Radiation Safety Manual for Research Applications

West Virginia University

The purpose of this manual is to provide Principal Investigators (PI), Authorized Radiation Users (ARU), and laboratory personnel who utilize radioactive material in a research setting 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 West Virginia University's Broad Scope License.

WVU Radiation Safety Department

2022 Revision

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CONTACT INFORMATION

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Monday through Friday 8:15 am – 4:45 pm
Call the Radiation Safety Department at

(304) 293 – 3413

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Call the on call Radiation Safety Specialist at

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1. INTRODUCTION

1.1 RADIOACTIVITY AND RADIATION

All matter in our environment is made of atoms and most atoms we encounter on Earth are stable. Some atoms are unstable, giving off energy in the form of ionizing radiation in order to reach a stable state. This process is called radioactive decay, and atoms that go through this process naturally are called radioisotopes. A specific example is the radioisotope carbon-14 (C-14, 14C), produced in the atmosphere when cosmic rays interact with stable nitrogen atoms. When a carbon-14 atom undergoes radioactive decay, it emits radiation in the form of a beta particle to become a stable nitrogen atom once again. The existence of carbon-14 in all living things enables archaeologists to date ancient artifacts. This is but one example of how radioisotopes can be used in the research environment. Radiation can be naturally emitted from radioisotopes through the decay process, or can be electrically generated by a radiation-producing device, such as an x-ray tube or linear accelerator. 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. At high enough levels, ionizing 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. 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. The vast majority of background radiation exposure comes from radon, a naturally occurring radioactive gas that comes from the ground.

Radiation is useful because of its ability to penetrate tissue, allowing imaging of internal structures. However, radiation can 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. Exposures to high levels of radiation produce the same effects faster and may cause hair loss, skin burns, radiation sickness, and even death. Radiation may also increase the risk of genetic abnormalities.

1.2 COMMITMENT TO SAFETY

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 Radiation Safety Committee under the authority of 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 exposed to radiation in an occupational setting. In general, there is a 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: Minimizing the time spent in a radioactive field.
2. Distance: Maximizing distance from a source of radiation.
3. Shielding: The use of appropriate shielding greatly reduces the dose rate.

Remember that radiation cannot be seen or felt, but can be detected with 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 radioactive materials include byproduct materials (radioactive materials that were made in a reactor or particle accelerator) and naturally occurring radioactive materials. In addition, radiation producing devices are subject to the regulations of the West Virginia Department of Health and Human Resources' (WVDHHR) Radiological Health Program (WVRHP), see WVU Radiation Producing Device Policy Manual.

Certain forms of isotopes are covered by what is referred to as a general license from the NRC. Static eliminators and electron microscopy reagents are common examples of generally licensed materials and do not currently require approval from the WVU RSD to purchase. However, the WVU RSD is bound by federal regulations governing the materials. At this time, we do require notification of intent to order material so that an accurate inventory can be maintained.

3. RADIATION SAFETY COMMITTEES AND USER RESPONSIBILITIES

3.1 RADIATION SAFETY COMMITTEE (RSC)

The Radiation Safety Committee is composed of WVUH Executive Management or his/her representative, WVU Health Sciences Executive Management or his/her representative, the RSO, others who may be nominated by any of the above, a representative from each authorized area of use, faculty Authorized Users, and the chairperson of each of the Sub-Committees reporting to the Radiation Safety Committee.

The committee meets at least quarterly to:

1. Review and approval of permitted program and procedural changes prior to implementation;
2. Implementation of program and procedural changes;
3. Take appropriate actions when non-compliance is identified, including analysis of the cause, corrective actions, and actions to prevent recurrence;
4. Adopt rules and policies on the use of ionizing radiation within the university and the hospital;
5. Review plans for all new buildings and modifications of existing structures where ionizing radiation is to be used;
6. Audit of licensed operations to determine compliance;
7. Review reports by the RSO and the chairs of the Radiation Safety Committees;
8. Approve or modify proposals for amendments to the various licenses or applications for new licenses;
9. 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;
10. Approve changes in the Radiation Safety Manual and recommend changes when these become necessary.
11. Review and approval of any changes to or the introduction of new training before implementation.

3.2 HUMAN USE OF RADIATION AND RADIONUCLIDE COMMITTEE (HUC)

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 as far as the diagnostic and therapeutic use of radiation on humans is concerned.

The committee meets at least quarterly to:

1. Adopt rules and policies pertaining to the use of ionizing radiation in or on humans at West Virginia University Medicine Ruby Memorial Hospital and WVU Robert C. Byrd Health Sciences Campus.
2. Review and either approve or return for amendment all proposals for the use of radiation or radionuclides in or on humans.
3. 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.
4. 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.
5. Review proposed shielding and operations of all radiation producing machines and equipment used for the exposure of humans.
6. Review all instances of alleged infractions of rules and unsafe practices in the human use of ionizing radiation, and 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.
7. 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.
8. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the human use of ionizing radiation.

3.3 NON-HUMAN USE OF RADIATION AND RADIONUCLIDES COMMITTEE (NHUC)

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:

1. Adopt rules and policies for use of radiation in vitro and in animals at West Virginia University Medicine Ruby Memorial Hospital and West Virginia University.
2. Review and either approve or return for amendment all proposals for the use of ionizing radiation in vitro, or in animals.
3. Evaluate the qualifications of all persons proposing the use of radiation in vitro, or in animals, to ensure that they are adequate for the proposed use.
4. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used in vitro or in animals and send its recommendations to the Radiation Safety Committee.
5. Review all instances of alleged infractions of rules and unsafe practices in the use of ionizing radiation in vitro, or in animals, 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.
6. Review reports from the Radiation Safety Department on the use of ionizing radiation in vitro, and in animals, including any changes or impending changes in regulations.
7. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the use of ionizing radiation in vitro, and in animals.
8. 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 Non-Human Use of Radiation and Radionuclides Committee.

The committee will meet when necessary to:

1. Adopt rules and policies for the use of ionizing radiation in or on animals.
2. Review and either approve or return for amendment all proposals for the use of ionizing radiation in or on animals.
3. 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.
4. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used in or on animals and send its recommendations to the Radiation Safety Committee.
5. Review all instances of alleged infractions of rules and unsafe practices in the use of ionizing radiation in or on animals and take, the necessary steps to ensure safe practice.

This may entail recommendations to the Radiation Safety Committee or to appropriate supervisory personnel in the department in which an offense occurs.
6. 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.
7. Ensure that all license obligations, federal and state regulations are met and that safe practice is maintained in the use of ionizing radiation in 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 chairperson 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:

1. Adopt rules and policies on the use of ionizing radiation on the Downtown and Evansdale campuses.
2. Review and either approve or return for amendment all proposals for the use of radiation or radionuclides on the Downtown or Evansdale campus.
3. 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.
4. Review plans for all new buildings and modifications of existing buildings where ionizing radiation is to be used on the Downtown or Evansdale campus and send its recommendations to the Radiation Safety Committee.
5. Review all instances of alleged infractions of rules and unsafe practices in using ionizing radiation on either the Downtown or Evansdale campus and take the necessary steps to ensure safe practice. This may entail recommendations to the Radiation Safety Committee or to supervisory personnel in the department in which an offense occurs.
6. 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.
7. 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:

1. To furnish consulting services to any potential user of ionizing radiation and to advise the potential user on radiation safety procedures.
2. To ensure that all license obligations, as well as local, state, and federal regulations are met.
3. To provide general surveillance of all health physics activities, including assisting all personnel in discharging their responsibilities.
4. To supervise the procurement and receipt of all radioactive materials coming to West Virginia University and West Virginia University Medicine Ruby Memorial Hospital.
5. To provide for individual and laboratory monitoring.
6. To instruct university and hospital personnel in radiation safety.
7. To administer a radioactive waste disposal program.
8. To perform leak tests on applicable sealed sources and provide environmental surveys after installation of radiation producing machines.
9. To supervise decontamination in case of incidents.
10. To provide a continuous program of environmental radiation hazard evaluation and hazard elimination.
11. To provide advice and assistance in the acquisition of dosimeters and monitoring equipment.
12. To facilitate maintenance and calibration of survey instruments.
13. To maintain all centralized records pertinent to the radiation safety program.
14. To develop and refine radiation detection, shielding and health protection techniques.
15. To be responsible for the overall day-to-day administration of the radiation safety program.
16. 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 WVUH Executive Management or WVU Health Sciences Executive Management).
17. To present periodic reports to the various committees on matters related to their functions.
18. To keep each department chair informed of all Authorized Users in the department who are conducting projects approved by a radiation safety committee.
19. To provide timely reports to the U.S. Nuclear Regulatory Commission and the West Virginia Department of Health as required by regulation.
20. 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:

