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</tbody>
</table>
Radiation Safety Officer (RSO) – Chad Johnson, 509-359-6455, Cell Phones 509-290-3510
Alternates – Don Elbert, 509-359-2287, Cell Phone 509-220-7049

RADIATION EMERGENCY REPORTING INSTRUCTIONS

In case of large spill, severe injury, fire or explosion:

If you are not in immediate danger from fire or explosion:

CALL: ....................... 911

REPORT:
1. Say "Radiation Emergency"
2. Give your name
3. Give your building and room number
4. Give the phone number you are calling from
5. Describe the emergency:
   a. Was there a fire or explosion?
   b. Are there any injuries?
   c. If so, how many?
   d. Was there a spill?
   e. If so, what was spilled?
   f. How big is the spill?
   g. Was any person contaminated?

If you have to evacuate due to fire or explosion, do the above from a safe location. If you are contaminated notify rescue personnel.

NOW -- Call the RSO!

STAY WHERE YOU ARE! HELP IS ON THE WAY!
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Guidance Documents
EH&S Staff RAM Package Processing
RAM Package Opening
Radiation Laboratory Survey Guidelines
Forms
- Application for Authorization to Use Radioactive Materials
- New User Statement of Understanding and Certificate of Affirmation
- Request for Radioactive Materials and Activity
- RAM Package Receipt
- Laboratory Survey Record Form Room 005
- Laboratory Survey Record Form Room 174
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- Post-Experiment Survey Form
- Radioactive Material Waste Collection Form
- Declaration of Pregnancy
- Waste Container Inventory
17-1 ORGANIZATIONAL STRUCTURE

Eastern Washington University’s (EWU) use of radiation is authorized by a license issued by the Washington State Department of Health (DOH). The state’s authority is derived from federal legislation and formal agreement between the Nuclear Regulatory Commission, a federal agency, and DOH. The University maintains a laboratory radioactive materials license. This license allows radionuclide possession and use as listed in the license. This license also specifies authorized users, the Radiation Safety Officer (RSO), and requires DOH review and approval for any changes to the license. The RSO and the Radiation Safety Committee review and monitor the use of radioactive materials at the University.

Fundamental responsibilities of the Committee are to formulate and recommend policies and procedures with respect to radiation safety. Following review and approval by the Committee, proposed changes to the list of authorized users will be submitted to DOH for review, approval, and amendment to the license.

The responsibilities of administration, staffing, and budgeting of the radiation safety program are conducted by the RSO. It is essential that the Radiation Safety Committee and the RSO function in a close and cooperative relationship. To achieve this, it is incumbent upon the authorized users, members of the Committee and the RSO to maintain open channels of communication in both directions on matters relating to the radiation safety program.

The individual user is responsible for the safe conduct of his or her activities involving the use of radioactive materials and/or radiation-producing equipment.

17-2 THE RADIATION SAFETY COMMITTEE

The Radiation Safety Committee is responsible for all matters pertaining to the formulation, administration, and operation of a comprehensive radiation safety program at EWU. This committee shall also provide consultation to individual users concerning radiation safety procedures.

The EWU Radiation Safety Committee shall include a dean or department head, or other administrative official from the science field; a faculty representative from each of the departments of Biology, Chemistry, Geology, Physics, Dental Hygiene, and any other department that uses radiation material, or radiation-generating equipment; and the RSO.

It shall be the duty of the Radiation Safety Committee to:

a. Develop policies and regulations for the safe handling, use, procurement, transfer, and disposition of all radioactive material on campus.

b. Develop policies and regulations for the safe operation of X-ray generators and any ionizing radiation-producing equipment.

c. Develop regulations to ensure adequate personal protection for all people working with or around ionizing radiation.
d. Review all reports of non-compliance with these and other applicable regulations (WAC 246, for example) and take the necessary corrective actions.

e. To perform safety analyses of proposed uses of ionizing radiation which take into consideration such matters as the adequacy of facilities and equipment, training and experience of the user, and the operating or handling procedures.

f. To review proposed uses of ionizing radiation prior to use, evaluate the safety of the proposed use, and verify that the user, isotope and application are authorized in the license.

g. To review and evaluate proposed authorized users and submit proposed changes to the license to the Department of Health.

h. To annually review a formal audit to determine the amount of radionuclide’s used, received, disposed of, current inventory, and how to reduce radiation exposure.

The Radiation Safety Committee shall meet as often as necessary to discharge its obligations, but at least once during each academic quarter. A quorum consists of one-half of the members plus one.

Minutes of the meetings shall be recorded, published, distributed to each member and other interested individuals, and kept on file by the RSO.

The Chairperson of the Radiation Safety Committee is the RSO. He/she shall be responsible for implementing the policies of the Committee. All routine operations necessary to ensure that the Radiation Safety Committee fulfills its obligations shall be conducted by the RSO. Non-routine, special requests, requests for approval of new programs or for the modification of existing programs shall be submitted to the Radiation Safety Committee through the RSO.

At each quarterly meeting, the Radiation Safety Committee will perform a management review of the status of the radiation safety program including:

a. Any accidents or incidents since the last meeting.
b. Review any proposed changes to the list of authorized users and approve any proposed amendments to the license.
c. The current inventory of radioactive materials.
d. Reports of inspections and surveys conducted by state inspectors.
e. Material received, transferred, or disposed of.
f. A comparison of the current inventory with licensed limits.
g. Adequacy of EWU policies and regulations governing radiation safety and any changes that might be required.
h. Review of any new or proposed uses of radioactive material or radiation-producing equipment.
i. A review of individual exposure levels/ dosimetry results, approve and comment on annual ALARA audit.
j. A review of any changes in federal or state regulations affecting radiation safety.
k. Review bioassay results.
17-3 THE RADIATION SAFETY OFFICER

The RSO has had specific formal training in radiological health (i.e., college level or equivalent) and experience in radiation protection with radioactive material. The RSO is responsible for carrying out the provisions of this directive and the Washington State Administrative Code (WAC) for Radiation Protection. He/she will ensure that all actions of the Committee are implemented on a timely basis and report any instances of noncompliance to the Committee.

Specific responsibilities include:

a. General surveillance over all activities involving radioactive material, including routine monitoring and special surveys of all areas in which radioactive material is used.
b. Determining compliance with rules and regulations, license conditions, and the conditions of project approval specified by the Radiation Safety Committee.
c. Furnishing consulting services on all aspects of radiation protection to personnel at all levels of responsibility.
d. Receiving, opening, and delivering all shipments of radioactive materials which arrive at the University, and receiving, packaging, and shipping of all radioactive materials leaving the institution. Perform Department of Transportation surveys as required.
e. Distribute and process personal monitoring equipment, determining the need for and evaluation of bioassays, keeping personal exposure and bioassay records, and notifying individuals and their supervisors of exposures approaching maximum permissible amounts and recommending appropriate remedial action.
f. Conducting training programs and otherwise instructing personnel in the proper procedures for the use of radioactive material prior to use, at periodic intervals (refresher training), and as required by changes in procedures, equipment, regulations, etc.
g. Supervising and coordinating the radioactive waste disposal program, including keeping waste storage and disposal records and monitoring effluents.
h. Storing all radioactive materials not in current use, including wastes.
i. Maintaining an inventory of all radionuclide’s at the University and limiting the quantity of radionuclides at the University to the amounts authorized by the license. The inventory should include the name of the person responsible for each quantity of radionuclides, where it will be used or stored, and the date the quantity was delivered to that person. Items are removed from the inventory by showing how and when the radioisotope was disposed of.
j. Conduct yearly radioactive material audits.
k. The authority to terminate immediately a project that is found to be a threat to health or property.
l. To ensure timely calibration of all radiation survey instruments used for safety survey purposes.
m. To inspect and survey each laboratory and facility where radioactive materials are used or stored.
n. To acquire and know current regulations, codes, rules, and reference materials and maintain a library of relevant documents.
o. To know all applicable state and federal regulations and license application guides, and ensure that license applications are properly filled out and submitted on time.
p. To ensure that the institutional radiation use and safety programs are in compliance and adhere to the license and license application conditions.

q. Ensure that individuals working with radiation have appropriate protective devices, including shielding, ventilation, fume hoods, clothing, gloves, remote handling equipment (where necessary), instrumentation, and facilities which aid in keeping exposure as low as is reasonably achievable.

r. To act as liaison agent with regulatory authorities, be available for assistance during inspections and audits, and notify the state:
   1. In writing before making any changes which would render the license no longer valid or accurate.
   2. Immediately in the event of any radiation accident or incident which causes or threatens to cause a whole body effective dose of 25 roentgen equivalent mammal/man (rem), an eye dose of 75 rem or more, or a shallow dose equivalent of 250 rem, or the release of radioactive material outside a restricted area.
   3. Within 24 hours in the event of any radiation incident which causes or threatens to cause an individual total effective dose of 5 rem, an eye dose of 15 rem or more, or a shallow dose over 50 rem, or a release outside a restricted area potentially exceeding the annual limit intake (ALI).
   4. Within 5 days of any positive leak test result of a sealed source.
   5. Within 30 days in a report stating remedial action after an accident or incident.

s. To ensure that authorized users post conspicuously "Notice to Employees" Radiation Health Form (RHF)-3, and any notices of items of non-compliance resulting from state inspections.

t. To take charge in all emergency situations in the event of major or minor spills, or release of radioactive material, to make sure that correct emergency decontamination and protection procedures are carried out. Also to evaluate the situation that led to the emergency, so as to reduce the chance of recurrence.

u. To keep this directive current.

