Washington State University

Radiation Protection Program Manual

REVISION 03.27.2024

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1 STATEMENT OF PURPOSE

This document serves as WSU policy to implement a radiation safety program that includes maintaining the level of occupational exposure to students, faculty, staff, and the public "As Low As Reasonably Achievable". The purpose of the radiation safety program is to protect health and minimize the risk to life, property, and the environment in the use of ionizing radiation.

This manual assists University personnel in using ionizing radiation in accordance with current standards of good practice, the provisions of WAC 246, WSU's Type A specific license of broad scope for radioactive materials, No. WN-C003-1, and state regulations pertaining to this type of license.

These provisions include the establishment of appropriate administrative controls to include a radiation safety committee, a radiation safety officer, and pertinent procedures. A copy of this Radiation Protection Program Manual can be found on the WSU Radiation Safety Program website: www.rso.wsu.edu/. Additionally, SPPM Chapter 9 complements this manual.

2 INTRODUCTION

The State of Washington is an Agreement State with federal regulations associated with control of radioactive materials and radiation producing machines, with the exception of licenses for the operation of nuclear reactors as issued by the US Nuclear Regulatory Commission (NRC). The State of Washington has promulgated appropriate control regulations contained in WAC-246 (Title 10) and are required as an Agreement State to meet or exceed federal regulations. Additionally, WAC-173 cover mixed wastes. The University, under the provisions of WAC-246-235-030 and WAC-246-235-090 has a Type A specific license of broad scope (the Broad Scope License) for radioactive materials, Broad Scope License No. WN-C003-1. This license requires the establishment of appropriate administrative controls at WSU to include a radiation safety committee, a radiation safety officer, and pertinent policies and procedures.

The Radiation Safety Committee (RSC) and the Radiation Safety Officer are authorized by the WA State broadscope license and institutionally by the President, via the Vice President for Research, to grant Authorized Users (AU) permits to use specified materials or radiation producing machines (WAC 246-240-051). The Radiation Safety Officer ensures that radiation safety activities are being performed in accordance with licensee-approved procedures and regulatory requirements. The RSC is a Presidential Committee, responsible through the Vice President for Research, and with the Radiation Safety Officer is charged with protecting WSU faculty, staff, students, and visitors and has the authority and obligation to stop any activity with radioactive materials believed to be unsafe. Applications and proposals that have been approved by the RSO or RSC may be subject to further appropriate review and approval by officials of the institution. However, those officials may not approve an activity involving the use of radioactive materials and radiation-producing machines if it has not been approved by the RSO or RSC. The RSC and RSO are authorized to limit, suspend, or revoke an individual's authority to use radioactive material(s) or radiation-producing machines if such use is immediately dangerous to the life and health of individuals or violates health and safety codes.

The AU is responsible for safety and security of the materials or machines on their authorization. The RSO and RSC conduct project-specific risk assessments for each research project or lab working with radioactive materials or radiation-producing machines, often adding additional

requirements to meet ALARA principles. The AU must follow the requirements of this document, the permit issued, and any additional requirements made by RSO, RSC, or Radiation Safety Program (RSP) personnel.

2.1 Regulated Personnel

WSU personnel who use, supervise, or control radioactive materials or radiation producing machines must follow the procedures outlined in this manual.

Using radioactive materials of any quantities are not exempt from the requirements of this manual.

WSU personnel using generally licensed consumer products containing radioactive material (balances, static eliminators, smoke detectors, and chemical reagents containing uranium and thorium) are not regulated under this policy.

3 ORGANIZATION AND RESPONSIBILITY

3.1 Vice President for Research

WSU Executive Policy 29 states that the Vice President for Research (VPR) is responsible for the radiation safety program that will maintain compliance with relevant local, state, and federal regulations related to the use of ionizing radiation.

The VPR has delegated responsibility for development/operation the radiation safety program to the committees, departments, and individuals as stated below.

3.2 Radiation Safety Committee

The RSC is the compliance body of faculty and other subject matter experts appointed by the VPR as authorized by the WSU broad scope license to establish policies and procedures governing the use of ionizing radiation at WSU, to maintain surveillance over activities involving them, and to report on the status of these activities to the VPR.

3.3 Office of Research Assurances

The Office of Research Assurances implements the radiation safety program. This program includes surveillance of all users of radioisotopes and/or radiation-producing machines and equipment. Specific license maintenance functions include monitoring of exposure levels, investigation of incidents, safety consultation, training in radiation safety, radiation safety services, and management of radioactive wastes.

- ***3.3.1 The Director of The Office of Research Assurances or designee:***

Responsible for the review of WSU policies on radiation and radiation safety. The Director or designee is an ex-officio member of the Radiation Safety Committee.

- ***3.3.2 The University Radiation Safety Officer (RSO), Radiation Health Physicists (HPs), and Program Administrators:***

The RSO, HPs, and other program administrators are responsible for developing and operating the radiation safety program and for assuring that radiation uses are in conformance with WSU policies and applicable government regulations. The Radiation Safety Officer is named in the broadscope license and fulfills the requirements of WAC 246-220-010 and 246-240-069. The RSO is responsible for referring to the Radiation Safety Committee matters requiring its review and approval and is a voting member of the Radiation Safety Committee.

4 TRAINING

4.1 Policy

The Radiation Safety Program provides radiation safety training for individuals who work with or around radioactive materials, radiation producing equipment, and moisture density gauges. Authorized Users and workers using radioactive material or radiation producing machines must have initial training before using radioactive materials. Refresher training is required every year for workers using radioactive materials, except gauge only users.

4.2 Worker Categories and Training Requirements

- ***4.2.1 Authorized Users***

An Authorized User (AU) must be a permanent employee of WSU. They are directly responsible for compliance with all regulations governing radiation safety in the laboratory. AUs must take all required radiation safety training classes before using radioactive materials and radiation generating machines and are subject to the same retraining requirements as radiation workers.

- ***4.2.2 Radiation Workers***

Personnel who work directly with radioactive material and who are listed as radiation workers under an AU are considered Radiation Workers. These personnel must initially train before starting work in the laboratory. The annual refresher training requirement can be fulfilled on Radiation Safety Program website at https://rso.wsu.edu/refresher-training.

- ***4.2.3 Employee Departure***

It is the responsibility of the employee's supervisor to notify the AU if the worker has departed the lab or have left WSU. The AU is then responsible for notifying the Radiation Safety Program of the worker's status change. The AU must also ensure that all dosimetry issued to the worker is returned to the Radiation Safety Program.

4.3 Radiation Safety Training

All new radiation workers must review this manual; take the applicable the Training modules, and the AUs lab specific protocols. Copies of this manual and the training courses are available on the Radiation Safety Program's website http://rso.wsu.edu. Each Authorized user is responsible for training workers under his/her direction on radiation safety procedures and practices specific to their laboratory.

4.4 Radiation Refresher Training

The radiation refresher training provides updates in radiation safety policies, as well as general topics of interest that are relevant to those working around radioactive materials. This training can be completed at https://rso.wsu.edu/refresher-training/. Refresher training is completed annually by all active radiation workers. In person training may be given, as needed, if prior arrangements are made.

4.5 Radiation Producing Equipment Training

Radiation-Producing Machines (RPM) AUs including the Authorized User must take all training modules required for RPM users. Annual retraining is not required for users of RPM only.

Individuals that are only using Radiation Producing Equipment (X-ray diffraction units, luminoscopes, accelerators, spectrometers, industrial radiography equipment, and electron microscopes should complete the modules listed under X-ray users. No refresher training is required.

4.6 Equipment Specific Training

Additionally, each user of RPM must undergo equipment-specific training. The AU for each piece of equipment provides this training, which includes a demonstration of the proper use of the equipment (operation of all controls, safety interlocks, and the proper start-up and shutdown procedures). The individual should also be instructed on what to do in the event of an equipment malfunction. Equipment-specific training must be documented and available for review by the Radiation Safety Program.

Equipment-specific training should be done if a new unit is purchased, or an existing unit is modified (i.e., primary beam direction change, or shielding modification).

Documentation of site-specific training is required and must be maintained by the AU. This documentation should include the following information: Worker's name, employee/student ID number, date of training, topics discussed, and worker's signature.

5 PURCHASE OF RADIOACTIVE MATERIAL

5.1 Policy

The Radiation Safety Program approves all acquisitions of radioactive materials and radiation machines in advance. Acquisitions include purchases, gifts, and transfers. Radioactive material may be purchased only by an Authorized user. All radioactive material purchases are approved by the Radiation Safety Program.

The Authorized user must be approved to possess the isotope and activity ordered. The activity, when added to the current isotope inventory, may not exceed the AUs approved possession limit for that isotope.

All acquisitions of radioactive material must follow the same procedures as if they were purchased. This includes replacement shipments, trial kits, and free samples.

5.2 Purchasing Radioactive Materials

Authorized user is responsible for notifying the purchasing agent for your department to enter your isotope order in Workday. The order is then reviewed by the Radiation Safety Program to ensure that the possession limits for the university as well as the possession limit for the user is not exceeded prior to approving the order.

- ***5.2.1 Minimum Contents Required on Purchase Order for RSO Review:***

  (1) Radioactive Materials

  a. Radioisotope and chemical form

  b. Activity

  c. Authorized User (specified as the technical contact on the Departmental Requisition)

  d. Shipper, donor and/or transferor

  (2) Radiation Machines

  a. Authorized User (specified as the technical contact on the Departmental Requisition)

  b. Type of machine (accelerator, radiographic, XRD)

  c. Manufacturer and model number

- ***5.2.2 Credit Cards and Blanket Orders***

Credit Cards may NOT be used for paying for Radioactive Materials or Radiation Producing Machines.

The Radiation Safety Program accepts only blanket orders for the purchase of radioactive materials or radiation machines. All orders must obtain a written (initialed and dated) approval from the Radiation Safety Program. The approved order is returned to the submitter who then has the responsibility of forwarding the approved order to purchasing.

Blanket purchase orders for users who routinely purchase specific radionuclides are permitted. All blanket purchase orders must be reviewed and approved in advance by the Radiation Safety Program. Delivery instructions must designate the Radiation Safety Program as the consignee for each shipment.

5.3 Exceeding Radioactive Material Possession Limits

The Radiation Safety Program won't deliver materials which will cause AUs to go over their permit limits. In some cases, a portion of the authorized user's inventory may be waste, and a pick-up can be scheduled to reduce the inventory. The AU needs approval to increase their possession limit for that isotope. Contact the Radiation Safety Program for further information on increasing possession limits.

5.4 New Isotope Purchasing, Authorization Amendments

The AU must request an amendment to their authorization before the new isotope can be ordered. The website (https://rso.wsu.edu/) field "Forms/Manuals" can be completed and sent to the Radiation Safety Program, where it will be reviewed and placed on the agenda for the next scheduled Radiation Safety Committee meeting. The Radiation Safety Officer can authorize a temporary authorization until the committee approves the application.

5.5 Purchasing Sealed Sources

If you plan to purchase a sealed source, follow the same procedure used for ordering other radioactive materials. Sealed sources include disc sources used for meter calibration, rod sources used as external standards for gamma counters, as well as sources contained in anti-static devices.

5.6 Purchasing Liquid Scintillation Counters

Send the Purchase Requisition to the Radiation Safety Program, as well as the following information when the counter arrives: Make, Model, Serial Number, isotope, reference activity, and reference date of the source contained within the counter. Also list the Authorized User responsible and location for the counter.

5.7 Purchasing Gamma Counters

Send the Purchase Requisition to the Radiation Safety Program, as well as the following information when the counter arrives: Make, Model, Serial Number, isotope, reference activity, and reference date of the source contained within the counter. Also list the Authorized User responsible and location for the counter.

5.8 Purchasing Radiation Producing Machines (RPM)

If you plan to purchase an RPM, follow the same procedure used for ordering radioactive materials. The appropriate information must be sent to the Radiation Safety Program as soon as the equipment is purchased and no later than 60 working days before the equipment arrives, or whichever is sooner.

Information should include the manufacturer of the equipment, the model number, the serial number, and the date of purchase. WSU is required to notify the Department of Health of any equipment added to our registration.

6 RECEIPT OF RADIOACTIVE MATERIAL

6.1 Policy

The Radiation Safety Program receives, inspects, and surveys all incoming radioactive materials on the Pullman Campus, except specific items delivered directly to the VTH. Designated local personnel on other WSU campuses and sites receive, inspect and survey.

