

West Virginia University

Radiation Safety Manual for Research Applications

2015



The purpose of this manual is to provide Principle Investigators (PI), Authorized Users (AU), and laboratory personnel who utilize radioactive material in laboratory research, with policies and procedures regarding the safe use and disposal of radioactive material as approved for non-human use by the University Radiation Safety Committee under the West Virginia University's Broad Scope License.

**Radiation Safety Department
Health Sciences North
P.O. Box 9006, Room G-139
Morgantown, WV 26506
Phone: (304) 293-3413
Fax: (304) 293-4539**

CONTACT INFORMATION

IN CASE OF A RADIATION EMERGENCY DURING NORMAL WORKING HOURS:

(Monday through Friday 8:15 am – 4:45 pm)

Call the Radiation Safety Officer at

(304) 293 – 3413

IN CASE OF A RADIATION EMERGENCY OUTSIDE NORMAL WORKING HOURS:

Page the on call Radiation Safety Specialist at

(304) 987 – 1586

When asked “number to be displayed,” enter your **full** 7-digit telephone number.

GENERAL CONTACT INFORMATION:

Address: Health Sciences Center–North, Room G–139

P.O. Box 9006

Morgantown, West Virginia 26506–9006

Office Phone: (304) 293 – 3413

Fax: (304) 293 – 4529

Website: <http://www.hsc.wvu.edu/rsafety/>

TABLE OF CONTENTS

1.	INTRODUCTION	6
1.1	Radioactivity and Radiation.....	6
1.2	Purpose of the Radiation Safety Manual	6
1.3	Radiation Protection – ALARA.....	7
2.	REGULATION AND BROAD SCOPE LICENSE	8
3.	RADIATION SAFETY COMMITTEES AND USER RESPONSIBILITIES	9
3.1	Radiation Safety Committee	9
3.2	Human Use of Radiation and Radionuclide Committee.....	9
3.3	Non-Human Use of Radiation and Radionuclides Committee	10
3.4	Committee on the Use of Radiation and Radionuclides in Animals	111
3.5	Radiation Research Committee.....	122
3.6	Radiation Safety Officer/Radiation Safety Department	133
3.7	Department Chairs	144
3.8	Authorized Users	155
3.9	Individual Radiation Workers.....	166
4.	OBTAINING AUTHORIZATION FOR USAGE OF RADIOACTIVE MATERIALS ...	188
4.1	Applying for Authorization.....	188
4.2	Authorization Amendments	199
4.3	Authorization Renewals.....	199
4.4	Authorization Termination.....	20
4.5	Laboratory Workers	20
5.	PROCUREMENT OF RADIOACTIVE MATERIALS	21
5.1	Authorization to Order Radioactive Materials.....	21
5.2	Approval of Radionuclide Order	21
5.3	Ordering Process	21
5.4	Radionuclide Order Receipt.....	233
5.5	Order Arrival.....	233
5.6	Disposal of Packaging Materials	233
6.	STORAGE OF RADIONUCLIDES.....	244
6.1	Liquids and Solids.....	244
6.2	Gases	244
7.	AUTHORIZED LABORATORY REQUIREMENTS.....	255
7.1	Physical Requirements.....	255
7.2	Use of Caution Signs and Labels	255
7.3	Posting Requirements	277
8.	GENERAL LABORATORY PROCEDURES.....	288
8.1	Objectives of Radiation Protection Measures.....	288

8.2	Basic Policy	288
8.3	Maintain Good Personal Hygiene.....	289
8.4	Preparation and Use of Working and Storage Areas	30
8.5	Survey of Working Area.....	31
8.6	Proper Use of Equipment.....	32
8.7	Transportation of Radionuclides On Campus.....	323
8.8	Survey Instruments	333
8.9	Air Sampling.....	344
8.10	Sealed Sources and Leak Tests	344
8.11	Unsealed Sources	355
9.	RADIATION PROTECTION MEASURES	366
9.1	Introduction.....	366
9.2	Requirement to Keep Doses ALARA.....	366
9.3	Radiation Protection Limits	366
9.4	NRC Occupational Dose Limits	366
9.5	Individual Monitoring.....	377
9.5.1	Conditions Requiring Monitoring.....	377
9.5.2	Types and Use of Monitoring Devices	388
9.6	Bioassays.....	399
9.7	Control of Access to High Radiation Areas.....	40
9.8	Control of Access to Very High Radiation Areas.....	40
10.	USE OF RADIONUCLIDES IN ANIMALS	41
10.1	Authorization	41
10.2	Animal Care Area	41
11.	SEALED SOURCE IRRADIATORS	433
11.1	Applicability	433
11.2	Users	433
11.3	Safety Precautions.....	433
11.4	Items Being Irradiated.....	444
12.	WASTE HANDLING, STORAGE, AND DISPOSAL	455
12.1	General considerations.....	455
12.2	General considerations.....	455
12.2.1	Short half-life waste.....	466
12.2.2	Disposal of Dry Solid Radioactive Waste (non-biological)	466
12.2.3	Disposal of Solid Biological Radioactive Waste	477
12.2.4	Materials	477
12.2.5	Proper Bagging	477
12.2.6	Waste Inventory Control.....	477
12.2.7	Disposal of Liquid Radioactive Waste	488
12.2.8	Liquid Waste Barrels	488
12.2.9	Disposal in the Sanitary Sewer system	499

12.2.10 Disposal of Liquid Scintillation Vials.....	499
12.2.11 Radioactive/Hazardous Mixed Waste.....	50
12.2.12 Bag Sealing Instructions	50
12.2.13 Additional Requirements for All Radioactive Waste	50
13. EMERGENCY/INCIDENT.....	52
13.1 Who to Notify	52
13.1.1 Incident	52
13.1.2 Fire, explosion or serious injury:	52
13.1.3 Spill Occurs or Contamination is found.....	52
13.1.4 For Skin and Body Contamination	53
13.1.5 Serious Injury with Radioactive Contamination.....	53
13.1.6 Possible Overexposure to Sources of Radiation	54
14. LABORATORY CLOSE OUT/TRANSFER PROCEDURE.....	55
14.1 Purpose.....	55
14.2 Scope.....	55
14.3 Objective	55
14.4 Roles and Responsibilities	55
14.5 Procedures.....	56
APPENDIX A: QUANTITIES OF LICENSED MATERIAL REQUIRING LABELING.....	58
APPENDIX B: CLASSIFICATION OF ISOTOPES ACCORDING TO RELATIVE RADIOTOXICITY PER UNIT ACTIVITY	599
APPENDIX C: COMMONLY USED SIGNS AND SYMBOLS.....	60
APPENDIX D: EMERGENCY PROCEDURES FOR RADIATION ACCIDENTS	61
APPENDIX E: RADIOACTIVE MATERIAL SPILL RESPONSE.....	62
APPENDIX F: RADIATION SAFETY FORMS AND GUIDELINES	633
RSD Form Numbers	64
APPENDIX G: LABORATORY CLOSEOUT CHECKLIST.....	635
APPENDIX F: LABORATORY CLOSEOUT/RELOCATION NOTICE.....	636

1. INTRODUCTION

1.1 RADIOACTIVITY AND RADIATION

All matter in our environment is made of atoms. Most atoms we encounter on Earth are stable. Some atoms, however, are unstable, giving off energy in the form of radiation in order to reach a stable state. These atoms are said to be radioactive. An example is the radionuclide Carbon-14, produced in the atmosphere when cosmic rays interact with stable nitrogen atoms. When a Carbon-14 atom undergoes radioactive decay, it gives off radiation in the form of a beta particle and then becomes a stable nitrogen atom once again. The existence of Carbon-14 in all living things enables archaeologists to date ancient artifacts. Radiation can be naturally-occurring or produced electrically, as in an x-ray tube. Radiation can only be detected by specially designed instruments. Radiation may pass through an object, but it may also be absorbed and cause changes at the site of absorption. Radiation is known to cause cancer and birth defects in animals and humans. The risk of radiation damage is related to the amount of radiation absorbed by an individual.

There are small amounts of naturally-occurring radioactive substances in soil, rocks, plants, animals, and in our own bodies, all of which give off radiation. Large amounts of radiation are present in outer space and a small portion of this radiation penetrates the atmosphere. This low level of naturally occurring radiation is known as background radiation.

Radiation is useful because of its ability to penetrate tissue, allowing imaging of internal structures. However, radiation may produce harmful biological effects. Observations of exposed human populations and animal experimentation indicate that exposure to low levels of radiation, over a period of years, may lead to an increase in the incidence of cancer and leukemia. Exposures to high levels of radiation produce the same effects faster and may also cause hair loss, skin burns, radiation sickness, and even death. Radiation may also increase the risk of genetic abnormalities.

1.2 PURPOSE OF THE RADIATION SAFETY MANUAL

The purpose of this manual is to provide Principle Investigators (PI), Authorized Users (AU), and laboratory personnel who utilize radioactive material in laboratory research, with policies and procedures regarding the safe use and disposal of radioactive material as approved for non-human use by the University Radiation Safety Committee under the West Virginia University's Broad Scope License.

The Administration of West Virginia University has a commitment to providing a safe environment for faculty, staff, and student use of radioactive material. It is the responsibility of all Deans, Department Chairs and researchers to implement radiation safety policies and procedures as approved by the University Radiation Safety Committee under the authority delegated by the Administration. Oversight of these policies and procedures is carried out by the Radiation Safety Department under the supervision of the Radiation Safety Officer (RSO).

1.3 RADIATION PROTECTION – ALARA

To minimize the biological effects of radiation, special rules and regulations are set forth for individuals occupationally exposed to radiation. There is, in general, minimal external radiation hazard to personnel from procedures involving radiation. Adherence to guidelines contained in this manual will help employees and students keep their exposures as low as reasonably achievable (**ALARA**), and should reduce radiation exposures to levels allowable for individuals or in some cases, to levels indistinguishable from natural background.

The radiation protection program is guided by the concept of keeping radiation exposure ALARA. The ALARA concept is based on the assumption that any radiation dose, no matter how small, can have some adverse effect. Under the ALARA program, every reasonable means of lowering exposure is used.

Radiation exposure can be minimized by utilizing three basic principles:

1. **Time:** Shorter exposure time means a lower dose.
2. **Distance:** Doubling the distance from a radiation source means one-fourth the dose rate.
3. **Shielding:** The use of appropriate shielding greatly reduces the dose rate. Standing in a protected area during x-ray exposures is one example.

Remember that radiation cannot be seen or felt, but can be detected with various radiation survey meters.

2. REGULATION AND BROAD SCOPE LICENSE

The United States Nuclear Regulatory Commission (NRC) has issued a specific Broad Scope License to West Virginia University and West Virginia University Hospitals that permits the procurement, storage and use of radioactive materials. These materials are limited to Byproduct Materials (radioactive materials that were made in a reactor) and naturally occurring radioactive materials. In addition all X-ray units, ionizing radiation producing devices, and radionuclides are subject to the regulations of the West Virginia Department of Health (WVDOH).

Source materials (uranium and thorium), special nuclear materials (enriched U-235 or U-233), plutonium in certain quantities, and large sources (e.g. irradiators) are not licensed at the present time.

3. RADIATION SAFETY COMMITTEES AND USER RESPONSIBILITIES

3.1 RADIATION SAFETY COMMITTEE

The Radiation Safety Committee is composed of the Provost of the university or his/her representative, the Vice President for Health Sciences or his/her representative, the Dean of the College of Medicine or his/her representative, the President of West Virginia University Hospitals or his/her representative, others who may be nominated by any of the above, the RSO and the chairperson of each of the Radiation Safety Committees reporting to the Radiation Safety Committee.

The committee meets at least quarterly to:

- A. Adopt rules and policies on the use of ionizing radiation within the university and the hospital.
- B. Review plans for all new buildings and modifications of existing structures where ionizing radiation is to be used.
- C. Review reports by the RSO and the chairs of the Radiation Safety Committees.
- D. Approve or modify proposals for amendments to the various licenses or applications for new licenses.
- E. Perform an annual review of the content and implementation of the Radiation Safety Program including ALARA considerations. This includes a review of the operation of the Radiation Safety Department on, at least, an annual basis to ensure that all license obligations and regulations of the U.S. Nuclear Regulatory Commission and the West Virginia Department of Health are met and that sources of ionizing radiation are being used in a safe manner.
- F. Approve changes in the Radiation Safety Manual and recommend changes when these become necessary.

3.2 HUMAN USE OF RADIATION AND RADIONUCLIDE COMMITTEE

The committee is composed of the chair of the Radiology Department or his/her representative, the Director of Nursing Service or his/her representative, physicians who are experts in radiation therapy, nuclear medicine, internal medicine, hematology or cardiology, a person experienced in the assay of radionuclides, and the RSO, as well as such additional members as shall be nominated by the chair of the Radiation Safety Committee and the RSO in consultation with the committee. This committee functions as the Radiation Safety Committee of the hospital so far as the diagnostic or therapeutic use of radiation on humans is concerned.

