current assignment with no change⁴

The SUNY Upstate Medical University shall have no responsibility for providing specific embryonic or fetal radiation dose precautions until the employee declares her pregnancy status to the supervisor and RSO.

Any employee may obtain embryonic/fetal dose and related radiation safety information at any time through the RSO without declaring pregnancy status.

³ Whichever option is chosen by the worker, the RSO shall discuss with the employee the implications and risks of radiation exposure to the embryo/fetus and as deemed necessary, the RSO will provide additional personnel monitoring devices so that rapid dose evaluation can be made.

⁴ If appropriate radiation safety precautions are taken, it is extremely unlikely an embryo/fetus would receive a radiation dose approaching 5 millisieverts during gestation. This observation is based on review of the permanent radiation exposure records found in files at the Radiation Safety Office.

10.2 Monitoring of External Radiation Exposure

External radiation exposure can result from the use of radioactive materials emitting x-rays, Gamma rays or Beta particles, and from radiation equipment emitting x- or gamma rays.

One can limit radiation exposure by observing the following basic rules of radiation protection:

1. Limit the time spent in the vicinity of a radiation source.
2. Maintain as much distance as possible between the individual and the radiation source.
3. Use appropriate shielding to reduce the intensity of radiation reaching the individual.

The radiation level to which a person is exposed in the work environment should be known. A properly calibrated survey meter can provide an estimation of the exposure rate for x- and gamma radiation.

10.3 Individuals Who Should Be Monitored.

In general, all individuals occupationally exposed on a regular basis to ionizing radiation or who handle radioactive materials may be issued a whole body monitor. In addition, individuals who may receive doses to the hands from handling radioactive materials on a regular basis may be issued an extremity monitor.

Individuals working only with Tritium, Carbon-14 and similar low energy Beta radiation emitting isotopes will not be issued monitoring devices. Also, those persons working with very small amounts of radioactive materials may not require monitoring.

10.3.1 Basic Guidelines for Requiring Radiation Monitoring.

The basic guidelines for requiring radiation monitoring shall be Part 16.11 of the NY State Sanitary Code, which states:

"16.11 Personnel monitoring.

(a) External radiation sources. Each person who possesses any radiation source shall supply and require the proper use of appropriate, calibrated and operable individual monitoring devices by:

(1) Adults likely to receive, in one year from sources external to the body, a dose in excess of 10 percent of the limits in paragraph (1) of section 16.6(a); and

(2) Minors and declared pregnant women likely to receive, in one year from sources external to the body, a dose in excess of 10 percent of any of the applicable limits in sections 16.6(g) or 16.6(h); and

(3) Individuals entering a high or very high radiation area.

10.3.2 Frequency of Issuing Monitoring Devices.

Devices will be issued on a quarterly, monthly or more frequent basis. The Radiation Safety Officer will determine, on an individual basis, the type of monitoring device and the issuance frequency required after review of the worker's radiation environment.

10.3.3 Rules for Using Radiation Monitoring Devices

Persons working with radioactive materials or around radiation producing equipment such as x-ray machines, are issued radiation monitoring devices.

These devices are used to measure the extent of radiation exposure you receive while working at the Upstate Medical University. The fact that you have been issued a radiation monitoring device indicates, in the judgment of the Radiation Safety Officer, that you are working in an area where the possibility of significant radiation exposure exists. Here, "significant" means there is a reasonable possibility of an employee receiving a significant portion of his or her maximum permissible dose each calendar quarter.

The radiation monitoring devices are sensitive instruments and must be handled carefully in order to obtain accurate readings. Please observe the following rules:

- a) Badge-type monitoring devices should normally be worn at or near the waist. However, if the badge holder must wear a protective apron, the badge would be placed at the neck, outside the apron.
- b) Ring badges should be placed under protective gloves that are worn while handling radioactive materials, with the detector portion on the palm side of the finger. The detector is usually located under the inscription on the ring.
- c) Please wear these devices only while working at the Upstate Medical University. However, if you are temporarily assigned to other institutions as a part of your regular work, use the monitor assigned to you from the Upstate Medical University.
- d) Store the device in a safe place when not being used. In many cases, badge holders are provided. Otherwise, storage in a locker or desk drawer is acceptable. It is assumed all storage areas will be away from sources of radiation.
- e) Do not expose the monitoring device to excessive heat (such as a room radiator) or moisture as this may invalidate any radiation dose determined by the monitor.
- f) Please return the used insert (or entire badge in the case of quarterly monitoring) or the ring badge as soon as you receive the replacement for the new period. You will be instructed in the return procedure for your area.
- g) Wear only the monitoring device assigned to you. Do not loan or borrow someone else's monitor. If you lose or misplace yours, contact the Radiation Safety Office immediately to arrange for a replacement.

10.4 Issuance of Radiation Monitoring Devices to Persons Involved in High Radiation Exposure Situations, e.g. Heart Catheterization.

At the discretion of the Radiation Safety Officer, a two-badge radiation monitoring system may be required of persons working in high radiation exposure areas where protective aprons, glasses and thyroid shields are used.

One badge will be worn at the neck, outside the apron, the other at the waist, inside the apron. Since neither badge will give a true estimate of total body exposure, the effective dose equivalent for external radiation will be determined as described in 16.6(a)(3)(ii)(b) of Part 16.

As an alternative to the above: A single monitoring badge can be worn outside the protective apron at an appropriate position as determined by the Radiation Safety Officer. The effective dose equivalent for external radiation will be determined as described in 16.6(a)(3)(ii)(a) of Part 16.

10.5 Internal Radiation Monitoring

When handling unsealed sources of radioactive material, the potential always exists for introduction of the materials into the body. Internal deposition can result from inhalation, ingestion or absorption.

Bioassay is required of individuals working with quantities and types of radioactive materials where significant internal deposition may occur. Bioassay is defined as the determination of the kind, quantity or concentration and location of radioactive material in the human body. The determinations are either by direct measurement (in vivo) or by analysis of materials excreted or removed from the body (in vitro).

When a potential authorized user is being evaluated for permission to use radioactive materials, the need for bioassay will be reviewed by the Radiation Safety Officer during his or her initial review of the application.

When established authorized users wish to change a research protocol, increase significantly the quantity of radioactive material used in a procedure, etc., the possible need for bioassay should be discussed with the Radiation Safety Officer.

Bioassays are required under specific conditions as listed below when using Hydrogen-3 (Tritium) and any of the radioisotopes of Iodine.

10.5.1 Hydrogen-3 Compounds. Conditions under which bioassay is necessary:

- a) Handling on a bench top a quantity of Hydrogen-3 which equals or exceeds 10 millicuries.
- b) Handling in a properly functioning chemical (fume) hood a quantity of Hydrogen-3 which equals or exceeds 100 millicuries.
- c) When an individual processes at any one time, or enters into process during any one month time period, quantities which exceed 10% of the values show in Table I.
- d) When surveys or calculations indicate an individual has been exposed to concentrations in air or water in excess of the maximum permissible concentrations, Part 16, Chapter 1, N.Y. State Sanitary Code.
- e) The Radiation Safety Officer has reason to suspect an individual may be internally contaminated.
- f) As required by state or federal guidelines.

**TABLE I
ACTIVITY LEVELS OR CONCENTRATIONS
ABOVE WHICH TRITIUM BIOASSAY IS
NECESSARY**

Types of Operation (a)	HTO(b) and Other Tritiated Compounds (Including Nucleotide Precursors)	Tritium (HT or T ₂)(c) Gas in Sealed Process Vessels	HTO Mixed with More Than 10 kg of Inert H ₂ O (e.g., in Reactor Coolant)(d)(e)
Processes in open room or bench with possible escape of tritium from process vessels	0.1 Ci	100 Ci	0.01 Ci/kg
Processes with possible escape of tritium carried out within a fume hood of adequate design, face velocity, and performance reliability	1 Ci	1000 Ci	0.1 Ci/kg
Processes carried out within gloveboxes that are ordinarily closed but with possible release of tritium from process vessels and occasional exposure to contaminated box and leakage	10 Ci	10,000 Ci	1 Ci/kg

- (a) Quantities (< 10 kg) of substances containing tritium that are present during operations may be considered to be either the amount processed by an individual at any one time (when accidental intake is more likely) or the amount of activity that entered into the process (throughout) during any one month (when routine handling of repeated batches is the more likely source of exposure).
- (b) HTO is a symbol for a water molecule in which a tritium atom (T) is present in place of a normal hydrogen atom (H).
- (c) A molecule of hydrogen gas contains two hydrogen atoms. Either one of these atoms may be replaced with T to form HT, or two T atoms may combine to form T₂ gas.
- (d) This assumes that adequate air monitoring has established that there is no tritium leakage or that no significant amount of tritium gas can be converted to HTO before intake.
- (e) This column is applicable in place of the previous two columns in cases where tritium can be identified at measurable concentrations in large amounts of water or other substances, such as at nuclear power plants.

10.5.2 Radioiodine Compounds. Conditions Under Which Bioassay is Necessary:

- a) Use on a bench top of a quantity of Iodine-125 or Iodine-131 at any time which equals or exceeds 100 microcuries.
- b) Use in an adequately functioning fume hood, a quantity of Iodine-125 or Iodine-131 at any time which equals or exceeds 1 millicurie.
- c) When an individual handles in an open form, unsealed quantities of radioactive Iodine that exceeds 10% of those shown in Table II. Table II quantities apply to quantities handled at any one time or integrated as the total amount of activity introduced into a process by an employee over any three month period.
- d) Surveys or calculations indicate an individual has been exposed to concentrations in air or water in excess of maximum permissible concentrations listed in Part 16, Chapter 1, N.Y. State Sanitary Code.
- e) The Radiation Safety Officer has reason to suspect an individual has been internally contaminated.
- f) As required by state or federal regulations.

TABLE II
ACTIVITY LEVELS ABOVE WHICH BIOASSAY FOR I-125 OR I-131 IS NECESSARY

Types of Operation (a)	Volatile or Dispersible(a)	Bound to Nonvolatile Agent
Processes in open room or bench with possible escape of iodine from process vessels	1 mCi	10 mCi
Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability	10 mCi	100 mCi
Processes carried out within gloveboxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage	100 mCi	1000 mCi

- (a) Quantities may be considered the cumulative amount in process handled by a worker during a 3-month period; e.g., the total quantity introduced into a chemical or physical process over a 3-month period, or on one or more occasions in that period, by opening stock reagent containers from which radioactive iodine may escape. Quantities in the right hand column may be used when it can be shown that activity in process is always chemically bound and processed in such a manner that 125I or 131I will remain in nonvolatile form and diluted to concentrations less than 0.2 mCi/mg of nonvolatile agent. Capsules (such as gelatin capsules given to patients for diagnostic tests) may be considered to contain the radioiodine in a contained form, and bioassay would not be necessary unless a capsule were inadvertently opened (e.g., dropped and crushed). However, certain compounds where radioiodine is normally bound are known to release radioiodine when the material is in process, and the left-hand column may then be applicable. In those laboratories working with only 125I in radioimmunoassay (RIA) kits, the quantities of 125I are very small and in less volatile forms; thus, bioassay requirements may be judged from the right-hand column. In field operations, where reagent containers are opened outdoors for simple operations such as pouring liquid solutions, the above table does not apply; bioassay should be performed whenever an individual employee handles in open form (e.g., an open bottle or container) more than 50 mCi at any one time.

Operations involving the routine use of 125I or 131I in an open room or bench are discouraged. Whenever practicable, sealed bottles or containers holding more than 0.1 mCi of 125I or 131I should be opened at least initially within fume hoods having adequate face velocities of 100 feet.min or more.

10.5.3 Scheduling Bioassay Tests.

Please contact the Radiation Safety Office for scheduling bioassay tests before handling of the radioactive material occurs.

In any event, appropriate testing must be carried out according to the following schedule:

- a) Hydrogen-3. Urine samples within 24 to 48 hours of exposure.
- b) Iodine-125 and Iodine 131. In vivo thyroid assay within 24 hours of exposure.