Authorized Users are not to receive radioactive materials directly from the vendor. Should a vendor have an unexpected delivery directly to the lab, personnel must contact the Radiation Safety Program.

6.2 Pullman Campus Package Receipt Check-In and Delivery

- ***6.2.1 Receipt and Delivery***

All off-site shipments of radioactive materials arrive at central receiving. the Radiation Safety Program delivers all radioactive packages after they are checked for radiation exposure and possible contamination. Damaged or contaminated packages will be held at the Radiation Safety Program until the matter is resolved with the vendor/shipper.

Information on the packing slip is checked against that recorded in the HP Assist database to verify that the items received are the same as those approved/ ordered. The inventory number generated by HP assist is written on the packing slip. Items that are standing orders need to be approved only prior to the initial order.

Radioactive materials must be received on the Pullman campus only during university working hours. Deliveries at any other time, such as holidays and weekends, are not allowed.

After surveying the incoming package, the Radiation Safety Program personnel deliver the materials to the Authorized User on the WSU Pullman campus.

If radioactive materials are inadvertently delivered directly to an Authorized User's laboratory, the Radiation Safety Program must be notified immediately so proper receiving surveys can be performed and the Radiation Safety Program's radioactive material inventory control system can be updated.

- ***6.2.2 Delivery to User***

Package delivery is made to the Authorized User's laboratory. If no one is available in the laboratory to receive the order, the Radiation Safety Program personnel will attempt delivery through the department office. If unavailable, the package will be returned to the Radiation Safety Program.

If received materials would cause the user to exceed possession limits, the Radiation Safety Program will not deliver the material. The Radiation Safety Program personnel will attempt to contact the Authorized User as soon as possible in such instances.

The Radiation Safety Program may elect not to deliver radioactive materials if the Authorized User is not in compliance with university radiation safety practices or protocols.

- ***6.2.3 Perishable Materials***

Researchers should place orders for perishable materials coordinated carefully to ensure that such materials arrive during regular business hours and can be processed without delay.

6.3 WSU Campuses

- ***6.3.1 Spokane***

Radioactive Materials shipped to Spokane are handled by a designee of the Office of Research Assurances. Delivery is made to the user's laboratory. If no one is available in the laboratory to receive the order, the designee will attempt delivery through the department office.

- ***6.3.2 Other Locations***

Materials and machines shipped to WSU locations other than Pullman or Spokane require the same approval process outlined above. However, delivery is made directly to the Authorized User, provided that:

- All purchases of radioactive materials must occur using Workday, which notifies the Radiation Safety Program.
- The Radiation Safety Program approves each requisition, a copy of which is sent to the Radiation Safety Program concurrently by mailing the requisition to the vendor.
- The recipient surveys the package upon receipt for exposure and contamination. A wipe (also referred to as a swipe) of the outside container must be taken, analyzed within 24 hours, and the results recorded.
- The recipient must notify the Radiation Safety Program in writing of receipt of the material by means of the Radioactive Delivery Record.
- The recipient maintains appropriate records.

Once the package arrives, the following steps must be completed:

- Inspect package for damage.
- Survey the contents for removable contamination and record the results on the Radioisotope Use Log.
- If damage is noted, notify the Radiation Safety Program.

- ***6.3.3 Veterinary Teaching Hospital (VTH)***

Only appropriately trained personnel (*e.g.,* radiation workers) listed on an Authorization are approved to receive and secure radiopharmaceuticals delivered by a commercial radiopharmacy directly to the VTH by courier.

All courier packages will be immediately secured in the restricted-access nuclear medicine materials processing lab (VTH 1303E).

Authorized VTH Imaging and Oncology Section staff (radiation workers listed on the ordering Authorization) are responsible for the performance of all necessary steps for the safe and compliant receipt of radioactive packages delivered directly to the VTH by the courier of a

commercial radiopharmacy for diagnostic imaging or radiotherapeutic purposes.

Package Check-in Procedure:

- Upon receipt of the package, ensure that the ordered material was received as specified and that the package is undamaged.
- Wear proper protective clothing when handling the package, such as a buttoned lab coat, gloves, and a body and ring badge, as needed.
- Check for evidence of potential contamination, such as packages that are crushed, wet, or damaged. If there is any evidence of leakage or contamination, contact the Radiation Safety Program immediately.
- Notify the AU, or their designee, that the material is secured in the NM lab.
- Notify the Radiation Safety Program of the receipt and the date of receipt; the radionuclide, its physical form, and the activity (as listed on the shipping papers provided by the vendor), the listed activity date; and the vendor's name.
- Measure exposure rate at 3-ft (1-meter) and at the surface of the package. Record the survey measurements including background levels on the Radioactive Delivery Record. If reading exceeds 10 mR/hr at 3 feet or 200 mR/hr at contact of the package surface, stop immediately and seek technical assistance and/or guidance from the Radiation Safety Program.
- Perform wipe tests for removable contamination on all RAM packages. If the external surface of the package is found to be contaminated in excess 22000 dpm/100 cm2 of beta-gamma emitting nuclides or 2200 dpm/100 cm2 of alpha emitters), contact the Radiation Safety Program and take appropriate precautions to assure containment of the contamination.
- Record the following information on the Radioactive Delivery (shipment) Record Form: Receipt date, Purchase Order, Authorized User' s name, department, building name and room #, Package shipper, container type, and type of label, Isotope, activity (MBq and mCi), reference date, catalog #, and chemical form.
- Check the appropriate statement specifying the proper shipping name, hazard class, UN # and whether the package contained dry ice.
- Record the survey results from the wipe test results and radiation levels from the dose rate survey.

Copies of all records for the shipment of radioactive materials must be retained by the AU taking possession of the material.

6.4 Precautions For Accepting Packages Containing Radioactive Materials

If a package is delivered to a room that is NOT authorized to use radioactive material, it must be moved to an authorized area prior to opening the package.

Wear proper protective clothing. Examples include a buttoned lab coat, latex, vinyl, butyl, or nitrile gloves, and a body and ring badge, as needed.

Check for evidence of potential contamination, such as packages that are crushed, wet, or damaged. If there is any evidence of leakage or contamination, contact the Radiation Safety Program immediately.

Open all packages containing volatile radioactive material (i.e., 35S and radioiodine) in a hood approved for radioactive material use.

If there is no evidence of isotope contamination, remove and/or completely deface the trefoil warning labels before disposing of the items as non-radioactive trash.

7 TRANSFER OF RADIOACTIVE MATERIALS, LIQUID SCINTILLATION COUNTERS, SEALED SOURCES, AND RADIATION PRODUCING MACHINES

7.1 Policy

All transfers of radioactive materials from one building to another on campus must be preapproved. This requires a transfer form to be completed and submitted to the Radiation Safety Program.

Radioactive material from the WSU nuclear reactor to a university lab requires a transfer form, even when the transfer contained within The Nuclear Science Center in order to document ownership from the US NRC license to the State's Broadscope License.

The Radiation Safety Program reviews and approves all procedures for transfer of radioactive materials, LSCs, and sealed sources to or from an AU, either on campus (internal transfer) or off campus (external transfer).

Radioactive materials (stock solutions, samples, gels), LSCs, and sealed sources may not be transferred to another AU or location until this review process has been completed.

Transport of radioactive material between AUs at WSU approved for the isotope transfer shall proceed in a manner that minimizes exposures and risks from accidental release of radioactive material.

Transport of radioactive material off-campus must conform to all applicable state and Federal regulations. **Contact the Radiation Safety Program if you plan on shipping or transporting radioactive materials off-campus.**

7.2 Transferring Radioactive Material to Another Authorized User

- ***7.2.1 On-Campus Transfers***

All transfers of radioactive material between laboratories must be arranged through the Radiation Safety Program. Before initiating an internal transfer of radioactive materials, verify that the receiving AU is authorized to possess the isotope. An internal **Transfer Form** must be signed by both the sending and receiving Authorized User as well as by the Radiation Safety Program, **before** the transfer may proceed. A copy of the form will be returned to both Authorized Users.

The Transfer Form can be found on the Radiation Safety Program website at https://rso.wsu.edu/transfers/.

7.3 Transferring Radioactive Material to Another Institution

Before initiating an external transfer of radioactive material, an External Transfer Form must be completed and sent to the Radiation Safety Program. Information provided must include the isotope, activity, and chemical form. A contact telephone and fax number of the receiving institution will help expedite the process for obtaining approval for the shipment. The shipping address of the receiving institution must also be written on the form. A copy of the form, signed by the Radiation Safety Program will be returned to both AUs. Do not proceed with the transfer until this form approved by the Radiation Safety Program is returned to the AU. The External Transfer Form can be found on the website (http://rso.wsu.edu) under "Radiation Safety."

7.4 Transferring Liquid Scintillation Counters (LSC), Sealed Sources, and Radiation Producing Machines (RPM) Inside and Outside of WSU

- ***7.4.1 LSC Transfer***

Contact the Radiation Safety Program. The Radiation Safety Program will ask you where the counter is going to be located, as well as the name of the Authorized User to whom the counter is being transferred.

- ***7.4.2 Sealed Source Transfer***

Contact the Radiation Safety Program. The Radiation Safety Program will ask you where the sealed source is going to be located, as well as the name of the Authorized User to whom the sealed source is being transferred. If the sealed source is being transferred to an Authorized User outside WSU, further documentation may be necessary from the receiving institution.

- ***7.4.3 External Transfer of RPM***

An e-mail should be sent to the Radiation Safety Program 30 days prior to the equipment being transferred. Information should include the manufacturer of the equipment, the model number, the serial number, and the date of the transfer, as well as the name of the institution that is receiving the equipment. WSU is required to notify the Department of Health of any transfer of machines under our registration.

- ***7.4.4 Internal Transfer of RPM***

If the individual is an AU, an e-mail should be sent to the Radiation Safety Program prior to the transfer. Information should include the manufacturer of the equipment, the model number, the serial number, building and room number of the new location, the date of the transfer, as well as the name of the AU that is receiving the equipment. The AU receiving the machine must complete all machine specific training if he/she has not already done so.

- ***7.4.5 Transport of Radioactive Materials and Equipment***

If you need assistance with transportation between buildings on campus, please contact RSP at (509) 335-4221 or Radsafe@wsu.edu

If you are transferring between campuses, please coordinate transportation with RSP. You will receive an email approval.

Walking or driving radioactive materials across campus is considered transport.

Most materials can be transported by any WSU radiation worker within the WSU Pullman campus. The Radiation Safety Program also provides transportation services upon request, please allow a one-day lead-time if requesting RSP transporting services.

Some items, such as high radiation materials, must be transported by a member of the Radiation Safety Program. In these cases, a notation will be placed on the transfer form and RSP will contact you to arrange transportation.

If driving the transfer, prepare the package using the guidelines established under Package Preparation. Non-exempt quantities must be transported in a university-owned state vehicle.

- ***7.4.6 Preparing Radioactive Materials for shipment by the Radiation Safety Program***

All packages used to transport radioactive materials must be strong tight containers that will not leak under normal transportation conditions (such as dropping, jarring, or temperature extremes). When transporting liquids, use at least twice the amount of absorbent needed to contain the entire volume in case the container should break or leak.

8 NUCLEAR GAUGES

8.1 Policy

It is the responsibility of the AU to contact the Radiation Safety Program regarding the requirements for use of a moisture density gauge. All moisture density gauges are leak tested by the Radiation Safety Program.

8.2 Applications and Definition

Nuclear gauges measure the density and/or moisture content of soil and/or construction materials. The gauge typically contains either a 137Cs or 241Am/Be sealed source. The source is sealed in a double wall, double welded stainless-steel capsule.

8.3 Use Requirements

It is the responsibility of the AU to ensure that the use log is filled out correctly with the following items: Name of the individual using the instrument, date, destination, and the date of return.

All users must also complete the radiation safety training modules for gauge users and undergo a Security Performance Audit and DOT transportation training.

8.4 Security Requirements

Soil Gauges are readily portable. It is important to pay extra attention to ensuring that gauges with radioactive sources are secured. Gauges must be secure during both transport and storage. The gauge must also have a lock designed to prevent unauthorized or accidental removal of the sealed source(s) from a shielded position.

A minimum of two independent physical controls that form tangible barriers to secure portable gauges from unauthorized removal must be used whenever portable gauges are not under the control and constant surveillance of the licensee.

The gauge and its container must be locked when in transport, storage, or when not under the direct control of an authorized user.