The committee meets at least quarterly to:

- A. Adopt rules and policies pertaining to the use of ionizing radiation in or on humans at West Virginia University Hospitals or the Robert C. Byrd Health Sciences Center.
- B. Review and either approve or return for amendment all proposals for the use of radiation or radionuclides in or on humans.
- C. Evaluate the qualifications of all persons proposing to use radiation or radionuclides in or on humans to ensure that they are adequate for the proposed use.
- D. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used in or on humans and to send its recommendations to the Radiation Safety Committee.
- E. Review proposed shielding and operations of all radiation producing machines and equipment used for the exposure of humans.
- F. Review all instances of alleged infractions of rules and unsafe practices in the human use of ionizing radiation, and take the steps necessary ensure safe practice. This may entail recommendations to the Radiation Safety Committee or to appropriate supervisory personnel in the department in which an offense occurs.
- G. Review reports from the Radiation Safety Department on the use of ionizing radiation in or on humans including any changes or impending changes in regulations.
- H. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the human use of ionizing radiation.

3.3 NON-HUMAN USE OF RADIATION AND RADIONUCLIDES COMMITTEE

The committee is composed of faculty members experienced in the laboratory use of radionuclides, the chairs of the Committee on the Use of Radiation and Radionuclides in Animals and the Radiation Research Committee or their representative, the RSO, and others who may be nominated by the chair of the Radiation Safety Committee and the RSO in consultation with the committee.

The committee meets at least quarterly to:

- A. Adopt rules and policies on the in vitro use of sources of ionizing radiation at West Virginia University Hospitals, West Virginia University, the Robert C. Byrd Health Sciences Center and at the Charleston Division.
- B. Review and either approve or return for amendment all proposals for the in vitro use of ionizing radiation.

- C. Evaluate the qualifications of all persons proposing the in vitro use of radiation to ensure that they are adequate for the proposed use.
- D. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used in vitro and send its recommendations to the Radiation Safety Committee.
- E. Review all instances of alleged infractions of rules and unsafe practices in the use of ionizing radiation in vitro and take the steps necessary to ensure safe practice. This may entail recommendations to the Radiation Safety Committee or to appropriate supervisory personnel in the department in which an offense occurs.
- F. Review reports from the Radiation Safety Department on the use of ionizing radiation in vitro including any changes or impending changes in regulations.
- G. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the in vitro use of ionizing radiation.
- H. Activate the subcommittees on Animal Use or Radiation Research necessary to review activities within their jurisdiction.

3.4 COMMITTEE ON THE USE OF RADIATION AND RADIONUCLIDES IN ANIMALS

The committee is composed of the director of the animal quarters, a person experienced in the assay of radionuclides, the RSO, and others who may be nominated by the chair of the Radiation Safety Committee and the RSO. The committee functions as a subcommittee of the Nonhuman Use of Radiation and Radionuclides Committee.

The committee will meet when necessary to:

- A. Adopt rules and policies for the use of ionizing radiation in or on animals.
- B. Review and either approve or return for amendment all proposals for the use of ionizing radiation in or on animals.
- C. Evaluate the qualifications of all persons proposing to use radiation or radionuclides in or on animals to ensure that they are adequate for the proposed use.
- D. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used in or on animals and send its recommendations to the Radiation Safety Committee.
- E. Review all instances of alleged infractions of rules and unsafe practices in the use of ionizing radiation in or on animals and take the necessary steps to ensure safe practice. This may entail recommendations to the Radiation Safety Committee or to

appropriate supervisory personnel in the department in which an offense occurs.

- F. Review reports from the Radiation Safety Department on the use of ionizing radiation in or on animals including any changes or impending changes in regulations.
- G. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the use of ionizing radiation in or on animals.

3.5 RADIATION RESEARCH COMMITTEE

The committee is composed of scientists and engineers of the Downtown and Evansdale campuses of WVU who have experience in the use of radionuclides in research protocols, the RSO, and others who may be nominated by the chairman of the Radiation Safety Committee and the RSO. The committee functions as a subcommittee of the Nonhuman Use of Radiation and Radionuclides Committee.

The committee will meet when necessary to:

- A. Adopt rules and policies on the use of ionizing radiation on the Downtown and Evansdale campuses.
- B. Review and either approve or return for amendment all proposals for the use of radiation or radionuclides on the Downtown or Evansdale campus.
- C. Evaluate the qualifications of all persons proposing to use radionuclides on the Downtown or Evansdale campus to ensure that they are adequate for the proposed use.
- D. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used on the Downtown or Evansdale campus and send its recommendations to the Radiation Safety Committee.
- E. Review all instances of alleged infractions of rules and unsafe practices in using ionizing radiation on either the Downtown or Evansdale campus and take the necessary steps to ensure safe practice. This may entail recommendations to the Radiation Safety Committee or to supervisory personnel in the department in which an offense occurs.
- F. Review reports from the Radiation Safety Department on the use of ionizing radiation on either the Downtown or the Evansdale campus including any changes or impending changes in regulations that might affect these campuses.
- G. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the use of ionizing radiation on the Downtown and Evansdale campuses.

3.6 RADIATION SAFETY OFFICER/RADIATION SAFETY DEPARTMENT

The responsibilities of the RSO/Radiation Safety Department include the following:

- A. To furnish consulting services to any potential user of ionizing radiation and to advise the potential user on radiation safety procedures.
- B. To ensure that all license obligations and regulations of the federal and state government are met.
- C. To provide general surveillance of all health physics activities, including assisting all personnel in discharging their responsibilities.
- D. To supervise the procurement and receipt of all radioactive materials coming to the university and the hospital.
- E. To provide for individual and laboratory monitoring.
- F. To instruct university and hospital personnel in radiation safety.
- G. To administer a radioactive waste disposal program.
- H. To perform leak tests on sealed sources and provide radiation surveys after installation of radiation producing machines.
- I. To supervise decontamination in case of accidents.
- J. To provide a continuous program of environmental radiation hazard evaluation and hazard elimination.
- K. To provide advice and assistance in the acquisition of dosimeters and monitoring equipment.
- L. To provide maintenance and calibration of survey instruments in the Radiation Safety Department.
- M. To maintain all centralized records pertinent to the radiation safety program.
- N. To develop and refine radiation detection, shielding and health protection techniques.
- O. To be responsible for the overall day-to-day administration of the radiation safety program.
- P. To suspend any operation causing excessive radiation hazard as rapidly and safely as possible. **(In carrying out this duty the RSO will report directly to the Vice President**

of WVU Health Sciences and the Provost of the University).

- Q. To present periodic reports to the various committees on matters related to their functions.
- R. To keep each department chair informed of all Authorized Users in the department who are conducting projects approved by a radiation safety committee.
- S. To provide timely reports to the U.S. Nuclear Regulatory Commission and the West Virginia Department of Health as required by regulation.
- T. To maintain an inventory and accountability record of the radioactive material used at the university and the hospital to ensure compliance with license limits.

3.7 DEPARTMENT CHAIRS

The Department Chairs' responsibilities include the following:

- A. To have plans for all new buildings and modifications of existing structures, where ionizing radiation is to be used, submitted through the Radiation Safety Department for approval by the appropriate Radiation Safety Committee prior to the construction or modification.
- B. To have any area where radionuclides were previously used surveyed by the Radiation Safety Department before workmen do any rearranging of the area. Call the Radiation Safety Department at 304-293-3413 to see that any needed decontamination or disposal is carried out properly.
- C. To have new staff members who desire to use ionizing radiation secure a copy of this Radiation Safety Manual from the Radiation Safety Department. In particular, the new staff member's attention should initially be directed to "Procurement of all Radiation Sources" for information about transferring radionuclides and equipment containing radionuclides to the university or hospital from another institution.
- D. To have Authorized Users who are leaving the university or changing laboratories inform the Radiation Safety Department. They should arrange for the transfer of unused radionuclides to other Authorized Users and any radioactive waste picked up by Radiation Safety. This will keep any potentially hazardous material from being unsupervised when a faculty member terminates.

Note: The RSO will keep each Department Chair informed of all Authorized Users in the department who are conducting projects approved by any of the radiation safety committees.

3.8 AUTHORIZED USERS

The Authorized User shall be responsible for:

- A. Controlling employee and visitor exposures, keeping them ALARA and always below the dose limits.
- B. Requesting proper radiation monitoring devices for laboratory personnel.
- C. Registering new radiation users with the Radiation Safety Department.
- D. Providing suitable monitoring instruments, protective clothing, equipment (such as shielding, if required) and supplies for employees.
- E. Notifying the Radiation Safety Department of any change or proposed change in radionuclide use which might affect radiation protection procedures.
- F. Following correct procedures for procurement of radionuclides and radiation producing devices.
- G. Maintaining up-to-date marking and labeling of laboratories, radioactive materials and equipment.
- H. Properly disposing of radioactive wastes and producing accurate disposal records.
- I. Immediately reporting, to the Radiation Safety Department, any spills, suspected overexposures, theft or misuse of radioactive material, and other accidents or incidents involving radiation or radioactive materials.
- J. Safely operating any radiation producing device for which he is listed as the possessor.
- K. Testing and care of radiation sources made by university or hospital personnel.
- L. Properly administering and using sources of radiation in or on humans (if authorized for this type of use).
- M. Providing employees with copies of portions of the Radiation Safety Manual applicable to them, such as:
 - i. General Procedures for Laboratory Personnel
 - ii. General Procedures for Radiation Producing Equipment Operators
 - iii. Emergency Procedures and Decontamination Procedures
- N. Completing training, provided on the WVU SOLE website, presented by the Radiation Safety Department and requiring that students and employees complete the

- orientation and training sessions appropriate for them.
- O. Properly using radiation sources in or on animals (if applicable).
 - P. Properly using a sealed source irradiator facility (if applicable).
 - Q. Securely storing all radiation sources used under his or her direction.
 - R. Making sure that appropriate surveys and monitoring are performed, any needed corrective action is carried out and that necessary records are maintained. Contamination Survey results (LS Counting and Gamma Well Counting) must be documented in units of disintegrations per minute (DPM) for both monthly and post experiment surveys.
 - S. Properly transferring radioactive material while working at the university or hospital and prior to leaving (as applicable).
 - T. Ensuring that radiation survey instruments are calibrated periodically for the type of radiation to be measured.

Note: The Authorized User is fully responsible for adherence to these requirements and the safe use of ionizing radiation by himself or herself and those under his or her direction.

3.9 INDIVIDUAL RADIATION WORKERS

An individual shall be responsible for:

- A. Controlling his/her radiation exposure, keeping it as low as is reasonably achievable and always below the dose limits.
- B. Assisting the Authorized User in keeping the marking and labeling of laboratories, radioactive materials and equipment up-to-date.
- C. Maintaining good housekeeping, minimizing clutter, and reducing the chance of transfer of contamination.
- D. Carrying out monitoring of self, work area and lab and producing required records of the monitoring performed.
- E. Using appropriate instruments, checking for proper operation before use and reporting any problems to the Authorized User in a timely manner.
- F. Storing and securing radioactive material properly.
- G. Wearing appropriate protective clothing such as a lab coat and gloves.

- H. Wearing and storing personal radiation monitors properly.
- I. Disposing of radioactive wastes appropriately and keeping accurate disposal records.
- J. Properly testing and caring for radiation sources made by university or hospital personnel.
- K. Promptly reporting spills, suspected overexposures, theft of material and other accidents to the Radiation Safety Department.
- L. Maintaining a working knowledge of emergency and decontamination procedures.
- M. Becoming familiar with his or her specific area of concern.

4. OBTAINING AUTHORIZATION FOR USAGE OF RADIOACTIVE MATERIALS

Any purchase, use or work undertaken with radioactive materials or radiation producing devices requires written authorization, known as a permit, from the Radiation Safety Committee. Individuals who wish to become authorized to use radioactive materials or radiation producing devices must submit a written application to the Radiation Safety Department and display conformance with specified training and experience criteria. The Authorized User is responsible for controlling all radioactive material and radiation producing devices covered by the permit from the time of receipt until transfer to the radiation Safety Department as waste, shipment to another location, or transfer to another Authorized User.

4.1 APPLYING FOR AUTHORIZATION

For an individual to become an Authorized User, the person must have completed Radiation Safety training and have ample experience before the Radiation Safety Committee will authorize his or her use of radioactive materials or radiation producing devices. The Authorized User (or Prospective Authorized User) must file an application that meets the requirements of this section. Applications must be submitted by the end of the current quarter (March 31st, June 30th, September 30th, and December 31st), later or incomplete applications will not be reviewed in the upcoming quarterly meeting. The application process includes a technical review of qualifications by the Radiation Safety Department staff, which will make a recommendation to the RSO. This recommendation will be reviewed by the RSO and, if deemed appropriate, forwarded to the Radiation Safety Committee for consideration. Authorized Users must complete Radiation Safety training prior to assuming duties with or working in the vicinity of radioactive materials. In addition to the initial Radiation Safety training, Authorized Users must attend training whenever there is a significant change in duties, regulations, or the terms of the license AND must complete Radiation Safety refresher training annually in order to maintain his/her authorization status.