11.0 Special Handling Procedures

11.1 Special Procedures for Handling Iodine-125 and Iodine-131.

Due to the volatile nature of iodine in its elemental form, its low solubility in aqueous solutions, and the ease with which it is oxidized to the elemental form, special care must be taken when opening containers of radioiodine. Aqueous solutions of sodium iodide may contain ^{125}I in the gaseous phase above the liquid. Opening the container will release radioactive ^{125}I . In order to prevent inhalation of radioiodine and to reduce the amount of radioiodine released into the environment, we are asking each user to follow the protocol outlined below:

1. If at all possible, purchase radioiodine only in containers equipped with a rubber diaphragm or septum. Use of a syringe and needle to add or transfer material would approximate a sealed system and reduce the possibility of radioiodine release. Once the radioiodine is bound, for instance, to a protein, the material can be handled in an open system.
2. If venting of the container received from the vendor is necessary, such venting must be done through an activated charcoal trap. The traps are available through the Radiation Safety Office and come equipped with a needle for insertion through the septum.
3. If your particular use requires radioiodine obtainable only in screw-cap containers without septa, the volatile ^{125}I must be vented in a closed system before opening in a fume hood.

Alternatively, by arrangement with the Radiation Safety Office, the office will vent shipments as they arrive from the vendor. Please make these arrangements at the time of ordering.

Note: The handling of materials containing radioiodine should always be done in a fume hood having an acceptable face velocity, e.g. ≥ 100 feet per minute.

Also, keeping NaI solutions basic will help to minimize the production of I_2 .

4. All containers holding radioactive iodine compounds should be opened in

a hood of proper design which has been checked and approved by the Radiation Safety Office and has a face velocity of 100 feet per minute, or greater.

5. When performing iodinations, two pairs of gloves should be worn as iodine has been shown to penetrate one thickness of plastic gloves.

6. Contaminated items can be decontaminated by using a solution of 0.1 M NaI, 0.1 M NaOH, 0.1 M $\text{Na}_2\text{S}_2\text{O}_3$. Overnight soaking in the solution followed by rinsing in water will remove the major portion of I_2 .

11.2 Some Precautions For Sulfur-35 Compounds.

Solutions of S-35 labeled amino acids and S-35 labeled ATP can release a volatile radioactive component when opened. Although the amount of S-35 released from a stock vial is small, contamination can occur, and it is prudent to observe a few precautions. The following are recommended:

- a) Open stock vials, etc. in a properly functioning fume hood.
- b) If possible, do assays in larger volumes, e.g. >14 ml/mCi or in a sealed container.
- c) Tricine (50 mM) can be added as a stabilizer in incubation media if it will not be toxic to the biological agents in culture.

NOTE: Charcoal is not a good trapping material for S-35 as the absorption is passive and the S-35 will be released from the charcoal over time.

11.3 Permissible Levels of Radiation Dose in Unrestricted Areas.

No authorized user shall possess, use or transfer sources of radiation in such a manner as to create in any unrestricted area from such sources of radiation in his or her possessions:

- a) Radiation levels which, if an individual were continuously present in the area could result in his or her receiving a dose in excess of 2 millirems in any one hour; or,
- b) Radiation levels which, if an individual were continuously present in the area could result in his or her receiving a dose in excess of 100 millirems in any seven (7) consecutive days.

NOTE: The above radiation levels apply to the operation of any source of ionizing radiation, e.g., x-ray machines, electron microscopes, etc.

12.0 Accidents Involving Radioactive Materials.

GENERAL

Accidents involving radioactive materials happen. It is essential that all persons working with radioactive materials consider the possible accident situations which can arise and plan appropriate remedial action in advance. Please feel free to contact the Radiation Safety Office for assistance (X46510).

The main objectives in a response to an accident involving radioactive materials are: (1) to limit the radiation exposure of personnel, and (2) to prevent the spread of radioactive material. A listing of emergency procedures is found on the next page.

EMERGENCY PROCEDURES
RADIOACTIVE MATERIALS

SPILL: CONTAMINATED PERSONNEL – WITH INJURY

1. If injury allows, remove contaminated clothing.
2. Obtain necessary medical attention. (Inform physician as to possible radioactive contamination.)
3. Have someone call the Radiation Safety Office **immediately** for further instructions **(x4-6510)^a**.

CONTAMINATED PERSONNEL – NO INJURY

1. Remove outer clothing that is contaminated.
2. **If liquid on skin** – Blot with absorbent cloth or paper. **DO NOT RUB OR SPREAD.**
3. **If dry material** – Hold breath, blot with moist absorbent cloth or paper.
4. Leave the room.
5. Call or have someone call the Radiation Safety Officer or Deputy, **(x4-6510)^a**.

SPILL: NOT INVOLVING CONTAMINATION OF PERSONNEL

IF LIQUID:

1. Cover spill with absorbent cloth or paper.
2. Vacate room, close door, prevent others from entering.
3. Call the Radiation Safety Officer or Deputy, **(x4-6510)^a**.

IF POWDER:

1. Hold breath, cover spill with damp absorbent cloth or paper.
2. Turn off room ventilation, if possible.
3. Vacate room, close door, prevent others from entering.
4. Call the Radiation Safety Officer or Deputy, **(x4-6510)^a**.

NOTE:

In order not to spread contamination, remain in the area until released by the Radiation Safety Officer or Deputy. Do not attempt further decontamination unless directed by the Radiation Safety Officer.

- (a) After hours call Radiation Safety at **x4-6510**, or if unable to get through, Public Safety at **x4-4000**, who will contact Radiation Safety personnel.

12.2 Radiation Emergency Response Team *

	HOME	WORK
Gerald M. Connock	706-0438	464-6510
Peter I. Fear	668-8758	464-6510
David Salerius	516-8278	464-6510
Dr. Andrezj Krol	637-0182	464-7054
Dr. Lizhong Liu	849-2963	464-6510

Also, the 24-hour "pager" number for the Radiation Safety Officer on-call, for assistance in an emergency involving radiation and/or radioactive materials, can be obtained by calling 464-6510. If an emergency occurs during working hours, call the work number.

13.0 Rules And Regulations Governing Use Of Radioactive Materials And
Radiation Sources On Humans At The SUNY Upstate Medical University.

The administration of radioactive materials or radiation to humans can only be done by or under the direct supervision of individuals who hold a valid NY State license to practice medicine, have written approval of the Radiation Safety Committee and, if the use is of an experimental nature, written approval of the Institutional Board For the Protection of Human Subjects (IRB).

The following policies have been established by the Radiation Safety Committee for the safe use of radioactive materials with patients.

13.1 Procedures for the Handling and Care of Patients Receiving Radioactive
Materials

13.1.1 General

The following is a list of various radioactive material procedures which patients may undergo. They can be high activity procedures or low activity procedures. They can involve sealed sources or unsealed sources. They can be temporary implants or permanent implants. They can be live loading procedures or after loading procedures. High activities usually involve activities of 8 millicuries or more and are often done for therapeutic reasons. Lower activities, usually less than 8 millicuries, are used for diagnostic purposes. Sealed sources make use of sources sealed in metal seeds or tubes and are inserted by personnel from the Radiation Oncology Division. Unsealed sources usually make use of radioactive material in liquid form. The radioactivity may

be administered orally or by injection. These administrations are usually, but not always, done by Nuclear Medicine personnel. Temporary implants use sealed sources wherein the radioactivity is placed inside the patient and removed at a later date. Permanent implants may use either sealed or unsealed sources. In the latter case, the radioactive material is placed in the patient and left in permanently. After-loading techniques make use of an applicator which does not contain radioactivity initially. The applicator is placed in the patient, then after proper positioning, the radioactive sources are then placed in the applicator. This procedure results in lower exposures to workers since the placement of the applicator does not involve radioactive materials. Live-loading techniques are techniques which involve the placement of radioactive materials directly in the patient. These techniques should be carried out in a minimum amount of time in order to minimize the radiation dose to personnel.

13.1.2 Nuclear Medicine Diagnostic Doses:

Patients receiving less than 5 millicuries of I-131 or receiving diagnostic doses of other radionuclides do not typically present radiation hazards. Precautions for these patients are minimal, use standard (formerly universal) precautions when caring for these patients and while handling any bodily fluids.

Patients who have received diagnostic studies in the Division of Nuclear Medicine contain small amounts of radiopharmaceuticals for varying times after treatment. Any body fluid will also be slightly radioactive. Since the potential hazard from viral or bacterial contamination is greater than that of any radiopharmaceuticals in body fluids, the policy for handling items contaminated with body fluids from these patients will be the same as that

presently established for the hospital, e.g., disposable items will be appropriately bagged and incinerated. Linens and similar items will be redbagged and handled in the usual manner.

As long as all persons handling these items use ordinary precautions, i.e., gloves, wash hands well after handling, etc., no hazard will be presented by the very small amounts of radioactive material which may be present.

Note: This policy applies only to diagnostic tests -- not for radiopharmaceuticals given for therapeutic purposes.

In-patient charts will be labeled with the radiopharmaceutical and dose which has been administered. The purpose of these labels is to alert direct care providers that patients are potentially radioactive. The Radiation Safety Office should be contacted prior to lengthy operative or interventional radiology procedures that require close contact with the patient for extended time periods.

1. The Nuclear Medicine technologist who administers the radiopharmaceutical will fill out the Nuclear Medicine precautions label with patient name, patient number, radiopharmaceutical administered dose, date and time of administration, and expiration date of precautions.
2. The label will be placed on the outside binder of the patient chart prior to the patient's return to the nursing floor.
3. Radiation Safety Office, Ext. 46510, will be available for any and all questions pertaining to radioactive materials precautions. Radiation Safety will provide monitoring of staff if necessary.
4. The nursing floor should remove the sticker after the expiration date and time.

Isotope	Max. activity (mCi)	Half life	Label expiration
Ga-67	9	78 hours	8 days
Tc-99m	40	6 hours	1 day
In-111	5	2.8 days	8 days
I-131	30	8 days	8 days
I-131	200	8 days	8 days
Tl-201	4	73 hours	8 days

13.1.3 Procedure for the Handling of Inpatients Receiving Less Than 30 Millicuries of Radioiodine

The following procedure will be followed for patients receiving therapeutic amounts of Iodine-131 at doses less than 30 millicuries:

1. Standard (formerly Universal) precautions will be observed by all persons entering patient's room (follow SUNY-Upstate's Standard Precautions Policy).
2. A "Caution Radioactive Materials" sign will be placed at the entrance to patient's room and on the exterior of the patient's chart. The patient will wear a bracelet indicating "Radioactive Materials."
3. Other restrictions may be applied by the Radiation Safety Officer (RSO) on a case-by-case basis as deemed necessary. The RSO will also determine when precautions and restrictions can be removed.

13.1.4 Radioactive Iodine 131 Therapy Doses :

Doses of 30 millicuries or greater of I-131, require that the patient be hospitalized. These procedures are usually done for thyroid cancer. The patient ingests anywhere from 100-250 millicuries of I-131. The patient is hospitalized until the activity is below 30 millicuries as determined by

measurements conducted by Radiation Physics. During this time, the patient's saliva, urine, sweat and other bodily fluids are contaminated with I-131 and must be handled appropriately. Patients who receive I-131 for hyperthyroidism may or may not be hospitalized if the activity is below 30 millicuries. Patients receiving in excess of 8 millicuries or less than 30 millicuries and who are hospitalized, must have certain precautions taken.

13.1.5 Procedures for the Use of Brachytherapy Sealed Sources, Cesium-137, Iridium-192, Gold-198

1. All patients treated with brachytherapy sources will be placed in a PRIVATE ROOM that has its own toilet. Any private room is acceptable but the list of desirable rooms are posted with these instructions.
2. Radiation signs shall be posted at the doorway of the room. A safe line shall be indicated on the floor with tape to mark where visitors shall stand.
3. Radiation Safety shall survey the room and the surrounding areas. Exposure rates at 1 meter, at the bedside, at the visitors' safe line, shall be determined. Allowable times for nursing staff and visitors shall be posted.
4. If the implant is performed in a room other than the patient's room, that room shall be surveyed immediately afterwards.
5. Radiation levels in unrestricted areas will be maintained less than the limits specified in Section 16.7, New York State Sanitary Code 10

NYCRR16. These shall be less than 2 mR in any 1 hour.