1. 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.
2. To have any area where radionuclides were previously used surveyed by the Radiation Safety Department before any maintenance, architectural, or engineering work is conducted. Call the Radiation Safety Department at (304) 293 – 3413 to see that any needed decontamination or disposal is carried out properly.
3. To have new staff members who desire to use ionizing radiation secure and read a copy of the Radiation Safety Manual for Research Applications 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 WVH RMH from another institution.
4. To have Authorized Users who are leaving the university or changing laboratories inform the Radiation Safety Department. They should arrange, with guidance from the Radiation Safety Department, 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:

1. Controlling employee and visitor exposures, keeping them ALARA and always below the dose limits.
2. Requesting proper radiation monitoring devices for laboratory personnel.
3. Registering new radiation users with the Radiation Safety Department.
4. Providing suitable monitoring instruments, protective clothing, equipment (such as shielding, if required) and supplies for employees.
5. Notifying the Radiation Safety Department of any change or proposed change in radionuclide use which might affect radiation protection procedures.
6. Following correct procedures for procurement of radionuclides and radiation producing devices.
7. Maintaining up-to-date marking and labeling of laboratories, radioactive materials and equipment.
8. Properly disposing of radioactive wastes and producing accurate disposal records.

9. Immediately reporting to the Radiation Safety Department, any spills suspected overexposures, theft or misuse of radioactive material, and other incidents involving radiation or radioactive materials.
10. Safely operating any radiation-producing device for which he/she is listed as the possessor.
11. Testing and care of radiation sources made by university or hospital personnel.
12. Properly administering and using sources of radiation in or on humans (if prior authorization has been obtained for this type of use).
13. Providing employees with copies of portions of the Radiation Safety Manual applicable to them, such as:
    a. General Procedures for Laboratory Personnel
    b. General Procedures for Radiation Producing Equipment Operators
    c. Emergency Procedures and Decontamination Procedures
14. 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.
15. Properly using radiation sources in or on animals (if applicable).
16. Proper use of an irradiator (if applicable).
17. Securely storing all radiation sources used under his or her direction.
18. 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/or gamma well counting) must be documented in units of disintegrations per minute (DPM) for both monthly and post-experiment surveys.
19. Properly transferring radioactive material while working at the University or WVU RMH and prior to leaving (as applicable).
20. Ensuring that radiation survey instruments are calibrated periodically for the type of radiation to be measured.
21. Training of laboratory personnel that will not be directly involved in radioactive experimentation. The specific content of the training is left to the to the discretion of the PI, but should contain at least: what to do in the event of a spill, whom to contact in emergent situations, and lab-specific procedures. At no time should the non-user handle radioactive materials or decontamination; this shall be undertaken by the PI and/or a radiation worker assigned to the PI.

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:

1. Controlling his/her radiation exposure, keeping it as low as is reasonably achievable and always below the dose limits.
2. Assisting the Authorized User in keeping the marking and labeling of laboratories, radioactive materials and equipment up-to-date.
3. Maintaining good housekeeping, minimizing clutter, and reducing the chance of contamination.
4. Carrying out monitoring of self, work area, and lab and producing required records of the monitoring performed.
5. Using appropriate instruments, checking for proper operation before use and reporting any problems to the Authorized User in a timely manner.
6. Storing and securing radioactive material properly.
7. Wearing appropriate protective clothing such as a lab coat and gloves.
8. Wearing and storing personal radiation monitors properly.
9. Disposing of radioactive wastes appropriately and keeping accurate disposal records.
10. Properly testing and caring for radiation sources made by university or hospital personnel.
11. Promptly reporting spills, suspected overexposures, theft of material and other accidents to the Radiation Safety Department.
12. Maintaining a working knowledge of emergency and decontamination procedures.
13. Becoming familiar with his or her specific area of concern.

4. RADIATION SAFETY TRAINING

The goal of providing radiation safety training to certain employees of West Virginia University is to empower workers to take personal responsibility for minimizing their exposure to radiation. By providing each employee with knowledge of radiation, its biological effects, and the regulations governing its use, WVU can provide an environment that is safe for its patients, students, visitors and employees. The content of radiation safety training courses will be determined by the RSO and the appropriate Radiation Safety Committee based on applicable regulatory guidance, industry consensus standards, and the specific needs of the target audience. Authorized Users are responsible for ensuring that their staff members have received instruction regarding the safe use of radioactive material and radiation sources in their specific laboratory settings, both through on-the-job training and through formal training offered by the Radiation Safety Department. The Authorized User is responsible for maintaining documentation of the completion of required training and will be required to supply such documentation to the RSO or his/her designee as a condition for continued Authorization to use radioactive material or radiation sources.

4.1 INDIVIDUALS OR GROUPS REQUIRING TRAINING

Individuals employed by WVU fall into three general categories with respect to their exposure to radiation.

1. Authorized Radiation Users/Principal Investigators and Radioactive Lab Workers: These workers work directly with radioactive materials as part of their research. While they may not exclusively use radioactive materials, they have a greater exposure potential than any other group. ARU/PIs have specific training and experience with isotopes and research techniques, and are approved to operate by the WVURSD. They directly oversee Radioactive Lab Workers, students or technicians that carry out work in these labs.
2. Ancillary Workers: These workers may occasionally come into contact with materials, or enter radioactive areas. These include some housekeeping personnel, maintenance personnel, and other related facilities workers.
3. Non-Radiation Workers: These workers are not expected to come into contact with radioactive materials or enter radioactive areas. These include administrative assistants, IT workers, and other operational support staff.

These groups require different levels and frequency of training. ARU/PIs must submit evidence of prior training and experience during the application process. The WVURSD provides a basic radiation safety course for all AUs as a supplement to previous experience.

4.2 TRAINING FREQUENCY

Training occurs on an as-needed basis. However, the WVURSD subscribes to some basic guidelines for frequency and intensity at which these groups receive training.

1. All new personnel in affected departments: safety orientation training which includes basic radiation safety training, as well as radiation basics.
2. ARU/PIs and Radioactive Lab Workers: Initial training on acceptance into radioactive use programs, as well as annually thereafter
3. Ancillary Workers: Annual refresher training

5. OBTAINING AUTHORIZATION FOR USAGE OF RADIOACTIVE MATERIALS

Any purchase, use or work undertaken with radioactive materials written authorization, from the Radiation Safety Committee. Individuals who wish to become authorized to use radioactive materials 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 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.

5.1 APPLYING FOR AUTHORIZATION

For an individual to become an Authorized User, the person must have completed radiation safety training and have ample experience in utilizing radioisotopes. The 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). Late 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 precursory recommendation to the RSO. This recommendation will be reviewed by the RSO and if deemed appropriate, refer to the Radiation Safety Committee for consideration. Prospective Authorized Users must complete the WVU Radiation Safety Department's training for ARU/PIs 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, in addition to completing annual refresher training (also published by the WVU RSD).

Authorized User application evaluations include the following:

21. 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. 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.
1. 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 the 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.

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.

Applicants to the Non-Human Use Committee must give pertinent information about their training and experience, a protocol for the proposed project, and a physical description of their laboratory.

Current policy requires that a prospective radionuclide user demonstrate his or her knowledge of radiation protection practices by successfully completing AU radiation safety training available on SOLE.hsc.wvu.edu. The prospective AU should contact the RSD for access to the radiation safety training course.

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.

Applications and appropriate forms may be found on the Radiation Safety website at www.hsc.wvu.edu/rsafety.

5.2 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. The investigator need not retake the initial radiation safety training for an authorization amendment.

5.3 Authorization Renewals

At present, there is no specific time limit set on radionuclide authorization once the investigator has been approved by the Radiation Safety Committee. However, the Radiation Safety Committee may withdraw authorization from an investigator who remains inactive for an extended period. An investigator may also request inactive status if he or she does not intend to use radioactive materials for some time. The investigator may not have any radioactive materials in the laboratory, including waste, when obtaining inactive status. Inactive status exempts the investigator from the requirement for monthly laboratory surveys and some posting requirements. It does not exempt the PI from annual refresher training. Specifics of inactive status are determined on a case-by-case basis by the Radiation Safety Officer. Reactivation of the laboratory requires a memo to the Radiation Safety Department. If the PI is not up to date on annual refresher training, the PI may be required to reapply for authorization upon requesting reactivation.

