UTAH STATE UNIVERSITY
RADIATION SAFETY HANDBOOK

Approved by the
RADIATION SAFETY COMMITTEE

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1.0 INTRODUCTION

The Utah State University (USU) Radiation Safety Committee (Committee) has, since its charter in 1958, provided information on radiation safety to USU personnel working with ionizing radiation. The first handbook was adopted by USU in 1975. Subsequent revisions have incorporated all new considerations from regulations and guidance pertaining to USU's Broad Scope License.

This handbook is a guide for USU personnel working with ionizing radiation. It provides operating principles and outlines rules for effective radiation safety.

1.1 TERMINOLOGY

Below are definitions of common terms and abbreviations relative to radiation safety at USU.

As Low As is Reasonably Achievable (ALARA) -- This is the guiding principle for radiation safety. The intent of ALARA is to apply all reasonable procedures and devices to limit workplace exposure to ionizing radiation.

Authorized User (AU) - An individual authorized by the Committee to perform radiological research utilizing radioactive material, devices or equipment.

Generally Licensed Items - Products available to the public under a general license provision of federal and state regulations. Stringent testing and design requirements establish these items as intrinsically safe for use (see 10CFR31).

Ionizing Radiation - High energy sub-atomic particles or rays capable of moving electrons from their normal orbits.

Laboratory Supervisor - Assistant to the Authorized User (AU) with supervisory authority over the lab and lab staff.

Participating Personnel - Lab staff or personnel using radioactive isotopes under the direction of the AU and/or Lab Supervisor.

Project - Specific research activity utilizing ionizing radiation or radioactive materials. It is not necessarily the same as or associated with a particular budget or grant.

Radiation, Radioactivity - These words, and variations of the same, are used interchangeably to refer to ionizing radiation emanating from materials, devices or equipment.

Radiation Safety Committee (Committee) - Quorum of individuals charged with oversight of radiation safety and the Radiological Control Program at USU.

Radiation Safety Officer (RSO) - Individual charged with daily management of the Radiological Control Program at USU.
Radiological - Relating to work with ionizing radiation.

1.2 PURPOSE

This handbook is intended as an exposition of useful and necessary procedures designed to protect researchers, the public, and the environment. It is the hope of the Radiation Safety Committee that the handbook will instill confidence with respect for, rather than fear of, radioactivity.

Humans cannot detect radiation with their physical senses, so we must rely on instrumentation to identify and quantify it. Because of the unique properties of radiation approved precautions and procedures are necessary for workplace safety. Conscious efforts must continually be made to avoid exposure and contamination by following ALARA principles.

The procedures, policies, and rules within this handbook shall only be amended or changed by approval of the Committee.

1.3 LICENSE

The State of Utah, Division of Radiation Control (DRC) has issued a Broad Scope License to USU for work involving ionizing radiation. The license is held in the name of the President of USU and administered by the President through a delegated line of authority. Research at USU involving radiological materials/devices must have appropriate authorization and operate within the limits of the license.

USU's license is sufficiently broad to allow Authorized Users (AU's) to work with necessary radioactive materials in reasonable quantities.

Individuals possessing their own radiological license may not use it for work supported or controlled, in any measure, by USU. This limitation also applies to grants administered by USU.

1.4 DELEGATION OF AUTHORITY

Responsibility for enforcement and interpretation of policies at USU is vested in the President of Utah State University (President). Federal and State regulations require the President to appoint a Radiation Safety Committee (Committee) and Radiation Safety Officer (RSO). The President has delegated appropriate authority and responsibility to the Vice President for Research, the Committee, and the RSO for administration of USU's Radiological Control Program.

A current list of Committee members and their qualifications is available on request, and may be obtained from USU's Environmental Health & Safety.

2.0 ADMINISTRATION OF THE RADIOLOGICAL CONTROL PROGRAM

USU's Radiological Control Program provides for a Radiation Safety Committee (Committee) and a Radiation Safety Officer (RSO). The Committee and RSO are charged with oversight of work with ionizing radiation at USU, including control and safety.

Responsibility for radiological control and safety also rests with AU's, Participating Personnel, Lab Supervisors, lab staff, Purchasing department staff, and Facilities department staff. Any person working with or around sources of ionizing radiation needs to be consciously concerned about the potential for unnecessary exposure.