6. Immediately, after the sources are placed in the patient, the form outlining Nursing Instructions for Patients Treated with Brachytherapy Sources shall be completed and attached to the patient's chart.
7. Persons providing care for brachytherapy patients will obtain and wear pocket dosimeters and complete the dosimetry log form prior to entering and after leaving the patient's room.
8. At the conclusion of treatment, a survey will be performed to ensure all sources have been removed and no sources remain in the patient's room. All radiation signs shall be removed and a note shall be placed in the patient's chart indicating patient meets conditions necessary for release from the hospital.

13.1.6 After-loading Techniques:

(a) GYN brachytherapy patients are usually treated with after-loading techniques. Inserted in the vaginal cavity is a Fletcher applicator or a vaginal cylinder. This application is usually done in the operating room under anesthesia. After the patient has recovered and dosimetric planning has been done, radioactive sources are placed in these applicators, usually in the patient's room. Vaginal cylinders are sometimes loaded with radioactive sources in the Division of Radiation Oncology. The patient is then transported to her room for the remainder of treatment. These sources are usually Cesium 137 tubes. These treatments usually last from 1-3 days. At the end of the treatment, the radioactive sources are taken out of the patient and returned

to storage. The applicator is also removed from the patient at this time. These procedures do not present a contamination problem since the radioactive sources are sealed sources. Therefore, the patient is not made radioactive and all those who come in contact with these patients are not made radioactive.

13.1.7 Iridium 192 Implants:

In these patients, nylon tubes are placed in the patient, usually in the operating room under anesthesia in a surgical procedure. Typically, these tubes are placed in the oral cavity or in breast lesions. After the patient recovers from anesthesia, the patient is sent to the Division of Radiation Oncology. At this time, the nylon tubes are loaded with Iridium seeds. These seeds are spaced in a nylon thread and are placed inside the nylon tubes and affixed in place. At this time, treatment planning radiographs are taken. The patient is then returned to his or her room for the duration of the treatment. The patient, of course, is now emitting radiation. The patient himself or herself is not radioactive because the Iridium sources are sealed sources. There is essentially no danger of radioactive contamination. The most serious consequence is if an Iridium source gets dislodged from the implant and gets misplaced or discarded. Typically, these treatments last from anywhere from 1-7 days. When treatment is completed, the radiation oncologist will remove the radioactive sources and the nylon tubes holding them. These sources will then be secured in a lead container and returned for disposal. The patient at this time is no longer radioactive and may be discharged if medically indicated.

13.1.8 Live-Loading Techniques:

(a) Gold 198 implantation, usually in the oral cavity, makes use of radioactive Gold which has a half life of about 2.8 days. These seeds are implanted using a special applicator, typically in the OR, under anesthesia. This is called a live-loading technique because the radioactive sources themselves are placed in the patient during the operative procedure. At this time, there is radioactivity present and precautions must be taken. After the surgical procedure, the patient is sent to the Recovery Room where recovery can take place. Since the patient emits radiation, special procedures must be followed. Typically, the patient will be placed in a far corner of the Recovery Room and nursing personnel will be monitored and instructed with respect to times allowed. After recovery, the patient will be sent to his or her room where precautions will be enforced. Occasionally, radioactive seeds will get dislodged and the patient will spit them out. Therefore, all bedding, gowns and clothing will be saved and surveyed before being released for cleaning or disposal. If a radioactive seed is found, it should be retrieved with a forceps (DO NOT TOUCH IT DIRECTLY WITH YOUR HANDS!) and saved in a safe place in the patient's room. The radiation oncologist on call or a radiation physicist shall be called immediately to recover the seed. After a period of anywhere from a short period of time to a few days, the patient will be sent home. Since there is a small possibility that one or more Gold 198 seeds may become dislodged from the patient, the room must be monitored after the patient has left and before anything is removed from the room.

13.1.9 I-125 Brain Implants:

This is a live-loading procedure in which radioactive Iodine 125 seeds are placed in a brain tumor during surgery. After surgery is completed, the

patient is sent to the Recovery Room and then to his or her room on the floor. Since I-125 emits very low energy radiation, often these patients are considered to be nonradioactive and no special precautions need be taken. This is a determination made by the Radiation Safety Officer or designee at the time of radioactive implantation. In this case, the major precautions are to ensure that I-125 seeds are not left in the Operating Room. After the patient leaves the Operating Room, the Radiation Safety personnel will monitor the area to ensure that there are no radioactive seeds. Suction apparatus, surgical dressings, drapes, etc. will all be checked for seeds. If any radioactive seeds are present, they will be retrieved.

The above procedures make up most of the radioactive procedures carried out at this hospital. Special procedures such as infusion of P32 or other materials in Omayo Reservoirs, or other bodily cavities are occasionally done. These are extremely rare and the procedures for these will be reviewed specifically at that time. In general, they are similar to one of the above procedures.

Written instructions concerning how to handle unusual procedures will be provided by the radiation oncologist and the Radiation Safety Office. Any questions concerning these procedures may be directed at the attending physician, the resident physician on call from Radiology, Nuclear Medicine or Radiation Oncology, or the Radiation Safety Office.

13.1.10 Procedures For I-125 and Pd-103 Seed Implants

ADDENDUM

Summary of Radiation Safety

Procedures For Iodine-125 (I-125) or Palladium-103 (Pd-103) Seed Implants

1. The whole body occupational dose limit is 5 rem per year. (1 rem = 1000 millirem). Background radiation is approximately 200 mR/year in Denver; 100 mR/year in Syracuse. The average 30,000 ft. jet flight exposes one to 0.2 mrem per hour.
2. The typical patient has about 30 millicuries of I-125 or its equivalent Pd-103 and has an exposure rate of approximately 0.1 to 0.5 mR/hr. at one meter. This is extremely low because of the low energy and activities used.
3. Nurses may work at bedside (2 feet) for 40 hrs./week for 50 week and still not exceed the occupational whole body dose limit.
4. The whole body dose limit for the general public is 0.1 rem (100 millirem) per year and for pregnant nurses is 0.5 rem (500 millirem) for the entire 9 month gestation period. They may work at the bedside for 1 hour per day for 50 weeks and still not exceed the limit. However, it is

Upstate's policy that pregnant nurses NOT be responsible for customary and routine care of radioactive patients. However, occasional care and emergency care is acceptable as long as it is less than 250 hours exposure for the entire pregnancy. (There is a large safety margin built in this requirement since the I-125 or Pd-103 radiation does not penetrate well and most of it will not reach the fetus.)

5. There is no need for personal monitors since the dose rate levels are small.
6. There is no need for private rooms at these levels. A pregnant patient should not be in the next bed. Other patients will typically receive less than 50 mR per week (most likely about 10 mR/week) NCRP Report 37 states that nonradioactive patients should receive no more than 100 mrem during any one hospital admission.
7. There should be no restrictions placed on visitors. However, in the interest of uniformity, one can adhere to the limit of one hour per day for radioactive patients. No pregnant visitors or children should be visitors under normal circumstances.
8. If the Iodine-125 or Palladium-103 seeds become dislodged, they may appear in wound dressings and be observed at the time dressings are changed, in wound irrigation fluids exiting the wound or in a male patient's urine. The seeds appear as small rods about 1/4 inch long and the diameter of a fat pin. If the seeds are observed outside the wound, pick them up with forceps and place in a container. Place the container in a safe place away from people, e.g., in a corner of the room. Call

the Radiation Safety Office for instructions as soon as possible. By following the above procedure, the radiation exposure to persons handling the seeds will be small.

13.2 General Points About Nursing Care Hazards of Radioactive Isotopes

Hazards may arise from three sources.

1. Skin contamination with radioactive materials.
2. Inhalation or ingestion of radioactive materials.
3. External irradiation of the body by the radiations emitted by radioactive materials.

No unusual precautions are needed for patients who have received diagnostic doses of radioactive materials. The usual procedures in handling blood, urine, vomitus, excrement is sufficient to protect from contamination or ingestion. External irradiation from these diagnostic doses are absolutely minimal.

13.2.1 General Principles Of Protection

1. Skin contamination is prevented in part by practicing good housekeeping, use of gloves, hand washing and clean work habits.
 - a. Radioactive materials should not be allowed to come in contact with the skin.
 - b. Eating and smoking where radioactivity is present is forbidden.

- c. Become knowledgeable concerning which items are likely to be contaminated and which items are not.
- 2. External irradiation of the worker's body can be reduced by:
 - a. Spending a minimum amount of time in doing necessary procedures. The allowable times are posted on the patient's door by Radiation Safety Office Personnel.

13.2.2 General Precautions

- 1. The length of time nurses, visitors and other personnel may spend at particular distances from the patient will be posted on the door. A copy of the posting sheet is found in Appendix H.
- 2. If there is a threat of contamination, the room will be so posted. Standard (formerly Universal) precautions, that is, the use of gloves, foot coverings, and careful hand washing will prevent contamination.
- 3. All contaminated materials shall be placed in the radiation designated container, the yellow can, or yellow marked container.
- 4. If visiting time is required to be limited, this will be posted on the door by Radiation Safety Office Personnel.

13.2.3 Care of Patients Receiving Radioactive Iodine-131

13.2.3.1 Minor Therapy

Patients receiving more than 8 millicuries but less than 30 mCi of Iodine-131 who are hospitalized, must be treated using the following precautions:

1. Standard (formerly Universal) precautions will be observed by all persons entering the patient's room (see Appendix L).
2. A "Caution, Radioactive Materials" sign will be placed at the entrance of the patient's room and on the exterior of the patient's chart. The patient will wear a bracelet indicating radioactive material.
3. Other restrictions may be applied by the Radiation Safety Officer (RSO) on a case by case basis.
4. The major threat from these patients is that of contamination by the urine, saliva or other body fluids. Standard (formerly Universal) precautions should ensure that this contamination will be kept to a minimum.

13.2.3.2 Major Therapy Doses Greater Than 30 Millicuries

1. The patient will be admitted to a single room with a private toilet.
2. Disposable gloves, gowns and shoe covers shall be positioned outside the patient's room and used. Clearly labeled receptacles should be positioned in the patient's room to contain contaminated food, gloves or other materials. Nurses shall use pocket dosimeters if they are going to work

for extended periods of time at the patient's side. No pregnant nurses shall be assigned to routine care of these patients. However, minimal care or emergency care can be carried out by a pregnant nurse.

3. The urine and vomitus from I-131 patients shall be disposed of through the sanitary sewer in the normal way. Male patients shall be instructed to sit while urinating. Extra special care shall be used with urine and saliva to ensure no contamination.
4. Patients containing I-131 shall be confined to their rooms except for special procedures approved by Nuclear Medicine or the Radiation Safety Office.
5. Attending personnel shall wear rubber gloves when handling the patient urinals or other possibly contaminated materials.
6. Disposable items should be treated as potentially radioactive unless otherwise determined.
7. All clothes and bed linen should be placed in the laundry bag and retained in the patient's room to be checked by the RSO.
8. If the urine is to be collected, a special container should be provided and labeled as radioactive.
9. Disposable plates, cups and eating utensils should be used by patients who have received greater than 30 millicuries of I-131.

10. Vomitus within 48 hours after oral administration shall be considered as highly radioactive. The Radiation Safety Office and Nuclear Medicine shall be called if this occurs.

11. If a nurse, an attendant, or anyone else suspects that their skin may have been contaminated, the Radiation Safety Office should be notified immediately to check it out.

12. If a patient who has received more than 5 millicuries of I-131 should die, the RSO and Nuclear Medicine should be notified immediately. The funeral director must be notified as well, by filling out the notification form which accompanies the body to the mortuary. The "Caution Radioactive Material" Toe-tag should be attached to the body. It is recommended the funeral director be contacted by the RSO in order to discuss any radiation safety precautions which may be necessary.

13. Patient discharges shall be recommended by the RSO. Generally when the patient is below 30 millicuries of I-131, the patient may be discharged. The dose rate for these patients should in general be less than 5 mRem per hour at 1 meter. Upon discharge, Nuclear Medicine and the Radiation Safety Office will supervise the clean up of the room. After it is determined that the room is safe from a radiation point of view, general housekeeping procedures shall be instituted.