17-4 RADIATION PRODUCING EQUIPMENT

Radiation-producing equipment such as x-ray machines shall be under the jurisdiction of the Radiation Safety Committee. Radiation-producing equipment shall be installed, maintained, and operated in accordance with WAC 246-228.

The Radiation Safety Committee will be notified, in advance, of all plans to procure new radiation producing machines or plans to modify or move existing machines. EWU-Environmental Health and Safety (EH&S) Guidance 07 Analytical X-ray provides information about the EWU analytical X-ray program.

17-5 AUTHORIZATION FOR USE

DEFINITIONS

AUTHORIZED USER - Any faculty or staff member of the University who is named on the license as an authorized user.
STUDENT USERS - Any student working under the supervision of an authorized user (on programs which have been approved by the Committee) who has successfully completed Radiation Safety Training and achieved 80% on the Radiation Safety Exam. Graduate students doing independent projects must obtain approval from the Radiation Safety Committee.

PROCEDURES FOR OBTAINING AUTHORIZATION
Any faculty or staff member who wishes to use radioactive materials or radiation generators shall first obtain authorization from the Radiation Safety Committee. A written request shall be submitted through the RSO.

The Radiation Safety Committee shall review each application. Expedited review and approval between Committee meetings will be performed when applications are received for short-notice projects. The Committee shall ascertain that there are adequate precautions taken by the applicant to ensure the safety of the personnel involved, the general public, and the facilities. In addition, the Committee will also ascertain that the applicant has adequate training, experience, equipment, and facilities to safely conduct the experiment or operation. The Committee may request additional information from the applicant to assist in the decision-making process. Following review and approval by the Committee, the RSO will submit a license amendment to the DOH. The applicant will be informed in writing of the disposition of his or her application by the RSO.

The authorization will be specific for the type of radiation or radioactive material, possession and use limits, location of use, chemical compound or form, and type of use. Authorization is necessary when programs change.

The RSO may restrict or forbid the use of any radiation that is not used within or according to a proper authorization. If any aspect of a properly authorized procedure presents an unrecognized hazard, the RSO may stop the procedure and require a reevaluation by the Radiation Safety Committee.

Substantial changes in the applicant's program of usage of radioactive material and/or radiation generators shall be submitted to the Radiation Safety Committee through the RSO.

PROCEDURES FOR TERMINATING AUTHORIZATION
An authorization for use of radioactive material may be terminated for one of the following reasons:

a. End of project.
b. Leave of Absence.
c. Violation of Regulations.

Termination of Radiation Use: This procedure shall include users who have finished work with radioactive material, expiration of their authorization, or termination of employment. The user shall initiate the procedure 30 days in advance of any of the above.
Submit a letter to the RSO requesting that the authorization be terminated. The letter shall state the transfer and disposal of the materials used.

The RSO shall perform a comprehensive survey of the laboratory(s) before they are released for unrestricted use.

The RSO shall forward a written confirmation to the user that the laboratory has been surveyed for contamination and found to be absent from contamination, and the authorization is officially terminated.

**Leave of Absence Procedure:** In the event of an unforeseen circumstance, in which an authorized user must abandon an experiment, contact the RSO.

### 17-6 PROCEDURES FOR BECOMING AN AUTHORIZED USER

A person (with or without previous experience with radiation) desiring to use radioactive material at EWU shall complete the Radiation Safety Training program conducted by the RSO or delegated persons.

An applicant desiring to use radioactive material shall submit a typed request to the Radiation Safety Committee through the RSO. The RSO shall perform an analysis of the proposal, and provide comments to the Radiation Safety Committee. Following review and approval by the Committee, the RSO shall submit a license amendment to DOH. The applicant will be notified of the disposition of the application in writing by the RSO.

Criteria to be used by the Committee in Evaluating an Application:

- The committee will evaluate the need for personal dosimetry in relation to the project and WAC 246.

- The Committee will determine if the intended use will meet EWU guidelines for safe use of radioactive materials. See EH&S Form [Application for Authorization to Use Radioactive Materials](#).

- There is a provision for sufficient ventilation for volatile materials and for evacuating any airborne radioactive material that might be suspended in the room's atmosphere and that adequate, properly fitted respiratory protection is used.

- Equipment/materials are available to contain spills.

- A suitable fire extinguisher is readily available and a phone or fire alarm is available for use.

- Remote handling tools are available if needed. Contact the RSO for assistance.

- Adequate shielding is available, if necessary.
• Adequate survey equipment is available.

The Committee will evaluate the credentials of the applicant to determine that:

• The applicant has had formal training in the use of radiation sufficient to satisfy the Committee that the radiation will be used safely.

• The applicant has had actual hands-on experience working with radionuclide’s including the specific radionuclide’s applied for so that the Committee is satisfied that the materials will be used safely.

Amendments to approved authorizations shall be requested and processed in a similar manner. The RSO may approve minor changes to authorizations without review by the full Committee. Examples of changes which must be approved by the RSO:

a. Relocation of laboratory equipment used during radiation experiment(s).
   b. Change in storage location of isotope or waste.
   c. Changes in the amount of isotope authorized to be purchased.

**INACTIVE AUTHORIZATIONS**

Authorized Users who do not have intention to use radiation in the following six months shall be placed in an inactive status. The authorized user shall follow the procedures below to change the authorization to an inactive status:

• Submit a letter to the RSO requesting that the authorization be changed to an inactive status.

• Submit an accurate inventory of all radioactive material on hand. Describe where the radioactive material(s) will be stored and secured from theft or unauthorized use.

• Return all keys to the RSO.

Beforereactivating his or her authorization, the authorized user will complete a refresher training session on Radiation Safety to ensure currency with rules and requirements.

New experiments or projects which differ in size, kind, and/or scope from those previously approved by the Committee, shall be submitted to the Committee through the RSO and will be reviewed in a manner similar to that of a new application.

**17-7 RESPONSIBILITIES OF AUTHORIZED USERS**

The authorized user of radiation is directly responsible for all aspects of radiation safety associated with his/her possession and use of radioactive sources.

These responsibilities include (but are not limited to):
a. Ensuring instructions on safe and proper radiation practices are provided to all persons working with radiation who are supervised by or within the facilities of the authorized user.
b. Ensuring that unrestricted areas will be free of radiation contamination.
c. Ensuring that radiation from restricted areas does not go beyond those areas.
d. Ensuring that necessary equipment and instructions for safe work with radiation are available.
e. Ensuring that radiation sources and areas are properly labeled and posted as required by this directive.
f. Ensuring security against theft or unauthorized use of radiation sources.
g. Ensuring that all radioactive waste is disposed of properly.
h. Notifying the RSO of any accident or abnormal incident involving or suspected of involving radioactive material or radiation equipment.
i. Notifying the RSO of the intended transfer of radioactive material from the normal area of use and/or to another authorized user.
j. Maintaining accurate inventory records of radioactive material possessed.
k. Arranging for transferring these responsibilities to another authorized user during extended absences, e.g., sabbatical leave or illness.
l. Complying with all applicable rules and regulations contained in WAC 246 and this directive.
m. Ensuring that all students and faculty are familiar with the procedures of an experiment before using radioactive material and radiation producing equipment.
n. Ensuring that surveys are performed and recorded.
o. Capable of being called to the user area within a reasonable length of time (a few minutes) when radioactive material and radiation equipment is being used by persons under his or her authorization. Keeping such persons informed of whereabouts in case assistance is necessary.
p. If unavailable, stopping all use of radioactive material and radiation equipment under his or her authorization as specified above unless a second authorized user (approved for that nuclide) has agreed to assume the responsibilities for the experiment of operation.
q. Informing all persons under his or her authorization of all changes to procedures or regulations as they are received.
r. Ensuring that all females involved with radiation have read NRC 8.13, *Instruction Concerning Prenatal Radiation Exposure*, sign a statement confirming that each has read and understands the guide, and signs the Certificate of Affirmation (part of the [New User Understanding Form](#)) to be placed on file. For exempted amounts of radioactive material, a memorandum for the record will be prepared listing the material used, the operation performed, radiation level involved, and list the name and employee identification number of each person involved. This memo will be filed by the RSO.
s. Ensure that students who work with radiation are approved by the Radiation Safety Committee and RSO, trained by the RSO staff to work under the supervision of an authorized user. Supervision is to be defined broadly in that students may not become authorized users, but must do their work under the general sponsorship of a faculty member who is an authorized user. This requirement is not to be interpreted to mean that a student must be under the constant surveillance of the authorized user, but that the authorized user does have a responsibility to periodically check on the student's progress, and procedures, to ensure radiation safety rules are being followed.
17-8 CONTROL OF PROCUREMENT

The following procedure shall be followed by all persons desiring to procure radioactive materials.