Gauges must be locked in a secured container and a secured storage area when not in use. Any room in which a gauge containing radioactive sources is being used or stored must be locked when unattended. Radioactive materials signs are required on the storage cabinet only. They are not required on the door to the room.

When transporting a gauge, three levels of security shall be always used. The outer two levels of security will be established so that each independently prevents the transport box with gauge from being removed from the transport vehicle and keep the lid of the transport box from opening.

- ***8.4.1 Security Performance Audits***

WSU's Broadscope License Condition 25. D. requires an annual "Performance Audit" of each gauge user to assure all security measures are in use and correctly applied.

Users of nuclear gauges need to have a performance security audit on an annual basis during the use season from the Radiation Safety Program.

8.5 Dosimetry Badge Use with Moisture Gauges

Contact the Radiation Safety Program to obtain a badge. A badge that can detect neutrons must be worn during operation of a moisture density gauge.

8.6 Transporting Gauges Off WSU Property

Gauges cannot be moved from their storage area overnight. The only exception to this is if the gauge must travel further than 50 miles one way from the research station. Any overnight stay must have prior approval from the Radiation Safety Program.

All personnel transporting gauges must be properly trained to meet DOT requirements. Contact the Radiation Safety Program regarding the specific requirements.

8.7 Lost or Stolen Gauges

The Radiation Safety Program must be contacted **IMMEDIATELY** at 509-335-7183.

9 SURVEY METER MAINTENANCE AND CALIBRATION

9.1 Policy

Authorized Users are responsible for having appropriate survey instruments available and for ensuring that their survey meters are calibrated annually.

9.2 Radiation Survey Instrumentation Requirements

Survey meters are not required for users of S-35, H-3, P-33, or C-14.

Users of S-35, H3, P-33, and C-14 are required to have access to a Liquid Scintillation Counter for surveys.

Users of other isotopes must have calibrated count rate survey meters available.

Dose Rate instruments are not required radiation safety program compliance; however, should they be used, the radiation safety program recommends that meters be calibrated annually. Authorized Users are responsible for the calibration, including shipping costs, of these instruments. The Radiation Safety Program can provide AUs with a list of service providers.

9.3 Calibrating Instruments

The Radiation Safety Program provides calibration free of charge for most common count rate meters upon request. Please email radsafe@wsu.edu to request calibration assessment from the Radiation Safety Program. Survey instruments that cannot be calibrated in-house will need to be sent to a service provider. In these cases, it is the responsibility of the AU to arrange for the shipping and calibration of the instruments. Contact RSP for a list of service providers.

Authorized Users may always elect to utilize the calibration services of another qualified provider. The authorized user must submit a copy of the calibration certification to the Radiation Safety Program immediately after calibration. The annual calibration frequency must still be maintained.

Count rate survey instruments that are not calibrated must be labeled as “out of service”. The Radiation Safety Program can provide a sticker up request.

If work with radioactive materials is to continue while an instrument is being calibrated or repaired, the authorized user may obtain a temporary loaner instrument from the Radiation Safety Program.

9.4 Requesting Calibration by the Radiation Safety Program

The Radiation Safety Program can calibrate most but not all count rate instruments. We can collect the meter from you, or you may deliver it to us. During calibration, the electronic linearity of the meter is checked, and meter efficiencies are determined based on the isotopes used in the laboratory. This procedure can take up to five working days. Please ensure that the meter has properly charged batteries. The lab will be contacted when the meter is calibrated and ready for pickup.

9.5 Calibrating Dose Rate Meters

Meters requiring dose rate calibration need to be sent by the authorized user to an outside vendor. If there are any doubts about where to have the meter calibrated, contact the Radiation Safety

Program prior to sending the meter to a vendor.

9.6 Calibration Requirements

Before the expiration date for calibration of the meter is reached. Make sure that the survey meter's batteries are in good working order and that the meter and probe are free from contamination. If the probe is protected with paraffin or plastic caps, these must be removed prior to bringing the meter in for calibration.

9.7 Troubleshooting Meter Issues

If the meter is not functioning properly, bring the meter to the Radiation Safety Program to be checked. Minor repairs such as loose connections or dirty battery connections can be fixed quickly. However, any meter that needs major repairs must be sent to an outside vendor. The AU is responsible for all charges incurred for repair by a commercial vendor and for commercial calibration of meters. The AU is also responsible for having a meter available in their laboratory for survey purposes if their meter is being repaired or calibrated. The Radiation Safety Program offers loaner meters for this purpose.

9.8 Registering New Survey Meters and Equipment

All required survey instruments on campus must be on the Radiation Safety Program's inventory. Upon purchase, contact the Radiation Safety Program to ensure that your instrument is added to the inventory. You must also provide the calibration paperwork.

9.9 Care and Use of Survey Meters

Many labs protect the probe of the survey meter with paraffin or plastic caps. This practice is appropriate when using the meter to detect possible contamination occurring during the experiment. However, when carrying out contamination surveys, an unshielded probe shall be used.

Protect the probe from contamination by avoiding contact with surfaces that may be contaminated.

Batteries in the survey meter should be checked every time the meter is used. This is generally done by turning a switch to the "BATT" position or by pressing the button labeled "Battery Check." If the needle does not reach the "Battery OK" range, the batteries must be replaced immediately to ensure that the meter functions properly.

To prevent damage from corrosion, remove the batteries from the meter if it will not be used for an extended period.

Protect the meter from bumps and drops. The crystals in a gamma detector shatter on impact, and Geiger-Mueller probe windows can easily become damaged, releasing the gas necessary for the meter to function. Also, the electronics in the meter box can develop loose connections.

9.10 Liquid Scintillation Counter Registry and Operation Requirements

All Liquid Scintillation Counters are tracked by the Radiation Safety Program. New purchases must be reported to the Radiation Safety Program.

Authorized User Liquid Scintillation Counters are not calibrated or maintained by the Radiation

Safety Program. Authorized Users are responsible for keeping any LSC used for compliance surveys in compliance with Department of Health efficiency standards set by state inspectors.

These standards can generally be met by running the Standards and Normalization (SNC) protocol weekly. If an LSC is not in regular use, the SNC protocol should be performed within 7 days of using the LSC for compliance surveys. The results of these protocols will be audited by the Radiation Safety Program during routine lab audits.

10 POSTING AND LABELING

10.1 Policy

All rooms and areas where regulated quantities of radioactive material are used or stored must be posted with appropriate signs and labels to inform personnel and visitors to use caution upon entering the area.

A Notice to Employees (Form #RHF-3) sheet must be posted so that all employees can observe and can read the notice on their way to or from their work area, as well as a notice containing emergency contact information.

All radiation labels and Notice to Employees forms can be obtained from the Radiation Safety Program. Contact radsafe@wsu.edu for requests. It is the responsibility of the laboratory to keep this information current.

10.2 Labeling Requirements

- ***10.2.1 Laboratory Areas***

A "Caution Radioactive Materials" label with a trefoil symbol must be posted at the entrance or on the door for each area or room where licensed quantities of radioactive materials are stored or used along with a notice containing emergency contact information.

A "Notice to Employees" and "Emergency Contacts" information sheet should be posted in an area in the main lab that is readily visible to all employees. It does not need to be posted in every room.

- ***10.2.2 Refrigerators, Freezers, Glove Boxes, Lock Boxes and Fume Hoods***

Large lab equipment that are used to store radioactive material stock solutions and samples should have full sized "Radioactive Material" labels with a trefoil symbol. If a secured, internal lockbox is used, a radiation label should be placed on the outside of the lockbox. Per Broadscope license (WN-C003-1), all hoods used for storage and/or use of radioactive material shall have a flow rate that meets the manufacturer's specifications, with the hood sash at the specified working height. Hood flow rates shall be checked annually.

- ***10.2.3 Waste Containers***

All radioactive waste containers must be labeled with a "Caution Radioactive Material" label. The trefoil labels must be large enough and clearly visible from all sides of the waste container. A radioactive waste accumulation log indicating the isotope, activity, and the disposal date should be posted on or near the container. If the log sheet is not directly on the waste container, the isotope, waste type, and maximum activity in the waste container should be written somewhere on the container. This can also be logged through EHSA.

- ***10.2.4 Small Laboratory Equipment***

All trays, containers, racks, tools, etc. that are used for radioactive material experiments must be labeled with "Radioactive Material" tape. A small yellow trefoil symbol in some instances is acceptable to label small laboratory equipment where tape may not be feasible.

- ***10.2.5 Stock Solutions and Sample Preparations***

All containers of stock solutions of radioactive material must be labeled with "Radioactive Material" and a label indicating isotope, estimated activity, and reference date. While it is not reasonable to expect that each tube or vial be labeled, each tray or rack that holds radioactive material must be labeled.

- ***10.2.6 Special Labeling Conditions***

"Radiation Area" refers to any area accessible to personnel in which the radiation levels are such that a major portion of the body could receive a dose of 5 mrem or more in one hour at 30 cm, or 100 mrem in any five consecutive days.

"High Radiation Area" refers to any area accessible to personnel in which the radiation levels are such that a major portion of the body could receive a dose of 100 mrem or more in one hour at 30 cm. Ropes or fences should be used in addition to the warning signs to clearly mark restricted areas. A locked door must be used to control access when unattended.

Please contact the Radiation Safety Program if you feel you have any lab areas that fall under these categories.

10.3 Exemptions From Posting and Labeling

Areas or rooms containing radioactive material for periods of less than eight hours are exempt from posting requirements if one of the following conditions is met:

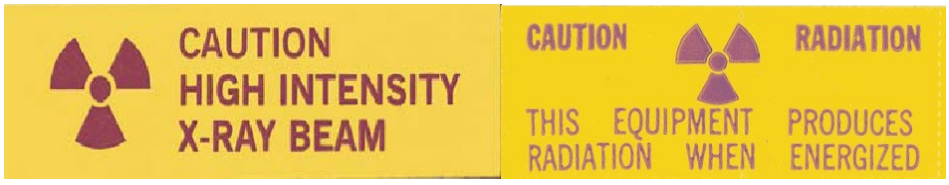
- Containers are attended by an individual who takes the precautions necessary to prevent the exposure of other people (less than 2 mrem) in an hour at a distance of one foot) and does not involve the manipulation of open radioactive material; or

- Containers are in transport and are packaged and labeled in accordance with the U.S. Department of Transportation (USDOT) regulations.

10.4 Labeling Radiation Producing Machines

A "Notice to Employees" (Form #RHF-3), and warning signs as appropriate should be posted at or near each unit.

Typical warning signs for RPM



Machines must be tagged with a notice posted indicating that the machine cannot be moved or used without clearance from the Radiation Safety Program. You can contact radsafe@wsu.edu for assistance in properly labeling these machines. The notice posting can be obtained from the Radiation Safety Program or can be made yourself. There is no specific wording requirement.

Machines being kept or moved to storage must first be locked out (either at the main switch or at the plug).

No one outside of the Radiation Safety Program should remove radiation labels without expressed written consent of the RSP.

11 INACTIVE STATUS OR ABSENCE FROM LAB

11.1 Policy

The Radiation Safety Program has a classification of “Inactive” for laboratories that do not need to use radioactive material for the foreseeable future. An inactive AU is relieved of the requirements to complete laboratory contamination surveys.

11.2 Steps to Make Lab Inactive

(1) Send a letter or email of intent to the Radiation Safety Program.

(2) If you do not wish to dispose of your isotope, you must store it in a sealed container, or you can transfer it to an AU that is authorized to possess the isotope.

(3) Perform and document a thorough survey of all posted lab areas.

(4) Return all personnel dosimetry to the Radiation Safety Program.

11.3 Reactivating An Inactive Radiation Lab

A lab can be reactivated if the following conditions are met:

(1) Send a request to the Radiation Safety Program requesting reactivation.

(2) If there have been no changes to your room maps or protocols, send an e- mail indicating there have been no changes to the Radiation Safety Officer. Otherwise, submit an Authorization amendment to the Radiation Safety Program.

(3) Verify that survey meter instruments are within annual calibration.

(4) Verify that radiation workers and the Authorized User were retrained within 1 year of their last training date.

(5) Obtain required personnel dosimetry for radiation workers, and the Authorized User.

11.4 Conditions to Maintain Authorized User Status

The Authorized User can enter inactive status without decommissioning the laboratory for radioactive material use. All remaining radioactive materials must be secured in a manner which prevents their use and waste must be picked up.

When the Authorized User decides to use radioactive materials, they must contact the Radiation Safety Program so the room can be posted with the appropriate signage and labels.