2.1 RADIATION SAFETY COMMITTEE (Committee)

The Committee's specific responsibilities were established in a letter from the Vice President for Research to the President of USU, dated December 23, 1958. The duties of the Committee are as follows.

1. Assume responsibility, from the standpoint of radiological safety, for all USU programs involving radioactivity or radiation producing devices.
2. Review and approve or disapprove permission for the use of radioactivity or radiation producing devices. Generally Licensed Items are excluded from Committee authorization or approval, though safety, accountability and security responsibilities remain.
3. If necessary, prescribe special conditions and requirements to assure safety.
4. Committee approval must be received before any project is initiated or before any substantial change is made in an original protocol.
5. Keep records of the actions of the Committee.
6. Make recommendations in advance of the construction or remodeling of structures or facilities where radiation will be used. Written approval for such facilities shall be requested from the Committee prior to construction.
7. Approve or disapprove the action of departmental representatives or departmental committees within USU in matters pertaining to radiological safety.
8. Recommend and assure the implementation of procedures for radioactive waste disposal.

Action taken by the Committee may be appealed by the staff member or department affected, to the President of USU for final decision. Appeals shall be made with the knowledge and consent of the Vice President for Research and Dean or Director of the School or Division involved.

The Chair of the Committee shall serve as administrative officer in promulgating policies established by the Committee, and accordingly is authorized to make recommendations for appointment of a qualified individual to serve as RSO.

The Chair of the Committee and the RSO, or their designated representatives (Deputies), are authorized to act for the Committee between meetings, and shall report to the Committee at least once a quarter. The Committee may conduct interim actions utilizing e-mail or other methods for documenting votes, concerns, and opinions of its

members.

The Committee shall conduct an annual audit and review of USU's Radiological Control Program.

2.2 RADIATION SAFETY OFFICER (RSO)

The RSO is charged with assisting AU's in establishing and maintaining laboratory conditions and operating practices that are safe for the user, safe for the general public, and are in compliance with rules and regulations of the U.S. Nuclear Regulatory Commission (NRC), State of Utah Division of Radiation Control (DRC) and USU. The RSO is empowered and directed to maintain these standards of radiological safety at all times.

The RSO is responsible for implementation and daily management of the Radiological Control Program as defined by the President of USU and the Vice President for Research.

The RSO maintains all pertinent records, including:

- Radiological Lab and Equipment Surveys
- Reports of Radiological Incidents/Accidents/Spills
- Receipts, Inventories, and Shipments and/or Transfers of Radiological Materials, Devices, and Equipment
- Leak Test Results of Radiological Sealed Sources/Devices
- Radiological Use Applications and Renewals
- Lists of Authorized Radiological Users and Participating Personnel
- Radiological Personnel Dose/Exposure Records
- Radiological Waste Disposals Records
- Current copies of Applicable Federal and State Regulations

Other responsibilities of the RSO include:

1. Ensure appropriate radiation caution signs, symbols and notices are posted and maintained.
2. Establish and maintain liaison with the DRC concerning all licensing matters. Prepare all applications for or amendments to USU's Broad Scope License, for the signature of the Vice President for Research. In cases of non-compliance with regulations or license conditions, the RSO reports options to the Vice President for Research for resolving compliance problems.
3. Serve as the key contact regarding radiological control at USU, and during inspections of radiological work or equipment. Provide access to information, data, and licenses as required by applicable laws or regulations.
4. Review all authorization and amendment requests, and present evaluations of them to the Committee.
5. Provide appropriate initial and refresher radiological training for USU personnel. Use of Generally Licensed Items usually does not require radiological training, however some training may be required if deemed necessary for safe operations.

6. Assist AU's with resolution of radiation safety concerns or problems. Consult and cooperate with AU's in assuring that radiological labs are operated safely and effectively.
7. Maintain an ongoing program of radiological hazard evaluation and elimination by:
    a) Promptly identifying and reporting new radiological safety concerns.
    b) Ordering cessation of operations if significant health impact is reasonably indicated.
8. Provide inspections of USU facilities where radioactive materials, devices or equipment are used, handled, or stored. Refer infractions to the Committee for resolution, if needed.
9. Receive, record, and survey all incoming shipments of radiological materials, devices, and equipment and notify AU's of receipt of such items.
10. Administer personnel dose/exposure monitoring, including device/dosimetry distribution and record keeping.
11. Oversee collection, storage, and disposal of all regulated radiological wastes.