ORDERING RADIOACTIVE MATERIALS

Donations of radionuclides are not accepted at EWU unless approved by the Radiation Safety Committee and the RSO. Anyone who is ordering radionuclides must receive prior written approval from the RSO and the Radiation Safety Committee after submission of the “Request for Radioactive Materials” form.

Persons who have received authorization from the Radiation Safety Committee to use radioactive materials must contact the RSO and purchasing department. Once approval is given by both the Purchasing Department and RSO the order can then be placed either through the users P-Card transaction or normal departmental Purchase Request, depending on the items requested. The Purchasing Department will not place an order for radioactive materials without the approval of the RSO.

The RSO shall be listed as the consignee on all shipments of radioactive material sent to EWU. This will allow the RSO to keep a current inventory of radioactive materials, to ensure the University does not exceed license limits, and to inspect the shipment for leakage before transferring the material to the authorized user.

The authorized user will ensure his or her name is on the purchase requisition.

All radioactive material will be shipped to: Eastern Washington University,
ATENTION: Radiation Safety Officer
101 Huston Hall
Cheney, WA 99004-2405

The RSO will receive the shipment, perform the required radiological safety survey, update the inventory records, and notify the authorized user that the material has arrived. The package may be picked up or delivered at the user's option.

Procedures for receipt during off-duty hours:

a. The Campus Police Officer on duty will accept delivery of the package at the Red Barn. If the package is crushed or wet, do not touch it. Refer to the emergency procedures contained in Section 17-24.

b. The Campus Police Officer will contact the RSO as soon as possible, notifying him or her that a package has arrived.

The Radiation Safety Officer performs a radiation safety survey, updates the inventory records, and notifies the authorized user of the arrival.
Receipt inspection instructions. All shipments of radioactive materials received at EWU will be monitored for leakage by the RSO or designee. The RSO or EH&S designee will follow Guidance G04 Radioactive Materials Package Processing Instructions and fill out the RAM Package Receipt.

Each package will be “wipe” tested for removable contamination.

If radiation levels are detected at three feet (1 meter) from the external surface of the package exceeding 10-millirem per hour or on the external surface of the package exceeding 50-millirem per hour, the RSO must notify DOH. The carrier and shipper may also be notified depending on DOH assessment. DOH may assist with notification. The package will be double bagged to contain and control any leakage until the material can be repackaged into a new container.

If no external contamination is found on the package, the package will be opened under a ventilation hood and a wipe sample taken of the inner package. Users must follow Guidance G05 Radioactive Package Opening Instructions set forth by DOH and the RSO.

The empty package and packing materials will be monitored for contamination prior to disposal.

No radioactive material will be transferred by the RSO until the required radiological survey has been performed and until he/she has verified that the user is authorized under the license.

17-9 INVENTORY CONTROL

MASTER INVENTORY FILE.
The RSO will receive all shipments of radionuclides and enter each shipment on the Master Inventory Log.

Each shipment received will be assigned a unique identification number as follows:

<table>
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<th>Department</th>
<th>Date Received</th>
<th>Element</th>
<th>Annual Sequence Number</th>
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<tbody>
<tr>
<td>B, C or P</td>
<td>July 7, 1984</td>
<td>I-125</td>
<td>09</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td><strong>B-070784-I125-09</strong></td>
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</tbody>
</table>

All transactions and records involving the particular shipment will refer to this ID number.

WASTE DISPOSAL.
When waste is disposed of, either by shipment to a waste disposal site or through decay, the master inventory log will be annotated.

DECAY CORRECTION
The Radiation Safety Officer will adjust the master inventory log to account for decay on a semi-annual basis. The log will approximately reflect the actual amount of radioactive activity on those dates.
RESPONSIBILITIES OF AUTHORIZED USERS
Each authorized user is required to keep records of radionuclides, both stored and used in his or her possession.

These records must accurately record use and disposition (storage and or disposal) of the isotope. Every milliliter (ml) withdrawn from the original vial must be logged and accounted for. As the isotope is consumed through decay, entries must be made to reflect the decrease. Meanwhile, as materials are used and placed in waste containers, records showing the contents of the waste container must be kept. An audit trail must be created for each ID numbered shipment so that the RSO or DOH inspector can trace the material and locate all portions of it, no matter whether it is in liquid waste, solid waste, biological waste, or the original container. The totals should closely approximate the original quantity received after correcting for decay.

RECONCILIATION OF INVENTORY
During each semi-annual radiation safety inspection, the RSO and the authorized user will compare inventory records and usage and reconcile with calculated decay values.

Failure to keep and maintain accurate records may be cause for termination of the authorization for the user to use radioactive materials.

17-10 CONTROL OF AREAS IN WHICH RADIOACTIVE MATERIALS ARE USED OR STORED

All radioactive materials must be used and stored in rooms or laboratories designated as RESTRICTED AREAS. All EWU labs and storerooms containing radioactive materials are hereby designated as RESTRICTED AREAS. A restricted area is "any area access to which is controlled by the authorized user for purposes of protection of individuals from exposure to radiation and radioactive material". Authorized users will ensure that no unauthorized persons enter a restricted area.

All radioactive material will be stored under lock and key. The keys will be controlled by the EH&S office to ensure no unauthorized person has access. If the user will not be using radioactive materials over an extended period of time (6 months) their keys (including access room keys) will be recalled. They will be reissued after approval of their research experiments by the committee and they have been re-trained by the RSO in radiation safety.

Restricted areas will be kept clean and neat. Cleaning will be done by or under the direct supervision of an authorized user or EH&S. At no time will maintenance personnel be permitted to clean in radiation laboratories or storage rooms without an RSO Staff escort present.

17-11 MARKING, LABELING, AND POSTING

Rooms, areas, and equipment where radioactive materials are used or stored shall be clearly marked with appropriately worded and designated standard radiation symbols whenever required under the conditions set forth in this section. The requirements for caution signs, labels, and instructions to
personnel are required by WAC 246. Each authorized user is responsible for insuring that the necessary signs, symbols, and labels are posted and kept in good repair.

LABORATORIES

Radiation Area - Any room or area accessible to personnel where radiation exists at such levels, that a major portion of the body could receive a dose exceeding 5-millirem in one hour is defined as a Radiation Area. Each such area shall be clearly marked with the standard radiation symbol and the words CAUTION - RADIATION AREA.

All Other Laboratories - All other laboratories where radioactive materials are used shall be clearly posted with a standard radiation symbol and the words CAUTION - RADIOACTIVE MATERIAL.

Storage Rooms - Each room where radioactive materials (except natural uranium or thorium) are used or stored shall be posted with the standard sign and the words “Radiation Area or Radioactive Materials (depending on activity), Authorized Personnel Only”. Contact information will also be posted. See WAC 246-220-010 for definitions.

17-12 WORK PRACTICES IN RADIOACTIVE MATERIAL LABORATORIES

General - Work with radioactive material presents levels of risk which vary. Each radionuclide has different decay characteristics; the chemical and physical form must be considered; the amount of material or activity is important; and the conditions of use such as containment and shielding affect the level of risk. Laboratory personnel must evaluate their lab situation to establish individual particular practices. In general compounds labeled with weak beta emitters, for example, carbon-14 and tritium, may be handled safely in the quantities found in most research and teaching laboratories with only modest precautions. In fact, most of the precautions necessary when handling small quantities are little more than good practice as found in any properly conducted laboratory. This does not mean that these materials may be treated casually. Users of even small quantities of radioactivity may find experimental work ruined by carelessness. When handling high-energy beta emitters, such as phosphorus-32 or gamma emitters, further precautions are necessary. See Chart of the nuclides at www.nndc.bnl.gov/chart for more information radionuclide decay characteristics.

Hazard Assessment - Before radiation work begins, assess the hazard. Measure or calculate the dose for expected work periods. Is shielding necessary? Assess possible release mechanisms. Are the controls practical? Are aerosols or vapors produced? Should the work be done in a hood? Ensure that proper procedures and equipment are in place to prevent internal exposures.

Consider adverse contingencies - Assess possible release pathways. Make preparations to control spilled material. Do others know the program so they could provide aid and assistance following an accident? Fire and security personnel may be reluctant if "radiation" is present. A neighbor should be cognizant of the hazards.

Hazardous situations that develop with radioactive material are seldom obvious. A monitoring and survey program must complement any use of radioactive material. The RSO and Users will
establish a schedule for their instrument surveys and wipe test. The survey results will be recorded so that changes of trends are apparent to the RSO and Users.

**Personal Contamination Precautions** - Control of personal contamination is the main factor in controlling internal uptake of radio nuclides.

Wear gloves when handling radionuclides. Gloves serve two purposes; they can reduce contamination and absorption through the skin. Remove gloves prior to touching any surface that must be clean; door knobs, phones, keys etc.