11.5 Leave of Absence for Authorized Users

If you are going to be absent for more than 30 days, an individual must be designated to assume responsibility for all radiation safety issues in your absence. This individual must be another AU preferably within the same department. Please contact the Radiation Safety Program indicating the date you are going to be absent, when you will be returning, and which AU will be assuming responsibility for all radiation safety issues in your absence.

12 INCIDENT RESPONSE AND REPORTING

12.1 Policy

All laboratories should have an emergency response plan appropriate for their laboratory.

12.2 Emergency Contact and Incident Response

Each Authorized User is responsible for making certain that the Radiation Safety Program (509) 335-4221 is contacted during office hours (8:00 a.m. – 5:00 p.m.) or WSU Police (911) is called after hours, weekends, and holidays immediately in the event of:

- A major spill, theft, or loss of radioactive material;
- Personnel contamination;
- Contamination outside of a restricted area;
- Accidental ingestion of radioactive material; or
- Accidental disposal of radioactive material to the normal trash.

The incidents listed MUST be reported to the Radiation Safety Program.

12.3 Release of Gas, Volatile Liquids, Dust, or Sealed Source

- No immediate attempt should be made to clean the spill.
- All windows should be closed, fans and air conditioners should be shut off or vents sealed, and everyone should leave the room.
- All doors should be closed, locked, and a warning sign placed at each access door.
- If powdered or gaseous sources are involved, the door and all other openings leading into the room should be sealed with wide tape (masking tape, duct tape, adhesive tape) and plastic sheeting or heavy wrapping paper.
- Minimize the spread of radioactive contamination by restricting the movements of potentially contaminated persons to a local zone just outside the “spill” area until the extent of personnel; shoe and clothing contamination is determined.
- Every person who might have been contaminated should be monitored for activity, and, if contaminated, should remove his/ her clothing and be decontaminated. If no means are available for monitoring, it should be assumed that the person is contaminated.
- The Radiation Safety Program must be called immediately. If necessary, outside consultants experienced in radiation hazards should be called in by the Radiation Safety Officer and their advice followed.

12.4 Spill Risk Assessments and Definitions

Spill assessment considerations:

- Isotope emission characteristics
- Radioactive material volatility
- Quantity of radioactive material involved
- Size of contaminated area
- Potential for spreading contamination
- Potential dose – external and internal

12.5 Minor Spills

A spill that remains contained, that can easily and effectively be cleaned up without assistance from the Radiation Safety Program, and that does not involve personnel contamination.

(1) Survey clothing, hands and shoes for potential personnel contamination.

(2) Notify others in the area of a minor radiological spill.

(3) Remove contaminated bench paper and/or gloves and dispose of as radioactive waste.

(4) Decontaminate the work area and survey to verify all contamination has been removed.

12.6 Major Spills

A spill that involves contamination of personnel or results in contamination outside of the intended work area, and that cannot be promptly cleaned up.

(1) Survey clothing, hands and shoes for potential personnel contamination.

(2) Notify others in the area of a major radiological spill.

(3) During business hours (weekdays 8:00 a.m. – 5:00 p.m.) call the Radiation Safety Program at (509) 335-4221.

(4) After hours (weekdays 5:00 p.m. – 8:30 a.m., weekends and holidays) call Police (911) and indicate there is a "**Radiation Spill**."

(5) Give them your name, the Authorized User's name, location, and telephone number.

(6) Establish a secure boundary to prevent spreading of contamination.

(7) Do not leave the area (unless in immediate danger) until initial investigations by the Radiation Safety Program have been completed.

12.7 Emergency incidents involving multiple hazards

When a radiation emergency is accompanied by other hazards (fire, explosion, chemical exposure, or other event that endangers life or property), it is important to deal first with those hazards that have the greatest potential impact. In an educational setting the quantities and types of radiation used are such that, in general, response personnel (fire and medical) are able to manage severe threats to life, health, and property without concern for the radiation present if: 1) They respond with their usual personal protective equipment, and 2) Are

monitored for radiation contamination and decontaminated as necessary before leaving the site of the emergency.

13 SECURITY OF RADIOACTIVE MATERIALS

13.1 Policy

Radioactive material shall be secured against unauthorized access or removal in compliance with WAC 246-221-150.

13.2 Radioactive Materials Security

Whenever someone from your laboratory authorized to use radioactive material is not present, radioactive materials must be secured. The Radiation Safety Program personnel will discuss site-specific levels of security with laboratory personnel.

13.3 Radioactive Waste Containers Security

Common and accepted practice is not to secure waste to the same degree as other radioactive material. However, waste is to be kept in the waste area of the laboratory and its activity sensibly minimized.

13.4 Laboratory Equipment Security

Equipment containing radioactive material (i.e., cabinets, refrigerators, freezers) must be locked or contain a secured lockbox within. Equipment containing radioactive material should also have a radioactive material posting on the outside (see section on Posting and Labeling in this manual).

13.5 Labeled Laboratory Equipment That Does Not Contain Radioactive Materials

If the labeled equipment (i.e., cabinets, refrigerators, freezers) is not being used for radioactive material, then the equipment should be decommissioned. For equipment that is used occasionally for radioactive material storage, the equipment shall be locked even if no radioactive material is currently present.

13.6 Radiation Producing Machines Security

Machines should be kept in restricted access areas.

With the exception of mobile x-ray and dental units, any change in location of a radiation producing machine must be approved by the Radiation Safety Program.

14 PERSONAL PROTECTIVE EQUIPMENT (PPE) AND GENERAL SAFETY REQUIREMENTS

14.1 Policy

To ensure the health and safety of all members of the WSU research community users of radioactive materials should always wear appropriate PPE.

14.2 Personal Protective Equipment Purpose

In general, the use of Personal Protective Equipment is meant to prevent direct skin contamination and minimize the risk of internal contamination. Laboratory coats, gloves, and eye protection are the primary form of Personal Protective Equipment against contamination.

14.3 Personal Protective Equipment – When Where and How

- ***14.3.1 Eye Protection***

Eye protection is required if there is risk of splash or splatter in the laboratory and where radioactive material is stored and handled. Contact lenses shall not be worn when working with volatile chemicals in the laboratory. Where there is danger of splashing or flying particles, safety goggles are mandatory.

- ***14.3.2 Laboratory Coats***

Laboratory coats and other Personal Protective Equipment shall be worn at all times while handling radioactive material. Laboratory coats must be fastened completely to provide complete protection.

- ***14.3.3 Gloves***

Selection of proper glove materials is important. Disposable gloves should be worn while handling unsealed radioactive material. Contaminated gloves must not be reused and must be disposed of as radioactive waste. Potentially contaminated gloves should not be worn when handling uncontaminated materials. DO NOT wear gloves outside the laboratory.

14.4 General Safety Requirements for Use of Radioactive Materials

- ***14.4.1 Food, Beverages, Cosmetics, and Medications***

Federal and state laws prohibit storing as well as eating, drinking, chewing gum, smoking, applying cosmetics, and taking medications in all radioactive laboratory areas. This includes standard laboratory areas, cold rooms, warm rooms, equipment rooms, common use and other laboratory related areas. Any food, drink, and their containers found in laboratory areas will be confiscated and disposed. All food or drink used for research purposes must be labeled “NOT FOR HUMAN CONSUMPTION.”

- ***14.4.2 Clothing***

Dresses, shorts, ties, or other dangling clothing should not be worn while conducting experiments in the laboratory. Open-toed shoes or sandals are not permitted in the lab.

14.5 Safety Requirements for Radiation Producing Machines

- ***14.5.1 Personal Protective Equipment (PPE)***

In general, personal protective equipment (leaded aprons, gloves, and goggles are useful only for low energy, less than about 100 kVp, x-ray sources. Recognizing this limitation, personal protective equipment should be used to protect any part of the body that may be exposed by a primary x-ray beam or whenever the exposure can be reduced significantly by their use, but not in place of other required engineering controls.

- ***14.5.2 Safety Devices***

Federal, State and local regulations require that many radiation producing machines have specified safety devices or features. In addition, the Radiation Safety Program may specify safety features to address the specific use of the machine at WSU.

Required safety devices/ features may include:

- Fail -safe warning lights
- Fail- safe interlocks
- Beam enclosures
- Shielding/ shielding interlocks
- Radiation survey meters
- Radiation area monitors

All required safety devices must be maintained in working order and must not be replaced or modified without specific approval by the Radiation Safety Program.

Safety devices must never be purposely defeated by any radiation worker on the WSU license. If the design of a safety device makes a desired/ necessary operation inconvenient or impossible, an alternate safety device/ method must be developed that provides the same degree of protection as the original.

Modified safety devices/ methods must be approved by the Radiation Safety Program prior to operation of radiation producing machine. When safety devices are modified, it may be necessary to modify existing operating procedures and to retrain operators.

If a required safety device fails, the machine must not be operated until it is repaired and subsequently checked by the Radiation Safety Program.

the Radiation Safety Program must be notified immediately if an unexpected personnel radiation exposure occurs or is suspected.

15 RADIOACTIVE WASTE DISPOSAL

15.1 Policy

The Authorized User shall implement an effective radioactive waste management program that includes proper labeling, shielding, minimization, and assurances that disposals go into the correct radioactive waste stream.

15.2 Authorized User Waste Responsibilities

The Authorized User is responsible for obtaining any shielding required for his/her waste management program, as well as for maintaining written inventory records of the activity of all waste in storage and those wastes removed from the laboratory. Boxes and liners are provided by the Radiation Safety Program.

15.3 Waste Pickup Scheduling

Before waste can be picked up from the laboratory, proper forms must be filled out in EHSA (https://radsafety.or.wsu) with total activity for each isotope and a survey of the container exterior. Contact the Radiation Safety Program if you have any questions regarding how to fill out the form.

15.4 Waste Handling Procedures

Radioactive waste should be separated by type – dry solids, vials, SHARPS, liquids, and animals – and by isotopes. **DO NOT**, under any circumstances, place radioactive waste in the hallways where housekeeping personnel might pick it up.

Liquid radioactive waste should be double contained so that leakage from a breach in the primary container is fully contained by the secondary vessel. Also, the container should not be left open and should be capped when not in use. An Ecofunnel could be used as a substitute for a cap.

Dose rates from any radioactive waste container should not significantly exceed background radiation levels when shielded. Any container used to store radioactive waste should be prominently labeled with a radiation trefoil sign. This will alert housekeeping personnel that it is a radioactive waste container and not an ordinary trash container.

15.5 Aqueous Radioactive Waste

Liquid radioactive waste is separated into two basic categories; aqueous and mixed wastes. These two types of waste must be kept segregated from each other to the maximum extent possible.

Radioactive liquid whose pH is in the range of 6 to 9 and which contains no hazardous or dangerous components is considered Aqueous.

Adjust pH of aqueous solutions to fall in the range of 6 to 9 to avoid creating mixed waste.

Isotopes that have similar half-lives may be combined in the same containers. Do not mix long-lived isotopes with short-lived isotopes. H-3 and C-14 may be combined but must be kept in a container separate from other long-lived isotopes.

Transuranic isotopes must be segregated from all other isotopes.

Liquid radioactive waste should only be placed in 1 gallon or 5-gallon plastic containers supplied by the Radiation Safety Program.

15.6 Biohazardous Wastes

Like the Radiation Safety Program, WSU manages biosafety within the Office of Research Assurances. Biohazardous waste and materials are defined at the following website: https://biosafety.wsu.edu/potentially-biohazardous-materials/.

the Radiation Safety Program cannot accept any biohazardous waste other than that containing C-14 and H-3.

If you have questions about biohazards, contact the University Biosafety Officer at (509) 335-1585.

15.7 Mixed Waste

Mixed waste is any waste that presents multiple hazards, for example- a radiation hazard and a chemical hazard. A radioactive liquid whose pH is outside the range of 6 to 9 or which contains substances considered to be hazardous and/or dangerous by the state of Washington.

Mixed waste is costly to dispose of and generation of mixed wastes should be avoided. In some cases, labs can be responsible for disposal costs, please consult with the Radiation Safety Program.

Please consult with Environmental Health and Safety to determine if the substances or concentrations other than radioactive material in your waste are considered hazardous.

Most liquid scintillation fluids are designated as hazardous waste. There are only three scintillation fluids currently approved by the State of Washington Department of Ecology as non-hazardous. Using one of these three will keep your scintillation waste from becoming a mixed waste.