During absences or incapacitation the RSO may designate a Deputy to continue daily implementation and management of the program, as well as respond to emergencies. Oversight of the Deputy may be by the Committee Chair and/or individuals assigned by the Vice President for Research.

2.3 PROJECT REVIEW

New applications for, or amendments to, authorizations are submitted to the RSO and Committee for review.

Application forms are available from the RSO. Form RSO-1A is for new applications or major protocol amendments, and RSO-14 is for minor amendments. Examples of minor amendments are changes in participating personnel, work facilities locations, or changing or modifying handling procedures, and changes in isotope limits related to economy of
resources.

Generally Licensed Items are excluded from the project review and authorization process.

Completed applications must include information on personnel training, facility design, work areas, handling procedures, and radiological materials/devices.

Project approvals are given as authorizations. Notifications of authorization for a new or amended projects are issued as Authorization certificates (RSO-11).

2.4 TRAINING

Applicants and applications are evaluated by the RSO and Committee Chair. Judgments are based on demonstrated ability to work with the specific radiological

material(s)/device(s)/ equipment in a safe and prudent manner.

In order to qualify to be AU's, applicants are also required to meet the following education requirements.

1. A college degree, at least at the bachelor level, or equivalent training in physical science, biological sciences, or engineering.
2. At least 40 hours of training and experience in the following:
    a) Safe handling of radioactive materials/devices/equipment.
    b) Characteristics of ionizing radiation, and units of radiation dose.
    c) Biological hazards of radiation exposure.
    d) Relative risks of radiation.

Lab Supervisors and Participating Personnel must have received basic radiation training before beginning radiological work. The RSO will verify prior training and provide sufficient additional training to qualify lab staff for work.

Each active radiological lab will receive refresher training annually from the RSO. Refresher training is required for personnel to be able to continue with radiological work.

Students enrolled in a laboratory course in which radiological materials/devices/equipment are used, are authorized to work with them for the "class" project, if they are over 18 years of age and the instructor is an AU.

Students under the age of 18 must receive special permission from the RSO before beginning work with radiological materials/devices/equipment.

Individuals applying for permission to possess and use sealed source devices, such as moisture density gauges, must have received operator training that is at least equivalent to that provided by the manufacturer of the device. Participating staff must also receive this training.

2.5 TEMPORARY AUTHORIZATION

If an applicant has inadequate training or experience, a temporary authorization may be granted with a stipulation that an AU supervise and provide training, or that the applicant concurrently take applicable formal course work.

Temporary authorizations will be reviewed after six (6) months, at which time the applicant may request full authorization.

2.6 AUTHORIZED USERS AND LABORATORY SUPERVISORS

Authorized Users (AU's) and Laboratory Supervisors are responsible for radiological safety within their specific operating unit. They are also responsible for compliance with all rules and regulations. Cooperation with the RSO and providing for safety on any project is expected. They must:

1. Comply with all safety rules in this handbook, and promulgated by Federal, State and local governments.
2. Comply with this handbook regarding posting warning signs and otherwise controlling special hazards pertinent to the authorization.
3. Identify all participating personnel on the project application. Ensure personnel under their supervision comply with all safety rules.
4. Ensure that project personnel are properly trained in radiological protection methods and procedures. This includes indoctrination in project protocol and understanding the contents of this handbook. Training updates should be promptly reported to the RSO, with information on content, participants, date(s), and length of the training.
5. Provide response procedures and safety training appropriate for emergency conditions that are likely to occur in the lab.
6. Post emergency response and safety procedures conspicuously.
7. Ensure that appropriate survey instruments are available, functional, and properly calibrated.
8. Ensure that appropriate surveys are performed and recorded immediately after use of radioisotopes. This could be many times a day, but no less than daily during times of use.
9. Ensure proper decontamination of all spills for which their personnel are responsible. Significant spills and personnel contamination require notification of the RSO. Promptly report to the RSO any incidents where radiation over-exposure or contamination may have occurred.
10. Make sealed radioactive sources available for leak-testing at least every 6 months or as specified by license conditions.
11. Notify appropriate USU Facilities staff when repair or maintenance work is requested for areas where radioactive material or radiation generating equipment is stored or used. Notify the RSO prior to, or at the same time as, requesting such work.
12. Order radioactive materials or radiation generating equipment through the radioactive materials purchasing agent.
13. Maintain complete and accurate records of receipt, storage, and use of radioactive materials.
14. Ensure proper storage and labeling of radioactive materials.
15. Ensure proper and frequent disposal of radioactive waste, and maintain accurate disposal records.
16. Annually review authorized project protocols, conditions, purpose, and scope and submit updates or amendments to the Committee as necessary.