13.2.3.3 Nursing Instructions For Patients Treated With Brachytherapy Sources

1. Special restrictions may be noted on the precaution sheet on the patient's chart. Nurses should read these instructions before administering to the patient. The Radiation Safety Office should be contacted, x46510, or the Radiation Oncology resident on call, x45276 to answer any questions concerning these patients.
2. Nurses should only spend the minimum time necessary near a patient for routine nursing care. Pocket dosimeters shall be utilized.
3. When the nurses are assigned to a therapy patient, the film badge or the pocket dosimeter should be used. Film badges shall only be worn by the nurse to whom it is issued. It shall not be exchanged among nurses.
4. Pregnant nurses shall not be assigned to the personal care of radioactive patients. Occasional care or care during an emergency is allowable however. (The total effective dose equivalent for pregnant nurses is 500 mRem for the entire 9 month gestation period.) The radioactive patient does not present a significant hazard to the pregnant nurse unless there is an extended period of time and a rather large dose. Any questions shall be referred to the Radiation Safety Office.
5. Do not touch needles, tubes or containers holding brachytherapy sources. If a needle or tube becomes dislodged, use forceps and put it in the corner of the room or in the shielded container provided. Contact Radiation Oncology and the Radiation Safety Officer as soon as possible. Bed baths may be omitted while the sources are in place. Perineal care is not given during gynecological treatment. Perineal pads may be changed when necessary unless orders to the contrary have been written.

6. Surgical dressings and bandages used to cover the area of insertion may be changed only by the attending physician, the Radiation Oncology physician or the Radiation Oncology resident. These dressings shall not be discarded until it is clear there is no source in them.
7. Special orders will be written for oral hygiene for patients with oral implants.
8. No special instructions are required for sputum, urine, vomitus, stools, dishes, instruments or utensils unless specially ordered. These items should be checked to ensure that no source has been inadvertently displaced into them.
9. All bed linens must be checked with the radiation survey meter before being removed from the patient's room to ensure that no dislodged sources are inadvertently removed.
10. These patients must stay in bed unless orders to the contrary are written and shall remain in their assigned rooms during the normal course of their treatment.
11. Visitors will be limited to those 18 years or older or as otherwise instructed on the precaution sheet. Visitors should stay at least 1 meter from the patient and remain no longer than the time specified on the visitor form. Pregnant nurses or attendants shall not be allowed in the room of a patient undergoing brachytherapy sources under normal circumstances. Female visitors shall be asked whether they are pregnant.
12. Emergency procedures:

1. If an implanted source becomes loose or,
 2. If the patient expires or,
 3. If the patient requires emergency surgery, immediately call the Radiation Oncology physician, 464-5276 (**on weekends and at night, a recording will give instructions as to where to call).
13. At the conclusion of treatment, the patient's room shall be surveyed. The radiation sources shall be removed and inventoried. A note shall be made in the patient's chart. If there are permanent sources in the patient, the Radiation Safety Officer or the Radiation Oncology physician or resident shall brief the patient on necessary precautions for minimizing radiation to others after discharge from the hospital.

See Appendix H for the various forms related to this section.

13.3 Typical Allowable Times For Nursing Care

	Thyroid CA I-131 (200 mCi)	GYN-Implant Cs-137 (100 mgRaEq)	Breast or Mouth Ir-192 (25 mCi)	Gold Grain Au-198 (50 mCi)	Brain I-125 (40 mCi)
Bedside	10 min.	6 min.	30 min.	30 min.	No limit
1 m	30 min.	20 min.	1.5 hr.	1.5 hr.	No limit
2 m	2 hrs.	1.5 hrs.	6 hrs.	6 hrs.	No limit

(20 mR/day at 5 days/yr is ALARA limit, 250 days/yr gives MPD)

13.4 Pocket Dosimeters

1. All nurses caring for patients undergoing radiopharmaceutical or brachytherapy treatment procedures shall use a pocket dosimeter.
2. Dosimeters are worn on the trunk of the body, preferably at the collar

level.

3. Individuals must enter the appropriate information in the dosimetry log prior to entering and after leaving the patient's room.
4. Instructions on use of the pocket dosimeter are posted. They can also be obtained from the charge nurse.

13.5 General Regulations Regarding Visitors

1. No visitors under 18 years old.
2. No pregnant visitors.
3. Visitors should wear pocket dosimeters obtained from the charge nurse.
4. Visitors shall remain at 2 meters away from the patient for most of the visit.
5. Visitation times are posted on the sheet at the door.
6. In the case of unsealed sources (I-131), visitors shall not have physical contact with the patient.

13.6 Quality Assurance Program for Brachytherapy Procedures Utilizing Temporary Implants

I. Training and Experience for Preparation of Sources

Sources will be prepared according to a physician's written prescription. Sources shall be prepared by any one of the following:

- a) Qualified radiation oncologists
- b) Qualified medical radiation physicists
- c) Qualified medical dosimetrists

The above personnel must be on the SUNY-Upstate and Crouse Irving Memorial Hospital's authorized user lists for brachytherapy sources. They shall include radiation oncologists who are authorized for brachytherapy procedures according to a New York State Department of Health Radioactive Materials License or a medical radiation physicist certified by the American College of Radiology in either radiation oncology physics or radiological physics or by the American Board of Medical Physics certified in radiation oncology physics. The medical dosimetrist shall have at least one year of full time experience in radiation oncology dosimetry and shall have been trained by and work under the direction of the certified medical radiation physicists described above. The above personnel may be assisted by resident physicians in radiation

oncology working under the direct supervision of either the radiation oncologists, the radiation medical physicists or the radiation dosimetrist.

II. Procedures for Dosimetry Calculation and Check

Dosimetry calculations shall be performed by either the medical radiation physicists or the medical radiation dosimetrist. This initial calculation usually utilizes a radiation therapy treatment planning computer. The calculations shall be checked by another person who did not do the original calculation utilizing a hand calculation within one working day of the initial calculation. The person performing the check shall be either a medical radiation physicist or a qualified dosimetrist and it shall be totally independent of the initial calculation.

III. Evaluation of Patients During Treatment

A radiation oncology physician or resident physician shall evaluate the patient daily including a visual inspection to ensure that radioactive sources are in the proper position. Attending nurses shall have been instructed concerning the proper positioning of these sources and shall have been instructed to notify the physician in the case of source dislocations.

IV. Source Removal

Radioactive sources shall be removed from the patient only by a qualified radiation oncology physician or by a resident physician working under the direction of the radiation oncology physician. The physician may be assisted by a medical radiation physicist or a radiation dosimetrist. Upon removal of the sources, the radiation oncology physician, physicists, or dosimetrists, shall ensure that all sources are accounted for. They shall be placed in the shielded container and returned to the storage location by either the physician, the physicists, the dosimetrist or the Radiation Safety Officer of the hospital. It shall be properly logged in when returned to the storage location. After removal of the radiation sources from the patient's room, the room shall be surveyed to ensure that no sources are left behind. Again, it should be emphasized that the person removing the sources shall ensure that all sources are accounted for, either by counting the sources, counting the ribbons or any other technique which virtually assures that all sources are accounted for.

V. Written Orders.

The authorized radiation oncology physician shall prepare a written order for the radioactive sources prior to the commencement of therapy.

VI. MODEL PROCEDURES

MODEL RADIATION SAFETY PROCEDURES FOR THERAPEUTIC USE OF SEALED SOURCES IN IMPLANTS

MODEL PROCEDURE

1. All patients treated with brachytherapy sources will be placed in a private room (unless the dose rate at one meter from the implant meets the requirements of 16.7 (a)) that has a toilet. The room will be as far away from the nursing station and heavy traffic hallways as is consistent with good medical care.

2. a) The patient's room will be properly posted with a "radioactive Materials" sign.
b) The patient will be briefed on radiation safety procedures as appropriate.
3. Mark a visitors' " safe line" on the floor with tape as far from the patient as possible.
4. a) Surveys of the patient's room and surrounding areas will be conducted as soon as practicable after sources are implanted. Exposure rate measurements will be taken at 3 feet (or 1 m) from the patient, at the patient's bedside, and at the visitors' "safety line." The Radiation Safety Officer or his designee will then determine how long a person may remain at these positions and will post these times and the exposure rate at 3 feet (or 1 m) from the patient on the patient's chart.
b) The measured exposure rate at 2 meter will be compared to the expected calculated value and deviations will be evaluated as possible indications of error in the source activity implanted.
c) If the implant is performed other than in the patient's room, the area used for the procedure will be surveyed immediately afterward. In the case of seeds, any area where the seed were handled (i.e. sterilization area, source storage room) will be surveyed immediately after use.
5. Radiation levels in unrestricted areas (surrounding hallways and rooms) will be maintained less than the limits specified in Section 16.7, New York State Sanitary Code (10 NYCRR 16).
6. Immediately after sources are implanted, the form "Nursing Instructions for Patients Treated with Brachytherapy Sources" will be completed and attached to the patient's chart.
7. Nurses caring for brachytherapy patients will use pocket dosimeters when providing care.
8. At the conclusion of treatment, a survey will be performed to ensure that all sources other than permanent implants have been removed from the patient and that no sources remain in the patient's room or in any other area occupied by the patient. At the same time, all radiation signs will be removed and all pocket dosimeters assigned to nurses will be collected. If the patient is to be discharged, the final survey will also include a notation on the patient's chart that the activity remaining in the patient meets conditions for release from the hospital.
9. Instructions to Nurses
a) Special restrictions may be noted on the precaution sheet on the patient's chart. Nurses should read these instructions before administering to the patient. The Radiation Safety Officer should be contacted to answer any questions about the care of these patients in regard to radiation safety precautions.
b) Nurses should spend only the minimum time necessary near a patient for routine nursing care. Obtain and wear a film or TLD badge or

a pocket chamber as instructed by the Radiation Safety Officer.

- c) When a nurse is assigned to a therapy patient, a pocket dosimeter should be obtained.
- d) Pregnant nurses should not be assigned to the personal care of these patients.
- e) Never touch needles, capsules, or containers holding brachytherapy sources. If a needle becomes dislodged, use long forceps and put it in the corner of the room or in the shielded container provided; contact Radiation Therapy, the Radiation Safety Officer, or the Nuclear Medicine Department at once.
- f) Bed bath given by the nurse should be omitted while the sources are in place.
- g) Perineal care is not given during gynecologic treatment; the perineal pad may be changed when necessary unless orders to the contrary have been written.
- h) Surgical dressings and bandages used to cover the area of needle insertion may be changed only by the attending physician or radiologist and MAY NOT BE DISCARDED until directed by the radiologist. Dressings should be kept in a basin until checked by the Radiation Safety Officer or his designee.

Special orders will be written for oral hygiene for patients with oral implants.

- i) No special precautions are needed for sputum, urine, vomitus, stools, dishes, instruments, or utensils unless specifically ordered, but these items should be saved for a check with a radiation survey meter to ensure that no sources have been inadvertently displaced into them.
- j) All bed linens must be checked with a radiation survey meter before being removed from the patient's room to ensure that no dislodged sources are inadvertently removed.
- k) These patients must stay in bed unless orders to the contrary are written. In any event, patients will remain in their assigned rooms during the treatment period.
- l) Visitors will be limited to those 18 years of age or over unless other instructions are noted on the precaution sheet on the patient's chart.
- m) Visitors should sit at least 9 feet (or 3 m) from the patient and should remain no longer than the time specified on the form posted on the patient's door and on his chart.
- n) No nurse, visitor, or attendant who is pregnant should be permitted in the room of a patient while brachytherapy sources are implanted in the patient. Female visitors should be asked whether or not they are pregnant.

o) Emergency Procedures

1. If an implanted source becomes loose or separated from the patient, or
2. If the patient dies; or
3. If the patient requires emergency surgery, immediately call

-----TELEPHONE NO. (days) ----- (nights)-----

13.7 Transportation Of Radioactive Patients

Often radioactive patients must be transported from their rooms to Radiation Oncology, Nuclear Medicine, or other areas for necessary procedures such as dosimetry x-rays or nuclear scans.

