



HUMBOLDT STATE UNIVERSITY

RADIATION SAFETY MANUAL



Environmental Health & Safety

February 2, 2009

Humboldt State University
RADIATION SAFETY MANUAL

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Section 1 Introduction

1.1 Program Policy

All radioactive materials and equipment capable of producing ionizing radiation shall be handled in accordance with the provisions of this Radiation Safety Manual which presents campus policy, standards and procedures for compliance with the applicable regulations. Predominantly, those regulations are the California Code of Regulations (CCR), Title 17, Division 1, Chapter 5, Subchapter 4, Group 1, Article 1, Section 30100, et. seq., the Code of Federal regulations (CFR) Title 10, Part 20 and CFR 49, Part 171, et. seq.

1.2 Purpose of the Radiation Safety Program

The primary purpose of the Radiation Safety Program is to assure that work with radioactive materials and radiation producing machines is conducted in a manner as to protect the health and safety of individuals subject to exposure to radiation from such sources. Furthermore, the program supports the instructional and research mission by providing training to faculty, students and staff in proper radiation safety procedures. The goal of the Radiation Safety Program is to keep all ionizing radiation exposures to personnel as low as reasonably achievable (ALARA).

1.3 Scope of the Manual

Statutes and regulations of the State of California pertaining to the licensing and use of ionizing radiation are expressly incorporated as part of this manual. Copies of the State regulations are available for review from the Radiation Safety Officer (RSO). This manual applies to all radioactive materials and radiation generating machines requiring licensing or registration in accordance with Title 17 CCR.

1.4 Responsibilities

A. Radiation Safety Officer

The RSO is the direct representative of the President in working with all university employees to assure understanding and compliance with appropriate radiation safety regulations and practices. The RSO:

1. Provides the users counsel and advice on regulatory changes, developments and interpretations.
2. Maintains all records mandated by the Radiological Health Branch, California Department of Health and Human Services and is named on the HSU Radioactive Materials License.

3. Arranges for equipment calibration, Dosimetry services and disposal of radioactive waste.
4. Reviews and makes changes or amendments to RUA's and MUA's at least annually and initiates any action taken on RUA's and MUA's as applicable.
5. Reviews all Dosimetry reports, reviews all proposed purchases of radioactive materials or radiation generating machines and provides written documentation of approvals.
6. Coordinates design and acceptance of new facilities including storage areas of radioactive materials.
7. Reviews all requests for relocations of existing radiation machines or radioactive materials storage.
8. Investigates accidents and provides emergency response to incidents.
9. Evaluates proposed uses of radioactive materials.
10. Acts as liaison with the Department of Radiological Health.
11. Advises users regarding Title 17, California Code of Regulations.
12. Coordinates inventory reporting requirements.
13. Responsible to advise department chairpersons of any major changes in regulations or good practices which may affect the possession, use, storage or handling of radioactive materials or use of radiation producing devices.
14. Responsible to promptly meet with new department chairpersons to provide a briefing on the salient features of the HSU Radiation Safety Program and the use of ionizing radiation in their departments.
15. Responsible to promptly bring to the attention of department chairpersons an unsafe acts or unsafe conditions involving the use of ionizing radiation so the department chairpersons may expeditiously take action to correct the situation.

B. Deans

The responsibility for the safe and prudent use of licensed radioactive materials and radiation producing machines rests with the Dean of the College in which these activities take place. The Dean is vested with the authority and responsibility to assure safe working conditions for the employees under his/her auspices and the safe learning conditions for students in the college.

C. Department Chairpersons

1. Responsible for review and approval of proposed uses of radioactive materials and radiation producing machines within their departments.
2. Responsible to provide resources for proper maintenance and safe operating conditions for all licensed radioactive materials and radiation producing machines in the department. If proper maintenance or safe operating conditions cannot be assured, the chairperson shall direct faculty users not to use the material or equipment and take

such actions to preclude use of material or equipment. Under such conditions, the chairperson shall notify the RSO of the situation.

3. Responsible for supervising staff radiation workers.

D. Faculty Users

1. Responsible for the safety of their students.
2. Are required to be named on the applicable Radiation Use Authorizations (RUA's) and or Machine Use Authorizations (MUA's).
3. Must understand and implement the proper and safe use of radionuclides and radiation producing machines in compliance with applicable regulations and University requirements.
4. Permit only activities authorized by the RUA and/or MUA.
5. Maintain Dosimetry use records where applicable, ensure students and/or instructors involved wear proper Dosimetry where applicable and that all Dosimetry is properly secured after use.
6. Implement proper safe handling and storage of all radioactive materials and the proper start-up, use and shut-down of radiation producing machines, both in classroom and research usages.
7. Instruct, inform and remind students of safe procedures in all matters of radiation protection.
8. Maintain safety procedures as an integral part of the instructional program.
9. Use written protocols when operating instructions and emergency procedures are required.
10. Ensure the proper return and security of all radioactive sources and Dosimetry at the end of the laboratory/classroom sessions.
11. Ensure use of non-exempt radioactive materials is permitted only in controlled areas, fitted with specially keyed locks, with access only by authorized personnel. Such areas shall be conspicuously marked with appropriate warning signs.
12. Ensure the student exposure is kept as low as reasonably achievable through safety instruction, design considerations and experimental procedures which are based upon good laboratory practices.
13. Promptly inform their department chairperson if there is a maintenance or operating condition problem and shall not operate equipment or use materials until such condition is corrected or accommodated.
14. Responsible to promptly bring to the attention of the department chairperson any unsafe acts or unsafe conditions involving the use of ionizing radiation so the department chairperson may expeditiously take action to correct the situation.
15. Maintain their proficiency in radiation safety practices, including attending radiation safety training sessions as a condition of their RUA/MUA.

Section 2 LICENSING AND REGISTRATION

2.1 Scope of the University License

The university possesses a license issued by the State of California, Department of Health Services (DHS), Radiological Health Branch. This license permits the use of all radionuclides in specified quantities according to their atomic number and mass number subject to all applicable rules, regulations and orders of the DHS and the limitation of the license. Details concerning restrictions are incorporated in this manual in part and can be obtained from the RSO.

2.2 Renewal and Amendment of the License

Renewal and amendment of the license is the responsibility of the RSO in consultation with authorized users and corresponding department chairpersons, and certification by the campus President or his/her designee. Amendment of the license will be required for the use of radioactive materials involving:

- a. Use of radionuclides under conditions other than those permitted in the license.
- b. Possession and use of radionuclides in amounts in excess of the limits in the license.
- c. Use of radioactive materials at offsite locations.

It is the responsibility of the faculty member initiating and/or supervising work that requires a license amendment to confer with the RSO as soon as possible. License amendments are at the discretion of the Radiologic Health Branch and can take in excess of six months to be approved.