5.4 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. ARUs should reference Section 15 of this Manual, Laboratory Close Out/Transfer, for radioactive laboratory close out procedures.

5.5 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. New staff entering authorized laboratories who will be working with radioactive materials/radiation producing devices are required to complete the radiation safety training prior to beginning work with materials.

Training of lab workers in research laboratories who do not work directly with radioactive material is covered later in more detail, but it is the sole responsibility of the Principal Investigator to train and keep records of this training.

6. PROCUREMENT OF RADIOACTIVE MATERIALS

6.1 AUTHORIZATION TO ORDER RADIOACTIVE MATERIALS

All individuals wishing to purchase radioactive materials at West Virginia University (WVU) must first have obtained 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 on behalf of the Radiation Safety Committee. Orders for non-authorized items or activities that go above the authorization limit will not be permitted.

6.2 APPROVAL OF RADIONUCLIDE ORDER

All radioactive material orders must first be approved by the RSD before placement of the 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.

6.3 ORDERING PROCESS

All orders of radioisotopes shall be conducted in accordance with the University's ordering policy through the Mountaineer Marketplace.

1. On the main screen of the Marketplace, in the table marked "PCPS Automated Forms," select the option for "Non-Catalog Form." Ordering radioisotopes for research use can only be done through this form.
2. Fill out the form in its entirety.
3. At the bottom of the form, there are a series of checkboxes under the category "Health and Safety."
4. Check the box marked "Radioactive."
5. Submit the form.
6. The item will be routed to the WVU RSD, where authorization and possession limitations will be reviewed for approval. If the requested isotope is one the ARU/PI is not currently licensed for, or the activity will exceed the permitted limit, the order will be rejected.

6.4 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.

6.5 Order Arrival

All radioactive material orders shipped to WVU must be sent to Central Receiving located on the Health Sciences Campus (64 Medical Center Drive) The RSD performs the required procedures for inspecting and monitoring packages. However, establishing the integrity of the innermost container is the responsibility of the ARU/PI. Should the package need transported to another WVU Campus (Downtown or Evansdale), a Campus Bill of Lading shall be attached by the WVU RSD Specialist that performed the package check-in. In addition, lab workers on campuses other than Health Sciences who will be transporting material across public highways must complete United States Department of Transportation training offered by the WVU RSD in compliance with 49 CFR 172 Subpart H.

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.

6.6 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.

7. STORAGE OF RADIONUCLIDES

7.1 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.

In addition to the above, if the shipping container for the isotope cannot safely act as secondary containment for a spill, the laboratory shall provide secondary containment for the isotope. 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 C for examples of approved signs and labels.

7.2 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 that are provided with appropriate filters. Only the amounts of material necessary for immediate use should be stored.

8. AUTHORIZED LABORATORY REQUIREMENTS

Once authorization approval has been granted, Principal Investigators must set up their labs following Radiation Safety Department guidelines. A member of the Radiation Safety Department must 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.

8.1 PHYSICAL REQUIREMENTS

Floors must be smooth continuous surfaces. Tile is acceptable if cracks are filled with a nonporous material such as wax. Any permanent porous or absorbent material is prohibited.

Walls, ceilings, and furnishings shall be composed of non-porous surfaces that can be easily cleaned.

Labs that use volatile radionuclides shall 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. Fume hood testing is the responsibility of West Virginia University Environment, Health, and Safety Department.

Suitable monitoring and measuring equipment for the radionuclides and activities used must be available.

Benches shall have non-porous tops with no sharp corners. Use of absorbent paper and strippable paint is recommended.

Appropriate monitoring for the radionuclides used will be required. This will generally consist of a check of the area with a survey meter and/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. A separate monthly survey is not required if a post-experiment contamination survey was performed. There are separate requirements for labs that have no radioactive inventory. Detailed laboratory survey requirements are discussed in Section 9.5.

8.2 USE OF CAUTION SIGNS AND LABELS

The following use of caution signs and labels is required by the NRC. Although these signs and labels initially will be available from the Radiation Safety Department, Authorized Users should purchase their own if there is a continuing need. Assistance in marking, labeling, and posting shall be supervised by the Radiation Safety Department.

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 in this section. 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.

Radiation Machines

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

Radioactive Material

The following shall be posted with a "Caution - Radioactive Material" sign or label:
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.
Each container in which radioactive material is TRANSPORTED, USED or STORED in amounts greater than the quantity specified in Appendix A.

All entrances and exits of the lab shall have the required door postings. These are furnished by WVU RSD.

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.

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.

Note: Equipment such as refrigerators or freezers, which are used for storage, should bear a "Caution - Radioactive Material" sign also.

Radiation Area

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 mrems) in one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

High Radiation Area

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 mrems) in 1 hour at 30 centimeters from the radiation source or from any surface that

the radiation penetrates.

Very High Radiation Area

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.

Airborne Radioactivity Area

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 –
In excess of the derived air concentrations (DACs) specified by the NRC, or
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.

8.3 POSTING REQUIREMENTS[1]

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. 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.

1. NRC Form 3 “Notice to Employees”
22. WVU Radiation Safety Emergency Procedures
2. Wipe test map and area diagram

[1] Forms can be printed or downloaded from the West Virginia Radiation Safety Department website

9 GENERAL LABORATORY PROCEDURES

9.1 Objectives of Radiation Protection Measures

To minimize exposure from external radiation to levels as low as are reasonably achievable (ALARA) and always within the set dose limits.
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:

1. Analyze in advance the hazards of each job.
2. Provide safeguards against foreseeable accidents.
3. Use protective devices and planned emergency procedures in accidents that do happen.

9.2 Basic Policy

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.

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

In some cases, before the procedure is actually performed with radiation, it should be given a "dry run" to preclude slip-ups or unexpected complications.

Each Authorized User must make a copy of this Radiation Safety Manual available to students and employees where radioactive materials are used, and may copy those portions of particular importance to individual employees and students.

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 website. (http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/appb/)

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

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

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. If this is not a feasible option, a locked container that is suitably difficult to remove from the lab shall be acceptable. This determination will be made by the WVURSD.

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 online at the WVU SOLE website. The ARU is also responsible for training non-radiation users in basic radiation safety awareness. The content is up to the PI, but should include basics such as radiation signage and common storage, avoiding unnecessary exposure, not cleaning up spills (only a Radiation Worker can conduct actual clean up and decontamination), ALARA principles, and security.

9.3 Maintain Good Personal Hygiene

Keep fingernails clean and reasonably short.

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

Do not smoke, eat, drink, apply cosmetics, etc. in radionuclide work areas. Do not use the same refrigerator for food and radioactive material.

Wear a lab coat and disposable gloves to protect personal clothing and hands from contamination. If you have a break in the skin, be sure to cover it prior to experimentation. Long pants and shoes offer more protection than shorts and sandals.

Check or change gloves periodically while working with radionuclides. Even small amounts of contamination with high-energy beta emitters (such as P-32 and Sr-89) can give very high shallow-dose equivalents over a short time.

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

Use proper glove removal technique when taking off gloves to minimize the chance of spreading any contamination that may be present.

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.

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

The maximum permissible amount of contamination is:

Group 1 radionuclides: 22 dpm/100cm^2 above background

Group 2, 3, and 4 radionuclides: 220 dpm/100 cm^2 above background

If clothing reads less than these limits, it may be released directly to the laundry. (See Appendix B)

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.

If several washings still are not able to lower the contamination, then treat it as solid radioactive waste.

9.4 Preparation and Use of Working and Storage Areas

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

All work surfaces and storage areas (tabletop, hood, floor, etc.) should be properly covered. Some surfaces, especially in older buildings, are very hard to decontaminate and should be protected. If needed, designate and properly label sink for radioactive glassware only. Protection from contamination can be achieved with disposable, absorbent paper. Remove the paper and dispose of as radioactive waste as needed.

Plastic or metal trays should be placed on the surface when liquids are to be used. The lip of the tray serves to confine a spill.