Authorized User application evaluations include the following:

- A. Identification and review of the types and proposed uses of all radiation sources in the application form. The review and subsequent permit approval is based on the radioactivity used at one time or the design parameters of the radiation producing device. Requests that include possession of radionuclides will consider the amount used at one time, with possession limits that are adequate to cover laboratory operations. In addition, the applicant must agree to abide by all policies and procedures for acquisition, use, storage and disposal of radioisotopes.
- B. The Prospective Authorized User must be a full time staff member demonstrating the appropriate education, training, and practical experience commensurate with the radiation sources to be used. Prospective Authorized Users who wish to be approved by a radiation safety committee must submit a statement from a sponsoring faculty member that he or she is the appropriate principal investigator and is granted full

- responsibility for the laboratory.
- C. Radiation Safety staff will review the application and may suggest changes. The application will then be considered at the next meeting of the appropriate radiation safety committee which may accept the proposal or suggest changes necessary for approval.
 - D. Applicants to the Human Use Committee for diagnostic or therapeutic use of radionuclides must show that they fulfill the pertinent training and experience requirements in 10 CFR 35 Subpart J. These include board certification, or specific classroom and laboratory training in relevant radioisotope handling techniques and appropriate clinical experience.
 - E. Applicants to the Nonhuman Use Committee or one of its subcommittees must give pertinent information about their training and experience, a protocol for the proposed project and a description of their laboratory. Current policy requires that a prospective radionuclide user demonstrate his or her knowledge of radiation protection practices by successfully completing a short examination. An investigator may arrange to take the exam at any time by calling the Radiation Safety Department.
 - F. A representative of the Radiation Safety staff may wish to interview the applicant or inspect the laboratory before radionuclide use is permitted. This will assure that the laboratory is properly set up, that acceptable monitor and survey instruments are available, and that required notices are posted.
 - G. Applications and appropriate forms may be found on the Radiation Safety website at www.hsc.wvu.edu/rsafety.

4.2 AUTHORIZATION AMENDMENTS

Investigators who wish to change their approved usage should also notify the Radiation Safety Department. Minor changes in usage, for example an increase in activity by a factor of two, may be handled simply by a memo. Major changes, such as addition of a radionuclide or change in location, may require partial resubmission of the application and review by the radiation safety committee. Once approved, however, the investigator need not retake the exam.

4.3 AUTHORIZATION RENEWALS

At present there is no specific time limit set on radionuclide authorization once the investigator has passed the exam. However the radiation safety committee may withdraw authorization from an investigator who remains inactive for an extended period. An investigator may also request being put on an inactive status if he or she does not intend to use radioactive materials for some

time. Inactive status exempts the investigator from the requirement for monthly laboratory surveys and some posting requirements. Any radioactive materials remaining in the laboratory must be properly labeled and secured. Reactivation of the laboratory usually requires just a memo to the Radiation Safety Department.

4.4 AUTHORIZATION TERMINATION

Investigators leaving WVU or deactivating their laboratory should notify the Radiation Safety Department as soon as possible. This will allow Radiation Safety staff to decommission the laboratory after work in it ceases. All remaining radioactive materials or waste will be removed from the laboratory, transferred to another investigator, or otherwise stored securely. Radionuclide use areas will be surveyed, decontaminated if necessary, and cleared of radiation notices.

4.5 LABORATORY WORKERS

The Authorized User is responsible for assuring that adequate training, as defined by the appropriate radiation safety committee, is provided to all personnel working in the laboratory. Laboratory assistants must read this Radiation Safety Manual. They are jointly responsible with the Authorized User for their training in radiation safety and radionuclide procedures and for any violation of radiation safety rules in their laboratory.

To assist in the training of radiation workers, the Radiation Safety Department provides Radiation Protection Training for WVU Research Laboratories on-line at the WVU SOLE website. Radiation Safety will no longer provide classroom training sessions (unless deemed necessary) for the completion of the training requirements for the active laboratory. This format will allow laboratory staff members and authorized users the freedom and flexibility to complete the training as required by Radiation Safety protocol and without the formality of attending a classroom session in order to receive Radiation Protection Training. This will also allow new staff entering authorized laboratories who will be working with radioactive materials/radiation producing devices to complete the training prior to beginning work with materials without waiting to attend regularly scheduled training sessions.

The Radiation Safety Department maintains several video tapes which show proper laboratory practices. These are available at any time in the Health Science Center library; a list of the tapes is available from the Radiation Safety Department. All laboratory workers are encouraged to review the training videos prior to working in the laboratory.

5. PROCUREMENT OF RADIOACTIVE MATERIALS

5.1 AUTHORIZATION TO ORDER RADIOACTIVE MATERIALS

All individuals wishing to purchase radioactive materials at West Virginia University (WVU) must first have authorization to possess such material in the type and quantity requested. The authorization for possession and use of radioactive materials is issued through the Radiation Safety Department (RSD). Orders for non-authorized items or activities that go above the authorization limit will not be permitted.

5.2 APPROVAL OF RADIONUCLIDE ORDER

All radioactive material orders must first be approved by the RSD before placement of order to ensure that the person ordering the material is authorized for what is being requested. The RSD makes the determination of approval based on the Authorized Radiation User/Principal Investigator's (ARU/PI) current on-hand inventory of radioactive materials versus the ARU/PI's possession limits.

5.3 ORDERING PROCESS

The ARU/PI or his/her designee must submit a written document (order forms can be found on the WVU Radiation Safety website) to their departmental accounting representative or EBO to request the purchase of any radionuclide or radiation producing device. Data must first be entered in Oracle to obtain a requisition number and subsequently request a Purchase Order Number from the RSD.

The following information must be included on each order form to complete procurement transaction in Oracle:

- A. Supplier name, address, and phone number
- B. ARU/PI name, address, and phone number
- C. Order type: HAZMAT
- D. Category: RADIOACTIVE MATERIAL
- E. Description must include:
 - i. Vendor Catalog Number
 - ii. Radionuclide requested (e.g. P-32, H-3, I-125, S-35, C-14, etc.)
 - iii. Compound (e.g. deoxycytidine 5' triphosphate/dATP, Thymidine, etc.)
 - iv. Radionuclide Activity in units of millicuries (mCi) or microcuries (μ Ci) (e.g. 1 mCi, 50 μ Ci, etc.)
 - v. ARU/PI Name

vi. NRC License # and Expiration Date

F. UOM: EACH

G. Quantity: 1

- i. Note: A separate Purchase Order Number must be generated for each order. The only exception to this rule is if you are ordering kits and they must come in quantities of more than one.

H. Unit Price

I. Total Price

J. Shipping Charges

K. Funding Information

L. Research Corp or State Funds

- i. WVU's NRC License Number and Expiration Date

M. Signature of ARU/PI

The department accounting designee or EBO should enter the order form data submitted to procure the radionuclide or radiation producing device into Oracle to generate a requisition number, solicit approval, and request a purchase order number. The requisition, if data is entered correctly as stated above, will automatically be forwarded to the RSD Radionuclide Buyer to audit, approve, and issue the Purchase Order Number.

The department accounting representative or EBO should then fax a copy of the completed order form to the RSD Radionuclide Buyer with the following information included:

- A. Assigned Oracle Requisition Number
- B. EBO Name
- C. EBO e-mail address (for notification of approved purchase order number).

Upon issuance of a Purchase Order Number, the departmental accounting representative or EBO should either:

- A. Place the phone order with the vendor or;

- B. Notify the ARU/PI or his/her designee of the approved Purchase Order Number so that they may place the phone order with the vendor.
- C. Note: When ordering, the following ship to address shall be used:
 - i. Radiation Safety Department
Health Sciences Central Receiving
One Medical Center Drive
Morgantown, WV 26506

5.4 RADIONUCLIDE ORDER RECEIPT

Nuclear Regulatory Commission (NRC) regulations require individuals receiving shipments of radioactive materials to follow procedures for opening packages safely. Also included in the regulations is the requirement to monitor the inside of these packages in order to mitigate the spread of contamination in the event of inner container leakage, and to further assure that packaging materials are free of contamination prior to disposal into the normal waste stream.

5.5 ORDER ARRIVAL

All radioactive material orders shipped to WVU must be sent to Central Receiving attention “Radiation Safety Department.” The RSD performs the required procedures for inspecting and monitoring packages. However, establishing the integrity of the innermost container is the responsibility of the AU.

If no contamination is detected, there is reasonable assurance that the shipping container and packaging materials are not contaminated. The laboratory contact will be notified of the arrival of the package and arrangements will be made for pickup or delivery. The lab may proceed by opening and inspecting the inner vial(s) before use or storage.

If contamination is detected, a survey must be done of the packing materials and of the area around where the package was opened. Any contamination of the shipping container, packaging materials, or surroundings must be controlled or removed. Contaminated shipping materials must be treated as radioactive waste. The company that shipped the package will be notified of the findings. The lab will be notified in order to seek a replacement shipment if necessary.

5.6 DISPOSAL OF PACKAGING MATERIALS

To provide further assurance that packaging materials are at background levels prior to disposal in the normal waste stream, the lab should survey them with a hand-held instrument, whenever it is reasonable to do so (package originally contained beta or gamma emitters of sufficient energy). The AU is responsible for ensuring that radioactive material labels have been defaced or removed prior to their disposal into the normal waste stream.

6. STORAGE OF RADIONUCLIDES

6.1 LIQUIDS AND SOLIDS

All sources of radiation shall be secured against unauthorized removal from the places of storage or use and shall be provided with reasonable protection against loss, leakage, or dispersion by the effects of fire or water. Radioactive material in a controlled or unrestricted area that is not in storage shall be controlled and given constant surveillance.

It is important that all stored radioactive samples be clearly labeled at all times. The label should show the radionuclides, their activity and date of activity, the chemical form, and the name of the responsible Authorized User plus any additional information that would help an individual to minimize his or her exposure.

Storage sites for large amounts of radioactive materials should be as remote from occupied areas as practicable. Materials must be stored so that the dose in any unrestricted area from external sources does not exceed 0.02 mSv (2 mrems) in any one hour. The total effective dose equivalent to individual members of the public shall not exceed 1 mSv (100 mrems) in a year. Storage areas must be well-marked with appropriate signs. These should read “Caution-Radioactive Materials” or “Caution-Radiation Area.” The name, address, and phone number of the responsible person and the RSO shall be posted in a conspicuous place near the area. See Appendix 2 for examples of approved signs and labels.

6.2 GASES

The storage requirements listed above apply as well to radioactive gases. In addition, radioactive gas cylinders or ampoules and radioactive solutions that emit gases should be labeled and kept in approved hoods which are provided with appropriate filters. Only the amounts of material necessary for immediate use should be stored.

7. AUTHORIZED LABORATORY REQUIREMENTS

Once Authorization approval has been granted Principle Investigators must set up their labs following Radiation Safety Department Guidelines. If necessary, a member of the Radiation Safety Department may be contacted to assist the Authorized User in lab setup. All labs where radioactive materials will be utilized must meet the following general criteria for authorization as an “Active” lab.

7.1 PHYSICAL REQUIREMENTS

- A. Floors must be smooth continuous surfaces. Tile is acceptable if cracks are filled with a nonporous material such as wax. Carpeting is prohibited.
- B. Walls, ceilings, and woodwork should be composed of non-porous surfaces should be washable.
- C. Labs with more than 10 μCi of radionuclides should have hoods with face velocities of at least 100 linear feet per minute when the sash is at working height and individual exhaust air filters.
- D. Suitable monitoring and measuring equipment for the radionuclides and activities used must be available.
- E. Benches should have non-porous tops with no sharp corners. Use of absorbent paper and strippable paint is recommended.
- F. Appropriate monitoring for the radionuclides used will be required. This will generally consist of a check of the area with a survey meter or wipe tests taken throughout the area. These surveys must be carried out on each day when radionuclides are used; monthly surveys are required even if no radionuclides are used. Results of these surveys must be recorded and be available for inspections.

7.2 USE OF CAUTION SIGNS AND LABELS

The following use of caution signs and labels is required by the NRC and the WVRHP. Although these signs and labels initially will be available from the Radiation Safety Department, Authorized Users should purchase their own if there is a continuing need. Catalogs and prices of caution signs and labels are available in the Radiation Safety Department. Assistance in marking and labeling may be requested by phoning the Radiation Safety Department, 304-293-3413.

Note: The signs and labels used must describe the actual situation. For example, do not use a "Caution - Radiation Area" sign unless it really is a Radiation Area as defined later on in this section. Also, keep signs and labels up-to-date. If the conditions change, then labels also require modification. More than one sign may be required. As an example, a Radiation Area that also contains sufficient radioactive material must be posted with a "Caution - Radiation Area" sign and a "Caution - Radioactive Materials" sign.

G. *Radiation Machines*

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

H. *Radioactive Material*

- i. The following shall be posted with a "Caution - Radioactive Material" sign or label:
 1. Each area of the laboratory in which radioactive materials are USED or STORED in an amount exceeding 10 times the quantity of radioactive material specified in Appendix A.
 2. Each container in which radioactive material is TRANSPORTED, USED or STORED in amounts greater than the quantity specified in Appendix A.
- ii. **Exception:** Laboratory containers such as beakers, flasks and test tubes are not required to be labeled if used only transiently while the person using them is present.
- iii. Labels on containers must provide sufficient information to permit individuals in the vicinity of the containers to take precautions to avoid or minimize exposures. Such information includes the radionuclides present, an estimate of the quantity of radioactivity, the date for which the activity is estimated, radiation levels, or kinds of materials.
- iv. **Note:** Equipment such as refrigerators or freezers, which are used for storage, should bear a "Caution - Radioactive Material" sign also.