2.3 Registration of Ionizing Radiation Generating Machines

All ionizing radiation generating machines shall be registered with the State of California, DHS, Radiologic Health Branch. Such registration shall be the responsibility of the RSO in conjunction with the chairperson for the department(s) responsible for the applicable machines.

Section 3 APPLICATION FOR USE OF RADIOACTIVE MATERIALS AND IONIZING RADIATION GENERATING MACHINES

3.1 Faculty Users

Department chairpersons will ensure that all ionizing radiation use in their departments is done only as approved by a RUA or MUA. All users of radioactive materials or ionizing radiation generating machines must be under the supervision of a faculty user who has been issued a RUA or MUA by the RSO.

3.2 Radiation Workers

Anyone who uses or handles ionizing radiation or radioactive materials as part of their job is a radiation worker and must be listed on a RUA or MUA.

3.3 Statement of Training and Experience

All users and radiation workers shall file with the RSO a “Statement of Training and Experience” (Form 1, Appendix A) which will be evaluated by the RSO. Students utilizing ionizing radiation in a classroom setting shall not be required to file a “Statement of Training and Experience” but must have documented training on file with the supervising faculty member and RSO.

The approval criteria for an authorized user is a minimum of a bachelor degree in biological or physical science or engineering and forty hours of training and experience in radiation safety and protection and the safe handling of radioactive materials. Departments may need to pay for training provided by a third party depending upon the nature of the intended radioactive material or radiation producing machine use.

3.4 Application for Use

Each faculty user shall have filed with the RSO for approval and application for “Use of Radioactive Materials or Radiation Generating Machine” (Form 2 or 3, Appendix A) for their particular use.

3.5 Approval Process – Radiation Use Authorization (RUA) and Machine Use Authorization (MUA)

Authorization shall be categorized as either classroom use or research use for liquid, solid or sealed sources and machine use for radiation generating machines.

Radiation use authorizations and machine use authorizations shall be issued for either one, two or three year periods and may be amended or cancelled by the RSO.

All applications for RUA’s or MUA’s shall be reviewed and signed by the department chairperson prior to review, approval by the RSO; RUA’s and MUA’s are issued by the RSO.

Upon issuing the RUA or MUA, Dosimetry shall be issued if required (see Appendix D) and a bioassay schedule established if required.

3.6 Renewal of Authorization

Annually the RSO shall determine if there are any changes in any RUA and any MUA. If there have been no changes, then the RUA or MUA shall be renewed accordingly, provided that good practices are followed and the results of personnel dosimetry is as low as reasonably achievable.

3.7 Termination of Use Authorization

If the RSO determines that the user is in violation of the University, State or Federal regulations, or recognized radiation safe practices, authorization for use may be revoked or suspended by the RSO with notice to the department chairperson, until proper use is assured by the

department chairperson. One option is that the user will only be able to work under a RUA issued to the department chairperson.

3.8 Amendment of the RUA or MUA

Any changes on the original authorization, as approved by the RSO, shall require an amendment to the RUA or MUA (Appendix A, Form 4 or 5).

The following can be approved by the RSO as long as license conditions are not compromised:

- a. On-campus location changes.
- b. Personnel changes in users or radiation workers.
- c. Changes in the physical or chemical form of radionuclides.
- d. Off-campus location use (requiring an amendment to the campus license; see note in Section 2.2).
- e. Changes or amendments to the license.
- f. Additions or changes to use authorizations.
- g. Increases in the possession or experimental limits of each radionuclide.

Section 4 PROCEDURES AND REGULATIONS GOVERNING USE OF RADIONUCLIDES

4.1 Procurement

Any purchase, loan or gift of radioactive material or radiation producing machine requires the prior written approval of the RSO. Purchases shall be requested on standard requisition forms indicating:

- a. The amount and identity of the radioactive materials or radiation generating machine.
- b. That the material is to be delivered to the RSO or another person designated by the RSO.
- c. The specific isotope and activity level, form.
- d. The words, "radioactive material".

The requisition shall be sent to the RSO who will either indicate approval by signing and forwarding the request to procurement, or university foundation, or returning it to the originator with an explanation as to why the purchase cannot be made. Telephoned orders must be cleared by this process before being transmitted to the supplier.

The user making the request is responsible to provide sufficient lead time that includes an allowance for review and approval by the RSO, as well as time during package receipt for the package to be wipe tested and checked for leaks.

4.2 Leak Testing and Delivery

Upon receipt of the radioactive materials at Shipping and Receiving, the material shall be checked by the RSO to confirm the order, wipe tested and surveyed (external and internal

package) for leakage and the radiation fields measured at the surface of the package and at one (1) meter from the package to confirm compliance with Department of Transportation (DOT) regulations. Packages found to exceed DOT regulations shall not be delivered to the faculty user, and the vendor shall be notified of the problems. Packages meeting all of the above criteria shall be delivered to the authorized locations on the RUA only after wipe test results are received back from the analytical laboratory. The authorized user must sign for receipt of the material.

4.3 Storage

Storage of radioactive materials shall be secured to prevent unauthorized removal and shall be provided with reasonable protection against loss, leakage or dispersion by the effects of fire or fire suppression activities. Only approved locations on the respective RUA or MUA are authorized as storage locations.

4.4 Warning Signs

- a. Rooms in which radioactive materials are used or stored shall be posted: "Caution – Radioactive Material" on a sign bearing the Radiation symbol. If the use area has a potential exposure rate exceeding 0.05mR/hr but less than 2.0 mR/hr, then the area shall also be posted as a "Restricted Area". Radioactive materials shall not be transferred to or used in an unposted, unrestricted area, i.e., exposure rate <0.05 mR/hr.
- b. Areas in which there exists a radiation level such that an individual could receive in any one (1) hour a dose to the whole body in excess of 5 millirems, or in any five (5) consecutive days a dose in excess of 100 millirems shall have a sign conspicuously posted bearing the radiation symbol and the words: "Caution – Radiation Area". Any area in which an individual could receive a whole body dose in excess of 100 millirems in one (1) hour shall be posted with a similar sign using the words: "Caution – High Radiation Area".
- c. Any area in which radioactivity is dispersed in the air in the form of dust, fumes, mists, vapors, or gases in excess of those allowed by regulation (T17 CCR §30355) shall be posted similarly using the words: "Caution – Airborne Radioactivity".
- d. Containers holding radioactive material for storage or during processing and use shall be clearly labeled with a sign bearing the radiation symbol and the words: "Caution – Radioactive Material" and shall state the quantities, identity of the isotope and the date it was placed in the container.
- e. Posting of rooms with the above warning signs which are known not to contain radionuclides or radiation sources is prohibited.

- f. "Notice to Employees", State of California form RH2364, shall be posted permanently and conspicuously in all areas where work with radiation is being carried out.
- g. Gas chromatograph units containing titanium tritide shall be posted with a sign: "Warning – Do Not Operate Above 225 Degrees Centigrade". Gas chromatograph units containing scandium tritide shall be posted with a sign: "Warning – Do Not Operate Above 325 Degrees Centigrade".