Survey gloves before removal. Survey hands after glove removal. Wash hands thoroughly after work with radio nuclides. Wash with soap and water.

A lab coat or apron should be worn while conducting laboratory work with radioactive material. Sleeves should be tight or banded around the gloves to prevent contamination. Lab apparel (lab coats, aprons, booties, etc.) must be surveyed and replaced when contaminated. At no time should laboratory coats and gloves be worn out of the laboratory area. Shoes, hands and clothing must be surveyed before leaving the laboratory.

Long hair must be secured to prevent it from falling into or touching radioactive material. Contaminated hair must be cutoff and placed in a radioactive waste container for proper disposal.

**Laboratory Surveys** - There are two types of necessary surveys for authorized users to confirm presence or absence of radioactive contamination: Instrument Surveys and Wipe Test Surveys. See Guidance G06, Radiation Laboratory Survey Guidelines and Laboratory Survey Record Forms.

**Instrument Surveys** - In laboratories where radiation is present, portable radiation survey instruments shall be used as follows:

- When working with radionuclides, carefully monitor hands, wrists, feet and garment fronts. Frequent monitoring is necessary to allow prompt detection of contamination, to determine the source, and to institute controls.

- Following each use of radionuclide’s; meter survey all use areas such as bench top, adjacent floor area, and associated equipment as described in the Post-Experiment Survey form.

- Smoking in a radiation laboratory is prohibited.

- Eating, drinking, and chewing gum or tobacco in radioactive material laboratories is forbidden. Food or drink should not be stored or prepared in radioactive material labs. Specifically, food or drink should not be stored in refrigerators used for laboratory materials.

- Mouth pipetting of any material is forbidden in radioactive material labs. This includes mouth pipetting of innocuous materials; the pipette mouth end may be contaminated. Also included is
the use of mouth tubes for micro pipetting; these devices are easily contaminated when dropped in a pocket or set down on the workbench.

- Any procedure or habit that includes placing anything in the mouth while working in radioactive material laboratories is discouraged. This includes chewing pencils, biting nails, wetting fingers to turn pages, holding eye glasses in one’s mouth, licking gum backed labels, using a toothpick, etc.

Wipe Tests- Removable contamination is found by wiping use areas and analyzing the wipes in an appropriate counter. Wipe tests are essential in areas in which tritium, carbon-14, and sulphur-35 are used because of low detection efficiency of survey meters for low energy beta particles. Wipe tests are also essential when the existing radiation levels are high due to the procedures in progress. For example, the high background from material within a flask will not allow detection of material spilled on the outside of the flask.

Wipes are taken from all use areas, such as, bench tops, knobs, handles, floors, and inside equipment storage areas. Wipe tests can be analyzed in several highly sensitive instruments such as liquid scintillation counters.

The wipe test is a very sensitive method to detect contamination; uniformity and reproducibility are expected. Follow the required survey schedule for wipe survey. Vary the location and pattern of the survey points. Wipe surveys are to be conducted from low use areas to high use areas and care must be taken to prevent cross contamination. All areas that could be contaminated must be surveyed to confirm absence of contamination.

17-13 RADIATION SAFETY - LABORATORY RULES AND PROCEDURES

A copy of these rules shall be posted in each laboratory or storage room where radioactive material is used or stored.

a. Use the minimum quantity of radioactive material needed for the investigation and always work over a suitable spill tray lined with an absorbent disposable pad.

b. Radionuclides shall be used in such a manner that radiation exposure rates to personnel shall be kept as low as possible. The use of lead bricks and other shielding will serve to minimize exposure. The authorized user must be on-site and capable of being called to the user area within a reasonable length of time (a few minutes) when radioactive material is being used by persons under his or her authorization. Keeping such persons informed of their whereabouts in case assistance is necessary. (Refer to section 17-7)

c. High standards of cleanliness and good housekeeping must be maintained in all laboratories where radioactive material is present.

d. One or more preliminary runs using appropriate test materials are recommended for new procedures and new personnel to test effectiveness of procedures and equipment.

e. All injuries involving radioactive material, no matter how slight, shall be reported to the RSO to determine if the wound is contaminated. If the wound is considered contaminated the injured person will be sent to the hospital for further evaluation. The transportation service (if used) and
the hospital will be informed as to the nature of the injury and the potential contamination present.

f. Special protection is required for wounds so as to prevent the entry of radioactive materials into the body through wounds. Each situation shall be evaluated on its merits by the RSO.

g. All equipment which is suspected to have come in contact with removable radioactive material shall be considered potentially contaminated and shall be monitored for contamination before being removed from the laboratory.

h. License conditions require dosimetry for certain radionuclides for certain activities. Tritium, carbon 14, and other low energy beta emitters cannot be determined by personal dosimetry. For use of tritium and carbon 14:
   1. Anyone working with* more than 100 mCi in a single use must have a bioassay within one week of experimentation. See Section 17-18 Table 2. If it is determined that bioassays are necessary the authorized users department will be responsible for the cost.
   2. Iodine. See Section 17-18 and Table 1. If it is determined that bioassays are necessary the authorized users department will be responsible for the cost.

   *Working with means opening and handling radionuclide’s of activity as defined in Table I and II.

i. Radioactive material shall be used, stored and secured as to prevent unauthorized persons from using or removing such material.

j. All containers for radioactive material shall be properly labeled with the name of the compound, radionuclide, date, activity, and radiation level, if applicable.

k. Radioactive materials must always be transported in shielded containers.

l. Radioactive solutions shall not be pipetted by mouth.

m. Keep all radioactive liquids in secondary containers.

n. Direct contact with radioactive materials must be avoided by using protective laboratory coats and by wearing proper gloves appropriate to the operation. In all cases, gloves shall be the minimum protection required. Such protective clothing is not to be removed from the laboratory.

o. Remote equipment (long-handled tongs, remote pipettes, etc.) shall be used routinely when handling high dose rate radioactive materials and sources.

p. Authorized users or their qualified laboratory personnel shall be responsible for monitoring and the housecleaning in their laboratories. Custodians are not allowed in use or storage areas.

q. When a use or storage room is terminated, the RSO must be notified, and will conduct a termination survey before releasing the area for other uses.

r. Coats and other personal belongings, including books (except those required for work), should not be brought into a laboratory where they may become contaminated.

s. Complete records of receipts, transfers, waste accumulation, surveys, and disposal of radioactive materials must be kept.

t. Work should be carried out inside a fume hood in all cases where radioactive material may disperse dust, spray or splatter. Wherever possible, work with closed containers.

u. Liquid wastes must not be poured down the drain. Wash contaminated items in a secondary container and dispose of liquid with liquid radioactive waste.

v. Solid radioactive wastes, and radiation contaminated articles (stoppers, paper wipes, plastics, etc.) shall be disposed of in designated containers and should never be placed in ordinary trash receptacles.
w. The disposal of radioactive materials via gaseous release is not approved. If airborne or gaseous releases are unavoidable, they must be reviewed and approved in advance by the Radiation Safety Committee and the RSO.
x. At the close of a working period, the laboratory work surfaces must be carefully monitored and results recorded.
y. At no time will glassware or equipment used for radioactive materials be returned to general use without the RSO and Radiation Safety Committee’s prior approval of decontamination process via application.
z. Decontamination:
   1. Skin should be washed thoroughly and surveyed with a survey meter with a thin window GM detector to ensure measured radiation is at background or below the levels described in Section 17-19 of the Radiation Safety Directive.
   2. Working surfaces must be cleaned such that a survey of the area shows no detectable contamination. In all cases surfaces must be below the levels described in Section 17-19 of the Radiation Safety Directive.

aa. All spills of radioactive material must be reported to the RSO immediately. In the event of a spill, *(perform decontamination response measures only if trained and qualified)*:
   1. Any liquid should be blotted up immediately. Attempts should be made to prevent spreading of contamination.
   2. The spill area should be isolated, identified as to the nature of the contaminant, and access to the area restricted.
   3. A radiation survey of the area and all involved personnel should be made immediately.

17-14 ANIMAL HANDLING PROCEDURES IF APPLICABLE

The Radiation Safety Office requires information for the authorization of projects involving the administration of radionuclide’s to animals. The information required includes:

- The kind and number of animals to be used in the study (number per experiment and total number of experiments).
- The radionuclide (including chemical form and activity) to be administered per animal and how administered.
- The ultimate fate of the animal and suspected excretion rate of the radionuclide.
- Instructions for handling and monitoring of the animals and proposed method of disposal of the animal and excreta. These instructions shall be posted in the animal housing area prior to administering the radionuclide to the animals.
- The concentration (in units of $\mu$Ci/g) of the radionuclide averaged over the entire weight of the live animal must be provided.
- The location(s) where the animals will be housed (bldg. /room #).