The hazard associated with transport can be made negligibly small if proper procedures are followed. The Transport Procedure Checklist (in Appendix H) shall be filled out by the Radiation Oncologist, Nuclear Medicine physician or the Radiation Safety Office. Procedures to be followed are detailed on that checklist.

13.8 Policy For Discharge Of Patients Being Treated With Radioactive Materials

This policy applies mainly to patients who have received therapeutic amounts of radioactive materials.

1. For patients undergoing therapeutic procedures involving the use of gamma-ray emitting nuclides with half-lives greater than 125 days, the patients shall be hospitalized for the duration of the treatment. Cesium-137, cobalt-60 and radium-226 are nuclides in this category. These sources shall be removed before discharge of the patient from the hospital.
2. Patients having received therapeutic amounts of nuclides with half-lives less than 125 days can be released from the hospital within the following guidelines:
 - a. As a general rule, patients will be released from the hospital only when the amount of radionuclide they contain will not give a total effective dose equivalent to other members of the household greater than 0.1 rem in one year. For examples of these levels, refer to Columns 3 & 4 of Table III.
 - b. Often it is necessary or highly desirable to release a patient in spite of that patient carrying an amount of radioactive material which could result in a dose to others exceeding 0.1 rem. In these cases, the restrictions in Table III shall be followed as well as pertinent sections of NCRP Report No.37 (specifically Section 4.1.2 (d) (e) and pertinent tables).

Table No. III

Activities for Which Records and Instructions Should Be Prepared and Dose Rates Below Which Patient May Be Released¹

Radionuclide	Column 1 ² Activity Below Which Patients May Be Released		Column 2 ³ Dose Rate at 1 meter at Which Patients May Be Released mrem/hr	Column 3 ² Activity Above Which Instructions to Patients and Records Should Be Prepared MCi GBq		Column 4 ³ Dose Rate at 1 meter Above Which Instructions and Records Should Be Prepared mrem/hr
	mCi	GBq		MCi	GBq	
Ag-111	390	14	8	77	2.9	2
Au-198	93	3.4	21	19	0.69	4
Cu-64	230	8.4	28	45	1.7	5
I-125	8.7	0.32	1	1.7	0.06	0.2
I-131	33	1.2	7	6.5	0.24	1
Pd-103	40	1.5	3	7.9	0.29	0.7
Re-186	780	29	16	160	5.8	3
Re-188	790	29	21	160	5.9	4
Sc-47	300	11	17	60	2.2	3
Sm-153	660	25	30	130	4.9	6
Tc-99m	960	36	58	190	7.1	11
Yb-169	7.6	0.28	2	1.5	0.06	0.4

¹This table does not include radionuclides not regulated by NRC such as In-111, Tl-201, or Ga-67

²Values have been rounded to two significant figures.

³Most values have been rounded to the nearest whole number.

EXCERPT FROM NCRP REPORT No. 37:

4.1.1 Patients Containing Radioactive Nuclides with Half-lives greater than 125 Days . It is recommended that for therapeutic procedures involving the use of gamma-ray emitting nuclides with half-lives greater than 125 days, the patients *shall* be hospitalized for the duration of the treatment. Radium, cobalt-60, and cesium-137 are nuclides in this category; these sources *shall* be removed before discharge of the patient.

4.1.2 Patients Containing Radioactive Nuclides with Half-lives Less than 125 Days .

(a) It is recommended that in the case of iodine-125, iodine-131, chromium-51, and radon, patients may be released without restrictions when their radioactive content does not exceed the amount listed in Table III, column 3. The physician, with the concurrence of the Radiation Protection Supervisor, *shall* be permitted to increase these values slightly for the

short-lived nuclides. However, it is suggested that rather than making any substantial increase he *should* make use of one of the restrictive procedures discussed in Section 4.1.2 (d)

(b) It is recommended that hospitalization be required for at least 48 hours following the intraperitoneal or intrapleural administration of colloidal gold-198. Accidental loss of colloidal gold occurs usually via the insertion site and a period of at least 48 hours permits observation of the progress of healing of the puncture wound. After this period release can be in accordance with Section 4.1.2 (a)

(c) Patients treated with the long-lived tantalum-182 or iridium-192 need special consideration (see 4.1.2 (e) below)

(d) Following hospitalization, as recommended in (a) and (b) above, discharge of all patients who have received therapeutic amounts of any radioactive nuclide *shall* be governed by the following provisions.

(1) A patient *shall not* be discharged from the hospital if the maximum integrated exposure, at a distance of one meter from the patient, for continuous exposure, exceeds .5 R in one year.

The initial exposure rates at one meter, or the activities which will result in an integrated exposure (for continuous exposure) of approximately 5 R in one year, can be obtained from columns 1 and 2 of Table III.

(2) If the initial exposure rate at one meter, or the activity remaining in the patient, indicates by the above application of values in columns 1 and 2, Table III, that the integrated exposure will not exceed 5 R in one year, provision for release from the hospital *shall* be made for one of two different situations, as follows:

(i) In the event that all persons in the household of the radioactive patient, and hence all those persons with whom the patient will have appreciable contact, are *over the age of 45 years*:

-The patient *should* be instructed to remain at distances greater than 3 feet (one meter) from other people, except for brief periods for necessary procedures.

-Babies and young people (*of ages less than 45 years*) *should not* visit the patient, but if they do, the visits *should* be brief, and a distance of at least 9 feet (three meters) from the patient *should* be maintained.

(ii) In the event that a person *under the age of 45 years* lives in the household of the patient:

-Stricter precautions *shall* be observed than when all contacts are with persons over 45 years of age.

-Children and persons under 45 years of age *shall not* be allowed in the same room, nor at a distance of less than 9 feet (three meters), for more than a few minutes a day. Observance of these conditions will insure that persons under 45 years of age will not be exposed to more than 0.5 R per year from the radioactive individual.

-Other restrictions may be specified by the physician.

All restrictions may be removed when the activity reaches that listed in columns 3 and 4 of Table III. The Radiation Protection Supervisor *shall* determine this time, and give the necessary instructions. The instructions *should* be printed or typewritten. These conditions for release are summarized in Table III.

13.9 Handling of Patients Who Die Containing Radioactive Materials

If a patient containing more than 5 mCi of radioactivity should expire, the Radiation Safety Office must be notified. A radioactivity report shall be filled out on every cadaver containing more than 5 mCi of radioactivity as prescribed by New York State law (Part 16.9(d)). The form on the next page of this manual shall be completed by the Radiation Safety Officer and accompany the body to the funeral director.

NOTE: The Radiation Safety Officer or designee has the only final authority on release of patients from the hospital who contain radioactive materials.

RADIOACTIVITY REPORT ACCOMPANYING DECEASED
SUNY Upstate Medical University
750 E. Adams Street
Syracuse, NY 13210

A completed copy of this form must accompany each body leaving the Upstate Medical University if RADIOACTIVE MATERIALS (RAM) were administered to the patient during this hospitalization period. RADIOACTIVE MATERIALS are defined as either radiopharmaceuticals given by injection or taken orally or sealed sources which are permanently implanted.

REPORT ON RADIOACTIVITY TO FUNERAL DIRECTOR FROM THE RADIATION PROTECTION SUPERVISOR OR DELEGATE:

[] This body does not contain significant amounts of radioactive materials. No special precautions are required if standard embalming procedures are employed.

[] This body contains a significant amount of radioactive material.

Name of the deceased:

Name, Address, & telephone # of next of kin:

Name, Address & telephone # of funeral home:

Location of RAM:

Type of material & activity:

Surface exposure rate closest to source:

The following precautions are to be observed:

Signed: _____
Radiation Safety Officer or Designee
(315) 464-6510

Date: _____

13.10 Protocol For The Safe Handling Of Radioactive Gases In The Hospital

Several radionuclides (Xenon-133, Technetium-99m and Iodine-131), used for patient diagnosis and/or treatment, are employed in the gaseous, vapor or aerosol forms. Consequently, these materials may become sources of internal and external contamination. In order to minimize the potential hazard from this source, the following protocol will be followed:

1. **Xenon-133**: A gas used for patient diagnosis. Xenon-133 will be administered to the patient using a closed system. Any material unused by the patient will be trapped in the apparatus used for administration. The trapping system will be tested for leakage biannually by an appropriate method. If the trap is found not to be operating properly, the trap or trapping material will be replaced according to the manufacturer's specifications. Results of the air sampling will be expressed in microcurie per milliliter. From this data and the number of patients handled by each technologist, the percentage received of the Annual Limit on Intake (ALI) will be determined. Appropriate action will be taken on the advice of the Radiation Safety Officer, if, at any time, the projected intake might exceed 25% of the ALI.

2. **Technegas (Technetium-99m-carbon aerosol)**: This radionuclide is attached to extremely small carbon particles (~1 uM). Administration of this material will be carried out with special apparatus designed for this procedure and which uses a closed breathing system with disposable trap. Biannual trap tests and operator breathing zone monitoring will be done using appropriate methods as designated by the Radiation Safety Officer. Air concentrations will be determined as well as estimating projected ALI's. Appropriate action will be taken by the Radiation Safety Officer, if, at any time, projected intake might exceed 25% of the ALI. Appropriate action may include service and/or repair of the Technegas unit or replacement of the

delivery portion of the unit.

3, **Iodine-131**: Radioactive iodine, as sodium iodide in solution, is administered orally to patients for diagnosis and treatment of thyroid disease. I_2 , as a vapor, can be evolved from the solution. Administration of radioactive iodine will be done using a closed system. Biannual air sampling during administration will be used to assess technician exposure. Air concentrations will be measured and projected intake will be determined. If the projected intake exceeds 25% of the ALI, appropriate action, as recommended by the Radiation Safety Officer, will be taken to minimize further exposure. As a standard practice, each person routinely handling radioiodine in the Division of Nuclear Medicine, will undergo thyroid bioassay during the week following contact. When therapy doses (100 to 200 millicuries) of radioiodine are administered to inpatients, thyroid bioassay of nursing personnel and all persons assisting inpatient administration of the radionuclide will be conducted by the Radiation Safety Officer after each administration. Biannual estimates and projections on intake will be done. If the projected intake exceeds 25% of the ALI, appropriate action will be taken by the Radiation Safety Officer.

ALARA. All use of radioactive gases, aerosols and vapors will be carried out in such a manner so as to keep exposure as low as is reasonably achievable.

14.0 PERIODIC TESTING OF PROTECTIVE DEVICES

14.1 Personal Lead Protection:

Purpose: Aprons, gonad shields, and gloves are screened periodically to determine if there are any defects in the lead (cracks, tears, etc) that may

affect the ability to shield radiation.

Procedure:

NOTE: Each department or unit that posses lead aprons, gloves, gonad shields, or other protective devices is responsible for inspecting these devices.

Department personnel or unit designated staff will perform these inspections.

Each item is inventoried, and then visually and manually inspected for any defects such as holes, cracks, or tears. If the integrity of the lead is uncertain it may be discarded or x-rayed under fluoro for verification of integrity.

Lead shields found to be defective or no longer needed are discarded through the Environmental Health and Safety Office to ensure proper disposal of lead and/or heavy metals.

Criteria for accepting or rejecting personal lead shielding -

1. Aprons should be rejected and replaced if the sum of the areas of defects exceeds 670 mm² (equivalent to a 29 mm diameter circular hole) over non-critical areas of the body.

2. Aprons should be rejected and replaced if the sum of the areas of defects exceeds 15 mm² (equivalent to a 4.3 mm diameter circular hole) if the defect is over the testes.

3. Thyroid shields should be rejected and replaced if the sum of the areas of defects exceeds 11 mm² (equivalent to a 3.8 mm diameter circular hole).

Each item shall be assigned a unique identifying number and a log shall be maintained to account for all items and inspections.

A copy of the Final Report is retained by the Department where the lead resides and a copy is also sent to the Radiation Safety Office indicating the results of the inspection and the point of contact.

APPENDIX A

RESPONSIBILITIES AND DUTIES OF THE RADIATION SAFETY COMMITTEE

The Committee is responsible for:

1. Ensuring that all individuals who work with and/or in the vicinity of radioactive material have sufficient training and experience to enable them to perform their duties safely and in accordance with Department regulations and the conditions of the license.
2. Ensuring that all use of radiation sources is conducted in a safe manner and in accordance with current regulations (N.Y. State Public Health Code and N.Y. State Department of Health) and the conditions of the license.