4.5 Limits of Exposure to Ionizing Radiation

- a. The University shall control any doses to students to less than one tenth ($1/10$) the occupational values identified below. The University shall control the occupational dose to individuals to:
 - 1. Annual occupational dose limit, which is the more limiting of:
 - a. 5 rems (0.05 Sv) as the Total Effective Dose Equivalent or
 - b. 50 rems (0.5 Sv) as the sum of the Deep Dose Equivalent and the Committed Dose Equivalent to any individual organ or organ other than the lens of the eye.

Any dosimetry results which are one tenth ($1/10$) the values specified above are action levels which shall be promptly investigated by the RSO.
- b. No individual shall be occupationally exposed to radioactive material by ingestion or inhalation in excess of the occupational values specified in 10 CFR 20.1001 – 20.2402, Appendix B, Table 1.
- c. In no case will an individual under the age of eighteen (18) years be permitted to receive an occupational dose in excess of 10% of the limits set forth in a. above or exposed to more than 10% of the values specified in b. above.
- d. No user shall possess sources of radiation in such a manner as to create in any area radiation levels which would cause an individual member of the public to receive a dose to the whole body in excess of:
 - 1. 2 millirems (0.02 mSv) in any one (1) hour or
 - 2. 0.1 rem (1 mSv) in any one (1) year.
- e. No user shall release or cause to be released into the air or water in any unrestricted area any concentration of radioactive material which, when averaged over any one (1) year, exceeds the limits specified in 10 CFR 20.1001 – 20.2402, Appendix B, Table 2.

4.6 Personnel Monitoring Program

- a. The responsibility for compliance with the personnel monitoring regulations rest on the authorized faculty user. It is an important part of the obligations assumed when approval for use of radioactive material or radiation generating machines is granted by the University.
- b. Personnel monitoring devices will be required for any person eighteen (18) years of age or older working with radioactive materials or ionizing radiation generating machines whenever entering a controlled area under conditions where he/she is likely to receive in any calendar quarter a dose in excess of the 10% dose listed in 4.5 a. or, if under eighteen (18) years of age, the dose listed in 4.5 b. (See Appendix D for specific guidelines on issuance).
- c. Personnel monitoring devices will be distributed by the RSO. Thermoluminescent dosimeters (TLD) will normally be the type of personnel monitor required. Ring badges will be required for individuals working where it is likely the hand exposure may exceed the dosage listed in 4.6 b. Pocket dosimeters may be utilized in lieu of of TLD's for individuals entering controlled areas on an infrequent or temporary basis.
- d. TLD's, when required, are to be worn at all times when the individual is occupationally exposed. They should be worn in a fashion so as to indicate whole body exposure (breast pocket, belt, etc., except in the case of finger rings. The badge is not to be worn when the individual is undergoing diagnostic or therapeutic radiation exposure.
- e. TLD exposure records will be maintained by the RSO; when requested in writing by an individual, the RSO shall provide a copy of his/her permanent occupational exposure. Records of exposure shall be forwarded to new employers upon written request of the individual.
- f. In cases where ingestion or inhalation of radioactive materials may have occurred, the RSO may require urine or blood samples from the individual for analysis. Other types of bioassay may be pursued as deemed appropriate. In addition, in an emergency situation or unusual event when it is suspected that an uptake may have occurred, a bioassay will be performed within 24-48 hours.
- g. Bioassay for Iodine 125 or Iodine 131 shall be performed on individuals involved in operations with those materials in a non-contained form as follows:

Any radioiodine compound which through a chemical or physical process becomes volatile (i.e., sodium iodide, Bolton-Hunter reagent) and the amount used at one time is greater than 1mCi, personnel shall be required to perform a thyroid bioassay with-in 24-72 hours after use.

- h. Bioassay for tritium uptake shall be performed on individuals involved in operations with that material in a non-contained form as follows:

Any tritiated compound which through chemical or physical process becomes volatile (i.e., water sodium borohydride) and the amount used at one time exceeds: (1) 10mCi – open bench; (2) 100mCi – fume hood, personnel shall be required to submit a urine sample for analysis within 24 hours after use.

4.7 Operational Safety Rules for Laboratories

- a. Principles of ALARA

The term ALARA is an acronym for maintaining radiation exposures in controlled and uncontrolled areas “as low as reasonably achievable”. This working philosophy takes into account the available technology, economic costs in relation to benefits to public health and safety, the instructional/research goals, and other considerations. Thus, authorized users are required to apply ALARA principles and work practices to the extent practicable.

ALARA principles include, but are not limited to:

- Users shall order and use only the smallest quantity of radioactive material necessary to accomplish the instructional or research task;
- Strategies of time, distance and shielding will be practiced not only to achieve compliance below regulatory exposure levels but also to further reduce exposures when practicable and safe to do so;
- Authorized users/faculty are responsible for instructing students and assistants under their supervision on the principles and practices of the ALARA program;
- Use of dry runs to optimize the efficiency and reduce the exposure period to source material;
- Authorized users are encouraged to develop procedures within the scope of their experimental protocol that could reduce exposures;
- The work area shall be as small as reasonably practical and clearly labeled;
- Use of appropriate and calibrated instrumentation and equipment; and,
- RSO review of Dosimetry records, as necessary, and written protocol.

- b. General Safety Rules for Unsealed Sources

The authorized user is responsible for assuring that every employee, instructor and student under his/her supervision who may be exposed to ionizing radiation is fully instructed in the necessary precautions specific to their operation for protection of themselves and others in prevention of radioactive contamination and radiation exposure. Furthermore, the faculty user shall be responsible to ensure that such training is documented and that the RSO receives copies of the training documentation.

Personal cleanliness and careful techniques are the primary means for the prevention of contamination and protection against internal intake of radioactivity. In order to minimize contamination and to prevent entrance of activity into the body, the following rules shall be observed in radioisotope laboratories where unsealed sources are used:

1. The pipetting of radioactive solutions by mouth is prohibited. Remote pipetting devices are available and mandatory for such applications.
2. Protective clothing and/or devices shall be used for all manipulations with unsealed sources where the possibility of contamination exists. In particular, disposable gloves and lab coats shall be worn whenever contamination is possible. Surgical glove techniques should be used for putting on and removing gloves in order to avoid contamination. Eye protection must be worn whenever aerosol contamination or splashing could occur.
3. Work which may result in contamination of work areas shall be done over trays of nonporous material lined with plastic-backed absorbent paper. Any work with materials susceptible to atmospheric distribution (i.e., by vaporizing, spillage, dusting, effervescence of solution or other releases of radioactive gas) should be done in a suitable hood or glove box with a minimum face velocity of 100 LFM.
4. Thorough monitoring of hands, feet and clothing is mandatory whenever leaving a radionuclide laboratory where work with unsealed radioactive materials is in progress. Each individual radionuclide user is personally responsible to check him/herself for contamination every time they leave the radionuclide area. Articles which show contamination shall be left in the work area or other area designated for this purpose. Such clothing shall be marked by the user with his/her name, the date, and the nature and degree of contamination and held for storage until the activity has decayed to background level; or the clothing has been decontaminated or disposed of as radioactive waste. Any contamination on the skin shall be removed by washing with soap and water immediately or reported to the RSO (see Appendix C). Contaminated equipment, or equipment that has been used and is suspected of contamination, shall be labeled, contained and isolated in designated areas in the laboratory or in a suitable storage space.