Additionally; authorization is required through EWUs Institutional Animal Care and Use Committee (IACUC). Please see their requirements and forms located at [http://access.ewu.edu/Documents/Grants/PRFnov07.pdf](http://access.ewu.edu/Documents/Grants/PRFnov07.pdf). Without IACUC authorization the RSO will not move the request forward to the Radiation Safety Committee.
SPECIFIC REQUIREMENTS FOR ANIMAL USE

Animals, bedding and excrement are to be collected as radioactive waste. Please see the animal section of the waste procedures in this manual for disposal information.

Cages and other potentially contaminated items are to be cleaned and checked for contamination at the end of each individual experiment. Acceptable levels for these items are less than 200 dpm/100 cm² removable contamination and background (0.02 millirem/hr) when measured with a thin end window Geiger Müeller (GM) detector. Survey records are to be maintained by the Authorized User.

All cages or pens containing animals with radioactivity must be labeled with a "Caution: Radioactive Materials" sign. Outside doors to animal rooms in which radioactive material is present must be posted with a "Caution: Radioactive Materials" sign. The Radiation Safety Office's Emergency Procedures must be conspicuously posted near the animal cages. All animals containing radioactive materials shall be secured by the Authorized User. All persons working with animals must be trained on response measures in the event any animal bites, scratches, excretes urine or behaves in a way that may cause transmission of any kind or causes additional exposure to radioactive materials.

17-15 RADIOACTIVE WASTE DISPOSAL

It is the practice of EWU to dispose of radioactive waste in a manner that will not create a hazard to human health or the environment. Improperly packaged waste is hazardous during subsequent handling and transportation. Proper packaging and labeling is required. Improperly packaged or labeled waste will not be accepted. Transporting packages which are not in compliance will result in monetary fines, citations and loss of user privileges.

All long-lived (half life > 120 days) radioactive waste materials shall be held for pickup by the RSO for shipment to a commercial waste disposal service. Each pickup shall be scheduled with the RSO by using the Radioactive Materials Waste Collection Form. The waste material shall be packaged and labeled according to the instructions which follow. When commercial waste disposal is required, arrangements will be made through a licensed broker by the RSO.

Do not combine nucleotides in the same containers. However, sometimes combining nucleotides in a container is unavoidable. Contact the RSO for options.

Short half-life material - Waste generated from shorter-lived nuclides (those with a half-life of 120 days or less) shall be stored long enough to allow decay of the radioactive material to background level. Normally, ten half-lives are sufficient. This is referred to as the Decay-In-Storage (D.I.S.) method. See EWU’s radioactive materials license conditions for disposal details.

The package shall be marked with a tag containing the standard radiation symbol, the words "CAUTION - RADIOACTIVE MATERIALS", the type of radionuclide, and the date of assay by the manufacturer or authorized user.
Radiation waste shall be stored in an area approved by the Radiation Safety Officer. Access is available only to authorized personnel.

After time has elapsed for the radioactive material to decay to background levels, the RSO and/or the designated RSO staff shall survey the waste material to confirm that activity is indistinguishable from background.

If the survey indicates no radiation levels above background, the RSO or designee will remove and destroy all labels identifying the material as radioactive and dispose of the material according to other existing hazards and their regulations.

The RSO shall keep records of material disposed of through decay-in-storage.

**OTHER RADIOACTIVE WASTE**

**Dry Waste** - (paper, gloves, plastic ware, etc.) Dry waste shall be placed in a standard cardboard box which has been lined with sturdy 4-mil plastic bag. Glass pipettes, broken glass, needles, and other sharp items should be placed in a strong inner package which can then be placed in the larger box. Damp material, small amounts of blood or other tissue (less than 10 grams) and waste that will give off vapors or fumes should be contained in small, well sealed plastic bags or containers before placing them in the large box. Biological material containing radioactive materials shall be packaged as directed by the radiation safety office.

**Liquid Waste** - Radioactive wastes will not be disposed of through the sanitary sewer. Liquid wastes will be disposed of by the EH&S staff personnel.

- Collection of liquid wastes - Non-solvent liquid waste must be collected in an approved container in the laboratory and transferred to the RSO. Evaporation of radioactive liquid is **not allowed**.

Scintillation fluids containing toluene, xylene or any other hazardous materials are not approved for use in the liquid scintillation counting process. Evaporation of solvent waste is not authorized. The RSO will collect, store, and arrange for disposal. A listing of alternative scintillation fluids is available from the EH&S Department. Currently, there are only **three** LSC scintillation cocktails approved by the State of Washington Department of Ecology (Ecology) for sewer disposal. Those products are:

- **Microscint-O**
  Perkin Elmer Life and Analytical Sciences, 710 Bridgeport Avenue, Shelton, CT 06484
- **Optifluor**
  Perkin Elmer Life and Analytical Sciences, 710 Bridgeport Avenue, Shelton CT 06484
- **Ecoscint Original**
  National Diagnostics, 305 Patton Drive, Atlanta, GA 30336

A listing of alternative scintillation fluids is available from the EH&S Department.
LIQUID SCINTILLATION ANALYSIS
When vials are used - Do NOT separate the liquid from the vials. Ensure the cap is tightly screwed onto the vial. Plastic and/or glass LSC vials are to be thrown into the LSC Vial waste container lined with a plastic bag and approved absorbent underneath the liner. The vials are to be separated between long and short lived materials. If you are using an unapproved hazardous scintillation fluid, do NOT throw the vial(s) in the LSC Vial waste container, it must be packaged and disposed of separately. Call EH&S @ 6455 if this is the case.

Vials disposed with contents - Contact the RSO for collection and disposal when 5-gallon container is full.

Packaging animal carcasses - Arrangements must be made with the RSO if animal carcasses will be generated.

Certain carcasses and tissue waste may be contaminated with serious infectious and bio-hazardous micro-organisms. The normal handling practices for radioactive waste do not ensure biological disinfection. Special arrangements must be made to destroy the biological agents before the waste is packaged for disposal. Incinerating radioactive biological agents requires approval of the RSO, Radiation Safety Committee and DOH.

Fumes and vapors - Direct release of radioactive material as gases, fumes, vapors and aerosols is not authorized under any condition.

Incineration - Incineration is not an authorized method for disposal.

RECORDS AND LABELING
The University's license and state regulations require that inventory and control methods cover all aspects of work with radioactive material. Therefore, all packages and containers of radioactive waste must be labeled with a standard radiation symbol, the words,” CAUTION - RADIOACTIVE MATERIALS", and a description of the contents. The label should indicate the radionuclide, the activity in microcuries (μCi) or millicuries (mCi) upon disposal, and name of the authorized user. Permanent tags or labels should be attached to each container. Containers should be securely closed. Plastic bags should be tied or taped closed.

A label with a radiation symbol should be attached to open containers in the laboratory when other labels are not apparent.

As waste is being accumulated in a container, a record of each addition should be made on the waste log for that container. One waste log is required for each waste container (Waste Container Inventory Form). The record sheet should be totaled and accompany the package when it is picked up for later disposal.
ADDITIONAL COMMENTS

It is not necessary to use the full capacity of a container before it is sealed for collection; the waste from a "hot run" (significantly high activity) could be sealed and removed, rather than keeping it in the lab until the container is full.

Vapor and fumes may accumulate in waste containers; waste collection should be maintained in or near a fume hood or other well ventilated space.

Culture media and other liquid waste may continue to "grow." This could build up pressure in a sealed can and cause a rupture. An appropriate "disinfectant" should be added to such waste. The disinfectant must be compatible with other chemicals present. Contact EH&S for assistance.

Radioactive liquid which is otherwise quite hazardous, e.g., strong acids or bases, flammable or very toxic substances, etc., should be treated with proper attention. Hazards contained within a container must be identified by using appropriate warning labels. If special containers or handling are necessary, arrangements should be made with the RSO before generating the waste.

The volume of radioactive waste should be kept to a minimum. Do not use radioactive waste containers for non-radioactive waste. Disposal is expensive.

17-16 LIMITS OF EXPOSURE TO IONIZING RADIATION

Every reasonable effort will be made to maintain radiation exposures as low as reasonably achievable (ALARA).

The following occupational limits below can be found at WAC 246-221-010.

Annual adult internal/inhalation radiation exposures will be controlled to the more limiting of the following:

1. total effective dose equivalent of 0.05 Sv (5 rem); or
2. sum of the deep dose equivalent and the committed dose equivalent to any organ or tissue of 0.5 Sv (50 rem)

Annual adult limit to the eye, skin, and extremities will be controlled to below:

1. a lens dose equivalent of 0.15 Sv (15 rem), and
2. a shallow dose equivalent to the skin or extremity of 0.5 Sv (50 rem)

Internal adult limit will be determined in accordance with WAC 246-221-100 Personal Monitoring for internal dose. Individuals under 18 years of age are limited to 10% of the adult occupational limits.

Pregnant women are limited to 5 mSv (0.5 rem) for the entire gestation period. Women, whether employees of the University or students, shall restrict their radiation exposures according to the guidelines established in NRC Guide 8.13, Instructions Concerning Prenatal Radiation Exposure. Such persons should make particular efforts to keep the radiation exposure of an embryo or fetus as low as reasonably achievable, but in no case exceed 0.5 rem for the gestation period or a monthly
equivalent dose limit of 0.05 rem (0.5 mSv). All female employees and students will be briefed and are required to read the NRC guide. They will also be given an opportunity to ask questions and have those questions answered.