I. *Radiation Area*

- i. The following shall be posted with the radiation symbol and a "Caution - Radiation Area" sign: any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.05mSv (5 mrem) in one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

J. *High Radiation Area*

- i. The following shall be posted with the radiation symbol and a "Caution - High Radiation Area" sign: any area, accessible to individuals, in which radiation levels could result in an excess of 1 mSv (100 mrem) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

K. *Very High Radiation Area*

- i. The following shall be posted with the radiation symbol and a sign bearing the words "GRAVE DANGER, VERY HIGH RADIATION AREA": any area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 5 Grays (500 rads) in 1 hour at 1 meter from a radiation source or from any surface that the radiation penetrates.

L. *Airborne Radioactivity Area*

- i. The following shall be posted with a "Caution - Airborne Radioactivity Area" sign: a room, enclosure or area in which airborne radioactive materials exist in concentrations –
 1. In excess of the derived air concentrations (DACs) specified by the NRC,
or
 2. To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

7.3 POSTING REQUIREMENTS¹

Along with posting of signs and labels to designate areas, materials, and equipment used in radioactive experiments, labs are also required to post the following regulatory documents. These documents ensure that lab occupants are properly notified of their rights and responsibilities associated with radioactive materials and radiation producing devices. These postings will be provided to the Authorized User by the Radiation Safety Department once authorization has been approved. It will be the responsibility of the Authorized User to ensure that these postings are maintained and kept current. Only WVU Radiation Safety Department staff may remove these postings after a lab has been decommissioned.

- A. NRC Form 3 "Notice to Employees"
- B. WVRHP Form X "Notice to Employees"
- C. WVU Radiation Safety Emergency Procedures
- D. Wipe test map and area diagram

¹ Forms can be printed or downloaded from the West Virginia Radiation Safety Department web site

8. GENERAL LABORATORY PROCEDURES

8.1 OBJECTIVES OF RADIATION PROTECTION MEASURES

1. To minimize exposure from external radiation to levels as low as are reasonably achievable (ALARA) and always within the set dose limits.
2. To minimize the entry of radionuclides into the human body by ingestion, inhalation, absorption, or through open wounds when unconfined radioactive material is handled and always keep doses within the set limits.

An important secondary objective is to maintain the integrity of critical experiments against cross-contamination. To accomplish these objectives requires positive planning and careful execution of procedures beyond the usual care taken in work with other materials.

It is necessary to:

- A. Analyze in advance the hazards of each job.
- B. Provide safeguards against foreseeable accidents.
- C. Use protective devices and planned emergency procedures in accidents that do happen.

8.2 BASIC POLICY

- A. In advance of the work, a full understanding must be reached between the Authorized User and the student or employee as to the work to be done and the safety precautions to be taken.
- B. The procedure for each project should be well outlined in writing; the amount of detail should be commensurate with the hazard.
- C. In some cases, before the procedure is actually performed with radiation, it should be given a "dry run" so as to preclude slip-ups or unexpected complications.
- D. Each Authorized User must make a copy of this Radiation Safety Manual available to students and employees where radioactive materials or machines are used, and may copy those portions of particular importance to individual employees and students.
- E. Persons should become familiar with the annual limits on intakes (ALIs) and derived air concentrations (DACs) of the radionuclides with which they are working. A comprehensive review of such isotopes is available on the NRC web site. (<http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/appb/>)

- F. Visitors to a laboratory that uses radionuclides should be supervised by a responsible member of the lab.
- G. Radionuclides shall not be left unattended in places where unauthorized persons may handle or take them, particularly without realizing that they are radioactive.
- H. All radioactive materials must be secured against unauthorized use or removal. This means that any room where radionuclides are used or stored must be kept locked whenever no one is present.
- I. Instruction of new radiation workers on the techniques and hazards of their work is required. This instruction is the responsibility of the Authorized User. To assist in the training of radiation workers, the Radiation Safety Department provides Radiation Protection training on-line at the WVU SOLE website. The Radiation Safety Department will no longer provide classroom training sessions.

8.3 MAINTAIN GOOD PERSONAL HYGIENE

- A. Keep fingernails clean and reasonably short.
- B. Wash hands and arms thoroughly before handling an object which goes to the mouth, nose or eyes.
- C. Do not smoke, eat, drink, apply cosmetics, etc. in radionuclide work areas. Do not use the same refrigerator for food and radioactive material.
- D. Wear a lab coat and disposable gloves to protect personal clothing and hands from contamination. If you have a break in the skin on the hand be sure to wear protective gloves. Long pants and shoes offer more protection than shorts and sandals.
- E. Check or change gloves periodically while working with radionuclides. Even small amounts of contamination of some radionuclides with high-energy betas (such as P-32 and Sr-89) can give rise to very high shallow-dose equivalents in a short time.
- F. Do not use the telephone, handle books, open cabinets or drawers, etc., with contaminated gloves.
- G. Use proper glove removal technique when taking off gloves to minimize the chance of spreading any contamination that may be present.
- H. Check your hands, shoes, and clothing with the survey instrument before leaving the work area and before leaving at the end of the day. If contamination is found, notify the Authorized User or Radiation Safety at once, taking precautions not to spread the contamination.
- I. Check lab coats with the survey instrument before returning them to the laundry.

- i. The maximum permissible amount of contamination is 220 dpm/100 cm² above background for radionuclides in Groups 2, 3 and 4; 22 dpm/100 cm² above background for radionuclides in Groups 1. If clothing reads less than these limits, it may be released directly to the laundry. (see Appendix B)
- ii. If readings are over these limits, or practically the entire garment is contaminated, then put on protective gloves and wash the garment until it is within contamination limits.
- iii. If several washings still are not able to lower the contamination, then hold it for decay if the half-life is short, or treat it as solid radioactive waste.

8.4 PREPARATION AND USE OF WORKING AND STORAGE AREAS

- A. As a general practice, work with radioactive material should be confined to only the area necessary. This simplifies the problem of confinement and shielding, and aids in limiting the affected area in case of an accident.
- B. All work surfaces and storage areas (table top, hood, floor, etc.) should be properly covered. Some facilities, especially in older buildings, are very hard to decontaminate and should especially be protected. If needed, designate and properly label sink for radioactive glassware only.
- C. Plastic or metal trays (stainless steel washes easily) should be placed on the surface when liquids are to be used. The lip of the tray serves to confine a spill.
- D. Absorbent mats or paper may also be used. Incontinent mats (Chux) or lab bench paper having a plastic back and absorbent paper front are especially useful. If contaminated, they may simply be discarded in the radioactive waste container.
- E. Floors made out of wood, stone, or concrete are very porous and hard to decontaminate. A plastic or asphalt tile covering is recommended. Some type of covering, even if just disposable absorbent paper, should always be used in areas where contamination is likely.
- F. Experiments involving any procedures which might produce airborne contamination (volatile radionuclides, powders or gases) shall be conducted in a hood, glove box or other suitable closed system.
 - i. Radioactive gases or material with radioactive gaseous daughters must be stored in gas tight containers and kept in areas having good ventilation.
 - ii. An approved hood should have an air flow of at least 100 linear FPM when the sash is at working height. This should be checked by a representative of the Radiation Safety Department before being put into use and at least annually thereafter.
 - iii. Precautions must be taken to limit effluents to unrestricted areas to no more than the amounts specified by the NRC.
- G. Practice good housekeeping. If an area is kept neat and clean and free from equipment and materials that are not required for the immediate procedure, the likelihood of

accidental contamination or exposure is reduced.

- H. Be your own monitor. Periodically (at least daily) check the work area and yourself with the laboratory survey instrument.
- I. Radionuclides received in shipments must be opened in a properly equipped laboratory only by the Authorized User or someone under his or her immediate supervision. It is advisable to open vials containing liquids in the hood, because the air space in the vial is likely to be saturated with the radionuclide.
- J. Whenever feasible, radioactive material, and particularly liquids, should be kept in unbreakable (i.e., plastic) containers. If kept in glass, a larger secondary container should be provided in which to place the glass container. Then, if breakage did occur, the radioactive material would still be confined by the secondary container.
- K. Vacuum pumps attached to contaminated systems should exhaust into a hood.
- L. Provisions for radioactive waste disposal must be made. See, "Radioactive Waste Disposal", for instructions concerning disposal of material.

8.5 SURVEY OF WORKING AREA

- A. At the end of each day that radioactive materials have been used, check the work areas for contamination with the laboratory survey instrument. Remove any contamination found. In many cases, the measures necessary to avoid contamination of experiments are more stringent than the measures required for protection of people. In addition to the routine daily check, these areas should be surveyed whenever there is a reason to suspect that contamination may be present. In addition, all active labs must check for contamination at least monthly. All results must be recorded and converted to disintegrations per minute (DPM).
- B. If the radioactive material is a gamma or high energy beta emitter, survey the radiation level. Shield the material when necessary according to "Shielding" regulations.
- C. Before using the survey instrument, check that:
 - i. The battery condition is acceptable;
 - ii. Its response to the check source is in the acceptable range.
 - iii. If difficulty is encountered, call the Radiation Safety Department for assistance.
- D. If an instrument does not respond to radiation, and experience indicates that there should be radiation present, secure another instrument and check your initial finding. If an instrument indicates the presence of radiation but seems to be erratic, take the reading at face value, then secure another instrument and check your initial finding.
- E. Upon request, Radiation Safety staff will monitor any lab or experimental setup.

- F. Laboratories using only low energy beta emitters, like H-3 (tritium) and C-14, should conduct the survey by swabbing the work areas with damp filter papers or cotton swabs and counting them in a liquid scintillation counter.
- G. Construction or repair in a laboratory that is using or has used radioactive materials should not be done until the area has been surveyed by a Radiation Safety representative. Call 304-293-3413 to arrange for the survey.

8.6 PROPER USE OF EQUIPMENT

- A. The use of tongs or other long-handled devices greatly reduces hand exposure by increasing the distance between your hand and the radionuclide. A general rule of thumb is that sources of activity greater than 10 μCi should be handled with tweezers or tongs and not directly. Of course, this does not apply to low energy beta emitters such as H-3, C-14, or S-35.
- B. Use pipette filling devices. NEVER PIPETTE RADIOACTIVE SOLUTIONS BY MOUTH.
- C. Equipment, such as glassware, that is used with radioactive material should be kept separate from non-contaminated items. It is recommended that a marked storage cabinet, sink, or other marked container or area be provided for glassware and tools used in radioactive work.
- D. All reusable glassware and tools should be cleaned after use. Contamination by trace quantities of material might seriously affect future low level experiments, even though the personnel hazards are negligible.
- E. No equipment used with radioactive material shall be removed from the laboratory or repaired until the Radiation Safety Department has surveyed it for possible contamination. It is the responsibility of the laboratory personnel to request this survey.
- F. Heavy rubber gloves can be used to significantly reduce the beta dose to the hands from high energy betas. Of course, this won't change the gamma exposure.
- G. Safety glasses, regular optical glasses, or goggles offer significant protection to the eyes from high energy beta emitters.

8.7 TRANSPORTATION OF RADIONUCLIDES ON CAMPUS

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

Safety Department and from commercial suppliers.

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

- B. Transportation of radionuclides from one building to another, unless they are immediately adjacent, will present greater difficulties. In this case the Radiation Safety Department should be contacted for advice.
- C. Unopened packages of radionuclides in their original shipping containers may be transported to any location where their use has been authorized without further restriction except as indicated in the following bullet.
- D. When shipments of radioactive material must be made on public highways, the regulations of the Department of Transportation on the preparation, packaging, marking and labeling of radioactive material packages, including the use of a shipping manifest, must be observed. Contact Radiation Safety for advice on making such shipments.

8.8 SURVEY INSTRUMENTS

- A. Each Authorized User must provide his or her workers with an appropriate survey instrument for the daily contamination surveys.
- B. These instruments must be appropriate for the type and level of ionizing radiation being used. Instruments with an audible output are preferred. The Radiation Safety Department maintains an up-to-date catalog file of currently available instrumentation and will be glad to assist in selecting these instruments.
- C. The one exception to the instrument requirement is for users of tritium; no satisfactory survey instrument is presently available for this radionuclide.
- D. Instruction of personnel in the use of survey instruments is the responsibility of the Authorized User. The Radiation Safety Department will assist by periodically offering instruction in use of these instruments. Notification of the classes will be given in advance.
- E. A check of the battery condition and the response of the instrument to a check source should be done on a daily basis when the instrument is used. Any deficiencies should be brought to the attention of the Authorized User and the problem corrected before the instrument is used for any measurements.
- F. The Radiation Safety Department will periodically calibrate these survey instruments at no charge. Initial maintenance will also be provided; the Authorized User will only be charged for batteries and replacement parts. Financial arrangements will be made directly

with each Authorized User.