- Ecoscint Original LS-271
  National Diagnostics
  305 Patton Drive, Atlanta, GA 30336
  1.800.526.3867 (USA)

- Microscint-O
  Perkin Elmer Life and Analytical Sciences
  710 Bridgeport Avenue, Shelton, CT 06484
  1.800.762.4000 (USA)

- Optifluor
  Perkin Elmer Life and Analytical Sciences
  710 Bridgeport Avenue, Shelton, CT 06484
  1.800.762.4000 (USA)

Containers used for mixed waste must have a dangerous waste label affixed to them. This label should be attached to the container before it is put in use. Please fill in the major hazard and constituents blocks. These labels are available from EH&S.

15.8 Dry Waste

This category of waste consists of anything comprised of solid materials containing no liquids that has come into contact with radioactive material such as disposable labware, gloves, bench paper and polyacrylamide gels.

Segregate solid waste as follows:

- Isotopes that have similar half-lives may be combined in the same boxes.
- Do not mix long-lived isotopes with short-lived isotopes. Long-lived Isotopes are isotopes whose half-life is greater than 120 days.
- H-3 and C-14 may be combined in the same boxes but must be kept separate from other long-lived isotopes. Transuranic isotopes must be segregated from all other isotopes.

Double walled fiberboard boxes are available in 2 cubic foot and 1 cubic foot sizes from the Radiation Safety Program for solid waste disposal.

15.9 Radioactive Sharps

Sharps include discarded hypodermic needles, syringes, scalpel blades; cannulas, or capable of causing puncture wounds or cuts, or any other item capable of causing puncture wounds or cuts.

Radioactive waste classified as Sharps MUST NOT be mixed with dry solid materials and must be contained in puncture-proof/rigid containers.

Sharps containers should be labeled as “SHARPS” with total activity for each isotope, date of closure, and AU name.

15.10 Liquid Scintillation Vials

Vials containing or which did contain scintillation fluids determined to be radioactive should be placed in a box provided by the Radiation Safety Program. Scintillation vials that contain no radioactive material must be kept separate from vials which contain radioactive material. If the vial contains no radioactive material and a non-hazardous scintillation fluid, it should be disposed of in regular trash.

Vials must be separated by isotope as described in the liquid waste procedures above.

Some liquid scintillation cocktails are considered to be Hazardous Waste in the state of Washington. We ask that you consider the use of liquid scintillation cocktails which do not designate as Hazardous Waste. Hazardous Waste mixed with Radioactive Waste is considered “Mixed Waste” and is very expensive to dispose. Please consult with Environmental Health and Safety to determine if the cocktail you plan to use is considered a Hazardous Waste. Each Mixed Waste batch of scintillation cocktail waste must have a filled out dangerous waste label affixed. These labels are available from EH&S. Please fill in the major hazard and constituents blocks.

Contact the Radiation Safety Program (radsafe@wsu.edu) in cases large amounts of liquid scintillation vials containing radiation.

15.11 Lead Pigs and Bricks

Lead is a regulated material and cannot be disposed of as normal trash. It must be surveyed and free of contamination before it can be picked up by EH&S.

Contact the Radiation Safety Program for disposal of contaminated lead bricks.

The inner lead lining of a lead pig must first be removed from the plastic container and surveyed prior to pick up.

Any radiation label must be completely defaced before the plastic container is disposed as regular trash. If your laboratory has lead to pick up, please contact the Radiation Safety Program at radsafe@wsu.edu.

15.12 Uranyl Compounds

Uranyl compounds are picked up by the Radiation Safety Program for disposal. This includes liquid, dry/solid waste, and uranyl acetate/nitrate in powder form. Use EHSA at https://radsafety.or.wsu.edu if you have access, otherwise you can contact the Radiation Safety Program at radsafe@wsu.edu.

15.13 Sealed Sources

If you want to dispose of a sealed source, contact the Radiation Safety Program at radsafe@wsu.edu.

15.14 Radioactive Animal Waste

Radioactive animal waste can include carcasses, bedding and excreta, animal blood, as well as animal waste containing etiologic agents.

Contact the Radiation Safety Program at radsafe@wsu.edu for instructions on how to package this type of waste.

15.15 Disposing Radioactive Material to Sewers

In accordance with the Washington State Administrative Code (WAC 246-221-190) authorized users on the WSU Pullman campus may release small quantities of non-alpha-emitting radionuclides to the sanitary sewer only if either of two conditions are met: the material is in a readily soluble form or if it is a biological material, which is readily dispersible in water. This applies to the Pullman campus ONLY. Non-Pullman locations must contact the Radiation Safety Program.

No hazardous waste is allowed; only aqueous waste may be released. Contact EH&S for assistance in determining if your waste designates as hazardous/dangerous.

To ensure that total releases do not exceed regulatory limits, authorized users are not to exceed release limits in the table below.

Isotope	Release Limit (Pullman)
H-3	5000 microcuries
C-14	1000 microcuries
All others (except alpha emitters)	100 microcuries per isotope

No alpha emitting isotopes may be discharged.

the Radiation Safety Program must maintain accurate records of releases to the sanitary sewer. Each authorized Pullman campus user must record radionuclide sewer releases on a Radioactive Sanitary Sewer Discharge can be recorded in EHSA at.

15.16 Release to Atmosphere

Authorized users may release small quantities of non-alpha-emitting radionuclides to the atmosphere.

Each authorized user must record radionuclide releases to the air in EHSA at https://radsafety.or.wsu.edu.

15.17 Disposal of Boxes Used to Ship Radioactive Materials

Boxes used to ship radioactive materials to individual labs may be disposed of after verifying by meter survey and swipe survey the absence of radioactive contamination and defacing any and all markings which would indicate the packaging contains or contained radioactive materials.

These verification surveys must be performed by personnel who have been qualified to work with radioactive materials by the Radiation Safety Program.

15.18 Radiation Producing Machines Disposal

Contact RSP prior to disposal of x-ray equipment. Information should include the manufacturer of the equipment, the model number, and the serial number. WSU is required to notify the DOH of any disposal of RPM that is under our registration.

16 BIOASSAYS

16.1 Policy

Bioassays are required for employees who are likely to receive an internal, measurable radiation dose. Bioassay procedures include, but are not limited to, thyroid screening and urinalysis.

16.2 Bioassay Frequency Requirements

- ***16.2.1 Tritium:***

A bioassay is required any time more than 100 mCi of H-3 is used at one time or if you are working sufficiently close to the handling or use if tritium at this level. This includes opening a stock vial containing more than 1mCi of volatile radioactive iodine or 100 mCi of 3H.

- ***16.2.2 Iodine:***

For iodine bioassay, please use the chart below to determine if bioassay is required.

Table 17-1. Radioactivity Levels in Unsealed Form Above Which Bioassay is Required

Type of Operations	Volatile or Dispersible	Bound to Nonvolatile Agent
Processes in open room or bench, with possible escape of iodine from process vessels	1 mCi (37 MBq)	10 mCi (370 MBq)
Process with possible escape of iodine carried out within well-controlled and ventilated areas (i.e., fume hoods with adequate design, face velocity, and performance reliability)	10 mCi (370 MBq)	100 mCi (3.7 GBq)
Processes carried out within gloveboxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage.	100 mCi (3.7 GBq)	1 Ci (37 GBq)

Contact the Radiation Safety Program (radsafe@wsu.edu) before handling any of the amounts of iodine or tritium listed above. If bioassays need to be performed, a baseline bioassay must be done for anyone involved in the procedure that does not have a baseline bioassay on file.

16.3 Bioassay Exceptions

If you use tritium sources in metallic foils, you are exempt from bioassay requirements.

17 DOSIMETRY

17.1 Policy

Each individual likely to receive a radiation dose 10% or above of the annual dose limit shall wear a personal radiation dosimeter per WAC 246-221-010.

17.2 Individuals Required to Wear a Badge

- Each individual likely to receive a radiation dose 10% or above of the annual dose limit.
- Individuals using high-energy beta or gamma emitters in quantities greater than 1mCi.
- Individuals using moisture density gauges.

17.3 Individuals Not Required to Wear a Badge

- Individuals working with gas chromatographs that contain H-3 or Ni-63 sealed sources.
- Individuals working with low energy beta emitters which include C-14, S-35, H-3 and Ca-45.

17.4 Dosimetry For Individuals Working with a Neutron Source

For experiments and procedures involving the use of neutron sources, a dosimeter sensitive to neutron radiation must be worn. These can be obtained by contacting the Radiation Safety Program.

17.5 X-ray Diffraction Units and Electron Microscopes

Individuals that use electron microscopes and other self-contained low kV/mA machines are not required to wear a badge.

Users of Particle Accelerators, Industrial Radiographic equipment and medical units are required to wear whole body badges.

Personnel operating Particle Accelerators are required to wear ring badges and neutron dosimetry.

17.6 Declaring a Pregnancy

Any radiation worker who is pregnant or may become pregnant may declare themselves as a “Pregnant Worker” by contacting the Radiation Safety Program. Pregnant workers are welcome to request cessation of work involving radiation exposure, but also have the option to continue. If a pregnant worker wishes to continue their responsibilities as a radiation worker an additional fetal badge dosimeter will be issued, which is read every month, and can be worn around the midsection such that any dose to the developing fetus is measured. Additional personal protective equipment may also be prescribed/recommended.

17.7 Obtaining a Dosimetry Badge

Badges can be requested through the Radiation Safety Program by emailing and/or completing a radiation worker application at rso.wsu.edu. Processing the request for a dosimeter may take several weeks.

Badges are received at the Radiation Safety Program and are mailed to the laboratory contact for each laboratory. Old badges can be returned either in person or by campus mail. The badges are then sent out for analysis. All dosimetry reports are reviewed by the Radiation Safety Program personnel.

- ***17.7.1 Dosimetry Exchange Process***

Badges exchanged monthly include:

- Fetal badges
- Badges of individuals using high energy beta or gamma emitter in quantities greater than 1mCi

Badges exchanged quarterly include:

- Any individual issued a badge that is not included in the monthly category.

17.8 Lost or Damaged Dosimeters

Report lost or damaged badges (crushed, broken, melted, washed, accidentally exposed, contaminated, heated in any way, etc.) to the Radiation Safety Program as soon as you are aware of the situation so that a new badge can be issued, and a dose estimate for the lost badge can be performed.

Radiation Workers must refrain from any activities that require the use of a dosimeter until a replacement badge has been issued to the individual.

17.9 Proper Use and Care of a Dosimeter

- The whole-body badge shall be worn between the neck and waist. If, however, one area of the body is more likely to be exposed than the rest, the badge should be worn in that area.
- The front of the badge must be exposed toward the source of radiation with no obstruction such that it correctly samples the actual exposure of the radiation worker
- The badge shall be worn outside of any Personal Protective Equipment.
- Extremity badges (ring badges) should be worn under any protective gloves, on the hand most likely to receive the greatest exposure. The front of the ring badge should face toward the radiation source.
- Badges are issued to a single user and shall not be shared.
- Store the badge in a radiation-free area, such as a desk drawer, when not in use. Do not take the dosimeter home.

17.10 Requesting Dose Records

Request for your personal dose records by email at radsafe@wsu.edu.

18 DECOMMISSIONING EQUIPMENT OR ROOMS

18.1 Policy

AUs or laboratory personnel needing to have equipment or laboratory areas cleared for maintenance or disposal must contact the Radiation Safety Program prior to the equipment leaving the lab or if any maintenance work that needs to be done in laboratory areas.

The Radiation Safety Program will respond to this request to ensure no potential radiological contamination exists to the equipment or specified lab area.

18.2 Disposing of Equipment That Was Used with Radioactive Material

Contact the Radiation Safety Program. The lab will be given specific instructions on cleaning of the equipment for radiological contamination.

If you are disposing of a liquid scintillation counter, the Radiation Safety Program must be contacted to arrange for removal of the sealed source. If the liquid scintillation counter is still in good working condition, the Radiation Safety Program must be contacted to initiate the transfer the equipment and sealed source to another licensed institution.

18.3 Broken Lab Equipment and Servicing Equipment Used with Radioactive Materials

Contact the Radiation Safety Program. The lab will be given specific instructions on cleaning of the equipment for radiological contamination.

Any radiation label on the equipment will be removed by the Radiation Safety Program once it has been surveyed and the survey verifies the equipment is free of contamination.

If the equipment is found to be contaminated, the lab will be responsible for decontaminating it. Fixed contamination will be dealt with as deemed appropriate by the Radiation Safety Program, as well as the manufacturer's requirements.