Absorbent mats or paper may also be used. Incontinent mats 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.

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.

Experiments involving any procedures that might produce airborne contamination (volatile radionuclides, powders or gases) shall be conducted in a hood, glove box or other suitable closed system.

Radioactive gases or material with radioactive gaseous daughters must be stored in gas tight containers and kept in areas having good ventilation.

An approved hood should have an airflow of at least 100 linear FPM when the sash is at working height. This should be verified by a representative of the Radiation Safety Department before being put into use and at least annually thereafter. The actual testing of face velocity is

conducted annually by the West Virginia University Environmental, Health, and Safety Department.

Precautions must be taken to limit effluents to unrestricted areas to no more than the amounts specified by the NRC in 10 CFR Part 20, Subpart K.

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

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

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.

Whenever feasible, radioactive material, and particularly liquids, should be kept in unbreakable (e.g., plastic) containers. If kept in glass, a larger secondary container should be provided in which to place the glass container.

Vacuum pumps attached to contaminated systems should exhaust into a hood.

Provisions for radioactive waste disposal must be made. See Section 14 "Radioactive Waste Handling, Storage, and Disposal", for instructions concerning disposal of material.

9.5 Survey of Working Area

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).

If the laboratory was not active, (no radioactive materials used) in the previous month or the current month, only a wipe test on areas where materials are present needs to be completed. This is typically waste areas and storage areas.

If the laboratory has no materials present, and a wipe test was completed after all material has been removed from the lab (including waste), then the lab is exempt from contamination tests. If the wipe test is not contaminated (no samples > 200 dpm/100cm2), the lab worker that conducted the wipe test shall sign the wipe test form in the following manner: “All samples less than 200dpm,” and then sign the results.

If a wipe sample is contaminated (> 200 dpm/100cm2), complete the following steps:

1. Sign the wipe test results; stating which wipe location was contaminated.
2. Recount the contaminated sample/s on the same machine.
3. If the count is now below 200 dpm, the area can be treated as uncontaminated. Sign the new results as described in the 9.5, paragraph 3 and file both wipe test results.
4. If the count is still above 200 dpm, sign the new wipe test results as described in Step 1 of this list, adding how the item/location will be decontaminated.
5. Decontaminate the item/location as described and resample.
6. If the wipe result is less than 200dpm, the item/location is decontaminated. Sign the wipe results as described in 9.5, paragraph 3 and file all wipe results.
7. If the wipe sample is still contaminated, repeat this checklist until the sample is less than 200 dpm. Consult the Radiation Safety Department for assistance with decontamination as necessary.

These procedures are presented in flowchart form in Appendices I and J.

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.

High energy beta emitters shall be shielded with acrylic in an appropriate thickness. Materials have a tenth-value layer (TVL), which is the thickness of material required to reduce the emission by 90%. This TVL thickness should be considered the minimum required thickness. Gamma emitters shall be shielded with lead in an appropriate thickness, referenced to the TVL.

Before using the survey instrument, check that:

1. The machine is in calibration;
2. The battery condition is acceptable;
3. Its response to the check source is in the acceptable range.

If difficulty is encountered, call the Radiation Safety Department for assistance.

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.

Upon request, Radiation Safety staff will monitor any experimental setup and provide guidance as required.

Laboratories using only low energy beta emitters, like H-3 (tritium) and C-14, shall conduct the survey by swabbing the work areas with cotton swabs and counting them in a liquid scintillation counter.

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.

9.6 Proper Use of Equipment

The use of tongs or other long-handled devices greatly reduces hand exposure by increasing the distance between your hand and the radionuclide. Sources of activity greater than 10 μCi should be handled with tweezers or tongs and not directly. This does not apply to low energy beta emitters such as H-3, C-14, or S-35.

Use pipette-filling devices. NEVER PIPETTE SOLUTIONS BY MOUTH.

Equipment such as glassware 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.

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.

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.

Heavy rubber gloves can be used to significantly reduce the beta dose to the hands from high-energy betas. Bear in mind that this will not change the gamma exposure.

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

9.7 Transportation of Radionuclides On Campus

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.

Before transporting radioactive materials on campus, ensure that the radiation exposure level is less than 2 mR/hr at the surface of the container. If the exposure rate is greater than 2 mR/hr, add appropriate shielding until the exposure rate is less than 2 mR/hr.

When going from one floor to another, use a service elevator. Ideally transportation of radioactive materials via elevator should occur without other passengers. Encourage others to use another elevator.

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.

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 paragraph.

Lab workers on campuses other than Health Sciences are required to take DOT training available from the Radiation Safety Department prior to transporting material on public roadways. Specifically regarding the above, the WVU RSD will provide security seals and a Bill of Lading for all inter-campus transportation.

9.8 Survey Instruments

Each Authorized User must provide his or her workers with an appropriate survey instrument for the daily contamination surveys. The WVU RSD can loan meters to ARU/PIs on a case-by-case basis for a short period while a meter is on order or the meter is undergoing maintenance.

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-14, S-35, and H-3 are the only exceptions to the instrument requirement, since the detector efficiency for these isotopes is quite low.

Instruction of personnel in the use of specific survey instruments is the responsibility of the Authorized User. The general use of a survey meter is covered in the online SOLE training.

A check of the battery condition, the response of the instrument to a check source, and calibration date check 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.

The Radiation Safety Department will calibrate certain 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.

A temporary replacement instrument will be provided by the Radiation Safety Department if available. However, a replacement cannot be guaranteed.

Bear in mind the need for survey instruments when applying for grants and contracts. These items are usually acceptable to granting agencies.

9.9 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:

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

Those performing iodinations should use a special iodination box with a minimum of 100 linear FPM airflow, 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.

9.10 Sealed Sources and Leak Tests

These sources will be given an initial leak test by a Radiation Safety representative when they are received from the vendor.

Subsequent leak tests will be performed by Radiation Safety staff at required intervals. They require no action on the part of the user.

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

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

9.11 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.

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.

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.

10.RADIATION PROTECTION MEASURES

10.1 INTRODUCTION

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

1. Radionuclides outside the body (external sources of gamma and/or high energy beta emitters)
2. Radionuclides inside the body (internal exposures from any radionuclide)
    a. Breathing radioactive vapor
    b. Ingesting radioactive material food, water, or from contaminated hands
    c. Entering though a cut
    d. 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.

10.2 REQUIREMENT TO KEEP DOSES ALARA

All licensees and permit holders are required by the Nuclear Regulatory Commission (NRC) 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.

10.3 RADIATION PROTECTION LIMITS

West Virginia University must comply with the radiation protection limits specified by the NRC in 10 CFR 20. 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.

10.4 NRC OCCUPATIONAL DOSE LIMITS

For adults, an annual limit shall not exceed:

1. 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.
   2. 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.
2. 15 rems (0.15 Sv) for the lens dose equivalent (LDE), which is the external dose to the lens of the eye.
3. 50 rems (0.5 Sv) for the shallow dose equivalent (SDE), which is the external dose to the skin or to any extremity.

A table of the above values is listed below, pulled directly from the NRC regulations.

NRC Occupational Exposure Limits

Exposed Body	Annual Limit (mrem)
Whole body	5,000
Skin of the whole body	50,000
Extremity	50,000
Lens of the eye	15,000
Minors (persons < 18 years old)	500
Fetus	500 per 9 month period

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 to satisfy the aforementioned limit. Thus, the monthly exposure during pregnancy should be less than 50 mrems (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 mrems (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 mrems (0.02 mSv) in any one hour.

10.5 Individual Monitoring

10.5.1 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. At a minimum, each Authorized User must monitor occupational exposure to radiation and must supply/require the use of individual monitoring for the following conditions:

1. 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.
2. 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
3. Individuals entering a high or very high radiation area.
4. For all radiation workers using high energy beta and gamma emitting radionuclides at a quanity of 1 millicurie (mCi) or greater are required to wear whole body and extremity monitors.

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

1. 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
2. Minors and declared pregnant women likely to receive a committed effective dose equivalent in excess of 50 mrems (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.

10.5.2 Types and Use of Monitoring Devices

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

1. Thermoluminescent Whole Body Dosimeter (whole body badge): provides x-ray, gamma, high energy beta, and neutron radiation monitoring with thermoluminescent (TLD) technology, utilizing an lithium fluoride (LiF) detector material. The dosimeter is affixed to a holder with a clip so that it can be fastened to clothing in a consistent location (waist, chest, or collar) to monitor radiation exposure to the worker's head and torso.
2. TLD Ring Dosimeter: provides extremity (hands) 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 thermoluminescence of a LiF 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, visit our website where the user/s can apply online.