- G. A temporary replacement instrument will be provided by the Radiation Safety Department if available. However, a replacement cannot be guaranteed.
- H. Bear in mind the need for survey instruments when applying for grants and contracts. These items are usually acceptable to granting agencies.

8.9 AIR SAMPLING

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

The Radiation Safety Department will normally initiate air sampling if:

- A. Verification is needed that any levels of airborne radioactive material are below the applicable derived air concentration (DAC);
- B. The results of film badge or bioassay monitoring indicate contamination of the work area;
- C. A previously untried iodination procedure is to be used; or
- D. The description of proposed experiments indicates that a large amount of volatiles or aerosols may be involved or generated in the procedure.

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

8.10 SEALED SOURCES AND LEAK TESTS

Commercially Obtained Sealed Sources

- A. These sources will be given an initial leak test by a Radiation Safety representative when they are received from the vendor.
- B. Subsequent leak tests will be performed by Radiation Safety staff at required intervals. They require no action on the part of the user.
- C. No commercially obtained sealed source is to be opened or the contents removed.
- D. Report immediately, to the Radiation Safety Department, all lost or deteriorating sealed sources.

Sources Manufactured by University or Hospital Personnel Sealed Sources
If you wish to make your own sealed source,

- E. Notify the Radiation Safety Department to test the source for contamination or leakage immediately after it is fabricated.
- F. After initial notification to the Radiation Safety Department, no further action is required unless the source is lost or a problem is found during use. The Radiation Safety Department will conduct the required periodic leak tests, which are the same as for a commercially manufactured source.

8.11 UNSEALED SOURCES

An unsealed source is defined as radioactive material that is deposited on a backing but has no cover. Planchets and other transiently used items are not included.

- A. These sources must be placed in individual boxes or other closed containers and marked with the radionuclide, approximate activity and date. Attach a "Caution - Radioactive Material" sticker to the box.
- B. Once a particular source has been assigned to a certain box, do not store the source in any other box. When a flaking or decayed source is disposed of, dispose of the box also.

Unsealed sources are susceptible to flaking of the material with age. Therefore, with the help of the users of the sources, the Radiation Safety Department will periodically check for deteriorating sources.

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

*Records of leak tests performed and the results must be maintained for 5 years.

9. RADIATION PROTECTION MEASURES

9.1 INTRODUCTION

There are two general ways in which the body may be irradiated:

- A. Radionuclides outside the body (external sources of gamma and/or high energy beta emitters)

- B. Radionuclides inside the body (internal exposures from any radionuclide)
 - i. Breathing radioactive vapor
 - ii. Ingesting radioactive material food, water, or from contaminated hands
 - iii. Entering through a cut
 - iv. Absorption through the skin

Exposure limits have been set for the protection of both personnel and the general public. It must be emphasized that the following limits are maximum permissible limits. In general, exposure is to be kept ALARA.

It is considered wise to avoid all unnecessary exposure to radiation.

9.2 REQUIREMENT TO KEEP DOSES ALARA

All licensees and permit holders are required by the Nuclear Regulatory Commission (NRC) and the West Virginia Department of Health (WVDOH) to use, to the extent practicable, procedures and engineering controls that are based upon sound radiation protection principles so that occupational doses and doses to members of the public are ALARA.

9.3 RADIATION PROTECTION LIMITS

West Virginia University must comply with the radiation protection limits specified by the NRC in 10 CFR 20 and by the WVDOH in 64 CSR 23. These dose limits apply to radiation exposures above those received from background radiation and medical exposure.

The regulations require that doses from external and internal sources must be monitored if an individual is likely to receive a dose in excess of 10% of the applicable dose limits. If both external and internal doses must be monitored, the dose resulting from each must be added together and the sum compared to the appropriate annual limit.

Limits are issued for occupationally exposed individuals: adults, minors, and an embryo/fetus. Dose limits for individual members of the public are also included.

9.4 NRC OCCUPATIONAL DOSE LIMITS

For adults, an annual limit shall not exceed:

- A. 5 rems (0.05 Sv) for the total effective dose equivalent (TEDE), which is the sum of the deep dose equivalent (DDE) from external exposure to the whole body and the

committed effective dose equivalent (CEDE) from intakes of radioactive material.

- B. 50 rems (0.5 Sv) for the total organ dose equivalent (TODE), which is the sum of the DDE from external exposure to the whole body and the committed dose equivalent (CDE) from intakes of radioactive material to any individual organ or tissue, other than the lens of the eye.
- C. 15 rems (0.15 Sv) for the lens dose equivalent (LDE), which is the external dose to the lens of the eye.
- D. 50 rems (0.5 Sv) for the shallow dose equivalent (SDE), which is the external dose to the skin or to any extremity.

NRC OCCUPATIONAL EXPOSURE LIMITS*

	YEARLY LIMIT (mrem)
WHOLE BODY	5000
SKIN OF THE WHOLE BODY	50000
EXTREMITY	50000
LENS OF EYE	15000
MINORS (PERSONS UNDER THE AGE OF 18)	500
FETAL EXPOSURE	500/Nine months

For minor workers, the annual occupational dose limits are ten percent (10%) of the dose limits for adult workers.

For protection of the embryo/fetus of a declared pregnant woman, the dose limit is 0.5 rem (5 mSv) during the

entire pregnancy. Efforts must be made to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the aforementioned limit. Thus the monthly exposure during pregnancy should be less than 50 mrem (0.5 mSv).

For individual members of the public, the total effective dose equivalent to individual members of the public from licensed operations at the University or Hospital shall not exceed 100 mrem (1 mSv) in a year, exclusive of any dose contribution from the Authorized User's disposal of radioactive material into sanitary sewage, and the dose in any unrestricted area from external sources shall not exceed 2 mrem (0.02 mSv) in any one hour.

9.5 INDIVIDUAL MONITORING

9.5.1 Conditions Requiring Monitoring

Each Authorized User must monitor exposures to radiation and radioactive material at levels sufficient to demonstrate compliance with the occupational dose limits of this section. As a minimum each Authorized User must monitor occupational exposure to radiation and must supply/require the use of individual monitoring devices by:

- A. Adults likely to receive a dose in excess of ten percent (10%) of the limits specified above in one (1) year from sources external to the body.
- B. Minors and declared pregnant women likely to receive a dose in excess of ten percent (10%) of the applicable limits in one (1) year from sources external to the body, and
- C. Individuals entering a high or very high radiation area.

Each Authorized User must monitor the occupational intake of radioactive material by and have the committed effective dose equivalent calculated for:

- D. Adults likely to receive an intake in excess of ten percent (10%) of the applicable Annual Limit on Intake (ALI) in one (1) year, and
- E. Minors and declared pregnant women likely to receive a committed effective dose equivalent in excess of 50 mrem (0.5 mSv) in one (1) year.

Contact the Radiation Safety Department for advice and help if you believe that monitoring will be required for internal exposures.

9.5.2 Types and Use of Monitoring Devices

There are two main options for external, personal monitoring available through the Radiation Safety Department:

- A. **Genesis Thermoluminescent Dosimeter (TLD) Badge:** provides x-ray, gamma, and beta neutron radiation monitoring with optically stimulated luminescence (OSL) technology, utilizing an aluminum oxide (Al_2O_3) detector material. The dosimetry badge is affixed to a holder with a clip so that it can be fastened to clothing in a consistent location on the worker's body (waist, chest, or collar).
- B. **TLD Ring Dosimeter:** provides extremity monitoring of x-ray, gamma, and beta radiation for workers required to manually manipulate or work in close proximity to radioactive materials and radiation producing equipment. It measures radiation exposure through TLD of a lithium fluoride crystal. The ring is to be worn on the index finger of the worker's dominant hand and is available in sizes small, medium, and large.

It is the responsibility of the Authorized User to request individual monitoring devices for him/herself and for personnel under his/her supervision. To request monitoring devices, call the Radiation Safety Department or visit our website in order to obtain the appropriate forms.

It is the responsibility of the Department Dosimeter Coordinator to turn in the badges and rings each quarter.

The Radiation Safety Department will contact anyone who receives an unexpectedly high exposure. Present policy is for the Radiation Safety Department to bill each department quarterly for all monitoring charges accrued.

9.6 BIOASSAYS

THYROID BIOASSAYS-SPECIFIC RECOMMENDATIONS

Based on the biokinetics of radioiodine, it is generally recommended that thyroid monitoring be performed between 24 and 72 hours following procedures whenever practical.

IODINATIONS PERFORMED IN AUTHORIZED RESEARCH LABORATORIES

Each individual handling radioiodine-125 or radioiodine-131 under any of the operations described below shall have thyroid monitoring. Note that the quantities shown apply to both the quantity used at one time or integrated as the total amount of activity used over a 3 month period. **Scheduling of the monitoring shall be done by the Radiation Safety Department.**

Types of Operations Involving I-125 or I-131

- A. Processes in open room or bench; with possible escape of iodine (a situation strongly discouraged):

Quantities requiring thyroid monitoring:

Volatile or dispersible:..... .1 mCi

Bound to non-volatile agent:..... 1 mCi

- B. Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability:

Quantities requiring thyroid monitoring:

Volatile or dispersible:..... 1 mCi

Bound to non-volatile agent:..... 10 mCi

- C. Processes carried out within glove boxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage:

Quantities requiring thyroid monitoring:

Volatile or dispersible:.....10 mCi

Bound to non-volatile agent:..... 10 mCi

- D. In those laboratories working only with I-125 radioimmunoassay (RIA) kits, the quantities of I-125 are very small and contained in a non-volatile form. Thyroid monitoring is not required.

URINE BIOASSAYS

Individuals involved in operations that utilize more than 100 mCi of H-3 (tritium) in a non-contained form (other than metallic foil), within a 30 day period, shall have bioassays performed within one week following a single operation and at weekly intervals for continuing operations. Bioassays performed in conjunction with other radionuclides may be required by the Committee. The Radiation Safety Department shall maintain reports of bioassay results.

9.7 CONTROL OF ACCESS TO HIGH RADIATION AREAS

The Authorized User must ensure that each entrance or access point to a high radiation area has one or more of the following features:

- A. A control device that, upon entry into the area, causes the level of radiation to be reduced below the level at which an individual might receive a deep-dose equivalent of 1 mSv (100 mrem) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates;
- B. A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; or
- C. Entryways that are locked, except during periods when access to the areas is required, with positive control over each individual entry.

In place of these, continuous electronic surveillance that is capable of preventing unauthorized entry may be substituted. The controls for controlling access must not prevent anyone from leaving the high radiation area.

Control of entrance or access to rooms or other areas in the hospital is not required solely because of the presence of patients containing radioactive material, provided that there are personnel in attendance who will take the necessary precautions to prevent the exposure of individuals to radiation or radioactive material in excess of the limits and to operate within the ALARA provisions of the radiation safety program.

9.8 CONTROL OF ACCESS TO VERY HIGH RADIATION AREAS

In addition to the requirements in the previous section, the Authorized User must institute additional measures to ensure that an individual is not able to gain access to areas in which radiation levels could be encountered at 5 Grays (500 rads) or more in 1 hour from a radiation source or any surface through which the radiation penetrates.

10. USE OF RADIONUCLIDES IN ANIMALS

10.1 AUTHORIZATION

All protocols involving the use of radioactive materials in animals must be submitted to the Committee on the Use of Radiation and Radionuclides in Animals. Approval by this committee is required by the Animal Care and Use Committee of the Institutional Review Board before it will consider a protocol for its approval.

10.2 ANIMAL CARE AREA

Authorized Users wishing to use radionuclides in the Animal Care Area (Animal Quarters) on any campus must submit their requests to the director of Animal Care. All requests must be made on the regular form for this purpose and must include all the information required in order that proper procedures for handling of animals, excreta, and for decontamination can be established.

The information should be submitted to the Radiation Safety Department and it will be forwarded to the Committee on the Use of Radiation and Radionuclides in Animals for recommendations or approval.

The general regulations for the radionuclide area in the Animal Quarters are listed below.

- A. All excreta are to be disposed of by the Authorized User, using procedures given in section heading, "Radioactive Waste Disposal".
- B. Feeding and watering of the animals given radionuclides are responsibilities of the Authorized User unless specific arrangements have been made with the Director.
- C. All Animal Care equipment used with animals given radionuclides must be washed, rinsed and monitored by the Authorized User before being turned over to the Animal Care personnel for routine cleaning.
Radioactivity must be non-detectable with an ordinary beta-gamma survey meter. For beta energies less than 0.3 MeV, damp filter paper and a liquid scintillation counter should be used. Do not return the equipment until the results of this count are known and are found to be acceptable.
- D. The Authorized User is responsible for monitoring the following areas at least once each week:
 - i. Floor of the room housing the animals
 - ii. Sink at which excreta are disposed
 - iii. Sink at which equipment is washed
- E. A record of all monitoring must be kept by the Authorized User.
- F. The area occupied by animals and equipment must be monitored at the termination of the experiment by a representative of the Radiation Safety Department.