4.8 Laboratory Monitoring Procedures

- a. The RSO or designee shall conduct surveys of all areas in which unsealed and sealed radiation is utilized and recommend/require corrective measures where contaminated surfaces have been detected. Surveys will be performed as below:

<u>Hazard Rating Category*</u>	<u>Frequency</u>
HRC1	Semi-annual
HRC2	Quarterly
HRC3	Monthly

* see Appendix E for the method of calculation

- b. It is the responsibility of the authorized user to monitor laboratory procedures and operations with an appropriate survey meter and wipe tests (for unsealed sources), to make appropriate corrective measures when needed and to maintain at minimum monthly records of the monitoring results if use has occurred.

The authorized user shall monitor the work area per the following:

<u>Hazard Category Rating</u>	<u>Frequency</u>
HRC1	meter: at end of each experiment wipes: quarterly; or at end of each use session if use is less frequent than quarterly
HRC2	meter: at end of each experiment wipes monthly; or at end of each use session if use is less frequent than monthly
HRC3	meter: constant during usage and at end of experiment wipes: weekly during use sessions

- c. It is the responsibility of the corresponding faculty user and department to ensure that each survey instrument used in these procedures must be calibrated annually during usage periods. When not in use, the survey meter may be tagged, "Not in Current Use – Must Calibrate Prior to Use".
- d. Each sealed source, other than Hydrogen-3 or Krypton-85 in gaseous form, and source material, shall be tested by the RSO or designee for contamination prior to initial use and for leakage each six (6) months. If there is reason to suspect that a sources might have been damaged, it must be tested for leakage before further use. If the test reveals the presence of 0.005 μCi or more of removable contamination by a standard wipe test, it shall be withdrawn from use and repaired or disposed. Sealed sources in storage do not need to be wipe tested for leakage.

4.9 Inventory and Disposal of Radioactive Materials

- a. A central inventory of radioactive materials on campus is maintained by the RSO. Each faculty user must keep records of the amounts and kinds of radioactive materials under his/her supervision so that the central inventory may be updated quarterly. Sealed sources shall be leak tested and inventoried every (6) six months by EH&S.
- b. The manner of disposal of all radioactive materials must be specifically approved as part of the application for use of radioactive materials (Appendix A, Form 2). All radioactive waste shall be deposited in approved containers, labeled with the standard caution sign

and must include the identity of the isotope, activity level, date and name of user. Such waste may be stored for decay or collected for storage or disposition by the RSO. Waste should be sorted into short (<65 days) and long half-life groups. EH&S shall be responsible for the disposal of all radioactive material via the RSO.

4.10 Radiation Training

All employees planning to work with ionizing radiation covered by this manual shall attend a radiation protection training session prior to such use. Attendance at a refresher training session is required at least once every two (2) years. Failure to meet the refresher training requirements after two (2) written notifications may result in loss of the privilege to use ionizing radiation at the University. Note: This training session is a supplement to and not a substitute for the minimum 40 hours of training/experience required to be an authorized user. All those individuals working under the direct supervision of an authorized user must attend this training session.

Classroom use training requirements for ionizing radiation can be met by either the instructor or the RSO or his/her designee presenting a summary of radiation safety guidelines prior to the commencement of laboratory work.

Exception to the above policy is as follows:

Temporary radiation workers (radiation work period less than or equal to one (1) month) must be trained by their supervisor in good health physics practices and policies, and directly supervised in his/her work. Attendance at a health physics seminar is recommended but not mandatory. The faculty user shall document the radiation safety training that they provide.

Section 5 PROCEDURES AND REGULATIONS GOVERNING THE USE OF IONIZING RADIATION GENERATING MACHINES AND LARGE GAMMA SOURCES

5.1 Procurement and Disposal of Ionizing Radiation Generating Machines

- a. All procurement, whether by purchase, loan or gift, requires the prior approval of the RSO. Certification of such approval is to be submitted to Procurement with the purchase request/order, or request for approval of a loan or gift.
- b. Disposal of an ionizing radiation generating machine requires prior written notice to the RSO. Disposal cannot take place without coordination with the RSO.

5.2 Requirements for Safety and Operating Procedures

Operation of an ionizing radiation generating machine or large gamma source (generally capable of producing in areas accessible to individuals a radiation level of 100 mRem per hour or larger) requires the preparation by the user and approval by the RSO of an operational guide

which includes safety and emergency procedures. The faculty user of the machine shall be responsible for supplying each user under his/her jurisdiction with a copy of the guide and insuring that each user is instructed in the appropriate procedures.

Physical changes to the space wherein the machine or gamma source resides may be required in order to meet ALARA and regulatory exposure requirements. The department requesting the use/installation of radiation producing machines or large gamma sources will be responsible for paying for the required physical changes to the space.

5.3 Controlled Areas, Operating Signals and Signs

- a. Controlled areas associated with ionizing radiation generating machines or large gamma sources shall have access restricted and be appropriately posted (4.4 b. & c.). Areas or rooms that contain permanently installed x-ray machines as the only source of radiation may be posted with a sign(s): "Caution – X-Ray" in lieu of the signs specified in 4.4 b. & c.
- b. Each ionizing radiation generating machine or large gamma source capable of producing a dose rate in any accessible area to individuals in excess of 100 mRem per hour shall be provided with a conspicuously visible or an audible alarm signal. Such alarm signal shall be activated automatically only when radiation is being produced. Further, each entrance or access to such shall be:
 1. Equipped with a control device to reduce the radiation level in that area to below 100 mRem per hour; or
 2. Equipped with a control device which shall energize an alarm to alert any individuals entering the area and the supervisor of the operation; or
 3. Maintained locked except during periods when access is required, with positive control over each entry.
 4. The controls must be established in such a way that no individual will be prevented from leaving the high radiation area.
- c. All devices and equipment capable of producing ionizing radiation when operated shall be appropriately labeled so as to caution individuals that such devices or equipment produce ionizing radiation.

5.4 Labeling – Containers/Sources of Radioactivity

All vials, containers and sources of radioactivity shall be labeled with isotope, activity level, user name, and date.

5.5 Labeling – Storage Areas

All storage areas will be clearly labeled with “Radioactive Material” placards and radiation fields posted in mR/hr.