18.4 Moving Equipment Used with Radioactive Materials to Another Lab

The Radiation Safety Program will ask the lab to perform a thorough contamination survey on the equipment or lab and email the Radiation Safety Program by email at radsafe@wsu.edu. The Radiation Safety Program will perform a verification survey and remove the radiation label from the equipment or room. If there is contamination, the lab is required to decontaminate the equipment or room, resurvey, and email the results to the Radiation Safety Program.

18.5 Decommissioning Laboratory Spaces

UPPM 60.38 "Notice of Faculty or Staff Departure–Vacating University Areas" details the appropriate WSU procedures. Contact the Radiation Safety Program indicating that you wish to decommission your laboratory. A survey should be completed by the laboratory and sent to the Radiation Safety Program. A representative from the Radiation Safety Program will conduct a final decommissioning survey. The Radiation Safety Program will not decommission the area until all the items in the room have been removed. Do not remove any postings until you receive approval from the Radiation Safety Program.

19 LABORATORY CONTAMINATION SURVEYS AND DECONTAMINATION GUIDELINES

19.1 Policy

Authorized User's shall ensure that proper contamination surveys are performed and documented for all areas where radioactive material is used or stored under their supervision.

The Radiation Safety Program will conduct periodic surveys and compliance reviews to assure proper use of all radioactive material, as well as instruct laboratory personnel on how to perform decontamination procedures.

19.2 Laboratory Survey Frequency Requirements

Any laboratory actively using radioactive material is required to perform and document a contamination survey following use of radioactive material. Frequency is determined per risk assessment, with most surveys occurring no less than once per calendar month; however, some activities may warrant increased frequency.

19.3 Long Term Storage of Radioactive Materials

Laboratories may store radioactive material, while not actively using it. When in storage only status, surveys can be performed monthly. For laboratories where materials have been security sealed by the Radiation Safety Program personnel, surveys are not required.

19.4 Maintaining Authorized User Status Without an Inventory of Radioactive Materials

An AU may maintain their status without having radioactive materials in their inventory. No survey is required if a survey was performed and documented after the last use.

19.5 Documentation of Laboratory Contamination Surveys

All survey documentation shall be stored on EHSA using the Radiation Safety Program protocols. Survey documentation should have a survey map and results.

19.6 Equipment Needed to Perform a Contamination Survey

These procedures are intended as a guideline for performing a standard lab survey and may vary from lab to lab.

- Gather all necessary items, including:
- A map of the survey area for marking locations of probe readings and wipe locations (this can be done directly in EHSA).
- An appropriate, calibrated meter.
- Material for performing the wipe test, such as cotton swabs, tissue, or filter paper.
- Vials in which to place the wipes.

The following chart was created to assist you in selecting the best method and instrument for

performing contamination surveys:

Nuclide	Radiation Emitter	Energy, keV	Contamination Survey Technique *
C-14	β (beta)	156	WL
Cr-51	γ (gamma)	320	SN
H-3	β	18.6	WL
I-125	γ	35	SN
I-131	β/γ	606/364	SN
Na-22	β/γ/γ	545/1275/511	SG
P-32	β	1710	SG
P-33	β	248	WL
S-35	β	167	WL
Others			Contact the Radiation Safety Program

* See key below
W = WIPE to check for removable contamination
S = SURVEY with meter (Geiger-Mueller (GM) or Sodium Iodide (NaI)) for fixed contamination
L = run on LSC
G = use GM pancake probe
N = use NaI probe

Example: “WL + SG” means to perform a smear to wipe the surface and count the smear with a liquid scintillation counter, plus perform a meter survey for fixed contamination using a GM probe.

If you detect any contamination with a handheld survey meter, you must also determine if the contamination is removable by performing a wipe. When checking for fixed contamination, you measure the total radiation from the surface with a hand-held instrument then subtract the removable component from this, if appropriate.

19.7 Conducting a Survey with a Survey Meter

When surveying a lab with a survey meter, concentrate on regions where radioactive material has been used. Do not overlook areas where radiation users may have inadvertently walked or items that they may have touched such as doorknobs. Hold the meter as close to the surface as possible without touching it to avoid contaminating the meter. Move the meter slowly and deliberately along lab benches, near selected floor regions, radioactive material work areas, all small equipment, sinks, refrigerators and freezers, telephones, light switches and doorknobs. Also, pay close attention to laboratory coats, waste areas, and containers for both radioactive and normal trash.

Meters are not accurate moving faster than 2 inches/ second.

All meter surveys should be performed with an unshielded probe. Meter surveys performed with a probe covered with parafilm, saran wrap, or a meter cap are not valid. Probe efficiencies are calculated using an unshielded probe.

- ***19.7.1 Documentation Requirements***

In EHSA the survey record should include the meter's Make, Model, Serial Number, and calibration date. Identify those areas which show count rates >100 cpm after background subtraction or readings 3x background. Also record next to the count rate the isotope that caused the contamination, decontaminate that area, re-wipe, and attach the results to the original survey.

19.8 Performing a Wipe Test

Wipe tests of the laboratory should include the areas indicated above. Also, take wipes anywhere high counts were found with a survey meter. Wipes may be wetted with alcohol or distilled water to increase the "lifting" ability. Typical wipe tests should be performed over a 100 cm^2 area.

- ***19.8.1 Documentation Requirements***

Record on the room map the locations of the wipe tests and the area wiped, recording directly in EHSA will help assist with these records. Take wipes of broader areas initially but remember that for determination of contamination, smaller wipes should be taken as well. Load wipes in the appropriate radioactivity counter (liquid scintillation counter for beta emitters or a gamma counter for gamma emitters).

A blank consisting of a clean wipe along with the same volume of scintillation fluid used for your sample wipes should be run along with your wipe samples.

If the results verify there is contamination (>100 cpm or 3x background), record the isotope that caused the contamination, decontaminate that area, re-wipe, and attach the results to the original survey.

19.9 Fixed Contamination

Fixed, or non-removable, contamination is when radioactive material has been absorbed into a material and can only be detected by a survey meter. A wipe test will not pick up this type of contamination. If you find contamination with a survey meter, but a wipe of the area has no detectable radioactivity, then the contamination is fixed.

19.10 Decontamination Processes

- ***19.10.1 Floor or Lab Surface Decontamination***

- Put on appropriate PPE (double gloves, shoe covers, lab coat, goggles) before entering areas where there may be contamination.
- Define the outer boundary of the contaminated area and mark off with tape.
- Clean from the outer edge of the contamination and work inward.
- Use a spray solution and wipe up with paper towels or other absorbent material to absorb as

much removable contamination as possible.

- Low activity spills not containing hazardous materials can be cleaned up by using soap and water. Take a 1ml sample of the wastewater. If it is radioactive, it must be disposed as liquid radioactive waste.
- While cleaning towards the center area, check newly cleaned areas for loose contamination before walking or kneeling in these areas. Bench paper may be placed over these areas to prevent recontamination.
- Tape off and shield any areas where the contamination cannot be easily removed for further decontamination efforts.
- Re-survey area.
- Wash until removable contamination is gone.
- When wipe tests confirm only fixed contamination remains, appropriately shield the contaminated area and label with isotope, activity and date.
- Document that the area has been decontaminated in EHSA along with the initial survey.

• *19.10.2 Equipment Decontamination*

- Use a spray solution and wipe up with paper towels or other absorbent material to absorb as much removable contamination as possible. Be cautious not to flood the area with cleanser since it will wash the contamination into cracks, which may be difficult to decontaminate.
- Low activity spills not containing hazardous materials can be cleaned up by using soap and water. Take a 1ml sample of the wastewater. If it is radioactive, it must be disposed as liquid radioactive waste.
- Wash until removable contamination is gone.
- Re-survey the equipment.
- When wipe tests confirm only fixed contamination remains, appropriately shield the contaminated area and label with isotope, activity and date.
- Document that the area has been decontaminated in EHSA along with the initial survey.

• *19.10.3 Chemical Hood Decontamination*

- Ensure that the chemical hood is running.
- Remove clean items free of other hazards (*e.g.,* volatile organic compounds (VOCs) should remain in the hood) from the hood and place them on clean bench paper outside of the hood, segregating contaminated items.
- Volatile isotopes should be placed into bags and sealed before removing them from the hood.
- Cut out and remove contaminated bench paper from the hood and remove the remaining bench paper. Place contaminated paper with dry rad waste.
- Check floor area for contamination from transporting contaminated items.
- Low activity spills not containing hazardous materials can be cleaned up by using soap and water. Take a 1ml sample of the wastewater. If it is radioactive, it must be disposed as liquid radioactive waste.
- Re-survey the chemical hood. Check the backside of the hood sash, as well as the walls of the hood for additional contamination.

- Wash until removable contamination is gone.
- When wipe tests confirm no transfer of removable contamination, fixed contamination may remain, appropriately shield the contaminated area and label with isotope, activity and date. Short-lived isotopes may be left for decay; long-lived isotopes may require destructive removal by the Radiation Safety Program.
- If all contamination has been removed, document that the area has been decontaminated in EHSA along with the initial survey.

• *19.10.4 Clothing Decontamination*

- Once in a safe location with minimal movement to prevent the spread of contamination to new areas, remove the contaminated clothing carefully to avoid or minimize contaminating your skin.
- Check your skin for possible contamination.
- Contact the Radiation Safety Program if skin is contaminated.
- Determine approximate activity on the clothing.
- If clothing contamination is less than the daily sewer disposal limit, wash the clothing with soap and water in the sink, recording the sewer disposal activity.
- Re-survey the clothing.
- If the clothing contamination is more than the daily sewer disposal limit and cannot be easily cleaned, the clothing will have to be held for decay or disposed as radioactive waste.

19.11 Surveys Required for Radiation Producing Machines

• *19.11.1 Surveys are performed by the Radiation Safety Program:*

- Upon installation of a new piece of equipment.
- Following any change in the initial arrangement, number, or type of local components in the system requiring non-routine changes.
- Following any non-maintenance requiring the disassembly or removal of a local component in the system.
- During the performance of maintenance and alignment procedures if the procedures require the presence of a primary x- ray beam when any local component in the system is disassembled or removed.
- If any changes in shielding, operation, or equipment could produce a greater radiation hazard than before.
- Any time a visual inspection of the local components in the system reveals any abnormal conditions.
- Whenever personnel monitoring reports show an unexplained increase over the previous monitoring period.

• *19.11.2 Surveys Required for Fluoroscopy Units*

All fluoroscopy units must have a Skin Entrance Exposure Survey performed by a qualified health physicist annually. This survey must be posted near the unit.

20 RECORD KEEPING AND AUDITS

20.1 Policy

Record retention must conform to all applicable Federal and state regulations. Records must be kept up-to-date and be readily available for inspection by University Administration, Federal, and state regulatory authorities. It must be possible from the documentation to establish that all conditions for the safe use of radioactive material have been met.

20.2 Database Records That Must Remain Current

- Radioisotope use logs
- Surveys
- Documentation of training provided in the laboratory to personnel
- Radioactive waste disposals to air and sewer

Records must be kept current and be readily available for inspection by the University Administration, Federal, and state regulatory authorities, as well as the Radiation Safety Program.

20.3 Record Recordkeeping Timeline Requirements

Records of the above items must be maintained until the appropriate Federal and state regulatory agencies terminate the University's radioactive material license.

20.4 The Radiation Safety Program Audits

An audit is performed for each AU four times per year and consists of two parts: A survey of all rooms that are surveyed by that AU, as well as an audit of all laboratory records. This includes contamination surveys, waste disposal records, isotope inventories, survey meter calibration, personnel status and training, and inventory of sealed sources. A copy of the compliance review is available for review by the AU.

The audit form is divided into the following areas: Contamination-Related Findings, Laboratory Practice-Related Findings, and Labeling/Record-related findings.

20.5 Resolving Audit Violations

Simple problems can be corrected during an audit. For more severe issues or persistent problems a written notice is sent to the Authorized User. The AU may be requested to document the correction.

Written notice may be provided to the AU, Department Chair, and Chair of the Radiation Safety Committee. Additionally, Radiation Use Authorization can be suspended unless the deficiencies are corrected within a specified period as described in the notice and AUs must correct deficiencies and document the actions taken to the satisfaction of the Radiation Safety Officer and/or the Radiation Safety Committee.