2.7 USU PURCHASING

USU's Purchasing Manager is responsible for making sure one or more purchasing agents have been instructed by the RSO in recognition of the various types of radiological orders. One individual and an alternate shall be given responsibility for processing all radiological requisitions.

The Purchasing Manager will ensure that all radiological requisitions will be held until

approved by the RSO, the Deputy RSO, or by the Chair of the Committee.

2.8 USU FACILITIES

The appropriate Directors of Facilities will prevent facilities staff from working in any room where radioactive materials have been used or stored until the RSO has given approval for the work needing to be performed.

3.0 RADIOACTIVE MATERIAL USE

Radioactive materials are regulated in transport as well as in research. Following appropriate guidance and rules, from ordering through to disposal, is an integral part of maintaining radiological programs at USU.

3.1 ORDERING AND RECEIVING RADIOACTIVE MATERIAL

Radioactive materials may only be procured by persons designated by the Committee as AU's. Instructions and request forms are available from the RSO. Orders are placed using form RSO-10. This form accompanies the Department's requisition submitted to Purchasing.

All radioactive materials ordered by AU's are applied toward fulfillment of their possession limit. Total material ordered and on hand may not exceed possession limits established in their authorization.

AU's may only purchase radionuclides listed in their authorization.

Vendors must be given the following instruction:

> Radioactive materials being shipped to USU must be sent to the following address:
>
> Utah State University Receiving
> Attn: Radiation Safety Officer
> Environmental Health & Safety
> Logan, UT 84322-8315
>
> Exception: When positron emission tomography (P.E.T.) isotopes are ordered they may be delivered directly to the lab authorized to use them, because of their very shorty half-life. (Added 9/12)

Shortly after delivery of radioactive materials to USU Receiving the RSO or designee will inspect the container for contamination. Copies of the shipping paper(s) will be kept on file, with pertinent information regarding inspection of the shipment. The AU will be notified that their material has been received, and it will be delivered to them unless other arrangements have been made. The RSO **must be notified immediately** if this procedure is circumvented and radioactive material is received directly by the Lab.

After inspection and delivery, the interior of the package must be surveyed for contamination by the AU or participating personnel, and the results reported to the RSO.

3.2 SHIPMENT AND TRANSFER

Shipment of radioactive material is complicated by various regulations from federal and state entities. EH&S has the only staff certified as "dangerous goods shippers," and authorized to ship radiological items. You must consult with the RSO regarding shipment of materials off USU property.

The AU is responsible for properly packaging material, as defined in U.S. Dept. of Transportation (DOT) regulations. The RSO will provide specifications, labels, and perform required radiological surveying. The AU must also properly identify the isotope, isotope activity, and intended means of transportation.
For on-campus vehicular transport of radioactive materials the following requirements apply.

1. The vehicle must be properly marked according to DOT regulations.
2. Shipping papers (e.g. Inventory Log Sheets) for materials must be on the seat by the driver
3. Liquids must be in tightly sealed containers and inside secondary containment capable of holding all the liquids.
4. If an accident or spill occurs, the RSO must be notified immediately.

[Note: For non-vehicular transport, items 3 and 4 apply.]

If an AU desires to receive a transfer of material they must be authorized to possess and use that specific form of radioactive material. Before transfer the owner must verify that the requester is duly authorized and will remain within their possession limit. A Radioactive Materials Transfer form must be completed by both parties and approved by the RSO before transfers of material.

3.3 PROJECT TERMINATION

When a project is completed, or discontinued, it is the AU's responsibility to initiate appropriate closure actions. The following procedures are to help ensure appropriate disposition of radioactive materials.

The AU must:

1. Notify the RSO of their intent to discontinue use.
2. Inventory all radioactive material, including unused material and that declared as waste.
3. Dispose of all radioactive wastes in approved containers.
4. Return all personnel dosimetry devices, when the above work is completed.

The RSO will:

1. Verify that all radioactive material is either stored, transferred or properly disposed of.
2. Survey all areas where radioactive materials have been used or stored.
3. Ensure that the AU's file is closed and all dosimetry records are completed.