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

Present policy is for the Radiation Safety Department to bill each department quarterly for all monitoring charges accrued.

10.5.3 Investigational Levels

The investigational level exposure notice is investigated by the RSO to determine the cause of the unusual exposure and may require additional action from the appropriate administrator. If an occupational worker's radiation dose reaches the levels in the table below, the worker is required to complete a questionnaire sent to them by RSD and return it to the RSO as part of the investigation. This process is intended to identify any deficiencies in the Radiation Protection Program to further the goal of ALARA.

	Investigational Level (mrem/calendar qtr)
Total Dose Equivalent	375
Sum of Deep-Dose Equivalent and Individual organ or tissue other than the lens of the eye	3750
Eye Dose	1125
Shallow Dose Equivalent to skin or any extremity	3750

10.6 Bioassays

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

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.

The following table indicates the quantities of radioiodine and circumstances of use in which a thyroid bioassay must be performed:

Table 2: Activity levels above which bioassay is necessary

Location of Use	Activity Used at One Time or in One Day	
	Volatile or Dispersible	Bound to Nonvolatile Agent
	Radioiodine Activity	Radioiodine Activity
Open Room or Bench	1 mCi	10 mCi
Fume Hood	10 mCi	100 mCi
Closed Glove Box	100 mCi	1 Ci

In order to establish a baseline, a worker should have a routine bioassay, whether it be urinalysis or thyroid scan, before exposure to radionuclides but not over one month prior. Subsequent to exposure, a bioassay should be conducted between 24 and 72 hours after exposure to activity greater than or equal to those listed in Table 2. Should exposure to this activity be frequent, it is sufficient to repeat the test every two (2) weeks. Workers in areas having on hand or having used in a calendar quarter an activity greater than or equal to that listed in the "Closed Glove Box" entry for Table 2 should have a bioassay at least quarterly.

If a thyroid scan is the proposed method of bioassay, call Nuclear Medicine and arrange an appointment. If a scan will be needed over a weekend, call the Radiation Safety Department for assistance.

Should a thyroid bioassay show more than 1 μCi radioiodine, notify the Radiation Safety Department immediately so an investigation, corrective actions, and additional monitoring can be initiated. If the thyroid bioassay exceeds 5 μCi, notify the Radiation Safety Department immediately so that medical consultation and additional monitoring can be initiated as described in NRC Regulatory Guide 8.20, Revision 2.

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.

10.6.1 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.

10.7 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:

1. 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 mrems) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates;
2. 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
3. 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.

10.8 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.

11.USE OF RADIONUCLIDES IN ANIMALS

11.1 AUTHORIZATION

All protocols involving the use of radioactive materials in animals must be submitted to the Non-Human Use of Radiation and Radionuclides Committee. 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.

11.2 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 Non-Human Use of Radiation and Radionuclides Committee for recommendations or approval.

The general regulations for the radionuclide area in the Animal Quarters are listed below.
All excreta are to be disposed of by the Authorized User, using procedures given in section heading, "Radioactive Waste Disposal".

Feeding and watering of the animals given radionuclides are responsibilities of the Authorized User unless specific arrangements have been made with the Director.

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, cotton tip swabs 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.

The Authorized User is responsible for monitoring the following areas at least once each week:

1. Floor of the room housing the animals
2. Sink at which excreta are disposed
3. Sink at which equipment is washed

A record of all monitoring must be kept by the Authorized User.

The area occupied by animals and equipment must be monitored at the termination of the experiment by a representative of the Radiation Safety Department.
The Authorized User must post appropriate radiation signs at the area in which his or her animals are housed.

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.

12.SEALED SOURCE IRRADIATORS

12.1 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.

At this time, the National Council of Radiation Protection recommends the complete removal of sealed source irradiators, and instead advocates for the use of x-ray based irradiators. The radiation producing devices have a number of advantages over a sealed source irradiator, most notably operator safety and no risk of unregulated release of material.

12.2 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:

1. Attend the general orientation to radiation safety.
2. 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.
3. 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.
4. 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.

12.3 Safety Precautions

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

1. Procedures for operating the irradiator
2. Instructions concerning monitoring
3. Instructions to lock the door to the room when the room is unattended.
4. Instructions concerning what to do if abnormal radiation levels are detected, including locking the door and contacting the Radiation Safety Department.
5. 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.

12.4 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 Non-Human Use of Radiation and Radionuclides Committee 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.

13.EMERGENCY/INCIDENT

An incident 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

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.

During normal working hours (8:15 AM – 4:45 PM), call The Radiation Safety Department (RSD) (304) 293-3413.

Outside normal working hours, page Radiation Safety on call phone (304) 293-6430 and leave a ten-digit call back number.

13.1.1 FIRE, EXPLOSION OR SERIOUS INJURY:

First, call Public Safety at 911 anytime.

Second, during normal working hours (8:15 AM – 4:45 PM), call RSD at (304) 293-3413.

Third, contact any Laboratory or Departmental Emergency contacts listed on the entry door.

13.2 INSTRUCTIONS TO WORKERS: MINOR SPILLS OF LIQUIDS OR SOLIDS/CONTAMINATION

1. Notify other persons in the area that a spill has occurred.
2. Evacuate if spill is of a volatile material.
3. Immediately remove contaminated shoes or clothing.
4. Prevent the spread of contamination by covering the spill with absorbent paper. Paper should be dampened if solids are spilled. Mark the spill or contaminated area and limit access to avoid the inadvertent spread of contamination.
5. Clean up the spill, wearing disposable gloves and using absorbent paper. Use shoe covers if floor is contaminated. Clean up the spill by wiping from the perimeter of the spill to the center of the spill. If the spill is too large to remediate on your own call RSD immediately for assistance.

6. Carefully fold the absorbent paper with a clean side out and place in a plastic bag for transfer to a radioactive waste container. Put contaminated gloves and any other contaminated disposable material in the bag.
7. Survey the area with an appropriate low-range radiation survey meter or other appropriate technique. Check the area around the spill for contamination. Also check hands, clothing, and shoes for contamination.
8. Promptly report the incident to the Radiation Safety Department.
9. Allow no one to return to work in the area unless approved by Radiation Safety.
10. Cooperate with the RSO and the RSO's staff (e.g., investigation of root cause, provision of requested bioassay samples).
11. Follow the instructions of the RSO and the RSO's staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

13.3 Instructions to Workers: Major Spills of Liquids and Solids

1. Clear the area. If appropriate, survey all persons not involved in the spill and vacate the room.
2. Evacuate if spill if of volatile material.
3. Immediately remove contaminated shoes or clothing.
4. Prevent the spread of contamination by covering the spill with absorbent paper (paper should be dampened, of solids are spilled), but DO NOT attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.
5. Shield the source only if it can be done without further contamination or significant increase in radiation exposure.
6. Close the room and lock or otherwise secure the area to prevent entry until Radiation Safety arrives.
7. Notify the Radiation Safety Department immediately.
8. Survey all personnel who could possibly have been contaminated. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with a mild soap.
9. Allow no one to return to work in the aera unless approved by Radiation Safety.
10. Cooperate with the RSO and/or the RSO's staff (e.g., investigation of root cause, provision of requested bioassay samples).
11. Follow the instructions of the RSO and/or the RSO's staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

13.4 Skin and Body Contamination

Notify RSD immediately whenever any case of skin or body contamination occurs.

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.

Wash skin using mild soap and warm water for 2-3 minutes. Do not abrade skin or use hot water.

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.

If the skin becomes irritated, discontinue decontamination.

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.

13.5 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.

Follow the Fire, Explosion & Serious Injury notification procedure. Public Safety responders are trained to provide first aid.

If possible, have someone meet emergency response personnel and escort them to the accident scene.

Remove contaminated items and clothing from the victim only if these actions will cause no further harm.

If time permits, attempt to provide an uncontaminated pathway for the emergency crew.

Have someone who can provide useful additional information accompany the victim to the emergency room.

13.6 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.WASTE HANDLING, STORAGE, AND DISPOSAL

14.1 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.