21 USE OF RADIOACTIVE MATERIALS AT THE VETERINARY TEACHING HOSPITAL

21.1 Radiation Safety Requirements for Use in Veterinary Clinical (client-owned) Patients

Clinical diagnostic imaging and treatment procedures are currently performed at the University Veterinary Teaching Hospital under the control and supervision of approved Authorizations that is held by a veterinary radiologist or veterinary oncologist who are fulltime, permanent faculty members at the University and are boarded by the American College of Veterinary Radiology (ACVR) or the American College of Veterinary Internal Medicine/ACVR-Radiation Therapy/Oncology.

21.2 Ordering radionuclides for animal imaging or treatment

All radiopharmaceuticals must be purchased from an approved radiopharmaceutical company. Order the dose prescribed by the Primary Care Clinician (Authorized User) as a pre-loaded syringe unit dose.

When ordering iodine, notify the Radiation Safety Program of the following information: Authorization under which the order is placed; activity; date of scheduled delivery; and patient.

21.3 Receiving and processing of radiopharmaceutical packages delivered directly to the Veterinary Teaching Hospital

Only appropriately trained personnel (radiation workers) listed on an Authorization are approved to receive and secure radiopharmaceuticals delivered by a commercial radiopharmacy directly to the VTH by courier.

All courier packages will be immediately secured in the restricted-access nuclear medicine materials processing lab (VTH 1303E).

Once orders other than iodine has been received, submit a completed receipt form to the Radiation Safety Program.

Authorized VTH Imaging and Oncology Section staff (radiation workers listed on the ordering Authorization) are responsible for the performance of all necessary steps for the safe and compliant receipt of radioactive packages delivered directly to the VTH by the courier of a commercial radiopharmacy for diagnostic imaging or radiotherapeutic purposes.

- ***21.3.1 Package Check-in Procedure:***

- Upon receipt of the package, ensure that the ordered material was received as specified and that the package is undamaged.

- Wear proper protective clothing when handling the package, such as a buttoned lab coat, gloves, and a body and ring badge, as necessary.

- Check for evidence of potential contamination, such as packages that are crushed, wet, or damaged. If there is any evidence of leakage or contamination, contact the Radiation Safety Program immediately.

- Notify the AU, or their designee, that the material is secured in the NM lab.

- Measure exposure rate at 3-ft (1-meter) and at the surface of the package. Record the survey measurements including background levels on the Radioactive Delivery Record. If reading exceeds 10 mR/hr at 3 feet or 200 mR/hr at contact of the package surface, stop immediately and seek technical assistance and/or guidance from the Radiation Safety Program.

- Perform wipe tests for removable contamination on all RAM packages. If the external surface of the package is found to be contaminated in excess 22000 dpm/100 cm2 of beta-gamma emitting nuclides or 2200 dpm/100 cm2 of alpha emitters), contact the Radiation Safety Program and take appropriate precautions to assure containment of the contamination.

- Complete the Radioactive Delivery (shipment) Record Form (forms provided by the Radiation Safety Program personnel).

The Radiation Safety Program must be notified immediately and prior to any further processing (other than securing and isolating) of any package that does not contain the ordered material, or that is visibly damaged or appears to be wet from potential leakage.

A trained radiation worker wearing appropriate PPE should place a damaged package into a large, sealable transparent plastic bag. All personnel involved in the handling of the damaged package (including the courier) must be surveyed for contamination. All workers must assure that contamination is controlled immediately and is not spread into a public area. If required, proceed through an appropriate decontamination process. Call the Radiation Safety Program for assistance. Radiation Safety will inform the vendor/shipper of any non-conforming shipment and will identify any extenuating circumstances surrounding the suspect shipment.

If a delivery error (incorrect radionuclide or quantity) or damaged package is identified while the courier is present, the receipt of the package may be refused. The Radiation Safety Program should be contacted whenever there is receipt of an unordered or misdelivered radioactive material.

• *21.3.2 Preparing Radiopharmacy Containers for Return*

Returning the pharmacy packages requires preparing packages that were received as a hazardous materials shipping container for transfer and release to the vendor's courier for transport on a public highway and to assure the University maintained compliance with DOT regulations.

Procedure:

1. Place the container on a covered benchtop with disposable covering (*e.g.,* lab paper) and remove all contents from shipping container.
2. Ensure all sharps are placed in a properly labeled horizontal entry sharps container if any are present.
   - Survey the container and its contents with a meter appropriate for the isotopes that were in the container. If the meter survey indicates the presence of radioactive contamination above background, contact the Radiation Safety Program for further instructions.
3. Perform a swipe survey of the following surfaces:
   - Outside of shipping container
   - Inside of shipping container

- Outside of pig(s)
- inside of pig(s)
- If the swipe survey indicates the presence of radioactive contamination > 2x background, contact the Radiation Safety Program for further instructions.

4. Once the container is verified to be free of radioactive contamination and ready for return:
   - Remove the placards from the outside of the shipping container and place them inside the container.
   - Reassemble the shipping pig(s) and place inside the shipping container.
   - Remove any labels or markings which would indicate the contents are radioactive.
   - Identify the container as being ready for return shipment.

21.4 Preparing animal housing areas containing radioactive animals

Except during imaging, animals administered radioisotopes will be housed in an approved location with appropriate labeling of the stall/cage with radioactive warning signs, and pre prepared staging of PPE.

Disposable gloves and shoe covers must be used whenever entering the room. PPE must be removed before leaving the isolation area.

All stalls or patient housing areas holding a patient that has received radioisotopes will be posted with an appropriate warning notice. This notice should include the nuclide administered, the administration date and time, and amount administered.

21.4.1 Marking animal housing areas containing radioactive animals

All stalls or patient housing areas holding a patient that has received radioisotopes will be posted with an appropriate warning notice. This notice should include the nuclide administered, the administration date and time, and amount administered.

The area should also contain an RHF-3 “Notice to Employees” notice and a “Caution Radioactive Material” sign.

It is recommended that additional postings containing language regarding release criteria also be posted in the housing area. For example: DO NOT RELEASE this animal and stall/cage until release has been signed off on by an authorized person.

21.5 Radiation safety protocols for administering the radiopharmaceutical to the patient

After the radiopharmaceutical has been properly logged in and wipe tested, place the syringe in an appropriate syringe shield and transport the radiopharmaceutical to the treatment location.

Notify the AU/primary care clinician that the radiopharmaceutical is ready for administration. Take the lead pig containing the radiopharmaceutical (in syringe shield) to the pre-planned, prepared area for administration to the patient. Wear a single pair of gloves when transporting the container. Avoid walking through congested and public accessible areas if possible.

Remember to wear proper PPE including gloves and a lab coat and protective shoe coverings. All personnel involved in the administration of the radiopharmaceutical should wear their whole-body badge. The person injecting a patient must also wear a finger ring dosimeter.

Ensure that the injection area is covered to prevent contamination during the procedure with a material such as a plastic-backed absorbent pads or disposable towel.

NEVER re-cap a needle used for radiopharmaceutical administration. DO NOT place needles (capped or uncapped) into radioactive waste containers All potentially contaminated needles must be carefully placed into a RAM-labeled horizontal-entry sharps container.

The AU or a trained radiation worker should immediately monitor personnel that performed the injection and the room for contamination after administration of a radiopharmaceutical. Perform a swipe survey as soon as possible after the administration.

21.6 Spills, exposure to the radiopharmaceutical, or another emergencies

All personnel handling a unit dose syringe or stock vial will be trained in appropriate emergency response procedures. In the case of any personnel contamination, the Radiation Safety Program must be notified.

If a loaded syringe or stock vial is dropped or radioactive material is otherwise spilled:

- Contain and restrict access to the area of the spill or release.
- Do not track the spill around. Ask a qualified radiation worker to assist you.
- Call the AU, and/ or their designee, to assist with the control and clean-up of the area.
- Put on appropriate PPE and gather the supplies you will need to perform a cleanup.
- Define a buffer zone around the spill with a marker.
- Cover a liquid spill with an absorbent pad.
- Notify the Radiation Safety Program immediately.
- If you need assistance or have difficulty completing the clean-up, call the Radiation Safety Program.
- Document the spill and the clean-up on sequentially prepared survey forms.

21.7 Procedures for aftercare of the radiopharmaceutical patient while at VTH

Only technicians or clinicians listed on the Authorization will be allowed to handle or examine the animal while it is in a restricted RAM-posted area.

Ensure proper PPE is worn, including gloves, protective gown, and disposable shoe covers when entering the patient housing.

Handle animals only when absolutely required to keep time and contact with the patient to a minimum. Personnel handling animals administered radioactive materials must wear body and finger badges.

When leaving the housing area:

- Remove protective gown,
- Remove protective shoe covering from one foot and step with this foot onto the high tack mat; remove the shoe covering from the other foot and put this foot onto the high tack mat,

- Remove gloves wrapping shoe covering inside gloves as gloves are pulled over the shoe covers. Dispose of gloves and shoe covers in one of the waste containers,
- Step from high tack mat to the area immediately outside of designated hot area.

Prior to leaving the area immediately outside of the restricted area, monitor your

hands, lab coat, and soles of your shoes to check for contamination and secure the area, (*i.e.,* ensure the doors are locked).

21.8 Handling patient health issues during radiopharmaceutical treatment

Any abnormalities in the patient's condition should be immediately addressed to the primary clinician.

If a medical/surgical emergency exists, the Radiation Safety Officer should be notified immediately, and the patient's medical/surgical emergency described and recommended patient management relayed. The Radiation Safety Officer will recommend appropriate radiation safety considerations and may dispatch personnel to monitor the implemented medical/surgical management.

If laboratory tests are required, all samples should be labeled as radioactive to ensure that laboratory staff are aware of the hazard.

21.9 Contamination surveys required in radiopharmaceutical patient housing area

Surveys are required only after release of a patient. These surveys must be performed and documented as described in the Radiation Protection Program Manual.

A survey log must be maintained for the radiopharmaceutical patient housing area.

Any areas showing contamination in excess of 2x background must be cleaned, re-surveyed with results recorded on a follow-up survey form. The cleaning, re- survey and documentation process must be continued until there is resolution of the contamination.

No new patients can be housed in areas until decontamination has been performed.

Completed survey forms must be available for inspection in the restricted area, organized chronologically and retained for 3 years. If the Authorization is terminated prior to the end of the retention period all RAM use and survey records must be transferred to the Radiation Safety Program.

During weeks when there are no radioactive materials use or storage (even RAM waste) in a restricted RAM-posted area, the lack of RAM use shall be noted in the survey logbook by the entry of No use/No storage statements.

21.10 Procedures for the unexpected death of a patient

In the event of a patient death occurring after treatment or administration of radioactive materials, the Radiation Safety Program must be notified immediately.

The AU is required to have a pre-plan for storage the body, secured in an appropriately labeled plastic bag, in a secure RAM-posted freezer.

The required storage duration required for RAM decay (weeks to months) prior to release of the body to the owner, or for disposal, will be estimated by the Radiation Safety Program. Radiation Safety Program personnel must verify that adequate decay has occurred prior to removal of the body from freezer storage.

21.11Handling Patient Waste

Unnecessary cage cleaning should be avoided and delayed allowing for RAM decay.

With the exception of dogs administered iodine, no patient excrement (urine and feces) is to be washed into the sanitary sewer until after an appropriate time has passed that would assure complete decay of the radionuclide.

• *21.11.1Dogs administered Radioactive Iodine*

It has been determined that iodine-131 in amounts of up to 600 mCi can be disposed of in the sanitary sewer system from the Bustad Vivarium at the Veterinary Teaching Hospital. The purpose of this program is to limit the possibility of any radioiodine uptake for personnel engaged in the clean-up of contaminated animal waste products. Radioiodine can be volatized and inhalation is a possible route of entry in addition to skin contact or ingestion.

This procedure will be carried out by Authorized and Trained personnel at the Veterinary Teaching Hospital (currently Rance Sellon, DVM, Attending) and any or all workers handling radioactive iodine waste or sufficiently close to the process so that intake is possible (e.g., within a few meters or in the same room as the worker handling the waste material, as appropriate).

Personnel should don appropriate Personal Protective Equipment (PPE) prior to starting clean-up of contaminated dog run. PPE should include, at a minimum (all items can be disposable):

PPE should be donned in a contamination free zone.

- Splash proof outer clothing, this may be in the form of disposable polypropylene, Tyvek or other such suits to protect from splashing material.
- Splash protection for the face, preferably a full-face shield.
- Appropriate footwear or shoe coverings.
- Appropriate gloves.