Section 6 EMERGENCY PROCEDURES

Emergencies resulting from accidents in restricted areas may range from minor spills of radioactivity involving relatively low personnel hazard, to major radiation incidents and spills involving extreme hazards and possible bodily injury. Because of numerous complicating factors which may arise, and because of the wide range and variety of hazards, set rules of emergency procedures cannot be established to cover all possible situations. In any emergency, however, the primary concern must always be the protection of personnel from radiation hazards. The secondary concern is the confinement of contamination to the local area of the accident.

Spill Kit

Each work area utilizing liquid radioactivity shall have a spill kit containing:

- Disposable gloves, 6 pair
- Package of detergent, large size
- Steel wool pads and scouring (powder) cleanser
- Plastic-backed absorbent paper
- Disposable shoe covers
- Plastic bags
- “Radioactive Material” tape
- Wipe test swatches
- Roll of masking tape or duct tape
- Paper towels
- Tongs for picking up broken glass
- Waterproof, all-surface marking pen

a. **Minor Spills** – spill response and cleanup

Minor spills: μCi amounts of radioactive material, no airborne release or potential, that can be handled by laboratory personnel.

1. Notify others in the room a spill has occurred.
2. Cover the spill with absorbent paper

3. Monitor skin and clothing for contamination. Skin should be decontaminated using copious water flushes, without abrasive scrubbing. If skin exposure occurred, call the RSO.
 4. Any contaminated clothing should be removed and bagged.
 5. Personnel not essential to the cleanup can leave the room after being monitored. To avoid the spread of contamination, the bottom of shoes must be monitored.
 6. Pick up broken glass with tongs and bag it or place it in a suitable "sharps" container.
 7. Using the spill kit and wearing gloves and disposable paper booties, decontaminate from the outside edge to the center of the spill, bagging all used cleaning materials. Do not increase the area of the spill during the cleanup process.
 8. Continue decontamination until removable contamination is less than two (2) times background per 100 square centimeter area. If no more can be removed, cover the area with absorbent paper, labeled with "Radioactive Material" tape, secure entry to the room and call the RSO.
 9. Monitor all cleanup personnel for contamination.
 10. Maintain a written record of the spill, how it occurred, date and time, activity level involved, exact location and who was present. Include how much radioactivity was involved and documentation that it was cleaned up to less than two (2) times background. The authorized user is responsible to provide the RSO with a copy of the written spill record.
- b. **Major Spills** involving substantial radiation hazards to personnel;> 1mCi, or problems removing smaller amounts.
1. Notify all persons in the room at once of the hazard.
 2. Request all persons not involved in the spill to vacate the room AT ONCE without spreading any contamination; their shoes may need to be monitored prior to exiting the area, and if need be, left inside the room.
 3. Make no immediate attempt to cleanup the spill. If the spilled substance is a liquid and the hands are protected, then right the container.
 4. If the spill is on the skin, flush thoroughly with water. If the spill is on the clothing, remove and bag clothing at once. [Note: If you are using quantities or

activity levels of an isotope that could result in a large spill, then it would be a good idea to keep a change of clothing available, or at least a clean lab coat.]

5. Vacate the room and prohibit entrance to contaminated area.
 6. Call University Police, 911 or extension 5555, ask them to notify the RSO as soon as possible giving all details of the spill.
 7. Use a radiation monitor to evaluate any residual personal contamination.
 8. Permit no person to work in the area until the approval of the RSO is secured.
 9. Under no circumstances should an untrained person attempt to examine or clean up the radioactive material.
 10. If necessary, in accordance with T17 CCR 30295, the RSO will notify and make a report to the Radiologic Health Branch.
- c. Accidents involving radioactive dusts, mists, fumes, vapors and gases.
1. Notify all other persons to vacate the room immediately.
 2. Hold your breath and, if possible, switch off air circulating devices.
 3. Vacate the room.
 4. Notify University Police, 911 or extension 5555, ask them to contact the RSO at once.
 5. Ascertain that all doors giving access to the room are closed and locked. If necessary, post guards to prevent accidental opening of doors.
 6. Do not reenter the room until approval of the RSO is secured.
- d. Fire involving radioactivity:
1. Notify all persons in the room and building at once. When persons in the room are notified, one (1) person shall be directed to call University Police (dial 911 from all campus phones; let the dispatcher know that radioactive materials are involved in the fire) and the RSO immediately.
- e. Overexposure or Ingestion
1. Any person who suspects overexposure to radiation from any source must report immediately to the RSO. (Any exposure in excess of 1.25 Rem whole body delivered in a period of thirteen (13) weeks or less is regarded as an overexposure for purposes of these regulations.)

2. Any person who swallows, absorbs or otherwise ingests radioactive materials (excluding normal environmental contaminants and excluding medical diagnostics or therapy) must undergo bioassay procedures to determine the extent of the exposure. The RSO shall make arrangements for all bioassay tests.

APPENDICES

STATEMENT OF TRAINING AND EXPERIENCE
 (Use additional sheets as necessary)

Instructions: Each individual proposing to use radioactive material is required to submit a Statement of Training and Experience **in duplicate** to **Radiologic Health Branch, 714/744 P Street, MS 178, P.O. Box 942732, Sacramento, CA 94234-7320**. Physicians should request form RH 2000 A when applying for human-use authorizations. Radiographers should request form RH 2050 IR.

1. Name of Proposed User		Position Title	
Employer Address (Street Address)	City	State	ZIP Code
Radioactive Materials License Number	Radioactive Materials License Name		
2. Training			
a. College or University <input type="checkbox"/> Yes <input type="checkbox"/> No			
Name			
City		State	
Years Completed	Degree	Course of Study	
b. Education specifically applicable to use of radioactive material			
3. Experience			
a. List experience with use of radioactive materials beginning with most recent			
(1) Dates From _____ To _____		Employer	
Titles and Duties			
Radioactive Materials License Number			Date
Employer Address (Street Address)	City	State	ZIP Code
(2) Dates From _____ To _____		Employer	
Titles and Duties			
Radioactive Materials License Number			Date
Employer Address (Street Address)	City	State	ZIP Code
(3) Dates From _____ To _____		Employer	
Titles and Duties			
Radioactive Materials License Number			Date
Employer Address (Street Address)	City	Employer Address (Street Address)	City
(4) Dates From _____ To _____		Employer	
Titles and Duties			
Radioactive Materials License Number			Date
Employer Address (Street Address)	City	Employer Address (Street Address)	City

b. Indicate the facilities and operations where training was received and refer to Part 3.a. when answering the following:

- | | | | | |
|--|------------------------------|------------------------------|------------------------------|------------------------------|
| <input type="checkbox"/> Laboratories using radiochemicals | <input type="checkbox"/> (1) | <input type="checkbox"/> (2) | <input type="checkbox"/> (3) | <input type="checkbox"/> (4) |
| <input type="checkbox"/> Restricted area laboratories | <input type="checkbox"/> (1) | <input type="checkbox"/> (2) | <input type="checkbox"/> (3) | <input type="checkbox"/> (4) |
| <input type="checkbox"/> Glove boxes | <input type="checkbox"/> (1) | <input type="checkbox"/> (2) | <input type="checkbox"/> (3) | <input type="checkbox"/> (4) |
| <input type="checkbox"/> Field operations | <input type="checkbox"/> (1) | <input type="checkbox"/> (2) | <input type="checkbox"/> (3) | <input type="checkbox"/> (4) |
| <input type="checkbox"/> Environmental applications | <input type="checkbox"/> (1) | <input type="checkbox"/> (2) | <input type="checkbox"/> (3) | <input type="checkbox"/> (4) |
| <input type="checkbox"/> Other (please describe) _____ | <input type="checkbox"/> (1) | <input type="checkbox"/> (2) | <input type="checkbox"/> (3) | <input type="checkbox"/> (4) |

c. Radioactive materials previously used. Identify typical radioisotopes in appropriate box and refer to Part 3.a. on preceding page:

	Quantities Handled			
	(a) Microcuries	(b) Millicuries	(c) Curies	(d) Kilocuries
(1) Sealed sources				
(2) Unsealed alpha emitters				
(3) Unsealed beta-gamma emitters				
(4) Neutron sources				

d. Describe the procedures similar to those proposed in which you have had experience. Indicate months or years for each and refer to Part 3.a. on preceding page.

4. Certificate:

The information you are asked to provide on this form is requested by the State of California, Department of Health Services, Radiologic Health Branch. This notice is required by Section 1798.17 of the Information Practices Act of 1977 (Code of Civil Procedure, Section 1798-1798.76) and the Federal Privacy Act to be provided whenever an agency requests personal or confidential information from any individual. It is mandatory that you furnish the information requested on this form. Failure to furnish the requested information may result in an inaccurate determination of statements and/or disapproval of your application.

I hereby certify that all information contained in this statement is true and correct.

Signature of proposed user

Date

APPENDIX A

Form 2

Humboldt State University
Environmental Health & Safety
Radiation Safety Program

RADIATION USE AUTHORIZATION APPLICATION INSTRUCTIONS

1. Faculty User

The Faculty User is the person responsible for the Radiation Use Authorization. Prior experience with radioactivity is mandatory. Fill in the requested information and submit a Statement of Training and Experience

2. Co-Workers

List the name of each person who will work with radioactive materials under this authorization. Submit a Statement of Training and Experience for each worker. Designate one (1) person as a backup Faculty User to take responsibility for this Radiation Use Authorization in your absence.

3. Locations for USE of Radioactivity

List the building and room numbers for each location you plan to store or utilize radioactivity. Diagram your facilities on the back of the application, clearly indicating where radioactivity will be stored or utilized.

4. Radionuclides Requested

List each radionuclide requested and the physical and chemical form in which the material will be received. List the maximum amount of radioactivity in mCi that you will need to have on hand per radionuclide (Possession Limit), excluding what will be present in your waste. List the maximum amount of radioactivity in mCi that you will use per experiment per radionuclide (Experiment Limit).

5. Protocol

Fill out a Safety Protocol for each proposed project. Indicate on the Safety Protocol the title of the project and the purpose of the experiment. Answer questions A through F indicating your proposed radiation safety practices.

In item G provide a step-by-step description of your project, emphasizing the safety features. Provide a copy of this protocol to each co-worker participating in the experiment.

6. Signatures

When the application is complete, sign under Faculty User, obtain your department chairperson's signature and return to the Radiation Safety Officer.

APPENDIX A

Form 2

Humboldt State University
Environmental Health & Safety
Radiation Safety Program

Application for Use of Radioactive Materials
Safety Protocol

Provide a copy of this protocol to each co-worker participating in the experiment.

Title of Project: _____

Purpose: _____

Radioisotope(s): _____

Chemical and Physical Form: _____

A. What personnel protection methods will be used to prevent contamination and internal exposures to radiation?

- | | | |
|--|---|---|
| <input type="checkbox"/> Disposable Gloves | <input type="checkbox"/> Disposable Booties | <input type="checkbox"/> Lab coat/Coveralls |
| <input type="checkbox"/> Glove Box | <input type="checkbox"/> Fume Hood | <input type="checkbox"/> Absorbent Paper |
| <input type="checkbox"/> Respirator | Other: _____ | |

B. How will you detect radioactive contamination and/or radiation fields?

- Wipes and liquid scintillation counting/or gamma well counting.
- G.M. Survey Meter (Model: _____)
- Ionization Chamber (Model _____)
- Other: _____

C. At what frequency will you check your laboratory for contamination?

- After each experiment Daily Weekly Bimonthly Other

D. Explain your method for decontamination of non-disposable objects coming in contact with the radioactivity.

E. What personnel protection methods will be used to prevent external exposures?

- Shielding (Explain below) Distance Time in the work area
 Engineering Controls (remote manipulators, etc. – Explain below)

F. List the types of radioactive waste you will have and where you will store each for of waste until EH&S picks it up. Estimate the volume per month.

	<u>Storage Location</u>	<u>Quantity/Month</u>
<input type="checkbox"/> Dry	_____	(ft ³)_____
<input type="checkbox"/> Liquid	_____	(gal)_____
<input type="checkbox"/> Biological	_____	(lbs)_____
<input type="checkbox"/> Scintillation Vials	_____	flats(100/flat)_____
Liquid chemical form (i.e., H ₂ O, ethanol, etc.) _____		

G. Protocol

Below, describe your protocol for the use of each radionuclide emphasizing radiation safety procedures..INDICATE LABORATORY PROCEDURES, THE SEQUENCE IN WHICH THEY ARE PERFORMED, PERSONNEL PROTECTION METHODS AS THEY ARE USED AND DISPOSITION OF WASTE AS IT IS PRODUCED. The scientific basis of the protocol should not be addressed. Attach additional pages if necessary. (Do not submit reprints.)

APPENDIX A

Form 3

Humboldt State University
Environmental Health & Safety
Radiation Safety Program

Application for Use of Radiation (Ionizing) Generating Machines

1. Department _____
2. Name of Faculty User (Attach a Statement of Training and Experience)

3. Name(s) of other personnel authorized to use this unit. (Attach a Statement of Training and Experience for each)
a. _____ b. _____ c. _____
d. _____ e. _____ f. _____
4. If for class use, attach class roster with birth dates. Course # _____
5. Location(s) of work (bldg/room) _____
6. Type of Machine: Radiographic Fluoroscopic CT Scanner
 Mammographic Electron Microscope Therapy Cabinet
 Diffraction/ Fluorescence Other: _____
7. Manufacturer _____ Model # _____
Year of Manufacture _____ Serial # _____
8. Maximum Operating Parameters (kVp, mA) _____
Normal Operating Parameters (kVp, mA) _____
9. Attach a Safety Protocol Specifically designed for this piece of equipment. The protocol should address all pertinent radiation safety procedures and equipment.