Written acknowledgement from all females who wish to work with or near radioactive materials or x-ray generators is required stating that she has read and understands the contents of the NRC Guide, prior to being allowed to work with ionizing radiation.

Women must be informed of the option to complete a declaration of pregnancy when the pregnancy becomes known to them. This information is kept confidential.

The RSO will maintain a file of written acknowledgements and declarations of pregnancy with estimated dose to the fetus/embryo for a period of 30 years. See Certificate of Affirmation/Declaration of Pregnancy Form.

17-17 PERSONAL MONITORING

Personal dosimetry is required of the radiation safety program under certain circumstances per WAC 246-221-090 and 100 and specific EWU licensing conditions.

Monitoring is required for:

- Adults likely to receive, in one year from sources external to the body, a dose in excess of ten percent of annual limits described in section 17-15.
- Adults likely to receive in one year, an intake in excess of ten percent of the applicable ALI.
- Minors or declared pregnant women likely to receive, in one year from sources external to the body, a dose in excess of the limits described in section 17-14.
- Minors or declared pregnant women likely to receive, in one year, a committed effective dose equivalent in excess of 100 millirem.
- Each individual who enters a high radiation area, which by definition is any area in which there exists radiation at such levels that a major portion of the body could receive in any one hour, a dose in excess of 100 millirem from any source or any surface.

Monitoring is occasionally used for persons who have expressed a special concern for their exposure to radiation even though the possibility of receiving a significant dose is very low. This applies to persons who have relatively little contact with radiation but are nevertheless concerned about their exposure. In many instances such monitoring will provide an assurance that they are working at background levels. This form of monitoring is also applicable to persons who are working with radioactive materials that emit non-penetrating radiation, e.g., alpha particle, low energy beta particles. Monitoring devices are issued at the discretion of the RSO. A primary consideration will be the concern expressed by the individual.

Personal monitoring devices shall be provided by the University through the Radiation Safety Office to persons who are qualified under one of the above reasons. The RSO shall maintain records as
required by regulations. Individuals shall be informed of their exposure at any time upon request and they shall receive an annual summary of their exposures for the past year.

The RSO shall supervise the receipt, distribution, and collection of personal monitoring devices. They shall be changed on a monthly or quarterly basis. If an exposure in excess of the limits allowed is suspected, the RSO shall be notified immediately so that the monitoring device may be processed for rapid analysis.

It is the responsibility of authorized users to notify the RSO whenever an individual will require personal monitoring and whenever the need for personal monitoring is terminated. When not in use, personal monitoring devices shall be stored in areas under their control where they will not be exposed to ionizing radiation on the EWU campus. At no time will a personal monitoring device be deliberately exposed to radiation unless it is worn by the user or unless the RSO approves.

Dosimeters must not be worn during medical or dental X-ray exposure. Occupational limits must include only occupational exposure. A person wearing a dosimeter while receiving any medical, dental or airport x-rays shall inform the RSO.

All personal monitoring records shall be maintained by the RSO.

17-18 BIOASSAY REQUIREMENTS

Bioassays are a necessary component to personal monitoring in a radiation safety program. It is the principle method for estimating an individual's exposure to radiation resulting from internally deposited radionuclides. State regulations require all persons identified as participants in the bioassay program to receive baseline, routine, and termination bioassays (WAC 246-221-100 and 246-221-015).

Bioassays are the monetary responsibility of the department in which the research is being conducted. Please contact the RSO to receive the contact information regarding the chosen vendor for bioassay services. All results received regarding internal exposure must be submitted to the RSO immediately and kept on file for personal monitoring as required by DOH.

Persons working with specified quantities of radionuclide’s H-3, I-125 and I-131 must receive routine bioassays. Please consult WAC 246-220 and the tables below.

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Action Level Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-3</td>
<td>10000 Bq</td>
</tr>
<tr>
<td>I-125</td>
<td>500 Bq</td>
</tr>
<tr>
<td>I-131</td>
<td>100 Bq</td>
</tr>
</tbody>
</table>

To make the determination on whether an individual is required to receive a bioassay, please see the chart below which has been retyped according to the USNRC Regulatory Guide 8.20, Table I for I-125 and I-131 for action level criteria.
Table I
ACTIVITY LEVELS ABOVE WHICH BIOASSAY FOR I-125 OR I-131 IS NECESSARY
Activity Handled in Unsealed Form Making Bioassay Necessary*

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

*Quantities may be considered the cumulative amount in process handled by a worker during a 1-month period; e.g., the total quantity introduced into a chemical or physical process over a 1-month period, or on one or more occasions in that period, by opening stock reagent containers from which radioactive iodine may escape. Quantities in the right-hand column may be used when it can be shown that activity in process is always chemically bound and processed in such a manner that I-125 or I-131 will remain in nonvolatile form and diluted to concentrations less than 0.1 mCi/mg of nonvolatile agent. Capsules (such as gelatin capsules given to patients for diagnostic tests) may be considered to contain the radioiodine in non-free form, and bioassay would not be necessary unless a capsule were inadvertently opened (e.g., dropped and crushed). However, certain compounds where radioiodine is normally bound are known to release radioiodine when the material is in process, and the left-hand column may then be applicable. In those laboratories working only with I-125 immunoassay (RIA) kits, the quantities of I-125 are very small and in less volatile forms; thus bioassay requirements may be judged from the right-hand column. In field operations, where reagent containers are opened outdoors for simple operations such as pouring liquid solutions, the above table does not apply; bioassay should be performed whenever an individual employee handles in open form (e.g., an open bottle or container) more than 50 mCi at any one time. Operations involving the routine use of I-125 or I-131 in an open room or bench should be discouraged. Whenever practicable, sealed bottles or containers holding more than 0.1 mCi of I-125 or I-131 should be opened at least initially within hoods having adequate face velocities of 0.5 m/sec or more.

To make the determination on whether an individual is required to receive a bioassay, please see the chart below which has been retyped according to the USNRC Regulatory Guide 8.32, Table I for H-3 (tritium) for action level criteria.
Table II

**ACTION LEVELS OR CONCENTRATION ABOVE WHICH TRITIUM BIOASSAY PROGRAMS SHOULD BE PROVIDED**

<table>
<thead>
<tr>
<th>Types of Operation</th>
<th>HTO and other Titrated Compounds</th>
<th>Tritium (HT or T₂) Gas in Sealed Process Vessels</th>
<th>Nucleotide Precursors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processes in open room or bench, with possible escape of iodine from process vessels.</td>
<td>0.1 Ci</td>
<td>100 Ci</td>
<td>0.01 Ci</td>
</tr>
<tr>
<td>Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability.</td>
<td>1 Ci</td>
<td>1,000 Ci</td>
<td>0.1 Ci</td>
</tr>
<tr>
<td>Processes carried out within gloveboxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage.</td>
<td>10 Ci</td>
<td>10,000 Ci</td>
<td>1 Ci</td>
</tr>
</tbody>
</table>

Quantities present (< 10 Kg) maybe be considered either the amount processed by an individual at any one time (when accidental intake is more likely), or the amount of activity entered into process (throughout) during any one month (when routine handling of repeated batches is the more likely source of exposure). Concentrations in the right-hand column may be used when activity in process is always diluted in more than 10 Kg of other reagents, as in nuclear reactor coolant systems.

### 17-19 MONITORING AND SURVEYS

Radiation hazards cannot be evaluated without measurements. Periodic monitoring and surveying of radiation facilities is essential to a proper radiation safety program. Radiation surveys are required where unsealed radioactive materials are used or stored. Frequency for surveying can be determined by referencing the radioactive materials license.

Each authorized user of radiation must conduct surveys within his or her areas. Instruments must be available to allow frequent checks during work as well as thorough surveys during cleanup phases.

The RSO or his/her designee shall conduct audit surveys to ensure the individual users are conducting surveys as required and properly decontaminating when necessary.

Radioactive material laboratories shall be inspected and surveyed by the RSO at least every six months or more often if the RSO or Radiation Safety Committee deems more frequent surveys advisable.

X-ray facilities shall be inspected at least once a year.
Sealed sources shall be leak-tested at least every 6 months.

**LABORATORY MONITORING**

**General** - The safe use of radioactive material requires frequent monitoring and surveys in each area where contamination or external radiation may exist. In laboratories where handling practices are good, the results of the survey will usually be within the regulatory limits. Monitoring is the best way to detect, quantify and ensure safe lab practices.

The regulations require users to practice ALARA principles. Removable contamination can and must be decontaminated until at or below the levels specified in 17-19 Table III.

Work practices and the types of radiation used shall determine the frequency and methods of monitoring. Records of monitoring must be included in a laboratory log and made available upon request.

**Frequency** - Laboratory monitoring should be conducted during radiation work. Complete the “Post-Experiment Survey” at the end of each day where radioactive materials were used.