3.4 RADIATION PROTECTION

ALARA (As Low As is Reasonably Achievable) is the guiding principle of radiation protection in the United States. Accordingly, the general policy of Utah State University is to keep exposures to ionizing radiation as low as can reasonably be achieved. It should be noted that the ALARA principle is intended to be a guiding concept, rather than an absolute requirement for minimization of exposures. ALARA takes into consideration:

- The benefits and impacts of utilizing ionizing radiation,
- The economics of utilizing currently available protection technology, and
- The interests of the USU community and its neighbors.

3.5 SAFE AND PRUDENT USE OF RADIOACTIVE MATERIALS

Ionizing radiation is not immediately evident by our senses, therefore contamination may be unknowingly spread. Application of proper procedures, rules, and practices will prevent or minimize contamination. The rules provided here cannot be expected to cover all situations, yet they should cover most. More specific guidance may be provided by the RSO.

Activity levels and hazards associated with each compound being used are key factors in determining the degree of precaution to apply. The following lists of safety rules are intended to minimize internal and external exposure, prevent contamination of the laboratory and project materials, and to comply with rules and standards for protection against radiation exposure.

We encourage all who work with ionizing radiation to:

- Develop, maintain and apply safe work practices,
- Abide by all safety rules, and
- Be ready to use more precautions, but never less.

Radioisotope Laboratory Safety Rules

1. Do not eat, store or prepare food, smoke, or apply cosmetics in areas where radioactive materials are stored or used.
2. Survey all radioactive samples and determine safe working distances and shielding requirements before beginning work.
3. Direct contact with radioactive materials must be avoided. Use protective lab coats, disposable gloves, safety pipettes, etc., for personal safety.
4. All spills of radioactive materials > 1mCi, or involving personal contamination, must be reported to the lab supervisor and the Radiation Safety Officer (RSO). The RSO should be contacted if there is difficulty removing contaminants or if they cannot be removed.
5. **COMPLETE AND ACCURATE RECORDS OF RECEIPTS, TRANSFERS, AND DISPOSALS OF RADIOACTIVE MATERIALS AND LAB SURVEYS <u>MUST</u> BE MAINTAINED.**
6. If assigned, wear personnel dose monitors (TLD) while working with licensed radioactive material. Occupational dose records are maintained by Environmental Health and Safety. (Revised 9/12)
7. Perform all isotope work on bench tops covered with absorbent paper to contain minor spills. Change paper frequently during active work periods.
8. As much work as possible should be carried out in a radio-chemical hood in order to contain products from volatilization, dust dispersion, or splattering.
9. Each radioactive sample should be properly labeled with identity and activity clearly indicated. Keep samples covered and shielded whenever possible.
10. Never pipette radioactive materials by mouth. This practice is strictly

forbidden.
11. Liquid radioactive wastes must be stored in properly identified containers until prepared for final disposal. Enter the quantity of disposed waste in the proper log.
12. Contaminated solid wastes must be identified and stored separately from other trash. Accurately record the µCi activity disposed of as waste.
13. The disposal of gaseous wastes through the hood must be approved by the Radiation Safety Committee.
14. Disposal of any radioactive material via the sewer is forbidden.
15. Storage of radioactive materials must be in approved, designated areas. All such areas must be locked when unattended.
16. **LABORATORY WORK SURFACES MUST BE MONITORED AFTER EACH HANDLING OF RADIOACTIVE MATERIALS AND THOSE MEASUREMENTS MUST BE PERMANENTLY RECORDED AND BE AVAILABLE FOR INSPECTION BY AUTHORIZED PERSONS.**
17. Before leaving the laboratory, after working with radioactive materials, one's hands should be washed thoroughly and monitored with the lab survey instrument.
18. All laboratory glassware and equipment should be checked and decontaminated, if necessary, before they are returned to general usage.
19. Confirmation of decontamination procedures should be determined by the RSO, who will monitor any questionable usage.