Signatures:

Faculty User _____
Department Chair: _____
Radiation Safety Officer: _____

Approval Date: _____

APPENDIX A

Form 4

Humboldt State University
Environmental Health & Safety
Radiation Safety Program

RADIATION USE AUTHORIZATION AMENDMENT/RENEWAL REQUEST FOR RUA's

(Please Print Clearly or Type)

RUA# _____ Faculty User _____ Date _____

Please amend my Radiation Use Authorization to reflect the following changes:

A. Personnel: (Attach a Statement of Training and Experience for each.)

Add: _____

Delete: _____

B. Change Possession/ Experimental Limits (state change justification):

Change in Chemical Forms (state change justifications):

C. Add or Delete Radionuclides (state change justifications):

Add Isotope:
Isotope Possession Limit (mCi) Exp. Limit (mCi) Chemical Form

Delete Isotope:

APPENDIX A

Form 5

Humboldt State University
Environmental Health & Safety
Radiation Safety Program

IONIZING RADIATION MACHINE AMENDMENT/RENEWAL FORM FOR MUA'S

Department: _____ MUA# _____

Applicant: _____ Date: _____

A. CHANGES IN LICENSE

1. MUA: _____
2. Responsible User: _____
3. Department: _____
4. Location: _____
5. Type No.: _____
6. Type: _____
7. Purpose: _____
8. Manufacturer: _____
9. Model: _____
10. CSUS Property No.: _____
11. Serial # : Tube _____ Control _____
12. Maximum Operating Parameters: _____ (kVp / mA)
13. Normal Operating Parameters: _____ (kVp / mA)
14. Inspection Month: _____
15. Recharge #: _____
16. Personnel: _____

B. COMMENTS: _____

Signatures:

Faculty User _____

Department Chair: _____

Radiation Safety Officer: _____ Approval Date: _____

APPENDIX A

Form 6

Humboldt State University
Environmental Health & Safety
Radiation Safety Program

RADIATION USE AUTHORIZATION (RUA)

Faculty User: _____ Department: _____

RUA#: _____ Amend. #: _____ Renewal Month: _____

Type: _____ Hazard Rating: _____

A. Authorized Isotopes and Amounts:

Isotope	Form	Experimental Limit (mCi)	Possession Limit (mCi)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

B. Authorized Personnel:

a. _____	b. _____	c. _____	d. _____
e. _____	f. _____	g. _____	h. _____

C. Authorized Locations:

a. _____	b. _____	c. _____	d. _____
e. _____	f. _____	g. _____	h. _____

D. Authorized Use:

E. Conditions or Restrictions:

All procedures must comply with the current protocol on file with this office. All uses must comply with State and University regulations.

F. Authorization:

Radiation Safety Officer Date Faculty User Date

APPENDIX A

Form 8

**Humboldt State University
Environmental Health & Safety
Radiation Safety Program**

RUA/MUA Supplement Sheet

Page _____ of _____ pages

RUA# _____

MUA# _____

APPENDIX B

Humboldt State University Environmental Health & Safety Radiation Safety Program

Facilities Requirements

Laboratories are restricted to set quantities of Radionuclide usage. The degree of restriction is based on the hazard rating of each RUA, the nature of the containment facilities and the laboratory design.

In some instances, specialized equipment will be necessary to assure a safe operation. Humboldt State University has established a laboratory classification system based on the RUA Hazard Rating Criteria that outlines minimum facility requirements.

A. LABORATORY CLASSIFICATION SYSTEM

The following criteria will be used to determine the laboratory assignment:

<u>Hazard Rating of Isotope (μCi)*</u>	<u>Laboratory Classification</u>
100 or less	Class A
101 to 50,000	Class B
50,001 to 100,000	Class C
Greater than 100,000	Class D

*In this case, the hazard rating is applied to the individual isotope, not to the accumulative rating of all isotopes authorized, unless isotopes are used in combination for a specific experiment.

Classification for Laboratories

Class A Laboratories

1. Ten (10) air exchanges per hour.
2. One hundred percent (100%) exhaust.
3. Smooth decontaminable floors and work surfaces.
4. Plastic packed absorbent coverage of all work surfaces.
5. Door(s) must be lockable.
6. Available survey instrument or counting device.

Class B Laboratories

1. All items in "Class A" above
2. A fume hood approved by the Office of Environmental Health & Safety/Radiation Safety, minimum face velocity of 100 linear feet per minute.

3. Assigned portable survey meter or counting device.

Class C Laboratories

1. All item in "Class A & B" above.
2. An approved glove box maintained under negative pressure.

Class D Laboratories

1. All items in "Class A, B & C" above.
2. An approved shielded glove box with remote manipulators.
3. Exhaust stack monitor.
4. Lead glass shields.
5. Strippable floors.
6. Air monitoring capability.
7. Hand and foot counters.
8. Separate waste storage area.
9. Continuous background monitor.

B. EXCEPTIONS TO FACILITIES CRITERIA

Exceptions to the above requirements may only be granted by joint approval of the RSO and campus Building Official.

C. BUILDING PLANS

Plans for new buildings or for alterations in existing buildings, where provisions are made for use or possible use of radionuclides or radiation generating machines, shall be reviewed by the Office of Environmental Health & Safety. **EH&S is responsible for obtaining further review and approval by others, as circumstances dictate.**

D. RELOCATIONS

Relocations of radionuclides or radiation generating machines at areas other than those stated in the RUA/MUA must have prior approval of the Radiation Safety Officer.

APPENDIX C

Humboldt State University Environmental Health & Safety Radiation Safety Program

Documentation Procedures for Radioactive Spills and Splashes

In laboratories where radioactive materials are used on a regular basis, spills and/or splashes may result in surface, equipment or even personnel contamination. In most cases the problem will be relatively minor, and quick action by laboratory personnel can eliminate any potential dangers.

REMEMBER

1. Minor spills and contamination (μCi amounts) of radioactive material may be handled by laboratory personnel. Situations involving 1mCi or greater amounts, or problems removing smaller amounts should be reported immediately to the RSO.
2. Before beginning decontamination:
 - a. Wear double gloves, lab coats and other protective equipment.
 - b. Always work from the outside inward to avoid spreading contamination.
 - c. Be careful not to “track” contamination around the room or building.
 - d. Have a suitable receptacle ready, such as a plastic bag, in which to deposit contaminated gloves, paper towels, etc.

BENCHTOP AND EQUIPMENT DECONTAMINATION

1. Locate and define the extent of contamination with a radiation survey meter and/or wipe tests. Wipe test will reveal whether or not the contamination is readily removable.
2. Clean up any liquid using paper towels, sponges, etc. Dispose of the cleaning implements as radioactive waste. Place broken glass in a can or other hard-walled receptacle prior to depositing in radioactive waste.
3. Soap and water, detergent or any number of commercially available decontamination solutions can be used to remove dry contamination from most surfaces.
4. Monitor the affected area. Repeat decontamination procedures if necessary.