- G. The Authorized User must post appropriate radiation signs at the area in which his or her animals are housed.
- H. If the radiation level at the cage surfaces exceeds 5 mR/hour adequate shielding must be provided by the Authorized User to reduce the amount of radiation received by the neighboring animals to less than 5 mR/hour. See "Shielding". Dose rates in an unrestricted area may not exceed 2 mrems in an hour and must not exceed 100 mrems to members of the public in one year. Assistance may be obtained from the Radiation Safety Department.

11. SEALED SOURCE IRRADIATORS

11.1 APPLICABILITY

This section concerns irradiators containing tens to thousands of Curies of radioactive material in sealed sources with adequate shielding as part of the design of the irradiator. Any device for which it is possible for all or part of the body to be irradiated by an unshielded source presents a much greater hazard and must be dealt with specifically on a case by case basis. For irradiators containing smaller activities, this section may serve as a model for a less extensive radiation safety program.

11.2 USERS

As with any other use of radiation under our licenses, an irradiator is under the supervision of an approved Authorized User and he or she is responsible for its safe use. Other individuals may use the irradiator, but each of these must be certified in writing by the Authorized User.

To obtain certification, the individual must:

- A. Attend the general orientation to radiation safety.
- B. Receive a specific orientation on the use of the irradiator, including, but not limited to, its design, operation, safe use, including any items that should not be irradiated, and emergency procedures.
- C. Satisfactorily pass a quiz on the use of the irradiator and radiation safety considerations during its use. The U.S. Nuclear Regulatory Commission insists that familiarity with these subjects be demonstrated by passing a quiz. The Radiation Safety Department will supply the Authorized User with general radiation safety questions for this quiz and the Authorized User is responsible for the more specific questions.
- D. Observe actual or simulated operation of the irradiator. Each user will be shown the irradiator operations procedure a sufficient number of times (minimum 3) to ensure familiarity with its proper operation. This training will be provided by the Authorized User or one designated individual.

It is the responsibility of the Authorized User to maintain records of who has passed the quiz and received the on-the-job training and who, therefore, is certified to use the irradiator.

11.3 SAFETY PRECAUTIONS

Detailed operating and emergency procedures must be available to each person who uses the irradiator. These should contain at least:

- A. Procedures for operating the irradiator
- B. Instructions concerning monitoring
- C. Instructions to lock the door to the room when the room is unattended.
- D. Instructions concerning what to do if abnormal radiation levels are detected, including locking the door and contacting the Radiation Safety Department.
- E. Requirements and instructions for performing inspections, maintenance and tests, to ensure that all interlocks, devices and components associated with the irradiator are functioning properly.

When the irradiator is in use, there must be an operable survey meter or area monitor in the room. This should be turned on while the irradiation is in progress in the unlikely event that problems develop with the shielding or source movement.

Leak tests will be conducted every six months by the Radiation Safety Department. If the irradiator fails the leak test, it must be withdrawn from service until it is repaired or replaced.

There must be no tampering, removal, replacement or disposal of the sealed source. Repairs may be performed only by someone specifically licensed by the U.S. Nuclear Regulatory Commission.

Irradiation of explosives, corrosives, or flammables must be avoided.

11.4 ITEMS BEING IRRADIATED

Irradiation with gamma rays from Cs-137 and Co-60 will not make something radioactive, so no special precautions are needed for the irradiated items after the irradiation is completed. Some items, such as explosives, corrosives and flammables may be sufficiently changed chemically by the irradiation to become more hazardous; irradiation of these items is to be avoided.

The Animal Care and Use Committee of the Institutional Review Board is concerned with the welfare of any animals being irradiated and insists that protocols for the irradiation of animals be submitted to the Committee on the Use of Radiation and Radionuclides in Animals for its approval. Only after this will the Animal Care and Use Committee consider approving the protocol.

For irradiation of other items, no specific approval of other committees is necessary once the Authorized User has obtained approval to use the irradiator.

12. WASTE HANDLING, STORAGE, AND DISPOSAL

12.1 GENERAL CONSIDERATIONS

Proper handling, labeling and packaging of radioactive waste is essential to minimize the chance for contamination, spills or other accidents in the work area or as the waste is handled further by Radiation Safety staff. Waste drums are being more closely inspected at disposal sites as rules become stricter and disposal sites may refuse to take waste from generators that do not comply with the rules.

Because of escalating disposal costs, it is also important that only radioactive waste be disposed of in the radioactive waste containers. Minimizing the volumes generated helps to keep costs down.

A charge based on an agreed fee schedule is made to an Authorized User for disposing of radioactive wastes generated in his or her laboratory. If unusually large volumes or special procedures become necessary, the Authorized User must bear any additional cost.

The Radiation Safety Department provides containers to use in the work area for radioactive waste disposal. Please call 304-293-3413 to obtain the types you need.

Radioactive waste is picked up from the work area by Radiation Safety personnel, repacked as necessary, and either held for decay or sent to commercial waste disposal centers.

Call 304-293-3413 to schedule radioactive waste pick-ups. Please do not wait until the container is overflowing! If you know a big experiment will generate a lot of waste on a particular day, please notify Radiation Safety in advance so that your lab is assured of getting a pick-up on the desired day.

No radioactive waste disposal by burial is permitted on any of the hospital or university campuses, and incineration is performed by the Radiation Safety Department only under tightly controlled circumstances, as permitted by the U.S. Nuclear Regulatory Commission and the U.S. Environmental Protection Agency and the West Virginia Department of Health.

Always maintain accurate records of the waste disposed in each container.

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

12.2 TYPES OF WASTE

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

- A. Dry Solid Radioactive Waste
- B. Solid Biological Radioactive Waste

- C. Liquid Radioactive Waste
- D. Liquid Scintillation Vials
- E. Radioactive/Hazardous Mixed Waste

All categories of waste should be separated according to the half-life of the radionuclide involved.

12.2.1 Short half-life waste

Radionuclides with half-lives of 120 days or less and Sulfur-35 are held for decay. If short half-life waste is mixed with long half-life waste the entire container must be treated as long half-life, and disposed of by a more expensive method.

If you hold waste for decay in your lab, storage area or freezers, call the Radiation Safety Department when you want to dispose of it (after 10 half-lives have passed). Radiation Safety personnel must perform the final monitoring and give approval before the waste may be disposed.

12.2.2 Disposal of Dry Solid Radioactive Waste (non-biological)

The general procedure is as follows:

- A. When using 5 gallon cans for solid waste, use plastic bags to line cans. Fold top of bag down over side of can. When a can is not used, package waste in plastic bags.
 - i. Place needles and other sharp objects in puncture proof containers before being put in the plastic bag.
 - ii. Wrap broken glassware in paper towels to prevent the plastic bag (and someone's hand) from being punctured.
 - iii. Place only radioactive materials in these cans. Other materials only increase volume and raise the cost of disposal.
- B. When a bag is full, close the bag and seal the top with masking tape. If a can reads greater than 2 mR/hr at one meter from the can, close the plastic bag and tape up the top whether the bag is full or not. Always tape according to Bag Sealing Instructions.
- C. Transfer the closed and marked plastic bags to the shipping barrel if one is provided to the department. Complete the pertinent entries on the waste disposal record attached to the outside of the barrel or 5 gallon can.

12.2.3 Disposal of Solid Biological Radioactive Waste

Radioactive biological wastes include radioactively-contaminated animal carcasses, feces, and bedding; tissue samples; and radioactive plants. It is very important that these wastes are properly bagged. No liquid must be able to leak out.

Waste material contained inside must be prepared so that it cannot pierce the bag. This may entail padding parts of the biological waste with gauze pads or other material to keep the plastic bags from being torn and punctured.

The NRC has issued an exemption for disposal of certain animal tissues. Those containing 50 nCi per gram or less (as averaged over the weight of the entire animal) of carbon-14 or tritium may be disposed of as if they were not radioactive. Please call the Radiation Safety Department if you need assistance with this procedure. It is essential that proper records be kept of all disposals made in this manner.

12.2.4 Materials

The Radiation Safety Department will provide each Authorized User or research group with Radionuclide Waste Identification Forms and yellow plastic bags for biological waste disposal. Call the Radiation Safety Department when you start to run low on these items to obtain replacements.

12.2.5 Proper Bagging

- A. Place radioactive biological material in YELLOW plastic bags. Make sure the material will not puncture or tear the bag.
- B. YELLOW bags are used only for radioactive material. Non-radioactive biological waste must not be placed in yellow plastic bags.
- C. Seal the bag as described in Section 12.2.12 of this chapter, "Bag Sealing Instructions."

12.2.6 Waste Inventory Control

- A. Waste inventory control and identification will be done by means of a copy, 4" x 6" Radionuclide Identification Form. Complete one form for each animal (plant) or small groups of animals (plants) when they are ready for disposal.
- B. Note the number on the top of the form. The number should be written directly onto the bag that corresponds to that form.
- C. Place the biological waste into a freezer designated for this purpose. Each campus will have a site for animal and plant storage as required. Freezing of these wastes is required.

- D. Call Radiation Safety when the freezer needs to be emptied. Be sure to give the 1st, 2nd, and 3rd copies of the Radionuclide Identification Forms for the waste being removed to the Radiation Safety person; the 4th copy should be kept in the Authorized User's file.
- E. Record information about the wastes disposed on your quarterly report sheet also.

12.2.7 Disposal of Liquid Radioactive Waste

Limited disposal of liquid radioactive waste via the sanitary sewer system is permitted as described below. Short half-life liquid waste should be held separately for decay before disposal. Note that the chemicals present in some liquids may preclude their disposal via the sewer system even though the radioactive content is within allowed limits.

12.2.8 Liquid Waste Barrels

Liquid waste intended for disposal into liquid waste barrels is to be separated into three categories by chemical composition of the liquid:

- A. Aqueous liquids with no organic solvents
- B. Liquid scintillation fluids
- C. Radioactive/hazardous mixed liquid waste

Heavy plastic one or five gallon containers are to be used for liquids if they are appropriate for the solvent being used.

NOTE: IT IS EXTREMELY IMPORTANT TO USE VENTED CAPS OR LOOSE CAPS ON THE STORED WASTE. THERE HAVE BEEN EXPLOSIONS IN SEVERAL LABS BECAUSE OF PRESSURE BUILD UP.

All of the waste containers must be labeled "Caution, Radioactive Material" and stored in an appropriate larger container to protect against leakage.

The use of glass waste containers is not recommended. If is necessary to store waste in a glass container, place it in a secondary break-resistant container in a location where it will not be dropped or knocked over.

For pickup of waste, call the Radiation Safety Department at 304-293-3413. Pickup will be weekly or as needed. Prior to pick up, fill out a radioactive materials tag (available at the Radiation Safety Department) and attach it to the waste container. It is very important that all solvents and their percentage composition be listed on this tag.

12.2.9 Disposal in the Sanitary Sewer system

Soluble or readily dispersible biological material may be released into the sanitary sewerage system provided that the amount released in one month divided by the average monthly volume of water released by the institution does not exceed the concentration specified by the NRC. In order to assure that this condition is met, the following procedure must be followed:

- A. Designate a sink in the laboratory as a "Radioactive Waste Sink" and have the Radiation Safety Department mark it as such. You may use this sink for rinsing of glassware and disposal of wash water. Do not use an unmarked sink for washing contaminated glassware and disposing of wash water.
- B. Rinse the sink with plenty of water after washing contaminated items in it. This will both reduce the contamination in the sink and further dilute the small amount of radionuclide released into the sewage system.
- C. Store other radioactive waste liquids in closed containers with a proper label. List the contents on the label.
- D. Call the Radiation Safety Department when you have accumulated waste to dispose. A member of the Radiation Safety staff will come to the lab to dispose of the waste or remove it to the Radiation Safety storage area.

12.2.10 Disposal of Liquid Scintillation Vials

Liquid scintillation vials are glass or plastic vials having a capacity of 20 ml or less that are used in scintillation counting. Small amounts of tritium and carbon-14 (50 nanocuries/gram or less) are commonly employed. The NRC has issued an exemption that allows persons to dispose of vials containing these low amounts of tritium and carbon-14 as if they were not radioactive.

However, in most cases, a "cocktail" must be used to produce the scintillations that are counted. Some of these cocktails contain a solvent (such as xylene) that has to be treated as a hazardous waste when it is time for disposal. Waste disposal facilities for this type of waste are very few and disposal costs are high.

There are alternative types of liquid scintillation cocktails that contain solvents that are not considered "hazardous" for purposes of disposal. Use these cocktails whenever possible! A list of currently available cocktails is available from Radiation Safety.

Liquid scintillation vials must be packed separately from other items such as gloves, etc., but glass and plastic vials may be mixed. In addition separate vials by:

- A. Half-life (short half-life, i.e., 120 days or less and sulfur-35 vs. long half-life)
- B. Type of cocktail (hazardous vs. non-hazardous)

C. Activity of H-3 and C-14 (50 nCi/g or less vs. greater than 50 nCi/g)

After use, store the vials in the five gallon open head pails with lever lock lids that are provided by Radiation Safety. These pails should be opened in a hood and, if feasible, stored in a hood when they contain hazardous scintillation fluids.

A record sheet is provided with each pail to record the date, radionuclides, total number of vials, total volume of fluid and total activity of the radionuclides in the pail. Call the Radiation Safety Department at 304-293-3413 for a pick up at your lab.