Radioisotope Contamination Prevention Rules

1. Auxiliary containers, blotters, and covers shall be used when there is potential for spills and/or contamination of personnel or equipment.
2. Contaminated equipment, or equipment that is suspected of contamination, shall be clearly marked and isolated in designated areas in the laboratory, or in suitable storage spaces.
3. Radioisotope handling tools, equipment, and apparatuses, when actively in use, should be placed in nonporous trays or pans lined with absorbent disposable paper. Absorbent paper should be frequently surveyed and changed as needed.
4. Laboratory areas marked for radiological work should contain only necessary apparatuses for the operation(s) being performed.
5. Equipment and tools should be routinely surveyed following use. No equipment or tools shall be released to stock unless they are known to be free of contamination.
6. Removable contamination shall not be allowed. This is particularly important in low-level isotope laboratories where shoe covers are not routinely required. [For the purposes of this handbook, removable refers to easily transferable radioactive compounds with activity levels greater than 100 dpm per 100 cm^2, as determined by a wipe (smear) test.]
7. Where floors are known to be, or suspected of being, contaminated the area involved shall be immediately restricted and designated as a shoe cover area until such time as it is shown to be free of removable contamination.

3.6 CAUTION SIGNS / LABELS / MARKINGS

Rooms, areas, and devices used in work with ionizing radiation are identified by specialized markings, labels, and signs. Specialized markings, labels, or signs are not required for rooms or areas with only Generally Licensed Items present.

Radiation caution signs, as well as informational posters, are required at entrances to areas used for radiological work. Markings and/or labels are required for identification of active work areas, equipment, tools, and containers that are or could be contaminated with radioactive materials. The intent is to visually identify all potential sources of radiation exposure. AU's are responsible for establishing and maintaining readable markings and labels.
AU's may provide additional caution signs, labels, or information to help reduce exposure in accordance with ALARA principles.

Standardized symbols, text, and colors are used in creating radiation warning signs, labels, and markings. The graphic symbol is a trefoil (see the three bladed graphic below) and is generally accompanied by the text "Caution, Radioactive Material." Our standard color scheme is black trefoil, and lettering on a yellow background. Magenta (purple) graphics and lettering on a yellow background is the original color scheme and is still acceptable. The same text can be found on labels and tape, with or without the trefoil.

CAUTION,
RADIOACTIVE MATERIAL

3.7 RESTRICTED AREAS

Labs authorized to use ionizing radiation are generally designated as Restricted Areas. The DRC defines these as areas which “could result in an individual receiving a dose equivalent in excess of 0.05 mSv (0.005 rem), in one hour at 30 centimeters from the source of radiation or from a surface that the radiation penetrates.” Access to these areas is limited for the purpose of protecting individuals from exposure to licensed radiation and radioactive materials. Unauthorized personnel should not be allowed in these areas. These areas should be locked when unoccupied, and under continuous surveillance by authorized personnel when occupied. These areas are required to have radiation signage at all entry points with the words “CAUTION, RADIATION AREA.”

Access restrictions are not required for rooms or areas with only Generally Licensed Items present.

The RSO may authorize portions of a lab as common areas for use by the public.

Greater restrictions or controls might be needed if a lab is determined to be a High Radiation Area, or Very High Radiation Area. A High Radiation Area is defined by the DRC as “an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of one mSv (0.1 rem), in one hour at 30 centimeters from the source of radiation or from a surface that the radiation penetrates.” A Very High Radiation Area is defined by the DRC as “an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of five Gy (500 rad) in one hour at one meter from a radiation source or one meter from any surface that the radiation penetrates.” For a High Radiation Area radiation signage must include the words “CAUTION, HIGH RADIATION AREA” or “DANGER, HIGH RADIATION AREA.” For a Very High Radiation Area radiation signage must include the words “GRAVE DANGER, VERY HIGH RADIATION AREA.”

3.8 CONTAINER LABELING

For the purposes of this handbook, "container" refers to a holder of radioactive material. This may be a rack, device, or container holding vials too small for labels. All containers, in which radioactive materials of the following quantities are stored, must be labeled with the radiation symbol (trefoil) and the words “Caution Radioactive Materials.”

Container Labeling Limits (Label when activity meets or exceeds amount listed.)				
1,000 µCi	**100 µCi**	**10 µCi**	**1.0 µCi**	**0.1 µCi**
^{3}H (Tritium)	^{14}Carbon	^{22}Sodium	^{125}Iodine	^{226}Radium
^{51}Chromium	^{33}Phosphorus	^{32}Phosphorus		
	^{35}Sulfur	^{48}Scandium		
	^{40}Potassium	^{59}Iron		
	^{45}Calcium	^{65}Zinc		
	^{55}Iron			
	^{63}Nickel			

When containers holding radioactive materials are in storage, labeling must identify the isotope, estimated activity, date of the estimation, and form (e.g. chemical name) of the material.