Duties

The Committee shall:

1. Be familiar with all pertinent New York State Health Department regulations, the terms of the license, and information submitted in support of the request for the license and its amendments.
2. Review the training and experience of all individuals who use radioactive material (including professional practitioners, technologists, physicists and pharmacists) and determine that their qualifications are sufficient to enable them to perform their duties safely and in accordance with New York State Health Department regulations and the conditions of the license.
3. Ensure that only professional practitioner and radiation therapy physicists who are named on the institution's license, or persons under their tutelage, perform licensed activities.

4. Be responsible for monitoring the institution's program to maintain individual and collective doses as low as reasonably achievable.
5. Review at least quarterly the Radiation Safety Officer's summary report of occupational radiation exposure records of all personnel working with radioactive materials; paying special attention to workers or groups of workers whose exposures appear excessive or are otherwise remarkable due to late or lost badges or absence of expected exposures.
6. Oversee Radiation Safety Officer's program to ensure that all individuals whose duties may require them to work in the vicinity of radioactive material (i.e. nursing, security and housekeeping personnel) are properly instructed as required by Section 16.13 of 10 NYCRR 16.
7. Review and approve all requests for use of radioactive material within the institution.
8. Prescribe special conditions that will be required during a proposed use of radioactive material such as requirements for bioassays, physical examinations of users, and special monitoring procedures.
- 9.A. Review the entire radiation safety program at least annually to determine that all activities are being conducted safely and in accordance with New York State Health Department regulations and the conditions of the license. The review could include an examination of records, reports from the Radiation Safety Officer, results of New York State Health Department inspection, written safety procedures, and the adequacy of the institution's management control system.
- 9.B. Review the diagnostic and therapeutic radioactive materials Quality Assurance programs at least annually, to determine that the programs are being conducted in accordance with New York State Health Department regulations and

conditions of the license.

10. Recommend remedial action to correct any deficiencies identified in the radiation safety program or quality assurance programs.

11. Maintain written records of all Committee meetings, including members present and numerical results of all votes taken.

12. Ensure that the radioactive materials license is amended, when necessary, prior to any changes in facilities, equipment, policies, procedures, radioactive material, possession limits, and personnel, as specified in the license.

13. Identify problems and develop solutions through the Radiation Safety Officer.

CURRENT MEMBERS OF THE RADIATION SAFETY COMMITTEE

(January, 2001)

Joseph Spadaro, Ph.D., Chairman
Department of Orthopedics

Daniel A. Bassano, Ph.D.
Department of Radiation Oncology

Gerald M. Connock, M.S.
Department of Radiology - Radiation Safety

Theresa Gagnon
Hospital Administration

Peter J. Hahn, Ph.D.
Department of Radiation Oncology

Mary Teelin, R.N.
Nursing Administration

Robert H. Sagerman, M.D.
Department of Radiation Oncology

Andrij Wojtowycz, M.D.
Department of Radiology

David Feiglin, M.D.
Department of Radiology

Kishor Phadke, M.D.
Department of Medicine - Cardiology

Peter Fear, B.S.
Department of Radiology - Radiation Safety

Marsha Roskopf
Department of Radiology - Radiation Physics

Donna Fritz
Recording Secretary

SUBCOMMITTEES OF THE RADIATION SAFETY COMMITTEE

HUMAN USE SUBCOMMITTEE

Daniel A. Bassano, Ph.D.

NON-HUMAN USE SUBCOMMITTEE

Peter J. Hahn, Ph.D.

Peter Fear, B.S.

APPENDIX B: QUALIFICATIONS FOR RADIATION SAFETY OFFICER
(From NYSDOH Radiation Guide 10.1, Rev. 2, April 1991)

The Radiation Safety Officer shall be appointed in writing by the President of the SUNY Upstate Medical University and shall meet training and experience requirements as outlined below:

16.2 (1) (42) Radiation safety officer shall mean an individual who, under the authorization of the operator of a radiation installation, administers a radiation protection program in accordance with section 16.5 of this Part and who is qualified by training and experience in radiological health to evaluate the radiation hazards of such installation and administer such radiation protection program.

(i) For human use radiation equipment installations, the radiation safety officer (RSO) shall be:

(a) a professional practitioner as defined in section 16.2(1)(34) of this Part, practicing within his/her professional practice as defined in section 16.2(1)(33) of this Part; or,

(b) a physicist certified by the American Board of Health Physics or the American Board of Radiology in a branch of physics related to the type of use of radiation sources in the installation, or, an individual with equivalent training and experience.

(ii) For non-human use radiation equipment installations, the radiation safety officer shall be:

(a) a veterinarian for veterinary installations; or,

(b) a physicist certified by the American Board of Health Physics, The American Board of Radiology, or, an individual with equivalent training and experience; or,

(c) a researcher determined by the institution and experience for installations using only x-ray diffraction and fluorescence analysis equipment.

(iii) For licensed radioactive materials installations, the radiation safety officer shall be:

(a) an authorized user named on the radioactive materials license issued by this department; or,

(b) a physicist certified by the American Board of Health Physics or the American Board of Radiology in a Branch of physics related to the type of use of radioactive material in the installation, or, an individual with equivalent training and experience.

16.5 Responsibility for radiation safety. No person shall operate or permit the operation of a radiation installation nor shall he operate, transfer, receive, possess or use or permit the operation, transfer, receipt, possession or use of any radiation source unless:

(a) He makes every effort to maintain radiation exposures and releases of radioactive material as far below the limits set forth in this Part as is reasonably achievable;* and,

(b) He provides a radiation installation safety officer and radiation protection program as described in paragraph (42) of subdivision (a) of section 16.2 of this Part; and,

(c) All radiation equipment and other radiation sources under his control are operated or handled only by individuals adequately instructed, as described in subdivision (c) of section 16.13 of this Part, and competent to safely use such radiation equipment or other radiation sources.

APPENDIX C: RADIOACTIVE MATERIALS LICENSE

Contact RSO for information on this.

APPENDIX D: RADIOACTIVE MATERIALS APPLICATION AND HUMAN USE SUPPLEMENT

Contact the Radiation Safety Office for these forms.

APPENDIX E: Suggestions for Making Periodic Radiation Safety Surveys

WIPE TESTING. Wipe tests are to be performed on a regular basis of any laboratory or storage area where unsealed sources of radioactive material are handled. Testing shall occur at a frequency of at least once per month, more often, if the nature of usage indicates. The Radiation Safety Officer (RSO) shall review the usage of radioactive materials in each laboratory and determine the frequency and manner of testing. Evaluation of the usage of radioactive materials will occur during each biannual inspection conducted by the RSO or designee.

PROCEDURE:

1. Each authorized user shall provide the Radiation Safety Officer a diagram of all laboratory and storage facilities under his or her supervision, indicating all areas where radioactive materials are handled or stored. The RSO shall then indicate on the areas where wipe tests will be performed..
2. The materials for performing the wipe tests will be provided by the Radiation Safety Office in sufficient quantity for several months of testing. It shall be the responsibility of the authorized user to inform the Radiation Safety Office when a new supply of testing materials are needed.
3. The wipe test will be performed using a single filter paper, moistened with 70% alcohol, Radiacwash or other appropriate solvent, by wiping approximately 100 cm² of the indicated area. Each completed wipe will be placed individually into the envelopes provided and returned to the Radiation Safety Office (Room 636, West Basement, University Hospital) for analysis.
4. The Radiation Safety Office will analyze the wipes and return a completed report to the authorized user within two weeks. Results will be given in units of the number of radioactive disintegrations per 100 cm² of area wiped.
5. When no usage of radioactive materials has occurred in the laboratory since the last wipe test was submitted to the Radiation Safety Office, it is not necessary to perform a wipe test, however, a monthly report must be submitted to the Radiation Safety Office. Use the wipe test form and indicate on the form that no use of radioactive materials has occurred since submission of the last report.

APPENDIX F: NY State Sanitary Code, Part 16.

This can be found by going to the link on the webpage at
<http://www.upstate.edu/radiationsafety>

APPENDIX G: NRC GUIDE 8.13, 1987

This Guide may be found at <http://www.nrc.gov/NRC/RG/08/08-013.pdf> and
<http://www.nrc.gov/NRC/RG/08/08-013.html>

APPENDIX H

NURSING INSTRUCTIONS FOR PATIENTS TREATED
WITH BRACHYTHERAPY SOURCES

Patient's Name _____
Patient's Room Number _____ Physician's Name _____
Isotope & Activity _____
Date & Time of administration _____
Date & Time Sources are to be Removed _____

Exposure Rates in mR/hr

Bedside	1 meter from Bed	2 meters from Bed
_____	_____	_____
_____	_____	_____
_____	_____	_____

Comply with all Checked Items

- _____ Wear film or TLD badge
- _____ Wear pocket chambers for supplementary personnel monitoring of individual tasks
- _____ Wear rubber gloves
- _____ Tag the following objects and fill out the tag:
_____ door _____ chart _____ bed _____ wrist
- _____ Place the laundry in linen bag and save
- _____ Housekeeping may not enter the room
- _____ Visiting time permitted: _____
- _____ Visitors must remain _____ from the patient.
- _____ Patient may not leave the room
- _____ Patient may not have visitors
- _____ Patient may not have pregnant visitors
- _____ Patient may not have visitors under 18 years of age
- _____ Patient must have a private room
- _____ A dismissal survey must be performed before the patient is discharged
- _____ All items must remain in the room until approved for disposal by the Radiation Safety Officer or his designee
- _____ Contact the Radiation Safety office when temporary sources (nonpermanent implants) are removed, to perform a survey to be sure all sources are removed from the patient, to do a physical source count, and to be sure no sources remain in the room
- _____ Contact the Radiation Safety Office when the patient is discharged, to survey the room prior to its assignment to another patient.
- _____ Other instructions _____

Radiation Safety Officer _____

On Duty Phone No.: _____ Off Duty Phone No.: _____

NURSING INSTRUCTIONS FOR PATIENTS
TREATED WITH RADIOACTIVE MATERIALS

Patient Name: _____ Patient Number: _____
 Attending: _____ Phone: _____ Pager: _____

Dose: _____ mCi of _____ as _____ was administered at _____ : _____
 Signature: _____ Date: _____ - _____ - _____.

RADIATION EXPOSURE RATES

Unrestricted areas: door _____ - _____ mR/hr; rm _____ - _____ mR/hr; rm _____ - _____ mR/hr
 Patient supine in bed or

Date	Time	Bedside	3 ft from bed	Door	_____
____ - ____ - ____	_____ am	_____ mR/hr	_____ mR/hr	_____ mR/hr	_____ mR/hr
____ - ____ - ____	_____ pm	_____ mR/hr	_____ mR/hr	_____ mR/hr	_____ mR/hr
____ - ____ - ____	_____ am	_____ mR/hr	_____ mR/hr	_____ mR/hr	_____ mR/hr
____ - ____ - ____	_____ pm	_____ mR/hr	_____ mR/hr	_____ mR/hr	_____ mR/hr
____ - ____ - ____	_____ am	_____ mR/hr	_____ mR/hr	_____ mR/hr	_____ mR/hr
____ - ____ - ____	_____ pm	_____ mR/hr	_____ mR/hr	_____ mR/hr	_____ mR/hr

INSTRUCTIONS

VISITOR RESTRICTIONS.

- _____ No visitors.
- _____ No visitors under 18 or pregnant.
- _____ _____ minutes each day maximum for each visitor.
- _____ Visitors must stay behind line on floor at all times.

NURSING RESTRICTIONS.

- _____ Patient is restricted to room.
- _____ No nurses who are pregnant may render care.
- _____ _____ minutes each day per nurse in the room.

PATIENT CARE.