**Techniques** - Laboratory monitoring should include two complementary techniques:

**Instrument surveys** - A portable instrument, normally a GM counter should be used to survey work surfaces, handles, knobs, floors and other areas which have potential contamination. High readings should be noted and explained. In many instances, a high reading is due to material which is in proper use. The high radiation field masks the radiation surface contamination. The instrument survey is necessary to evaluate shielding, accumulation of high levels from waste containers and general external radiation levels. Some types of radiation, especially low energy beta emitters, are not detected with standard survey instruments. The sensitivity and calibration of any instrument must be appropriate for the nuclide (in use).

**Wipe surveys**. A serious hazard in most radioactive material laboratories is from ingestion or inhalation of unsealed radioactive material and the resulting internal dose. A small amount of radioactive material, if fixed on a work surface and shielded may present minimal hazards. The same amount of material constitutes a serious hazard if it is removable, transferred or ingested/inhaled. The main method for evaluating removable radioactive material is to take a series of wipes from surfaces with applicator swabs and then evaluate wipes with an appropriate detector. The same counting system that is used in the experimental work will usually serve to evaluate the wipes, e.g., liquid scintillation counter, gamma counter. In addition to the regularly surveyed areas, additional areas should be checked since contamination may or may not be uniform throughout the room.

For all required documented surveys, a permanent record will be kept of all survey results, including negative results. The records shall include:
A. Location, date, and person performing the survey.
B. Identification of equipment used, including serial number and pertinent counting efficiencies for nuclide(s) used.

C. Drawing of the area surveyed, identifying relevant features such as storage areas, waste areas and major use areas. Also include numbered locations corresponding to the places surveyed.

D. Measure contamination in counts per minute (CPM) or disintegrations per minute (DPM), or measured dose rate exposure in millirem/hr or exposure of count rates, keyed to locations on the drawing.

E. Results of surveys for removable contamination, keyed to locations on the drawing.

F. A background reading in CPM for the portable instrument and the results of a blank wipe for non-portable counters.

G. Corrective action taken when survey results exceed action levels (2x’s greater than the blank wipe or 2x’s greater than background in an area where no radioactive materials are present).

Radiation Safety Office Audit Surveys. The Radiation Safety Office staff will conduct periodic surveys in all locations of radiation use. The survey records will be filed. Contamination results will be reported to the Radiation Safety Committee and Authorized User. All records will be maintained by the RSO and will be available in the EH&S Office.

### Table III

<table>
<thead>
<tr>
<th>NUCLIDES A</th>
<th>AVERAGE B C F</th>
<th>MAXIMUM B D F</th>
<th>REMOVABLE B E F</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-nat, U-235, U-238, and associated decay products</td>
<td>5,000 dpm α/100 cm2</td>
<td>15,000 dpm α/100 cm2</td>
<td>1,000 dpm α/100 cm2</td>
</tr>
<tr>
<td>Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129</td>
<td>100 dpm/100 cm2</td>
<td>300 dpm/100 cm2</td>
<td>20 dpm/100 cm2</td>
</tr>
<tr>
<td>Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133</td>
<td>1000 dpm/100 cm2</td>
<td>3000 dpm/100 cm2</td>
<td>200 dpm/100 cm2</td>
</tr>
<tr>
<td>Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except SR-90 and others noted above</td>
<td>5000 dpm α, beta &amp; gamma/100 cm2</td>
<td>15,000 dpm α, beta;&amp; gamma/100 cm2</td>
<td>1000 dpm α, beta &amp; gamma/100 cm2</td>
</tr>
</tbody>
</table>

A Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

B As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

C Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.
D The maximum contamination level applies to an area of not more than 100 cm$^2$.

E The amount of removable radioactive material per 100 cm$^2$ of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

F The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

From WAC 246-232-140 Schedule D

**Operation of survey instruments** - Each instrument used for safety surveying purposes will be checked for proper operation prior to use on days that the instrument is used. This preoperational check will include a battery check and confirmation the survey meter responds to a check source or radiation field and background to ensure proper detection. The preoperational checks shall be included and documented at all times.

**Calibration of survey instruments** - All survey instruments used must be calibrated annually to ensure accurate readings. The RSO will ensure calibration for all EWU instruments which require periodic calibration. Other instruments such as those used for classroom instruction or research can be calibrated through the Radiation Safety Office at the user’s request. Instruments will be calibrated at least every year or after any maintenance or repair affecting the calibration.

**Sealed sources** - All sealed sources, other than tritium, with a radioactive half-life greater than thirty days and not in the form of a gas shall be tested for leakage at intervals not to exceed six months. No leak test is required when the source contains tritium, or 100 microcuries or less of total beta and/or gamma emitting material, or 10 microcuries or less of alpha emitting material.

**17-20 VIOLATION OF REGULATIONS AND TERMINATION OF USE**

Violation of Regulations Procedure: The Radiation Safety Office staff has the authority to immediately suspend or stop any action or procedure that presents a significant radiation hazard to personnel, facilities or the environment. Any authorized user unable to demonstrate compliance with the radioactive materials license or the EWU radiation safety program can be suspended from operation by the Radiation Safety Committee. Upon notification of the alleged violation, the Radiation Safety Committee shall hold a prompt review of the incident. If it is the decision of the Committee that the authorization be terminated, the following procedure will apply:

- The user shall immediately transfer all radioactive material under his or her responsibility to another authorized user or to the RSO.
- The RSO shall conduct a comprehensive survey of the laboratory (s) to confirm absence of contamination before releasing for unrestricted use.
- A letter of termination signed by the RSO shall be forwarded to the user for inclusion in his or her records. The letter shall state the reasons for the termination.
DEFINITION OF VIOLATIONS

Minor Violations - Violations which are relatively minor, e.g., failure to maintain proper survey records or similar infractions are minor violations.

Major Violations - Willful negligence, allowing radioactive material to be lost, using radioactive material in such a way that excessive exposure occurs to one or more persons, deliberate disregard of safety rules, etc., are major violations.

PENALTIES FOR MINOR VIOLATIONS

First violation - a written reprimand from the Radiation Safety Committee detailing the violation with a copy sent to the department concerned. The violation notification shall also list the additional levels of reprimand possible should further violations occur.

Second violation – is a two week suspension of the user's authorization. Users may be required to review the Radiation Safety Directive. Copies of the reprimand will be sent to the department concerned, the dean of the user's college, and the Provost.

Third violation – is a suspension of a period of up to 3 months of the user's authorization. Copies of the reprimand will be forwarded as specified above.

Fourth violation – is permanent termination of the user's authorization. Copies of the reprimand will be forwarded as specified above.

Penalties for major violations shall consist of, at a minimum, a 30 day suspension of the authorization to use radioactive materials. Penalties for major violations may be more severe and may also include any of the options for reprimand authorized by EWU.

Determination of validity of violations - The RSO will investigate all reports of violations and report to the Radiation Safety Committee, which will determine the validity of the charge before any reprimands are taken. The individual user involved has the right to appear before the Committee.

Appeals - If a user wishes to appeal an action, he/she has the right to appeal to the Radiation Safety Committee. If the user wishes to appeal an action by the Radiation Safety Committee, he/she has the right to appeal to the University's administration in accordance with established procedures.

17-21 TRANSPORTATION OF RADIOACTIVE MATERIALS

Transportation of radioactive material on campus will be by methods approved by the RSO and as approved by the Radiation Safety Committee. Normally, packages of radioactive material will only be transported by University vehicle. Packages will be positioned, in the vehicle block and braced to prevent damage in transit.

Transportation of radioactive material from the campus will be done under the supervision of the RSO.
17-22 TRAINING

All persons who are permitted to work with radiation at EWU, those who enter radiation areas regularly, and those who direct the activities of those who work with radioactive materials or enter radiation areas must be thoroughly familiar with the safety requirements for handling radiation. Initial and annual refresher training is required for all persons who handle radioactive materials or who generate radioactive waste. The RSO and/or designated qualified person will be responsible for conducting this training.

The Radiation Safety Committee will screen the credentials of all persons applying to use radioactive materials or who wish to become authorized users. When additional training is deemed necessary for an individual laboratory or experiment, the RSO or the Radiation Safety Committee have the right to require additional training.

All persons including authorized users who are permitted to work around ionizing radiation are required to complete the radiation safety training course given by the RSO. All individuals will be required to pass a written test on topics covered in the training. The RSO and/or designate will administer exams and keep records of training and testing. The test requires an 80% or higher to pass.