Waste pickup requests can be generated from the EHSA online portal (available to all HSC ARU/PIs and their workers), or via email. 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.

14.2 TYPES OF WASTE

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

1. Dry Solid Radioactive Waste
2. Solid Biological Radioactive Waste
3. Liquid Radioactive Waste
4. Liquid Scintillation Vials

5. Radioactive/Hazardous Mixed Waste

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

14.3 SHORT HALF-LIFE WASTE (DECAY-IN-STORAGE)

Radionuclides with physical half-lives of 120 days or less are considered short half-life, and may be held for decay-in-storage. Decay-in-storage means that short-half life radionuclides may be stored and allowed to sufficiently decay after which it can be disposed of as ordinary waste when radiation surveys of the waste indicate that radiation levels are indistinguishable from background. 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.

Labs may **not** hold waste for decay-in-storage unless given prior approval by RSD. Radiation Safety personnel must perform the final monitoring and give approval before the waste may be disposed.

Decay-in-storage disposal procedure:

1. Only short half-life waste may be disposed of by decay-in-storage, and must be segregated from long half-life waste.
2. Waste must be stored in suitable well-marked containers, and the containers should provide adequate shielding.
3. Liquid and solid waste will be stored separately.
4. When a container is full, it should be sealed. The container should be labeled with the date it was sealed and the longest half-life radionuclide in the container.
5. Move the container to the decay-in-storage area.
6. The contents of the container should be allowed to decay for a period of time after which it is expected that the radiation levels would not be distinguishable from background. As a guideline – radioactive waste should be allowed to decay at least 10 half-lives.
7. Prior to disposal as ordinary waste, each container must be monitored with an appropriate radiation detection instrument, on the lowest setting, as follows:
    a. Check the radiaton survey meter for proper operation.
    b. Survey the contents of each container in a low background area.
    c. Remove any shielding from around the container.
    d. Monitor all surfaces of the container.
    e. If the surveys of the contents indicate no residual activity (i.e., surface readings are indistinguishable from background), deface or remove all radiation labels from the container and discard as ordinary trash.
    f. If the surveys indicate residual activity, return the container to the decay-in-storage area for further decay.

g. If the surveys indicate no residual radioactivity, record the date when the container was sealed, the disposal date, type of waste, survey instrument used, and the name of the individual performing surveys and disposing of the waste.

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

The general procedure is as follows:

1. 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. Label the waste container with the type of waste (solid, LS, etc.) and the isotopic contents (H-3, C-14, etc.).
2. Do not place sharps in normal solid waste buckets. Contaminated needles shall be placed in disposable sharps containers furnished by the ARU/PI.
3. The WVU RSD also supports labs using labeled sharps containers for disposal. The container shall be labeled on two opposing sides with the proper radioactive signage. Contact the RSD for guidance as needed.
4. Wrap broken glassware in paper towels to prevent the plastic bag (and someone's hand) from being punctured.
5. Place only radioactive materials in these cans. Other materials only increase volume and raise the cost of disposal.
6. 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.
7. 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.

14.5 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 be 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.

Carcasses must be prepared for disposal in accordance with WVU IACUC requirements to prevent leakage. Low-energy beta emitting isotopes in carcasses may be stored without shielding. High energy betas and gammas must be shielded inside their cold storage. Contact the WVURSD for assistance.

14.6 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.

14.7 PROPER BAGGING

Place radioactive biological material in YELLOW plastic bags. Make sure the material will not puncture or tear the bag.

YELLOW bags are used only for radioactive material. Non-radioactive biological waste must not be placed in yellow plastic bags.

Seal the bag as described in Section 14.13 of this chapter, "Bag Sealing Instructions."

14.8 WASTE INVENTORY CONTROL

Waste inventory control and identification will be done by means of a waste tracking sheet. Each waste container has one associated with it and must be filled out by the ARU/PI. Blank copies are available from the WVURSD.
Most of the time, simply identifying the waste by type is sufficient. However, labs that perform a high volume of waste may have multiple containers that hold the same type of waste. In such cases, each container must be labeled in a distinct manner (e.g., Solid Waste 1, Solid Waste 2, etc.)

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.

Call Radiation Safety when the freezer needs to be emptied. Keep a copy of the waste tracking form for your records, as well as provide the RSD with a copy of the completed sheet.

14.9 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:

1. Aqueous liquids with no organic solvents
2. Liquid scintillation fluids
3. 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, use the online EHSA form or email WVU RSD with a waste manifest (online form preferred). Pickup will be 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.

14.10 Disposal in the Sanitary Sewer System

Disposal of liquid radioactive waste into the sanitary sewer system is not permitted at WVUH. However, bodily waste (urine, feces, vomit) may be disposed of via the toilet.

You may use a sink for rinsing of contaminated glassware and disposal of wash water. Designate a sink in the laboratory as a “Radioactive Waste Sink” and have the Radiation Safety Department mark it as such. Do not use an unmarked sink for washing contaminated glassware and disposing of wash water.

Wash water generated from the first few washes of items contaminated with radioactive material shall be contained in liquid waste barrels. Rinse the items multiple times into the liquid radioactive waste barrels, and then wash in a radioactive material labeled sink a final time, using plenty of clean water. 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 in the sanitary sewer.

14.11 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.

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.

Therefore, these types of scintillation fluid are not permitted for use. The WVURSD can recommend specific scintillation fluids, or your equipment manufacturer may have a suggested

fluid.

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 isotope. If you may have vials that contain activities of C-14 and H-3 greater than 0.05 μCi/mL, please contact the Radiation Safety Department.

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, 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.

14.12 Radioactive/Hazardous Mixed Waste

There are no facilities that are authorized to take this type of waste at the present time. Therefore, this type of waste is not permitted.

14.13 Bag Sealing Instructions

1. Twist the neck of the bag tightly. Wrap tape tightly two or three times around the twisted section.
2. Fold twisted section in half and wrap the tape around the loop two or three more turns.
3. If a bag tears, then re-bag it before putting it in the waste container.
4. 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.

14.14 Additional Requirements for All Radioactive Waste

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.

The chemical form of all waste must be specified.

All waste must contain less than 1% oil by volume.

Ion exchange resins and filter media must be dewatered.

There must not be any detectable freestanding liquids in waste barrels.

No radioactive waste may contain pyrophoric materials or materials that react violently with water.

The radioactive hazard must be greater than the chemical hazard. We must have an analysis of the chemical, biological, and radioactive hazard.

The physical form of all waste must be specified, e.g., compressed paper, glass, etc.

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.

The radionuclide and activity must be specified in microcuries (μCi) or millicuries (mCi). Radionuclides and activity must coincide exactly with the barrel sheet.

Use of thorium and/or uranium in a laboratory setting (typically electron microscopy staining) is permitted as these materials are low concentrations and are generally licensed. However, labs are required to complete a financial assurance form prior to ordering the material. In the event that the material requires an exceptional cost to dispose of, the lab itself, or the department, is responsible.

15 LABORATORY CLOSE OUT/TRANSFER PROCEDURE

15.1 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/relation 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.

15.2 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:

1. The PI/ARU is leaving the University;
2. The PI/ARU is relocating to a new laboratory at the University;
3. The PI/ARU is relocating to an off campus location; or
4. 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.

15.3 OBJECTIVE

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

15.4 ROLES AND RESPONSIBILITIES

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.

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.

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.

15.5 PROCEDURES

15.5.1 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.

15.5.2 GENERAL HOUSEKEEPING:

1. 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.
2. 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.
3. 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.

15.5.3 DISPOSAL OF RADIOACTIVE MATERIALS

1. All radioactive materials must be removed from the lab by one of the following methods:
2. 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.
3. 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.

4. Materials can be shipped back to the manufacturer.
5. 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.

15.5.4 LABORATORY EQUIPMENT AND SUPPLIES

1. Equipment (fume hoods, refrigerators, freezers, centrifuges, incubators, countertops, sinks, cabinets, etc.) must be completely empty of all radioactive materials.
2. Prior to defrosting freezers, conduct wipe tests to ensure no contamination is present. If contamination is present, contact the RSD at (304) 293-3413.
3. 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 is below background limits. If there are any issues or questions, consult the RSD for guidance.
4. Ensure all personnel have returned their dosimetry badge to the RSD, if applicable.

15.6 RADIATION SAFETY DEPARTMENT INSPECTION

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.