- _____ Wear disposable gloves. Wash hands after caring for patient.
- _____ Discard linen/bedclothes, plates/utensils, dressings, etc., in boxes in room.
- _____ Collect urine in containers provided. Discard feces in toilet.
- _____ Discard urine and feces in toilet. Flush three times.
- _____ Housekeeping personnel are not permitted in the room.
- _____ Only Radiation Safety Officer may release room to admitting office.
- _____ Wear your radiation monitor when caring for patient. Leave at nursing station at the end of your shift. You may use the same monitor on your next shift. Do not share. Call Radiation Safety Officer for additional monitors as needed.

IN CASE OF EMERGENCY, OR IF YOU HAVE A QUESTION, CALL:

RSO: _____ WORK: _____ HOME: _____ PAGER: _____
 MD: _____ WORK: _____ HOME: _____ PAGER: _____

**EXPOSURE RATES AND ALLOWABLE CONTACT TIMES FOR PATIENTS TREATED WITH
RADIOACTIVE MATERIALS**

Patient Name _____ Room Number _____

Radionuclide _____ Activity Administered _____

Maximum Permissible Times
for non-pregnant nurses, physicians, attendants (limit 20 mR/day)

Area						
Bedside (2 ft)						
1 meter						
Doorway						

* * * * *

Exposure Rates (mR/hr)

Area						
2 ft from pt.						
1 meter from pt.						
2 meter from pt.						
Doorway						

* * * * *

Visitor Times (limit 2 mR/day)

Area						
At 2 meters						
At Doorway						

PREGNANT OR POSSIBLY PREGNANT WOMEN VISITORS OR PERSONS UNDER 18 YEARS OLD
ARE PROHIBITED AS VISITORS.

VISITOR BARRIER TAPE PLACED? _____
YES NO

COMMENTS: _____

Radiation Safety Officer or Deputy

Room Survey Form

**This form to be returned to
Radiation Safety Office**

ROOM SURVEY: Each room and contents must be carefully surveyed, using appropriate instrumentation, after the patient has left. The criteria in the following table shall be used for room release.

**Part 16, TABLE 7
SURFACE CONTAMINATION LIMITS
FOR RELEASE OF MATERIAL OR
FACILITIES TO NORMAL USE.**

(Beta/Gamma)¹

Total (mR/hr)	Removable (dpm/100cm ²)
0.2	1,000

¹ Measured at 1 cm from surface.

Radiation Survey at the Time of Administration (Maximum Exposure Rates in Adjacent Rooms and Hallways)	
Room Number	mR/Hr
1	
2	
3	
4	
5	
6	
Hallway	

Survey Instrument Used (Type and S/N) _____ Calibration Date _____ :

Background Reading _____ cpm or mR/hr

Final Survey Readings

	Beta / Gamma	
	Fixed (mR/Hr)	Removable (dpm/100 cm ²)
1 Maximum - Room	_____	_____
2 Maximum - Clothing	_____	_____
3 Maximum - Other Area(s)	_____	_____
_____	_____	_____
_____	_____	_____

THIS SECTION TO BE COMPLETED BY RADIATION ONCOLOGIST AFTER IMPLANT REMOVED

Date Implant Removed _____ Time _____ a.m. p.m.

Survey reading after implant removed _____ (maximum reading)

All sources removed from patient YES NO

Any permanent sources remaining in patient YES NO

If yes, patient given written precautions for minimizing exposure to others after discharge
 YES NO

Radiation Oncologist's Signature _____, M.D.

**THIS SECTION TO BE COMPLETED BY RSO OR DESIGNEE AFTER IMPLANT REMOVED ONLY IF
SURVEY NOT DONE BY ONCOLOGIST**

Survey reading after implant removed _____ (maximum reading)

Comments: _____

Room Released:

(Radiation Safety Officer or Deputy)

Date

TRANSPORTATION OF RADIOACTIVE PATIENTS

Transport Personnel Allowed to Transport Patient:

- Anyone
- Nurses
- Radiation Oncology Staff
- Transport Services
- Volunteers
- Physician/Resident

Elevator Restrictions:

- No restrictions
- Clear elevator of all personnel

APPENDIX I. Examples of radionuclide inventory, use and disposal forms.

APPENDIX J. List of E.P.A. Hazardous Materials

Contact Environmental Health and Safety for a list of hazardous materials.

APPENDIX K. Form: Transfer of Control for Radioactive Materials



State University of New York
Upstate Medical University

College of Medicine
Radiation Safety Office

RECORD OF RADIOACTIVE MATERIAL TRANSFER

PLEASE FILL OUT THIS FORM AND SENT TO THE RADIATION SAFETY OFFICE
WHEN TRANSFERRING RADIOACTIVE MATERIALS.

NOTE: RADIOACTIVE MATERIALS CANNOT BE GIVEN OR SOLD TO ANYONE
WHO DOES NOT POSSESS A RADIOACTIVE MATERIALS LICENSE

DATE OF TRANSFER:

NUCLIDE, AMOUNT, CHEMICAL FORM:

NAME AND LICENSE NUMBER OF AUTHORIZED USER TRANSFERRING THE
RADIONUCLIDE:

NAME

LICENSE #

NAME AND LICENSE NUMBER OF AUTHORIZED USER TRANSFERRING THE
RADIONUCLIDE:

NAME

LICENSE #

PURCHASE ORDER NUMBER:

P.O. #

REASON FOR TRANSFER:

SUNY-UPSTATE, RSO, 11/00

APPENDIX L. SUNY-Upstate Standard (Universal) Precautions

The Standard Precautions for University Hospital may be found at <http://www.universityhospital.org/intra/uhpolicies/uh/S-15.pdf>.

GLOSSARY

Alpha Particle: A charged particle emitted from the nucleus of an atom having a mass and charge equal in magnitude of a helium nucleus, i.e., two protons and two neutrons.

Atom: Smallest particle of an element which is capable of entering into a chemical reaction.

Atomic Mass: The mass of a neutral atom of a nuclide, usually expressed in terms of "atomic mass units." The "atomic mass unit" is one-twelfth the mass of one neutral atom of carbon-12; equivalent to 1.6604×10^{-24} gm (Symbol: u).

Atomic Number: The number of protons in the nucleus of a neutral atom of a nuclide. The effective atomic number is calculated from the composition and atomic numbers of a compound or mixture. An element of this atomic number would interact with photons in the same way as the compound or mixture. (Symbol: Z)

Atomic Weight: The weighted mean of the masses of the neutral atoms of an element expressed in atomic mass units.

Attenuation: The process by which a beam of radiation is reduced in intensity when passing through some material. It is the combination of absorption and scattering processes and leads to a decrease in flux density of a beam projected through matter.

Average Life (Mean Life): The average of the individual lives of all the atoms of a particular radioactive substance. It is 1.443 times the radioactive half-life.

Barriers, Protective: Barriers of radiation-absorbing material, such as lead, concrete, and plaster, used to reduce radiation exposure.

Barriers, Primary Protective: Barriers sufficient to attenuate the useful beam to the required degree.

Barriers, Secondary Protective: Barriers sufficient to attenuate stray radiation to the required degree.

Beam: An unidirectional or approximately unidirectional flow of electromagnetic radiation or of particles.

Beta Particle: Charged particle emitted from the nucleus of an atom, with a mass and charge equal in magnitude to that of the electron.

Bremsstrahlung: Secondary photon radiation produced by deceleration of a measuring instrument to ascertain necessary correction factors.

Calibration: Determination of variation from standard, or accuracy, of a measuring instrument to ascertain necessary correction factors.

Capture, Electron: A mode of radioactive decay involving the capture of an orbital electron by its nucleus. Capture from a particular electron shell is designated as "K-electron capture," "L-electron capture," etc.

Carrier: A quantity of non-radioactive or non-labeled material of the same chemical composition as its corresponding radioactive or labeled counterpart. When mixed with the corresponding radioactive labeled material, so as to form a chemically inseparable mixture, the carrier permits chemical (And some physical) manipulation of the mixture with less label or radioactivity loss than would be true for the

undiluted label or radioactivity.

Carrier Free: An adjective applied to one or more radioactive isotopes of an element in minute quantity, essentially undiluted with stable isotope carrier.

Contamination, Radioactive: Deposition of radioactive material in any place where it is not desired, particularly where its presence may be harmful. The harm may be altering the experiment or procedure, or in actually being a source of danger to personnel.

Count: (Radiation Measurements) The external indication of a device designed to enumerate ionizing events. It may refer to a single detected event or to the total number registered in a given period of time. The term often is erroneously used to designate a disintegration, ionizing event, or voltage pulse.

Spurious Count: In a radiation counting device, a count caused by any agency other than radiation.

Counter, Geiger-Mueller: Highly sensitive, gas-filled radiation-measuring device. It operates at voltages sufficiently high to produce avalanche ionization.

Counter, Scintillation: The combination of phosphor, photomultiplier tube, and associate circuits which register coincidences caused by the type of events under consideration.

Counter Liquid Scintillation (LSC): A scintillation counter in which a sample of radioactive material is placed in a solution containing a phosphor. The intimate contact of the radioactive material and the phosphor is especially useful in the detection of low energy radiation.

CPM: Counts per minute.

Curie: The special unit of activity. One curie equals 3.700×10^{10} nuclear transformations per second. (Abbreviated Ci.) Several fractions of the curie are in common usage.

Daughter: Synonym for decay product.

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

Decay Constant: The fraction of the number of atoms of a radioactive nuclide which decay in unit time (Symbol: See Disintegration Constant).

Decontamination: Removal of unwanted radioactive material from an object or personnel.

Decontamination Factor: The ratio of the amount of undesired radioactive material initially present to the amount remaining after a suitable processing step has been completed. Decontamination factors may refer to the reduction of some particular type of radiation or to the gross measurable radioactivity.

Detector, Radiation: Any device for converting radiant energy to a form more suitable for observation; an instrument used to determine the presence, and sometimes the amount, of radiation.

Disintegration Constant: The fraction of the number of atoms of a radioactive nuclide which decay in unit time: in the equation $N=N_0e^{-t}$ where N_0 is the initial number of atoms present, and N is the number of atoms present after some time, t .

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

Absorbed Dose: 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.).

Dose Commitment: The total accumulative dose of radiation received by an individual as a result of ingesting radioactive material.

Dose Equivalent: 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. It is defined as the product of the absorbed dose in rads and certain modifying factors. The unit of dose equivalent is the rem.

Maximum Permissible Dose Equivalent: The greatest dose equivalent that a person or specified part thereof shall be allowed to receive in a given period of time.

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

Permissible Dose: The dose of radiation which may be received by an individual within a specified period with expectation of no significantly harmful result.

Dose Rate: Absorbed dose delivered per unit time.

Dosimeter: Instrument to detect and measure accumulated radiation exposure. In common usage, a pencil-size ionization chamber with a self-reading electrometer used for personnel monitoring.

DPM: Disintegrations per minute.

Dry Run: A trial exercise in which a procedure involving radiation or radioactive material is simulated without actually using radiation or radioactive material. A dry run allows the experimenter to examine the procedure for changes which would minimize radiation exposure and contamination.

Electron: A stable elementary particle having an electric charge equal to $1.60210 \times 10^{-19} \text{C}$ and a rest mass equal to $9.1091 \times 10^{-31} \text{ kg}$.

Electron Volt: A unit of energy equivalent to the energy gained by an electron in passing through a potential difference of one volt. Larger multiple units of the electron volt are frequently used: keV for thousand or kilo electron volts; MeV for million or mega electron volts. (Abbreviated: eV, $1 \text{ eV} = 1.6 \times 10^{-12} \text{ erg}$.)

Element: A category of atoms all of the same atomic number.

Energy Dependence: The characteristic response of a radiation detector to a given range of radiation energies or wave lengths compared with the response of a standard free-air chamber.

ESU: Electrostatic Unit.

Excitation: The addition of energy to a system, thereby transferring it from its ground state to an excited state. Excitation of a nucleus, an atom, or a molecule can result from absorption of photons or from inelastic collisions with other particles.

Exposure: A measure of the ionization produced in air by X or gamma radiation. It is the sum of the electrical charges on all ions of one sign produced in air when all electrons liberated by photons in a volume element of air are completely stopped in air, divided by the mass of the air in the volume element. The special unit of exposure is the roentgen.

Film Badge: A pack of photographic film which measures radiation exposure for personnel monitoring. The badge may contain two or three films of differing sensitivity and filters to shield parts of the film from certain types of radiation. Non-film badges are also often called film badges.