12.2.11 Radioactive/Hazardous Mixed Waste

There are no facilities that are authorized to take this type of waste at the present time. Therefore every effort should be made not to generate this type of waste.

If the radioactive material in the waste has a short enough half-life it can safely be held for decay. In that case, the waste will have to be disposed of as hazardous waste after the radioactivity decays away. It is essential to record the chemical composition of the waste on the label in order to be able to dispose of it properly. Extra costs involved in determining the chemical composition will be passed on to the authorized User.

12.2.12 Bag Sealing Instructions

- A. Twist the top of the bag tightly. Wrap tape tightly two or three times around the twisted section.
- B. Fold twisted section in half and wrap the tape two or three more turns.
- C. If a bag tears, then re-bag it before putting it in the waste container.
- D. Place extra bags around the original bag if necessary in order to ensure against leakage or puncture, and seal each additional bag according to the bag sealing instructions above.

12.2.13 Additional Requirements for All Radioactive Waste

- A. Only radioactive materials with an atomic number between 1 and 83 can be placed in waste barrels. All other materials with a higher atomic number such as radium (atomic no. 88), uranium (atomic no. 92), plutonium (atomic no. 94) and other source material or special nuclear material must be brought to the Radiation Safety Department for separate disposal. Example: smoke detectors containing americium-241 (atomic no. 95) must have special handling.
- B. The chemical form of all waste must be specified.
- C. All waste must contain less than 1% oil by volume.

- D. Ion exchange resins and filter media must be dewatered.
- E. There must not be any detectable free standing liquids in waste barrels.
- F. No radioactive waste may contain pyrophoric materials or materials that react violently with water.
- G. The radioactive hazard must be greater than the chemical hazard. We must have an analysis of the chemical, biological, and radioactive hazard.
- H. The physical form of all waste must be specified, e.g., compressed paper, glass, etc.
- I. Biological (excluding animal carcasses), pathogenic or infectious material or equipment (e.g., syringes, test tubes, capillary tubes) used to handle such material shall be treated so that the material, if not radioactive, could have been disposed of as infectious waste.
- J. The radionuclide and activity must be specified in microcuries (μCi) or millicuries (mCi). Radionuclides and activity must coincide exactly with the barrel sheet.

13. EMERGENCY/INCIDENT

An accident may happen to even the most careful of workers, and any worker may be called upon to assist in the case of a spill, a contamination incident, or an emergency. Be prepared and know how to respond **before** an incident happens.

The following procedures provide an overview of who to notify and how to respond to several different types of incidents. Emergency Response Guidelines books which list incident contact phone numbers and procedures are posted near a telephone in every lab.

13.1 WHO TO NOTIFY

13.1.1 Incident

An incident can be readily handled with laboratory or other University resources and may include a spill of radioactive materials, an incident of personal contamination or a possible exposure to an x-ray source.

- A. During normal working hours (8:15 AM – 4:45 PM), call The Radiation Safety Department (RSD) 304-293-3413.
- B. Outside normal working hours, page Radiation Safety on call pager 304-987-1586 and leave a ten digit call back number.

13.1.2 Fire, explosion or serious injury:

- A. First, call Public Safety at 911 anytime.
- B. Second, during normal working hours (8:15 AM – 4:45 PM), call RSD at 304-293-3413.
- C. Third, contact any Laboratory or Departmental Emergency contacts listed on the entry door.

13.1.3 Spill Occurs or Contamination is found

- A. Notify other persons in the area of the spill.
- B. Evacuate if spill is of a volatile material.
- C. Immediately remove contaminated shoes or clothing.
- D. Mark the spill area and limit access to avoid the inadvertent spread of contamination.
- E. Flush contaminated skin thoroughly with water.

- F. Remediate small spills and contaminated areas by:
 - i. Put on protective gloves and lab coat. Use shoe covers if floor is contaminated.
 - ii. Drop absorbent paper on a liquid spill.
 - iii. Dampen a dry spill; take care not to spread the contamination
 - iv. Dispose absorbent papers into Radioactive Waste containers.
 - v. Survey area either by GM survey meter and Gamma Well or Liquid Scintillation wipe test, depending on the isotope, to ensure that all contamination has been removed.

- G. If the spill is too large to remediate on your own call RSD immediately for assistance.

13.1.4 For Skin and Body Contamination

- A. Notify RSD immediately whenever any case of skin or body contamination occurs.
- B. Note the original survey meter reading, the location of the contaminated area and the time of the contamination was discovered. RSD will use this information to calculate dose.
- C. Wash skin using mild soap and warm water for 2-3 minutes. Do not abrade skin or use hot water.
- D. Measure and record the count rate after the initial attempt at decontamination. Survey and repeat decontamination until the count rate cannot be reduced any further.
- E. If the skin becomes irritated, discontinue decontamination.
- F. When decontamination efforts are not immediately successful, often a substantial reduction in count rate is achieved during the next 24 hours with periodic washings with soap and water, combined with normal flaking of the skin.

13.1.5 Serious Injury with Radioactive Contamination

Serious injury and life-or-death situations always take priority over radiological concerns. In all cases of physical injury, even minor injuries, medical attention and hospitalization take precedence over contamination concerns. There are no radiation sources at the University that produce contamination and radiation exposure risks large enough to prevent first aid from being given.

- A. Follow the Fire, Explosion & Serious Injury notification procedure. Public Safety responders are trained to provide first aid.
- B. If possible, have someone meet emergency response personnel and escort them to the accident scene.

- C. Remove contaminated items and clothing from the victim only if these actions will cause no further harm.
- D. If time permits, attempt to provide an uncontaminated pathway for the emergency crew.
- E. Have someone who can provide useful additional information accompany the victim to the emergency room.

13.1.6 Possible Overexposure to Sources of Radiation

The most likely scenario for a serious overexposure to radiation involves exposure to the primary beam of an x-ray diffractometer or to a high activity sealed source. In any case, notify RSD, who will provide additional instructions, based on the exposure conditions.

14. LABORATORY CLOSE OUT/TRANSFER PROCEDURE

14.1 PURPOSE

Vacated laboratories and their associated research materials (e.g. radioactive materials, sharps) and equipment that have not been properly cleaned and/or decontaminated pose radiation hazards to persons who may enter. These hazards are amplified when materials are not labeled or unidentified, especially to those who will have to enter to later dispose of them.

This policy provides procedures to ensure safe and compliant transitions in the laboratory occupancy. Any Principal Investigator/Authorized User (PI/ARU) who anticipates terminating his/her authorization shall notify the Radiation Safety Department (RSD) of the termination, in writing, as soon as the closeout/relocation is anticipated and/or no less than ninety (90) days prior to the anticipated date of termination. The proper disposal of relevant radioactive materials is required from the PI/ARU by way of the enclosed signed Laboratory Closeout Checklist.

14.2 SCOPE

This policy applies to all University research laboratories and any auxiliary support areas. It contains procedures for the management and removal of all radiation hazards prior to transition for any of the following reasons:

- A. The PI/ARU is leaving the University;
- B. The PI/ARU is relocating to a new laboratory at the University;
- C. The PI/ARU is relocating to an off campus location; or
- D. The space is being vacated for renovations.

Upon completion, the PI/ARU (or Department Chair in the absence of the PI/ARU) certifies that all laboratory equipment and items that may pose a potential, radioactive hazard to people or the environment have been removed/transferred, decontaminated, and/or properly disposed.

14.3 OBJECTIVE

To maintain a safe working environment, reduce radioactive waste generation and to comply with all applicable regulations.

14.4 ROLES AND RESPONSIBILITIES

- A. *Radiation Safety Department*
Will provide guidance for lab closeout, decontamination, relocation, and other issues that may arise. Radioactive waste disposal and transfer will be coordinated through RSD.
- B. *Radiation Safety Officer/Designee*
Must survey and sign off on closeout procedure form for all rooms where radioactive materials were in use. Will assist with and confirm proper disposal of radioactive materials. The lab will

not be given final clearance until the Radiation Safety Officer (RSO) has signed off on form.

C. *Principal Investigator/Authorized User*

Responsible for proper management of radioactive materials and contaminated equipment or laboratory surfaces. At least 90 days, preferably as soon as closeout/relocation is anticipated, before vacating the laboratory space the PI/ARU will inform the RSD of the planned move by completing the Laboratory Closeout Notice (located in Appendix H and on the RSD website). The RSO will provide the PI/ARU a copy of the Laboratory Clearance Checklist (located in Appendix G and on the RSD website) which will be used to complete the exit clearance process.

14.5 PROCEDURES

14.5.1 NOTIFICATIONS:

A laboratory representative shall notify the RSD, in writing, as soon as the laboratory closeout/relocation is anticipated, approximately 90 days prior to vacating the laboratory and any laboratory support areas (e.g., storage rooms and shared research areas). Notice is given by completing the Laboratory Closeout Notice and sending it to the RSD. If proper notification is not given, the PI/ARU and/or the department will be held responsible for all costs incurred for safe disposal of remaining radioactive material wastes.

After receiving the Laboratory Closeout Notice, the RSD will conduct a pre-inspection of the space with the PI/ARU to identify all radiation hazards present.

The laboratory will be cleaned according to the following guidance.

14.5.2 GENERAL HOUSEKEEPING:

- A. Trash shall be removed from the space, including empty containers, papers, and disposable materials. Remove all lab matting, absorbents or chucks from all benches and cabinets, and empty all drawers. Prior to disposal conduct contamination surveys (GM and/or Wipe) to ensure items being disposed of are not radioactive. If materials are contaminated dispose of in radioactive waste pail otherwise dispose of in regular trash. If more radioactive waste containers are needed, contact the RSD for another pail or drum.
- B. Radiation fume hoods must be empty of all radioactive equipment and materials. Interior surfaces of the hood shall be wiped down with a soap and water solution.
- C. Uncontaminated broken glass or unwanted glassware shall be disposed of in a glass waste box with a clear plastic liner. Sharps, such as needles or razor blades, shall be disposed of in an approved sharps-container and shall be removed from the space.

14.5.3 DISPOSAL OF RADIOACTIVE MATERIALS

- A. All radioactive materials must be removed from the lab by one of the following methods:
 - i. Materials can be transferred to another PI/ARU or laboratory within the institution while complying with all license restrictions of that user/laboratory. Approval from the RSO is required prior to radioactive material transfer. To schedule an internal transfer of radioactive material, submit form 708 (*Internal Transfer of RAM*) to the RSD.

- ii. Materials can be shipped to a non-West Virginia University licensee while conforming to all applicable shipping regulations. Radioactive materials will be prepared for shipment by the RSD. To schedule an external transfer of radioactive material submit form 740 (*Radioisotope Transfer Request Form*) to the RSD. *Note: There will be notification/acceptance requirements at the new facility.*
 - Materials can be shipped back to the manufacturer.
 - Materials/waste can be disposed of by submitting form 826 (*RSD Waste Removal Request Form*) to the RSD at least one week prior to final closeout.

14.5.4 LABORATORY EQUIPMENT AND SUPPLIES

- A. Equipment (fume hoods, refrigerators, freezers, centrifuges, incubators, countertops, sinks, cabinets, etc.) must be completely empty of all radioactive materials.
- B. Prior to defrosting freezers, conduct wipe tests to ensure no contamination is present. If contamination is present contact the RSD at 304-293-3413.
- C. Perform a radiation survey of the whole lab, including equipment that may have contained radioactive material (GM survey and wipe test survey) to ensure all radioactive sources have been removed and area is free of contamination. If contamination is found, the area must be decontaminated and resurveyed until it's below background limits. If there are any issues or questions, consult the RSD for guidance.
- D. Ensure all personnel have returned their dosimetry badge to the RSD.

14.5.5 RADIATION SAFETY DEPARTMENT INSPECTION

- A. When all work has been completed and checked off, per the Lab Closeout Checklist, send original to department chairperson. The department chairperson will insure all work is complete, sign off on form, and send to RSD.
- B. Upon receiving Lab Closeout Checklist from department head, RSD will conduct an inspection to confirm completion. Once contamination survey is complete, RSD will remove radiation hazard/warning signs and replace with Radiation OK sticker.
- C. RSO must sign off on Lab Closeout Checklist.
- D. Laboratories cannot be reoccupied, nor work done by Facilities or Housekeeping until RSD/RSO has verified the closeout procedure has been completed.