5. Call EH&S/RSO for non-removable contaminations.

GLASSWARE DECONTAMINATION

Bath solutions or rinse water from decontamination procedures must be assayed with a liquid scintillation or gamma counter for activity level. Solutions exhibiting cpm less than background + 3 background cpm can be disposed of appropriately as nonradioactive waste.

1. After removing any visible residues, soak glassware in a decontamination solution for twenty-four (24) hours. Commercially prepared cleansers or detergent with chelating or complexing agents are acceptable.
2. Rinse, monitor and repeat procedure in the levels of contamination remain unacceptable.

PERSONNEL DECONTAMINATION

In the event of accidental contamination of personnel, DO NOT PANIC. Most contamination which might occur in campus laboratories can be removed by one of the following methods. However, if the level of contamination is still unacceptable, call immediately the RSO and/or EH&S (5711).

<u>Surface</u>	<u>Method</u>	<u>Technique</u>
Skin and Hair	Wash with soap and water.	Wash 2-3 minutes and monitor. Repeat no more than 3-4 times, using care not to abrade the skin.
	Wash with detergent.	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to abrade the skin. More effective than soap and water.
Eyes, ears, nose, mouth, wounds	Flush with water	Flush affected area with large amounts of water. Call the RSO and/or EH&S (5711)
Internal		Call RSO and/or EH&S (5711)

WHEN IS SOMETHING DECONTAMINATED?

As a rule, decontamination is adequate when the results of wipe tests or assays reveal activity levels to be less than two (2) time background.

APPENDIX D

Humboldt State University Environmental Health & Safety Radiation Safety Program

Summary of Dosimetry Issuance and Exchange Information

I. Unsealed Sources

Dosimetry Issuance Activity Values (in mCi)

<u>Radionuclide</u>	<u>Finger Ring</u>	<u>Whole Body Badge</u>
H-3	-	-
C-11	0.5	0.5
N-13	0.5	0.5
C-14	-	-
O-15	0.5	0.5
F-18	0.5	2.0
Na-22	0.5	1.0
Na-24	0.5	0.5
P-32	0.5	0.5
P-33	-	-
S-35	-	-
Cl-36	0.5	2.0
K-40	0.5	0.5
K-42	0.5	0.5
Ca-45	-	-
Sc-46	1.0	1.0
V-48	1.0	1.0
Cr-51	10.0	10.0
Mn-54	2.0	2.0
Fe-55	10.0	10.0
Co-57	10.0	10.0
Co-58	2.0	2.0
Fe-59	2.0	2.0
Co-60	1.0	1.0
Ni-63	-	-
Zn-65	5.0	5.0
Cu-67	2.0	10.0
Ga-67	10.0	10.0
Se-75	5.0	5.0
Kr-85	5.0	2.0
Sr-85	5.0	5.0
Rb-86	0.5	0.5
Sr-90/Y-90	0.5	0.5

<u>Radionuclide</u>	<u>Finger Ring</u>	<u>Whole Body Badge</u>
Nb-95	2.0	2.0
Mo-99	2.0	0.5
Tc-99	5.0	5.0
Tc-99m	10.0	10.0
Cd-109	10.0	10.0
Ag-110m	1.0	0.5
In-111	5.0	5.0
I-123	10.0	10.0
I-125	10.0	10.0
I-129	10.0	10.0
I-131	1.0	5.0
Ba-133	5.0	5.0
Xe-133	10.0	10.0
Cs-137/Ba-137	1.0	2.0
Ce-141	2.0	10.0
Pm-147	-	-
Gd-153	10.0	10.0
Yb-169	5.0	5.0
Ir-192	1.0	3.0
Au-198	2.0	1.0
Tl-204	10.0	10.0
Hg-203	10.0	10.0
Tl-204	1.0	2.0
Bi-210	-	0.5
Pb-210	-	>500
Po-210	-	-
Pu-239	>500	>500
Am-241	10.0	10.0
Pu-241	-	-
Ra-226	>500	>350

II Sealed Sources

Dosimetry is not necessary for sealed sources which are below the values in Section I above. The whole body Dosimetry issuance activity in Section I above should be viewed for the evaluation of gamma sealed sources. In the case of beta/gamma and beta sealed sources, consult a health physicist.

III Neutron Sources

Whole body Dosimetry should be issued for all neutron sources (e.g., Am/Be, Pu/Be). Make sure you issue an XBNG film badge.

IV Special Cases

The following individuals shall be issued Dosimetry:

1. People entering high radiation areas.
2. Pregnant workers with expected monthly dose equivalents of more than 10 mRem.

V X-Ray Equipment

Cabinet X-Ray	Whole Body Badge & Ring
Diffraction X-Ray	Whole Body Badge & Ring
Radiographic	Whole Body Badge
Fluoroscopic	Whole Body Badge & Ring

VI Exchange Frequency For All Dosimetry

Monthly exchange shall be performed for all Dosimetry.

*Note: Radionuclides not listed shall be issued Dosimetry based on consultation with a Health Physicist.

APPENDIX E

Humboldt State University Environmental Health & Safety Radiation Safety Program

Methods of Computing Hazard Rating

Hazard ratings are computed by the following formula:

$$HR = \frac{QUA}{T}$$

where: Q = quantity of radionuclide in microcuries (μCi)
U = use factor
A = assessment factor
T = tolerance factor

<u>Hazard Rating</u>	<u>Hazard Category</u>
100 or less	1
101 to 1000	2
Over 1000	3

Quantity

The quantity of the radionuclide is expressed in microcuries (10^{-6} curies).

Use Factor

The use factor is based on the type of experimental procedures that will be involved in the proposed use of the radionuclide(s). Consideration is given to the probability of: (a) release of the radionuclide into the environment, (b) contamination of persons engaged in the operation, (c) contamination of equipment and facilities, and (d) external radiation hazard potential. Examples of use factors are shown in the table below.

<u>Type of Operation</u>	<u>Use factor (U)</u>
Moisture Density Probes	0.0001
Sealed Sources	0.001
Storage	0.01
Simple Wet Operation (e.g., RIA Kits, Electrophoresis, Nick Translation, Chromatography, etc.)	0.1
Simple Dry Operations (e.g., Transfer of Dry Precipitates)	1.0
In-Vivo Work, Radiolabeling, Work with volatile components	1.0 to 5.0
Complex Wet Operations (e.g., Evaporation to dryness, aerosols)	5.0 to 10

Complex Dry Operations (e.g., crushing, Mixing, Sieving)

10 to 100

Assessment Factor

The assessment factor may range from 0.1 to 10 depending on the investigation of the project and review of the performance and compliance record. The value will be determined by the Radiation Safety Officer (RSO).

Tolerance Factor

The tolerance factor is based upon the microcurie amounts established for each isotope listed in the California Code of Regulations, Title 17, §30356, Appendix B. For radioisotopes not listed, the tolerance factor shall be determined by the RSO.