The training will cover the following topics as a minimum:

1. Health protection considerations associated with exposure to radiation or radioactive material.
2. Precautions and procedures to minimize exposure (ALARA).
3. The purposes and functions of any protective devices employed.
4. Each person shall be instructed in, and instructed to observe, to the extent within the person's control, the applicable provisions of these regulations, department form NRC-Form 3 "Notice to employees," and license conditions for the protection of personnel from exposures to radiation or radioactive material (WAC 246-222-030).
5. The applicable provisions of state and University rules and regulations as the license provisions for the protection of personnel from exposures to radiation or radioactive material occurring in such areas.
6. Their responsibility to report promptly to the RSO any condition which may lead to or cause a violation of the state or University regulations or license provisions, or any unnecessary exposure to radiation or radioactive material.
7. The appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material.
8. Care and use of personal dosimeters.
9. Use of survey instruments.
11. Radioactive contamination.
14. Acute and chronic radiation effects on humans and other animals, including the effects on fetuses.
15. Modes of exposure - internal and external.
16. Assessment of dose equivalent.
17. Basic protective measures - time, distance, shielding, contamination control, protective clothing, workplace design, safe procedures.
18. Responsibilities of faculty, students, the RSO, and the University.
20. Radiation monitoring programs and procedures.

In addition to the training provided by the RSO, each authorized user may need to provide additional, detailed training to persons working under his/her authorization pertaining to the particular experiment or laboratory involved.

In addition to the training required above, hands-on training is highly recommended in the following areas:

- A description and demonstration of the procedures using radioactive materials by a qualified staff or faculty member. Qualified staff or faculty in this case is anyone who has been authorized by the radiation safety committee and RSO, trained in basic radiation safety and who has knowledge of the authorized experiment and equipment.
- A non-radioactive practice of the procedures by the trainee while being observed by a qualified staff or faculty member.
- Observation of the trainee on practice of the full and actual procedure using radioactive material(s).

Radioactive materials training is required before any authorization is received.

Where radioactive materials are used in the classroom as an integral part of a course, the instructor will ensure that the students receive sufficient training to ensure that the demonstration or experiment will be conducted safely. The RSO is available to conduct such training. In any case, whether the training is conducted by the instructor or the RSO, a record will be prepared listing the names of the students, the topics covered, the date of instruction and a description of the involvement with radioactive material. The record will be filed by the RSO.

Annual training is given to facilities personnel having occasion to work in the areas where radiation may exist. Custodial personnel are not permitted to clean radiation areas or collect waste from areas where radioactive materials are used or stored.

Retraining after key recall - If the user will not be using radioactive materials over an extended period of time (6 months) their keys (including access room keys) will be recalled. The keys will be
re-issued after approval of their research experiments by the committee and they have been re-trained by the RSO in radiation safety. During the extended time period of non-radioactive research, radiation training or update radiation training will not be necessary, since the authorized user(s) are not using radioactive materials.

17-23 RECORDS

The RSO shall establish and maintain the following records:

1. List of current authorized users, and all authorization records
2. Personal exposure records.
3. Radioactive materials inventory and locations.
5. Sealed Source Leak Tests
6. Radioactive waste generated and disposal activity.
8. Training records.
9. Certificates of affirmation.
10. Minutes of Radiation Safety Committee meetings and copies of ALARA annual reviews (Annual Radiation Safety Program Audit).

Each authorized user will maintain the following records:

1. A running log of each radioactive nuclide in his or her possession, to include: receipt, use log, and final disposition.
2. Waste inventory for each container of waste as waste accumulates.
3. Survey results for his/her laboratories.

17-24 EMERGENCY PROCEDURES

TAKE ACTION ONLY IF TRAINED, QUALIFIED AND APPROVED TO DO SO!

Radiation incidents - All incidents involving personal exposures and/or radioactive contamination of personnel or facilities shall be reported to the RSO immediately. He/She shall supervise all activities relating to the incident investigation and correction. The authorized user shall assist in these efforts.

Notification of incidents is required by WAC 246-221-250.

The following are general guidelines intended to assist users and other individuals involved with the handling of radioactive materials:

1. Procedures for loss or theft of radioactive materials: If you discover the loss or theft of any radioactive materials, call and report the matter immediately to the Campus Police. All efforts must be made to locate and recover the material. Do not disturb the storage area.
Provide information to the police as to the quantity, size, shape, etc. The RSO will brief the police on the possible hazards they might encounter or precautions they must take.

2. Procedures for receipt of a crushed or wet shipment after normal hours. Do not touch the package. Evacuate all persons in the building and prevent anyone from entering. Immediately call the Radiation Safety Officer or alternate. One of these will inspect the package using appropriate equipment and will deal with any spill or contamination. She/he will also make the necessary reports.

**Minor Spills** (<200 ml and <100 mCi/ml):

1. Notify all persons in the room and/or area at once.
2. Confine the spill to prevent additional contamination.
3. Using appropriate personal protective equipment, clean up the area and dispose properly of all contaminated items and clothing.
4. Monitor people who may have been contaminated and collect any contaminated clothing. Do not allow contaminated persons to leave the building unless life safety is threatened.
5. Permit access only to the minimum number of qualified persons necessary to deal with the spill.
6. Notify the RSO at once.

**Major Spills** (>= 200 ml or >100 mCi/ml)

1. Notify all persons in the room and/or area at once.
2. Confine the spill; prevent it from reaching any additional areas.
3. Shield the source, if possible, without causing further contamination.
4. Secure and evacuate the area.
5. Permit access only to the minimum number of qualified persons necessary to deal with the spill.
6. Notify the RSO at once.
7. Notify DOH via a routine call and report as an unusual occurrence.
8. After preparing a plan of action, decontaminate. Decontaminate by cleaning from the outside of the spill toward the center.

**Liquid spills:**

1. Wear protective gloves.
2. Place absorbent paper or pads on the spill.

**Dry Spills:**

1. Wear protective gloves.
2. Wear respiratory protective equipment if needed.
3. Switch off or close ventilating system if possible.
4. Place wet paper towels over solids to avoid further disturbance.
5. Dampen paper towels thoroughly to reduce the spread of contamination.
In general, water may be used unless a chemical reaction with the water would generate an air contaminant.

**Spills having immediate radiation hazards to personnel:**

1. Notify any persons who have not been contaminated to vacate the room at once.
2. If the spill is liquid and the hands are gloved, up-right the container; otherwise, use some type of remote handling device (tongs, stick, ruler, etc.)
3. If possible, confine the spill; prevent it from reaching additional areas.
4. Notify the RSO at once. The RSO may call the DOH if necessary.
5. Shut off all fans and close ventilating ducts.
6. Vacate and seal off the room.
7. Wear respiratory protective equipment if an airborne hazard is present.
8. Monitor the skin with a survey meter and follow up by scrubbing with a soft brush and detergent when indicated.
9. Take necessary steps to decontaminate other personnel involved.
10. If material has spilled on the skin, decontaminate by flushing thoroughly with water.
11. If the spill is on clothing, remove, bag and label contaminated clothing at once.
12. Decontaminate the area until wipe samples are negative. (Personnel involved in decontamination must be protected adequately.) The RSO will direct the decontamination.
13. Permit no person to resume work in the area without the approval of the RSO.
14. Coordinate a complete history of the accident, actions taken, and provide the history, actions and updates to the DOH as required.

**Incidents involving radioactive dusts, mists, fumes, organic vapors and gases:**

1. Notify all persons to vacate the room or area immediately.
2. Notify the RSO at once. The RSO may call the DOH if necessary.
3. Don respiratory protective equipment.
4. Shut off fans and close ventilating ducts.
5. Vacate the room or area and seal it off if possible.
6. Ascertain that all doors permitting access to the room are closed. Post conspicuous warnings or station guards to prevent accidental opening of doors.
7. Monitor all persons suspected of being contaminated.
8. Decontaminate personnel if necessary.
9. Report all known suspected inhalations of the radioactivity to the RSO at once.
10. Evaluate the hazards and requirements for safe reentry.
11. Determine the cause of contamination.
12. Decontaminate the area only upon the advice of the RSO.
13. Ascertain the absence of airborne contamination before permitting work to be resumed.
14. Prepare a complete history of the accident and subsequent remedial or protective measures for submission to the state.
Injuries to personnel involving radiation hazards:

1. Wash minor wounds under running water immediately.
2. Report all radiation accidents to personnel (wounds, overexposures, ingestion, and inhalation), to the RSO as soon as possible. If the RSO is not available, report to nearest emergency medical facility.
3. Call 9-1-1 and RSO.
4. The RSO may call the DOH if necessary.
5. Permit no person involved in a radiation injury to return to work without the written approval of the attending physician and the RSO.
6. Prepare a complete history of the accident, and subsequent activity related thereto, for the state.

Fires or other major emergencies:

1. Notify all other persons in the building at once. Pull alarm and evacuate building.
2. Call 9-1-1 and RSO when in a safe area.
3. Prepare a complete history of the emergency and subsequent activity related thereto, for submission to the state.

University Police/Cheney Police Actions: Law enforcement personnel, with their responsibility and special jurisdictional authority, have an important role in radiation emergencies. Therefore, it is important that the University Police Officers and the Cheney Police Department be aware of the following emergency guidelines:

1. Notify the RSO. The RSO may contact DOH if necessary. Follow these guidelines in the event of an accident involving radioactive materials:
   a. Inform all emergency personnel that the accident involves or may involve radioactive material.
   b. Obtain names, addresses and phone numbers of persons involved. All non-injury persons suspected of being contaminated must remain on site until monitored by the RSO.