Fluid, Liquid Scintillation: A solution of a fluorescent substance dissolved in toluene or other suitable solvent. Radioactive material is added directly to the solution or cocktail for detection in a liquid scintillation counter.

Flammable Solvent: An organic liquid whose vapor can form an ignitable mixture with air.

Gamma Ray: Short wavelength electromagnetic radiation of nuclear origin (range of energy from 10 keV to 9 MeV) emitted from the nucleus of the atom.

Geiger Region: In an ionization radiation detector, the operating voltage interval in which the charge collected per ionizing event is essentially independent of the number of primary ions produced in the initial ionizing event.

Genetic Effect of Radiation: Inheritable change, chiefly mutations, produced by the absorption of ionizing radiations. On the basis of present knowledge these effects are purely additive; there is no recovery.

Geometry Factor: The fraction of the total solid angle about the source of radiation that is subtended by the face of the sensitive volume of a detector.

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.

$$\text{Effective half-life} = \frac{\text{Biological half-life} \times \text{Radioactive half-life}}{\text{Biological half-life} + \text{Radioactive half-life}}$$

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.

Half Value Layer: The thickness of a specified substance which, when introduced into the path of a given beam of radiation, reduced the exposure rate by one-half.

Health, Radiological: The art and science of protecting human beings from injury by radiation, and promoting better health through beneficial applications of radiation.

Health Physics: (Physicist) - See Physics, Health

ICRP: International Commission of Radiological Protection. Under the auspices of the International Congress of Radiology, the commission prepares recommendations to deal with the basic principles of radiation protection.

Interlock: A device, usually electrical and/or mechanical, which prevents operation of a control until a preliminary condition has been met. Its purpose is usually safety.

Inventory: A quantity of radioactive material on hand including stock and waste.

Ion: Atomic particle, atom, or chemical radical bearing an electrical charge, either negative or positive.

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

Irradiation: Exposure to radiation.

Isotopes: Nuclides having the same number of protons in their nuclei, and hence the same atomic number, but differing in the number of neutrons, and therefore in the mass number. Almost identical chemical properties exist between isotopes of a particular element. The term should not be used as a synonym for nuclide.

Kilo Electron Volt (keV): One thousand electron volts, 10^3 eV.

Kilovolt Peak (kVp): The crest value in kilovolts of the potential difference of a pulsating potential generator. When only half the wave is used, the value refers to the useful half of the cycle.

Labeled Compound: A compound consisting, in part, of labeled molecules. By observations of radioactivity or isotopic composition, this compound or its fragments may be followed through physical, chemical, or biological processes.

Labeled Molecule: A molecule containing one or more atoms distinguished by nonnatural isotopic composition (with radioactive or stable isotopes).

Laser: Light amplification by stimulated emission of radiation. The laser region is that portion of the spectrum which includes ultra-violet, visible light, and infrared.

Mass Defect: Difference between the mass of the nucleus as a whole and the sum of the component nucleon masses.

Mass Numbers: The number of nucleons (protons and neutrons) in the nucleus of an atom. (Symbol: A.)

Mega Electron Volt (MeV): One million electron volt, 10^6 eV.

Microwave: An electromagnetic wave having a wavelength of approximately 1 meter to 1 millimeter corresponding to frequencies of about 300 to 300,000 megacycles per second.

Milliroentgen (mR): A submultiple of the roentgen, equal to one one-thousandth of a roentgen. (See Roentgen.)

Monitoring: Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region.

Area Monitoring: Routine monitoring of the radiation level or contamination of a particular area, building, room, or equipment. Some laboratories or operations distinguish between routine monitoring and survey activities.

Personnel Monitoring: Monitoring any part of an individual, his breath, or

excretions, or any part of his clothing.

NCRP: National Council on Radiation Protection and Measurements. A nonprofit corporation chartered by Congress to provide the public with information and recommendations concerning radiation and radiation protection. NCRP handbooks are available on many specific issues or problems.

Nuclide: A species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of protons (Z), number of neutrons (N), and energy content; or, alternatively, by the atomic number (Z), mass number $A = (N+Z)$, and atomic mass. To be regarded as a distinct nuclide, the atom must be capable of existing for a measurable time. Thus, nuclear isomers are separate nuclides, whereas promptly decaying excited nuclear states and unstable intermediates in nuclear reactions are not so considered.

Pair Production: An absorption process for X and gamma radiation in which the incident photon is annihilated in the vicinity of the nucleus of the absorbing atom, with subsequent production of an electron and positron pair. This reaction only occurs for incident photon energies exceeding 1.02 MeV.

Parent: A radionuclide which, upon disintegration, yields a specific nuclide either directly or as a later member of a radioactive series.

Photon: A quantity of electromagnetic energy (E) whose value in joules is the product of its frequency (ν) in hertz and Planck constant (h). The equation is: $E=h\nu$.

Physics, Health: A science and profession devoted to the protection of man and his environment from unnecessary radiation exposure.

Plateau: As applied to radiation detector chambers, the level portion of the counting rate-voltage curve where changes in operating voltage introduce minimum changes in the counting rate.

Protective Clothing: Items worn by an individual to minimize the spread of contamination or shield the individual from external radiation (ex. plastic gloves, lab coat, lead apron, face shield).

Quality Factor (QF): The linear-energy transfer dependent factor by which absorbed doses are multiplied to obtain (for radiation protection purposes) a quantity that expresses on a common scale for all ionizing radiations the effectiveness of the absorbed dose.

R: (See Roentgen).

Rad: The unit of absorbed dose equal to 0.01 J/kg in any medium. (See Absorbed Dose.) (Written: rad)

Radiation: (1) The emission and propagation of energy through space or through a material medium in the form of waves; for instance, the emission and propagation of electromagnetic waves, or of sound and elastic waves. (2) The energy propagated, through space or through a material medium as waves. The term radiation or radiant energy, when unqualified, usually refers to electromagnetic radiation. Such radiation commonly is classified, according to frequency, as Hertzian, infrared, visible (light), ultraviolet, x-ray, and gamma ray. (See Photon.) (3) By extension, corpuscular emission, such as alpha and beta radiation, or rays of mixed or unknown type, as cosmic radiation.

Background Radiation: Radiation arising from radioactive material other than

the one directly under consideration. Background radiation due to cosmic rays, and natural radioactivity is always present. There may also be background radiation due to the presence of radioactive substances in other parts of the building, in the building material itself, etc.

External Radiation: Radiation from a source outside the body. The radiation must penetrate the skin.

Internal Radiation: Radiation from a source within the body (as a result of deposition of radionuclides in body tissue.)

Ionizing Radiation: Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.

Radiation Area: An area in which the level of radiation could cause a major portion of an individual's body to receive 5 mrems in 1 hour or 100 mrem in 5 consecutive days of external exposure.

Radiation Area, High: An area in which the level of radiation could cause a major portion of an individual's body to receive 100 mrems of external radiation in any hour.

Radiation Area, Airborne: An area in which radioactive material is dispersed in the air as dust, vapor, or gas.

Radiation Equipment: Any equipment or device which can emit ionizing radiation by virtue of the application thereto of high voltage (ex: x-ray machines, x-ray diffractometers, fluoroscopes, electron microscopes).

Radioactive Materials License: A license issued by New York State to an individual or an organization for the use of radioactive materials pursuant to part 16 of the New York State Sanitary Code.

Radiation Safety Committee: A committee appointed by the Upstate Medical University as the administrative body responsible for the safe use of radiation at the Upstate Medical University.

Radiation Worker: An individual authorized by the Radiation Safety Office to use radioactive materials under the direct supervision of an Authorized User.

Leakage (Direct) Radiation: All radiation coming from the source housing except the useful beam.

Monoenergetic Radiation: Radiation of a given type (alpha, beta, neutron, gamma, etc.) in which all particles or photons originate with and have the same energy.

Primary Radiation: The useful beam of an x-ray tube.

Scattered Radiation: Radiation which during its passage through a substance, has been deviated in direction. It may also have been modified by a decrease in energy.

Secondary Radiation: Radiation resulting from absorption of other radiation in matter. It may be either electromagnetic or particulate.

Radioactivity: The property of certain nuclides of spontaneously emitting particles of gamma radiation, or of emitting x radiation following orbital electron capture, or of undergoing spontaneous fission.

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.

Resolving Time, Counter: The minimum time interval between two distinct events which will permit both to be counted. It may refer to an electronic circuit, to a mechanical indicating device, or to a counter tube.

Roentgen (R): The special unit of exposure. One roentgen equals 2.58×10^{-4} coulomb per kilogram of air. (See Exposure.)

Scattering: Change of direction of subatomic particles or photons as a result of a collision or interaction.

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

Shield: A body of material used to prevent or reduce the passage of particles of radiation. A shield may be designated according to what it is intended to absorb (as a gamma-ray shield or neutron shield), or according to the kind of protection it is intended to give (as a background, biological, or thermal shield). The shield of a nuclear reactor is a body of material surrounding the reactor to prevent the escape of neutrons and radiation into a protected area, which frequently is the entire space external to the reactor. It may be required for safety of personnel or to reduce radiation enough to allow use of counting instruments for research or for locating contamination or airborne radioactivity.

Specific Gamma-Ray Constant: For a nuclide emitting gamma radiation, the product of exposure rate at a given distance from a point source of that nuclide and the square of that distance divided by the activity of the source, neglecting attenuation.

State Regulations: Requirements pertaining to radiation equipment and radioactive material as set forth in Chapter 1 - Part 16 of the New York State Sanitary code.

Standard, Radioactive: A sample of radioactive material, usually with a long half-life, in which the number and type of radioactive atoms at a definite reference time is known. It may be used as a radiation source for calibrating radiation measurement equipment.

Survey, Contamination: A procedure to determine the level of radioactive contamination on the surface of an object through the use of wipe tests or radiation survey meter. Such surveys are made on a routine basis in laboratories using unsealed radioactive material to prevent further spread of contamination.

Survey, Radiological: Evaluation of the radiation hazards incident to the production, use, or existence of radioactive materials or other sources of radiation under specific 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 sufficient knowledge of processes using or affecting these materials to predict hazards resulting from expected or possible changes in materials or equipment.

Swipe (Wipe) Test: A survey technique for locating removable contamination on surfaces. The test involves wiping the surface with a damp absorbent material and then monitoring the level of radiation on the absorbent material. Testing which is done periodically to check for contamination of areas where radioactive materials are used. Normally, the wipes are done on a monthly basis. However, situations may warrant that they be done on more frequently. Areas that are used for radioactive materials must be tested before they are used for any other purpose.

Tritium: The hydrogen isotope with one proton and two neutrons in the nucleus.

Tracer, Isotopic: The isotope or non-natural mixture of isotopes of an element which may be incorporated into a sample to permit observation of the course of that element, alone or in combination, through a chemical, biological, or physical process. The observations may be made by measurement of radioactivity or of isotopic abundance.

Van DeGraaff Accelerator: An electrostatic machine in which electrical charge is carried into the high voltage terminal by a belt made of an insulating material moving at a high speed. The particles are then accelerated along a discharge path through a vacuum tube by the potential difference between the insulated terminal and the grounded end of the accelerator.

Volt: The unit of electromotive force ($1V = 1W/1A$).

Wavelength: Distance between any two similar points of two consecutive waves (2) for electromagnetic radiation. The wavelength is equal to the velocity of light (c) divided by the frequency of the wave ($\lambda=c/v$). The "effective wavelength" is the wavelength of a monochromatic x rays which would undergo the same percentage attenuation in a specified filter as the heterogenous beam under consideration.

X-Ray: Penetrating electromagnetic radiations whose wavelengths are shorter than those of visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions, it is customary to refer to photons originating in the nucleus as gamma rays, and those originating in the extranuclear part of the atom as x rays. These rays are sometimes called roentgen rays after their discoverer, W.C. Roentgen.

Waste Radioactive Materials (or Radioactive Waste): Solid, liquid or biological waste material containing radioactive material in excess of natural levels. Contact the RSO for instructions should any waste requiring special attention be encountered.

Wipe Tests: (see swipe tests)

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