Before disposal of radiological containers all radiation labeling must be removed or obliterated.

Before reusing containers in non-radiological work all radiation labeling they must be removed or obliterated, and the container must be fully decontaminated.

3.9 SEALED SOURCES

Sealed sources have radioactive materials that are permanently bonded to a substance, fixed in a capsule, or fixed in a matrix. They are designed to prevent release or dispersal of the material during normal use. The intent of sealed sources is to utilize the effects of emitted particles or rays, rather than the emitting material.

Sealed sources should have a permanent tag or label with the radiation symbol and words, "CAUTION (or DANGER) RADIOACTIVE MATERIAL". The nuclide, its activity, and date of assay should be included on the tag. Tags must not be removed or replaced without authorization from the RSO. Incomplete or missing tags must be reported to the RSO.

Each sealed source must be used in accordance with its manufacturers instructions. Remote manipulation is the best method for working with sealed sources, and this supports ALARA exposure principles. Generally Licensed Item designs usually allow for direct handling.

Though the material is sealed, or fixed, it can be accidentally or inadvertently ruptured and begin to leak. Sealed source users must monitor themselves and their work, and immediately report any contamination to the RSO. CALL THE RSO IMMEDIATELY IF A SEALED SOURCE IS DAMAGED OR IS SUSPECTED OF LEAKING. Do not continue to use, or try to repair, a sealed source if it is damaged or suspected of leaking.

Periodic leak testing of sealed sources is required (see R313-21 and 10CFR31). Exceptions to this rule may only be authorized by the DRC. AU's are required to make their sealed sources available for testing as often as requested by the RSO or authorized staff.

Sealed sources which fail a leak test must be removed from use immediately.

Costs of repair or disposal of a sealed source are the responsibility of the user. Consultation with the RSO is required if a sealed source needs to be shipped away for repair or disposal.

4.0 RADIOACTIVE WASTE

Use of radioactive materials will generate radioactive waste in the form of project materials, supplies, tools, and equipment. Contaminated items must be decontaminated or treated as radioactive waste. To conserve resources and reduce project expenses it is best to verify that reusable items are contaminated and cannot be efficiently cleaned before including them in radioactive wastes.

EH&S manages all radioactive wastes produced on campus. Radiation Safety Staff will set-up, remove, and replace various sizes and types of waste containers as needed. A waste log sheet is provided with each container, and is essential for recording information on wastes added to the container. These containers are only for collection of radioactive wastes. All radioactive wastes/compounds/materials must be disposed of using containers provided by EH&S.
It is illegal to allow radioactive wastes to enter the public sewer or landfill systems.

Radioactive wastes are currently separated into 2 major categories and 4 sub categories. The major categories are long-lived and short-lived isotopes, and are generally kept in separate sets of containers. The primary sub categories are dry/solids, liquids, biologicals, and scintillation vials.

The following are basic rules for radioactive wastes at USU.

RADIOACTIVE WASTE RULES

1. Waste from work with short-lived isotopes (half-life less than 90 days) shall be collected in containers separate from those for long-lived isotopes .
2. Waste containers should not be shared with other Authorized Users (AU's).
3. Short-lived isotope wastes should also be segregated by isotope, and not mixed with wastes of different half-lives.
4. Short-lived isotope waste will be stored by Environmental Health & Safety (EH&S) for a minimum of 10 half-life time periods. Disposal will occur after the minimum storage period, and according to procedures prescribed by the RSO.
5. Long-lived isotope waste will be processed for eventual disposal at an approved disposal site.
6. **Wastes may not be held for decay in (AU's) labs, unless express permission is granted by the Committee.**
7. Wastes must have shielding sufficient to limit exposure to 2.5 mR/hr at a distance of 10cm. Generally the waste container, or 3/8 inch of Nalgene plastic surrounding the container is sufficient to meet exposure limitations. Other shielding appropriate for the isotope and activity must be used as conditions warrant.
8. All waste containers must have a "CAUTION, RADIOACTIVE WASTE" label in accordance with DRC requirements. In addition, labeling should include the AU's name, isotope used, and estimated amount of activity in the waste.
9. AU's are responsible for all costs associated with radioactive waste produced by their project. Disposal costs will be billed based on actual waste volume in each container collected. Current disposal cost schedules are available at EH&S offices.