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.

RSO must sign off on Lab Closeout Checklist.

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 C

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

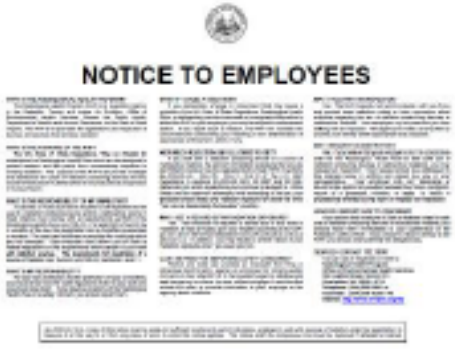
Radiotoxicity Group	Radioisotopes
Very High (group 1)	Pb-210, Po-210, Ra-223, Ra-226, Ra-228, Ac-227, Th-227, Th-228, Th-230, Pa-231, U-230, U-232, U-233, U-234, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Am-243, Cm-242, Cm-243, Cm-244, Cm-245, Cm-246, Cf-249, Cf-250, Cf-252
High (group 2)	**Na-22**, Cl-36, Ca-45, Sc-46, Mn-54, Co-56, Co-60, Sr-89, Sr-90, Y-91, Zr-95, Ru-106, Ag-110m, Cd-115m, In-114m, Sb-124, Sb-125, Te-127m, 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
Moderate (group 3)	Be-7, **C-14**, F-18, Na-24, C1-38, 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, 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-l91, Pt-193, Pt-197, Au-196, Au-198, Au-l99, 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
Low (group 4)	**H-3**, O-15, Ar-37, Co-58m, Ni-59, Zn-69, Ge-71, Kr-85, Sr-85m, Rb-87, Y-9lm, 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

* Isotopes in **bold** print are those most commonly used in a research setting.

APPENDIX C: COMMONLY USED SIGNS AND SYMBOLS

NRC Form 3 "Notice to Employees"

WVRHP Form X "Notice to Employees"



The WVU RSD has customized versions of Form 3 and Form X on their website that satisfy a number or regulatory requirements; it is recommended to print from there.

APPENDIX D: EMERGENCY PROCEDURES FOR RADIATION ACCIDENTS

EMERGENCY PROCEDURES FOR RADIATION INCIDENTS

Minor Spills of Liquids and Solids

1. NOTIFY persons in the area that a spill has occurred.
2. PREVENT THE SPREAD of contamination by covering the spill with absorbent paper.
3. CLEAN UP the spill, wearing disposable gloves and using absorbent paper. Put contaminated gloves and other contaminated disposable material in a plastic bag for transfer to a radioactive waste container.
4. SURVEY the area with an appropriate low-range radiation survey meter or other appropriate technique. Check the area around the spill for contamination. Also check hands, clothing, and shoes.
5. PROMPTLY REPORT the incident to the Radiation Safety Department.
6. ALLOW NO ONE to return to work in the area unless approved by Radiation Safety.
7. DETAILED INSTRUCTIONS are provided in Section 13 of the WVU Radiation Safety Manual.

Major Spills of Liquids and Solids

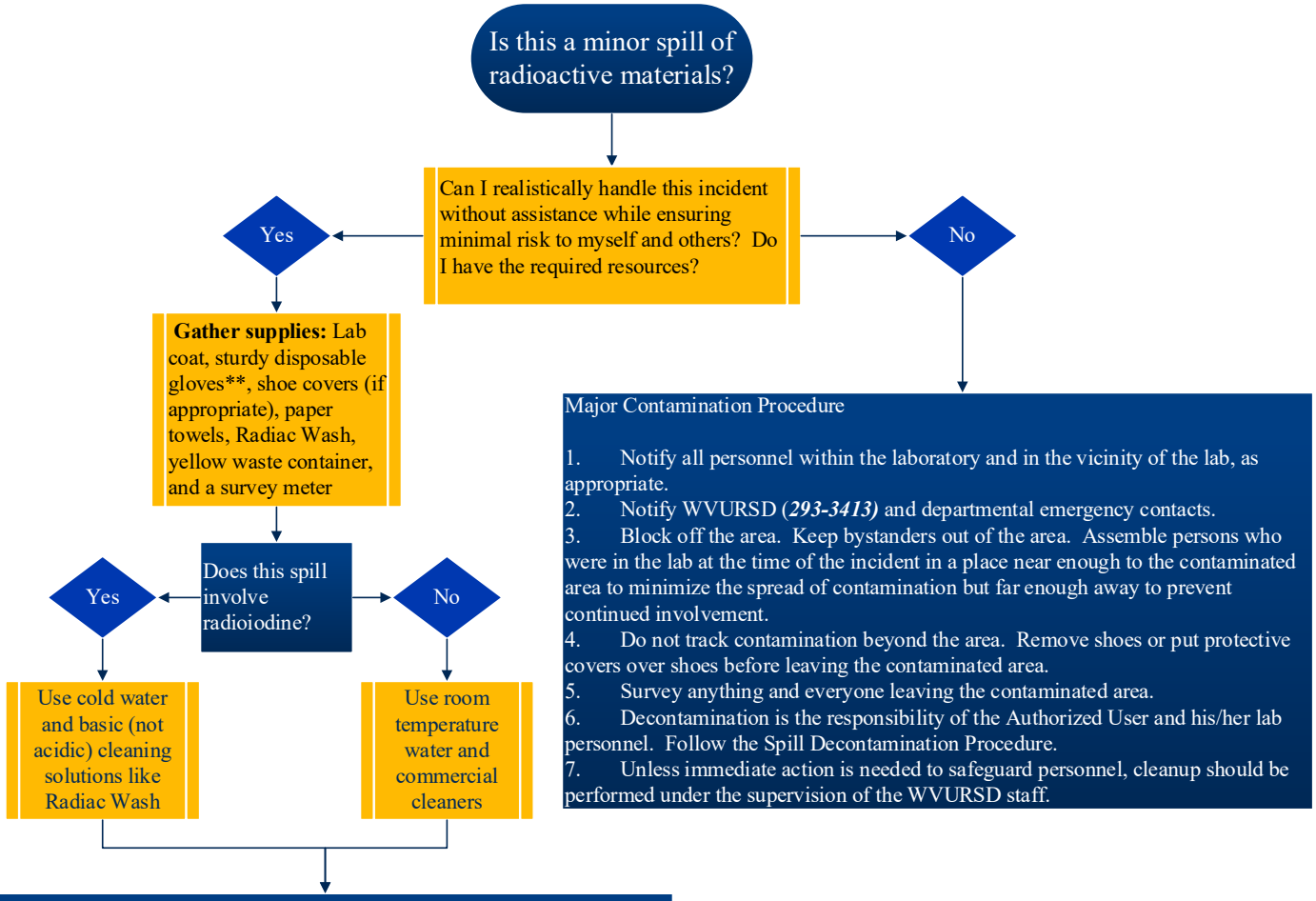
1. CLEAR THE AREA. If appropriate, survey all persons not involved in the spill and vacate the room.
2. PREVENT THE SPREAD of contamination by covering the spill with absorbent paper, but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated. Shield the source only if it can be done without further contamination or significant increase in radiation exposure.
3. CLOSE THE ROOM and lock or otherwise secure the area to prevent entry until Radiation Safety arrives. Post the room with a sign to warn anyone trying to enter that a radioactive material spill has occurred.
4. NOTIFY the Radiation Safety Department immediately.
5. SURVEY all personnel who could possibly have been contaminated. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with a mild soap.
6. ALLOW NO ONE to return to work in the area unless approved by Radiation Safety.
7. DETAILED INSTRUCTIONS are provided in Section 13 of the WVU Radiation Safety Manual.

Emergency Numbers

Radiation Safety Department Office: 304-293-3413
On-Call Radiation Safety Specialist: 304-293-6430
Stephen Root, RSO: 304-685-2371
WVU Police Department: 304-293-3136

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 Department at (304) 293-3413
Outside normal working hours:	Call the on call Radiation Safety Specialist at (304) 293-6430



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
n/a	HU Application	4/25/2005
601	NHU Application*	3/2020
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
n/a	Badge Application Form*	3/2020
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

* Denotes online form currently in use.