APPENDIX A: QUANTITIES OF LICENSED MATERIAL REQUIRING LABELING ^{A, B}

Radionuclide	Abbreviation	Quantity (μCi)
Hydrogen-3	H-3	1,000
Carbon-14	C-14	1,000
Fluorine-18	F-18	1,000
Sodium-22	Na-22	10
Sodium-24	Na-24	100
Phosphorus-32	P-32	10
Phosphorus-33	P-33	100
Sulfur-35	S-35	100
Calcium-45	Ca-45	100
Chromium-51	Cr-51	1,000
Cobalt-57	Co-57	100
Cobalt-60	Co-60	1
Nickel-63	Ni-63	100
Gallium-67	Ga-67	1,000
Gallium-68	Ga-68	1,000
Germanium-68	Ge-68	10
Strontium-89	Sr-89	10
Molybdenum-99	Mo-99	100
Technium-99m	Tc-99m	1,000
Indium-111	In-111	100
Iodine-123	I-123	100
Iodine-125	I-125	1
Iodine-129	I-129	1
Iodine-131	I-131	1
Xenon-133	Xe-133	1,000
Cesium-137	Cs-137	10
Barium-133	Ba-133	100
Gold-198	Au-198	100
Thallium-201	Tl-201	1,000
Rubidium-86	Rb-86	100
Radon-222	Rn-222	1
Radium-226	Ra-226	0.1
Uranium-235	U-235	0.001
Uranium-238	U-238	100
Americium-241	Am-241	0.001

- a. Each container in which radioactive material is transported, used or stored in amounts greater than the quantity specified above require labeling.
- b. Each area of the laboratory in which radioactive materials are used or stored in an amount exceeding 10 times the quantity of radioactive material specified above require labeling.

For a complete listing of nuclides refer to 10 CFR 20

**APPENDIX B: CLASSIFICATION OF ISOTOPES ACCORDING TO RELATIVE
RADIOTOXICITY PER UNIT ACTIVITY**

Radiotoxicity Group	Radioisotopes
<i>Very High (group 1)</i>	Pb-210, Po-210, Ra-223, Ra-226, Ra-228, Ac-227, Th-227, Th-228, Th-230, Pa-231, U-230, U-232, U-233, U-234, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Am-243, Cm-242, Cm-243, Cm-244, Cm-245, Cm-246, Cf-249, Cf-250, Cf-252
<i>High (group 2)</i>	Na-22, Cl-36, Ca-45, Sc-46, Mn-54, Co-56, Co-60, Sr-89, Sr-90, Y-91, Zr-95, Ru-106, Ag-110m, Cd-115m, In-114m, Sb-124, Sb-125, Te-127m, Te-129m, I-124, I-125, I-126, I-131, Cs-134, Cs-137, Ba-140, Ce-144, Eu-152, Eu-154, Tb-160, Tm-170, Hf-181, Ta-182, Ir-192, Tl-204, Bi-207, Bi-210, At-211, Pb-212, Ra-224, Ac-228, Pa-230, Th-234, U-236, Bk-249
<i>Moderate (group 3)</i>	Be-7, C-14, F-18, Na-24, Cl-38, Si-31, P-32, P-33, S-35, Ar-41, K-42, K-43, Ca-47, Sc-47, Sc-48, V-48, Cr-51, Mn-52, Mn-56, Fe-52, Fe-55, Fe-59, Co-57, Co-58, Ni-63, Ni-65, Cu-64, Zn-65, Zn-69m, Ga-72, As-73, As-74, As-76, As-77, Se-75, Br-82, Kr-85m, Kr-87, Rb-86, Sr-85, Sr-91, Y-90, Y-92, Y-93, Zr-97, Nb-93m, Nb-95, Mo-99, Tc-96, Tc-97m, Tc-97, Tc-99, Ru-97, Ru-103, Ru-105, Rh-105, Pd-103, Pd-109, Ag-105, Ag-111, Cd-109, Cd-115, In-115m, Sn-113, Sn-125, Sb-122, Te-125m, Te-127, Te-129, Te-131m, Te-132, I-130, I-132, I-133, I-134, I-135, Xe-135, Cs-131, Cs-136, Ba-131, La-140, Ce-141, Ce-143, Pr-142, Pr-143, Nd-147, Nd-149, Pm-147, Pm-149, Sm-151, Sm-153, Eu-152, Eu-155, Gd-153, Gd-159, Dy-165, Dy-166, Ho-166, Er-169, Er-171 (9.2 hr), Tm-171, Yb-175, Lu-177, W-181, W-185, W-187, Re-183, Re-186, Re-188, Os-185, Os-191, Os-193, Ir-190, Ir-194, Pt-191, Pt-193, Pt-197, Au-196, Au-198, Au-199, Hg-197, Hg-197m, Hg-203, Tl-200, Tl-201, Tl-202, Pb-203, Bi-206, Bi-212, Rn-220, Rn-222, Th-231, Pa-233, Np-239
<i>Low (group 4)</i>	H-3, O-15, Ar-37, Co-58m, Ni-59, Zn-69, Ge-71, Kr-85, Sr-85m, Rb-87, Y-91m, Zr-93, Nb-97, Tc-96m, Tc-99m, Rh-103m, In-113m, I-129, Xe-131m, Xe-133, Cs-134m, Cs-135, Sm-147, Re-187, Os-191m, Pt-193m, Pt-197m, Th-232, Th-Nat, U-235, U-238, U-Nat

APPENDIX C: COMMONLY USED SIGNS AND SYMBOLS



NRC Form 3 "Notice to Employees"



WVRHP Form X "Notice to Employees"



APPENDIX D: EMERGENCY PROCEDURES FOR RADIATION ACCIDENTS

Minor Spills

- 1) **NOTIFY** people in the area that a spill has occurred.
- 2) **CONTAIN THE SPILL.** Cover the spill with absorbent paper and tape off area.
- 3) **CLEAN UP.** Use disposable gloves and remote handling tongs. Dispose of absorbent material in radioactive waste container.
- 4) **SURVEY** the area with Geiger Meter or use damp filter paper and scintillator. Also, survey hands, feet and clothes.
- 5) **REPORT INCIDENT** to the Radiation Safety Office.
- 6) **DETAILED INSTRUCTIONS** are provided in Section 13 of the Radiation Safety Manual.



Major Spills

- 1) **CLEAR THE ROOM** of all people not involved in the spill.
- 2) **CONTAIN THE SPILL.** Cover the spill with absorbent paper and use shielding to decrease contamination exposure.
- 3) **SECURE THE ROOM** to prevent entry until Radiation Safety arrives.
- 4) **REPORT** incident immediately to **RADIATION SAFETY**.
- 5) **DECONTAMINATION** procedures will be administered by Radiation Safety.
- 6) **DETAILED INSTRUCTIONS** are provided in Section 13 of the Radiation Safety Manual.

Emergency Numbers

Radiation Safety Office (RS):	293-3413
Radiation Safety Pager:	987-1586
Nasser Razmianfar, RSO:	376-7237
Dept of Public Safety & Security:	293-3136

10/25/2010

APPENDIX E: RADIOACTIVE MATERIAL SPILL RESPONSE

IN CASE OF A RADIATION EMERGENCY	
DURING NORMAL WORKING HOURS: (Monday through Friday 8:15 AM – 4:45 PM)	CALL THE RADIATION SAFETY OFFICER AT (304) 293-3413
OUTSIDE NORMAL WORKING HOURS:	PAGE THE ON CALL RADIATION SAFETY SPECIALIST AT (304) 987-1586

Assess the contamination and ask yourself:

Is this a minor spill of radioactive materials? *

Can I realistically handle this incident without assistance while ensuring minimal risk to myself and others? Do I have the required resources?

YES
↓

NO
↓

Spill Decontamination Procedure

Supplies: Lab coat, sturdy disposable gloves**, shoe covers (if appropriate), paper towels, Radiovac Wash, yellow waste container, and a survey meter
For most isotopes (e.g. H-3, C-14, P-32, P-33, S-35), commercial products or mild acids, such as acetic acid, may be used as decontamination solutions.
For I-125 contaminations do not use hot water, acids, or acidic detergents because volatile iodine may be produced. A basic decontamination solution such as Radiovac Wash may be used.

1. Get supplies ready before cleanup.
2. Use a survey meter to carefully define the extent of the contaminated area. For low energy beta-emitters such as H-3, C-14, S-35, contaminated areas must be defined using wipe tests.
3. Mark the contaminated area with tape or other marking.
4. Start the cleanup at the edge of the contaminated area and work inward.
5. Clean wet spills or contamination using absorbent paper towels.
6. Change paper towels frequently to avoid smearing contamination around.
7. Change gloves frequently and watch out for rips and tears.
8. Survey all personnel involved in the cleanup effort. Survey shoes as well as hands and lab coats.
9. Record the cleanup and personnel surveys in the lab survey log.
10. Contact WVU-RSD for assistance and information.

Major Contamination Procedure

1. Notify all personnel within the laboratory and in the vicinity of the lab, as appropriate.
2. Notify WVU-RSD (**293-3413**) and departmental emergency contacts.
3. Block off the area. Keep bystanders out of the area. Assemble persons who were in the lab at the time of the incident in a place near enough to the contaminated area to minimize the spread of contamination but far enough away to prevent continued involvement.
4. Do not track contamination beyond the area. Remove shoes or put protective covers over shoes before leaving the contaminated area.
5. Survey anything and everyone leaving the contaminated area.
6. Decontamination is the responsibility of the Authorized User and his/her lab personnel. Follow the Spill Decontamination Procedure.
7. Unless immediate action is needed to safeguard personnel, cleanup should be performed under the supervision of the WVU-RSD staff.

***Reporting Requirement:** Promptly report uncontained spills (e.g., spills outside of contained areas on the workbench or hood) in excess of ten microcuries (10 µCi) to WVU-RSD.

**If hazardous chemicals are involved, use gloves appropriate for protection from chemicals. See the chemical's MSDS for guidance.

Appl

APPENDIX F: RADIATION SAFETY FORMS AND GUIDELINES

RSD FORM NUMBERS

Form #	Form Name:	Date Last Revised
6	Declared Pregnant Worker Monthly Reporting Memo	4/19/2005
501	Declaration of Pregnancy Form	4/25/2005
502	Regulation 8.13 Instruction Prenatal Radiation Exposure	4/25/2005
503	Pregnant Radiation Worker Info Sheet	4/25/2005
601	HU Application	4/28/2005
602	NHU Application	4/28/2005
697	Survey Meter Borrowing Registration Form	4/25/2005
698	Survey Meter Pickup and Return Record Form	4/25/2005
699	Survey Meter Registration Form	3/16/2005
708	Internal Transfer of RAM	4/19/2005
722	Analytical X-Ray Equipment Service/Repair/Alteration Request Form	4/11/2005
724	RSD Radiation Producing Device Registration Form	4/11/2005
740	Radioisotope Transfer Request Form	3/16/2005
800	Lab Worker Registration Form	4/28/2005
801	Radiation Monitoring Policy Statement	4/28/2005
804	Badge Application Form	4/28/2005
824	Waste Composition Record (30-50 gal)	3/16/2005
825	Waste Composition Record (5 gal)	3/16/2005
826	RSD Waste Removal Request Form	3/16/2005
827	Liquid Waste Disposal Form	4/28/2005
828	Uranyl Acetate/ Nitrates" Waste Disposal Form	4/28/2005

APPENDIX G: LABORATORY CLOSEOUT CHECKLIST

Principal Investigator/Authorized User: _____
 Department: _____
 Building and Room Number(s): _____
 Office Phone: _____
 E-mail Address: _____

This is to certify that the laboratory equipment and/or room listed above is considered safe for maintenance work and/or occupancy. All radioactive materials have been removed. All potentially contaminated surfaces have been decontaminated in accordance with Radiation Safety Department requirements.

	Inspection Date		
	Yes	No	N/A
Check the box that is applicable:			
Radioactive isotopes removed			
Radioactive waste removed			
Personnel dosimetry badges returned			
Equipment, drawers, and cabinets are emptied, cleaned, and wiped down			
Fume hood(s) emptied and cleaned			
Broken/uncontaminated glassware removed or disposed in glass waste box			
General cleanliness and hygiene acceptable			
Final PI/ARU survey of all laboratory areas, equipment, and furniture complete (see attached results)			
TO BE COMPLETED BY RSD			
RSD survey conducted			
<600 dpm/100 cm ²			
<0.02 mR/hr			
Radiation hazard/warning signs removed (by RSD)			
Other/comments:			

Signature, Principal Investigator/Authorized User

Date

Signature, Department Chairperson

Date

Signature, Radiation Safety Officer/Designee

Date

APPENDIX H: LABORATORY CLOSEOUT/RELOCATION NOTICE

Complete and send this notice as soon as move is indicated; no less than 30 days prior to departure. **Send completed form via fax (304-293-4529) or mail to PO Box 9006.** Once the notice is received, an RSD representative will contact the laboratory with instructions for proper closeout.

P.I./A.R.U.: _____

Department: _____

Building: _____

Room(s): _____

Lab Coordinator: _____

Phone: _____

Box #: _____

Contact: _____

E-mail: _____

Please check one of the following:

Permanent Lab Closeout **Laboratory Relocation**

Date Form Submitted: _____

Anticipated Date of Move: _____

IN CASE OF A RADIATION EMERGENCY	
DURING NORMAL WORKING HOURS: (Monday through Friday 8:15 am – 4:45 pm)	Call the Radiation Safety Officer at (304) 293-3413
OUTSIDE NORMAL WORKING HOURS:	Page the on call Radiation Safety Specialist at (304) 987-1586
Radiation Safety Department Health Sciences Center – North, Room G-139 P.O. Box 9006 Morgantown, WV 26506-9006 Office Phone: (304) 293-3413 Fax: (304) 293-4529 http://www.hsc.wvu.edu/rsafety/	