• *21.11.2 Washing of Dog Run/Enclosure:*

It is important to not volatilize radioiodine when washing the dog run. Care should be taken to reduce splashing when using the hose and nozzle. Water temperature should be kept to temperatures that will reduce the volatilization of the radioiodine. Water pressure should be kept as low as possible.

• *21.11.3 After Work Clean-Up and Surveys:*

Upon completion of clean-up procedures all PPE should be surveyed to determine contamination. If disposable outerwear is used it may be disposed of as radioactive waste if it is found to be contaminated. Non-disposable items should be bagged and labeled with the date. These items can be surveyed for release after 10 half-lives have passed (80 days).

Once PPE is removed, and prior to departing the Radiation Use area, the individual(s) must

survey themselves to determine that they are not contaminated.

- ***21.11.4 Effluent Reporting:***

The amount of I-131 radioiodine that is disposed in the sanitary sewer system must be reported to the Radiation Safety Program on a monthly basis. The amount to be reported is the full amount injected into the patient since it is assumed, for calculation purposes, that all radioiodine injected is secreted through urine and feces over the course of treatment.

21.12 Preparing the radiopharmaceutical patient for release to an owner

Animals injected with Tc-99m may be released by VTH after 10 half-lives (60 hours) have passed from the time of injection. These animals must still be surveyed to ensure that they have decayed to background levels before release. Release surveys must be recorded and available for review by the Radiation Safety Program.

For animals administered other, longer-lived isotopes a post-injection the dose rate survey should be performed by VTH staff using an appropriate survey meter. During this scanning procedure, the patient will remain in the cage or enclosure and will be secured in an appropriate position and proximity using a leash or other form of restraint (not a radiation worker's hand). Veterinary patients that have been treated with radioactive isotopes must be released by the Radiation Safety Program before they can be sent home. The exception is horses treated With Tc-99m, which may be released by veterinary personnel 3 days after injection as long as all other requirements are met. Cats injected with I-131 will normally need a week or more to metabolize enough radioiodine to meet release limits.

Cats will be placed in a cardboard carrying case. The cat will be removed to a location with a low radiation background, typically, across the hall from the current Cat Room.

Dogs will be placed in a carrier and removed from the run to a low radiation background area.

Horses may be scanned in the stall prior to removal.

When the AU, or their designee, has determined that the dose rate has decreased to the appropriate level for preparation of the patient for release, the Radiation Safety Program will be notified.

A representative of the Radiation Safety Program will perform a dose rate survey of the patient to verify the conditions for release have been reached.

Patient Release criteria will be determined prior to the ordering and administration of the radiopharmaceutical to the patient. The criteria and procedure for establishing the criteria, limits and conditions of release of the patient are described in the Authorization. the Radiation Safety Program must verify that the release criteria have been met before a patient that has been treated with a radiopharmaceutical is released to the owner.

Radiopharmaceutical patients will remain in the restricted patient housing area until the owner has arrived and checks into the VTH reception area. These patients are not to be allowed into any other patient housing wards, nor are they to be taken outside of the VTH prior to their release.

21.13 Cleaning cages, runs, and rooms after radiopharmaceutical patients' treatment

After the discharge of a patient, the cage or run and bedding material should be left undisturbed to decay for as long as practical (up to 10 half-lives if the space is not needed).

Individuals cleaning these areas should wear a cap, mask, gown, and double gloves. The caging material should be gently swept to minimize suspended particulate production and collected in bags.

Plastic lined radioactive waste boxes will be located inside the isolation area. One box is for disposable gloves, shoe covers, and gowns; the second box is for radioactive waste generated by the patient(s).

Bags should be labeled with the initial activity injected, date, and radionuclide and stored in the RAM-posted restricted access area (with other radioactive waste containers) until decay-in-storage is completed or it is transferred to the Radiation Safety Program. Contact the Radiation Safety Program before releasing any potentially contaminated waste as normal waste (non-RAM waste).

When the emptied cage or run have been cleaned, it should be wiped with a damp Swiffer mop, which can be surveyed. If counts above 2x background are documented the cleaning materials must be disposed of in radioactive waste and the cage or run must remain restricted.

The person cleaning the run should then survey his/her shoes, pant legs, sleeves, and hands for radiation contamination with an appropriate survey instrument.

With the exception of Dogs administered iodine, no patient excrement (urine and feces) is to be washed into the sanitary sewer until after an appropriate time has passed that would assure complete decay of the radionuclide.

22 URANYL ACETATE

22.1 Policy

Uranyl acetate is not regulated as radioactive material but must be disposed as waste by the Radiation Safety Program.

22.2 Description of Uranyl Acetate

Uranyl acetate is a naturally occurring radioactive material that emits alpha (α), beta (β) and gamma (γ) radiation. It is used as a stain for electron microscopy viewing enhancement. Although the radiation associated with the material is far less hazardous than its chemical toxicity, it should be treated as a radioactive hazard.

The stochastic annual limit of intake is 10 µCi. Do not inhale or ingest it. A chemical fume hood should be used for work involving uranyl acetate. Chemical safety procedures will suffice. Follow the safety procedures from the Safety Data Sheet (SDS) for uranyl acetate.

23 REQUIREMENTS FOR THE SAFE USE OF X-RAY MACHINES

23.1 Requirements for X-ray Diffraction Units

23.1.1 Enclosed-Beam System

In an enclosed-beam system, all possible x-ray paths (primary and diffracted) are completely enclosed so that no part of a human body can be exposed to the beam during normal operation. Because it is safer, the enclosed-beam system should be selected over the open-beam system whenever possible.

The x-ray tube, sample, detector, and analyzing crystal (if used) must be enclosed in a chamber or coupled chambers. The sample chamber must have a shutter or a fail-safe interlock so that no part of the body can enter the chamber during normal operation.

The dose rate measured at 2 inches (5 cm) from the outer surface of the sample chamber must not exceed 0.25 mrem/hour during normal operation.

23.1.2 Open-Beam System

In an open-beam system, one or more x-ray beams are not enclosed, making exposure of human body parts possible during normal operation. The open-beam system is acceptable for use only if an enclosed-beam system is impractical for any of the following reasons: a need for adjustments with the x-ray beam energized, a need for frequent changes of attachments and configurations, motion of specimen and detector over wide angular limits, or the examination of large or bulky samples/specimens.

An open-beam x-ray system must have a guard or interlock to prevent entry of any part of the body into the primary beam. Each port of the x-ray tube housing must have a beam shutter with a conspicuous shutter-open indicator of fail-safe design.

The dose rate at 2 inches (5 cm) from the surface of the source housing must not exceed 2.5 mrem/hour during normal operation.

23.2 Important Things to Remember When Using an X-ray Diffraction Unit:

- All individuals using a unit must have documented training to use the specific equipment.
- Must follow approved written operating procedures.
- Establish a “Use Log” that is available for review.
- Using an appropriate survey instrument, monitor radiation exposures at the time of initial operation and when modifications are made.
- Wear appropriate radiation monitoring devices.
- Appropriate warning lights and other safety devices must be in place and operational.
- Appropriate radiation shielding must be installed on each x-ray diffraction unit. Required shields should be interlocked to prevent radiation exposure to personnel if the shield is removed or displaced.
- All beam shutter mechanisms must be interlocked to prevent operation if the shutter is not

properly closed.

- Post required notices and radiation warning signs.
- Report unusual events/exposures to the Radiation Safety Program.

23.3 Requirements for the safe use of Electron Microscopes

Generally, electron microscopes present little risk of significant radiation exposure if they are not modified or damaged and if the manufacturers operating instructions are followed. However, it is essential to comply with the following requirements/ safety practices:

- Follow the manufacturer's operating instructions
- Stop operation and notify your supervisor if equipment is damaged (cracked windows) or if operating parameters are not within acceptable limits
- The radiation exposure limits for electron microscopes must not exceed 0.5 mR/hour at 2 cm from the surface
- Unless specified otherwise by the Radiation Safety Program, radiation exposure monitors are not required for personnel who work with electron microscopes.

23.4 Requirements for the safe use of Medical Radiographic Machines (Dental and Medical)

To minimize the radiation exposure received by workers during medical radiographic procedures, it is essential to comply with the following requirements/ safety practices:

- All x-ray equipment must satisfy appropriate requirements of federal, state and local regulations;
- Shielding of x-ray rooms must satisfy appropriate requirements of federal, state and local regulations;
- A sign for all radiation-producing machines (*e.g.,* X-Ray) must be at each entrance;
- Post operating/ safety instructions must be near the equipment console;
- Equipment must be checked according to requirements of the State of Washington Radiation Protection Regulations;
- Personnel working with radiation must wear personnel monitors;
- Only essential individuals can be in the x-ray room during the production of x-rays;
- Any individual required in the room during the production of x-rays must wear a leaded apron of at least 0.25 mm lead equivalent, or stand behind an approved protective barrier;
- Any individual who holds a patient during an x-ray examination must wear a leaded apron (at least 0.25 mm lead equivalent) and, if the hands are likely to be in the primary beam, leaded gloves (at least 0.50 mm lead equivalent);
- Lead aprons, gloves, and other protective devices should be inspected once every six months to detect cracks and breaks in the shielding and should be replaced immediately if defects are found;
- Collimate the x-ray beam to the area of interest, but no larger than the film size.

23.5 Requirements for the Safe Use of Cabinet Radiography Units

By nature, cabinet radiography units present minimal risk of significant exposure if the shielding is not modified, if interlocks and warning lights operate properly, and if users follow approved operating procedures.

- Unless approved by the Radiation Safety Committee the radiation exposure at a distance of 2 cm from the surface of a cabinet radiography units must not exceed 0.5 mR/hour
- The necessity for radiation dosimetry at each cabinet radiography unit will be determined by the Radiation Safety Program.

23.6 Requirements for the Safe Use of Particle Accelerators

A particle accelerator uses electrostatic or electromagnetic fields to increase the speed (energy) of electrically charged particles or electrons and to direct the charged particles to a target. This interaction can produce ionizing radiation, which is generated when the primary beam is activated. In addition, ionizing radiation may be produced by interactions between the beam and the materials in the path of the beam, such as targets and enclosures and may cause addition exposure hazards. Neutron radiation may also be generated.

An assessment will be performed by the Radiation Safety Program to ensure that dose rates do not exceed the annual dose limits for radiation workers and dose limits to the public. This will require the presence of area monitors located in the vicinity of the accelerator. A sign will be posted outside the room indicating that the accelerator is in use and that entry to the room is prohibited.

If the accelerator contains a Faraday cup, a no-entrance “High Radiation Area” should be designated 1 meter from the cup.

The Radiation Safety Officer should be consulted on any planned addition or change of any materials potentially subject to 1.5MeV bombardment.

Beamline or Radiofrequency Quadrupole (RFQ) parts should be surveyed by the laboratory staff using a Geiger counter.

If the accelerator is to be disposed or transferred to another Authorized User outside of WSU, the accelerator as well as the room containing the accelerator must be decommissioned by an outside contractor due to the presence of potential activation products and air contaminants.

24 REGULATORY REFERENCES USED IN THIS MANUAL

- WAC Chapter 246-221, 10/11/2023
- Broadscope License Number WN-C003-1, Amendment No. 86, issued by State of Washington Department of Health (Raj K. Maharjan, MS), to Washington State University, March 1, 2022
- US NRC Regulatory Guide 8.20 Application of Bioassay for I-15-I131, Revision 2, September 2014
- US NRC Regulatory Guide 8.32, Criteria for Establishing a Tritium Bioassay, July 1988
- Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) via US NRC NUREG-1575, Revision 1, August 2000, and EPA 402-R-97-016, Revision 1, August 2000

25 ISOTOPE AND SHIELDING REQUIREMENTS

The following chart is meant as a general guide only. Please call the Radiation Safety Program (509-335-4221) or consult the information sheet that comes with the isotope should you require further information on the specific thickness of the shielding that is required.

Isotope	Energy (MeV) & Type	Shielding
Ca-45	0.257 beta	None
Cr-51	0.320 beta	Lead
C-14	0.156 beta	None
Cl-36	0.710 beta	Lucite
I-125	0.035 gamma / X-ray	Lead
P-32	1.71 beta	Lucite
P-33	0.249 beta	None
Na-22	1.275 gamma 0.546 positron	Lead
Tc-99m	0.141 gamma	Lead
H-3	0.019 beta	None
S-35	0.167 beta	None
Na-22	1.275 gamma	Lead