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		
Check the box that is applicable:	Yes	No	N/A
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 cm2			
<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: _____

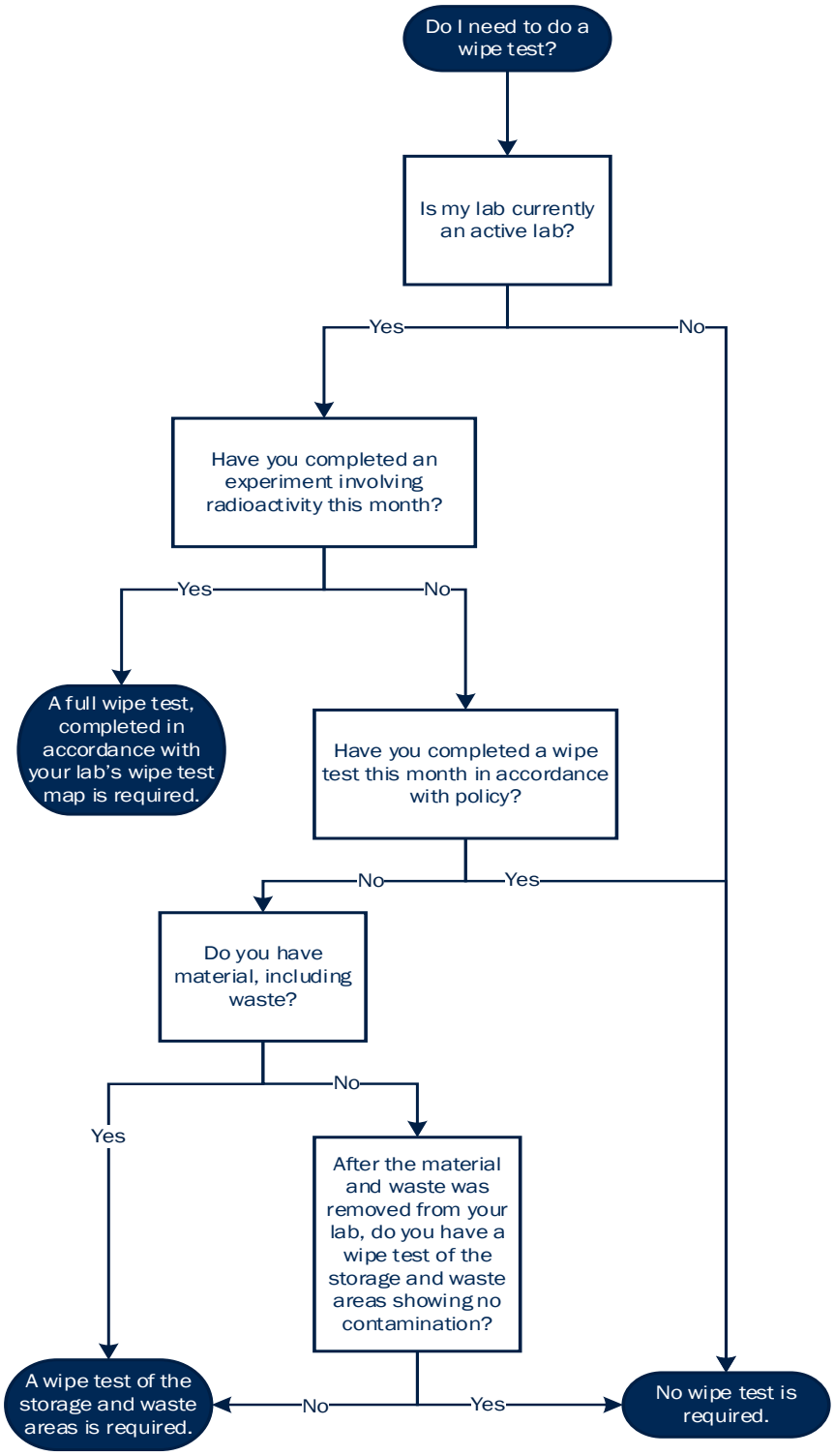
Please check one of the following:

☐ Permanent Lab Closeout ☐ Laboratory Relocation

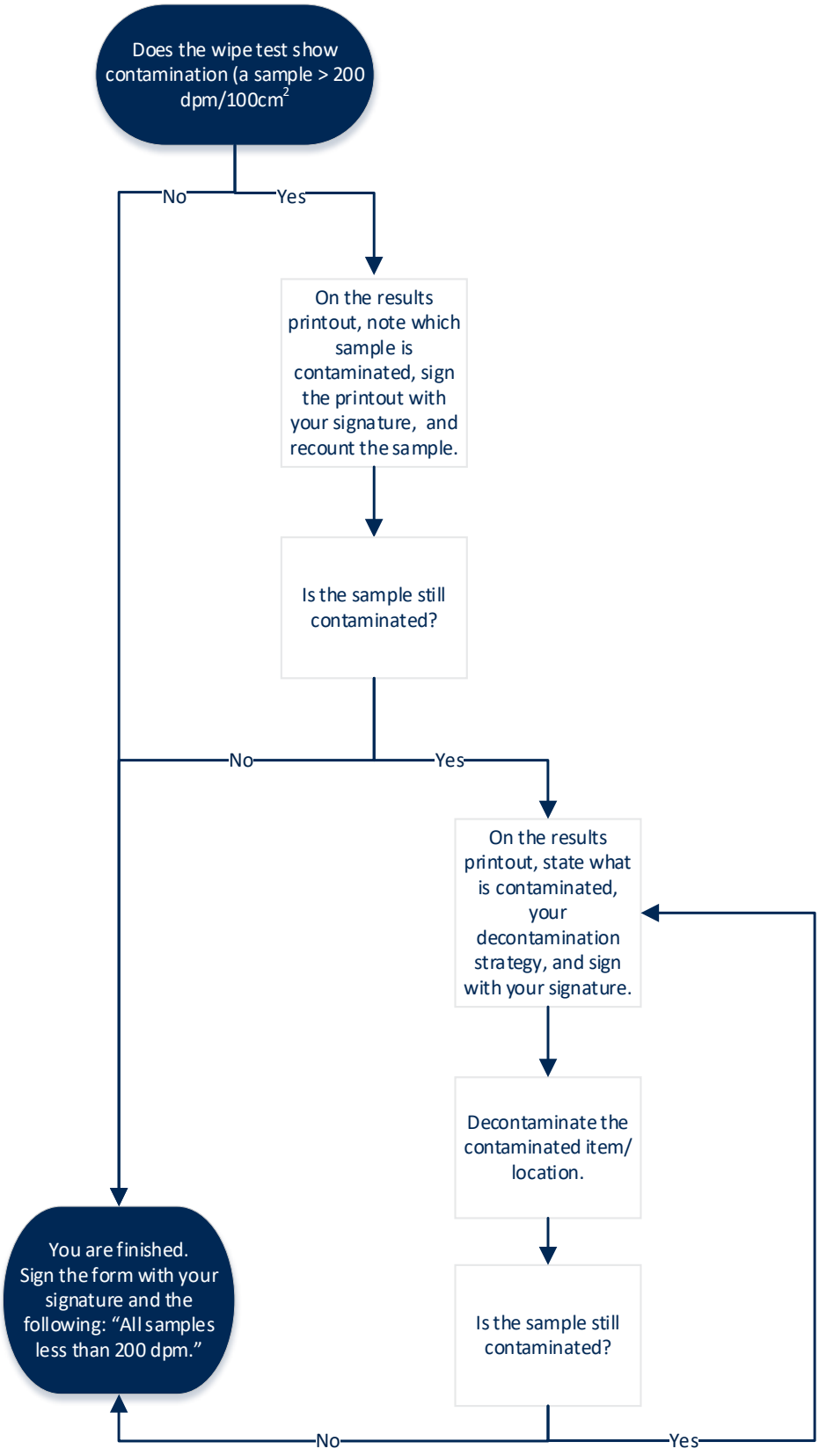
Date Form Submitted: _____

Anticipated Date of Move: _____

APPENDIX I: WIPE TEST DECISION FLOW CHART



APPENDIX J: CONTAMINATED WIPE TEST FLOW CHART



IN CASE OF A RADIATION EMERGENCY	
DURING NORMAL WORKING HOURS: (Monday through Friday 8:15 am – 4:45 pm)	Call the Radiation Safety Department at (304) 293-3413
OUTSIDE NORMAL WORKING HOURS:	Call the on call Radiation Safety Specialist at (304) 293-6430
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/	