10. Preparation of waste containers for collection, along with the required documentation, is the responsibility of the AU. Requests for collection can be made by completing a “Rad Waste” pick-up request on EH&S's web site, or by calling or E-mailing EH&S.
11. Ruptured or discolored waste containers will not be accepted until concerns regarding integrity and contamination have been resolved.
12. Shipping containers, used to transport radioactive materials, can only be disposed of in cold trash if there is no contamination found in/on them, and any radioactivity labeling has been removed or obliterated.
13. Radioactivity labels (tape, labels, stickers, markings, etc.) that are not contaminated must be obliterated if they are to be disposed of in cold trash.

4.1 DRY WASTE

EH&S provides preprinted lined boxes with labels for dry/solid waste collection . Other containers may only be used if approved by the RSO.

Only radioactive dry/solid wastes should be added to this type of container.

Sharps/Syringes must be placed in puncture proof/resistant containers before being added to dry/solid wastes.
Broken glass should be placed in puncture proof/resistant containers before being added to dry/solid waste. A separate container can also be provided by EH&S.

Ethers and aerosols are to be kept separate from dry/solid wastes. Call the RSO for help with disposal of radioactive aerosols or ethers.

4.2 LIQUID WASTE

EH&S provides marked plastic containers of various sizes for radioactive liquid waste collection. Other containers may only be used if approved by the RSO. No other liquid waste containers are authorized (e.g. glass bottles).

All liquid waste containers must have secondary containment capable of holding the entire contents of the liquid container.

Only radioactive liquid wastes should be added to this type of container.

Wash/Rinse water from cleaning contaminated containers, tools, equipment, etc., must be collected and disposed of as radioactive liquid waste.

Segregate liquid wastes according to chemical composition (e.g. Methanol Only, Aqueous Only, etc.). EH&S provides separate containers as needed.

DO NOT OVERFILL LIQUID CONTAINERS. EH&S labels or marks each liquid container to indicate the maximum fill level. Overfilling causes safety and contamination concerns.

To prepare liquid containers for collection ensure that any caps are tightened, and the waste log sheet is accurate, complete, and signed.

4.3 SCINTILLATION VIALS

EH&S provides preprinted lined boxes with labels for waste scintillation vial collection. Other containers may only be used if approved by the RSO. No other containers are authorized.

Waste scintillation vials and other small containers, where the contents are primarily liquid scintillation cocktails, must be collected for proper disposal. Call for assistance if non-standard cocktails (e.g. acetonitrile solutions) are to be used.

Only radioactive waste scintillation vials should be added to this type of container. Waste scintillation vials are to be collected separately from dry/solid wastes, though some exceptions may apply. The RSO can provide guidance.

[Note: ALARA and waste minimization principles encourage use of the smallest scintillation vials that will be adequate for your research needs.]

4.4 GASEOUS AND/OR AIRBORNE WASTE

Where release of volatile or aerosol radioactive material is anticipated, means must be provided to trap and contain the materials. The products of such traps or containing devices must be disposed of appropriately.

4.5 BIOLOGICAL WASTE

Biologically hazardous wastes require special handling and controls. Both the RSO and the Biological Safety Officer (BSO) must approve lab safety protocols and procedures prior to work with biological hazards.

EH&S provides waste bags, liners, and/or containers with labeling for biohazard wastes. No other bags, liners, or containers are authorized.

AU's are responsible for neutralization of biohazards prior to EH&S disposal of wastes.

If permission has been granted by the RSO, excreta or animal bodies (sacrificed or living) which contain short-lived radioactive isotopes may be stored by the user for at least 10 times the half-life time period from origination. After the storage period is complete, and prior to disposal, the lack of radioactivity must be verified by the RSO.

Stored wastes should be held in durable plastic bags in a frost free freezer. Each package should be properly labeled and identified for easy retrieval and disposal. Packages should be labeled with the AU's name, isotope, date packaged, projected disposal date, and activity at the time of packaging.

Live animals treated with radioactive material may be retained for research **IF** their excreta is collected as radioactive waste. Excreta collection must continue until sufficient time has passed to ensure permitted levels of activity are reached, and/or sufficient evidence is given for the same conclusion.

Incineration of animal bodies, parts or excreta, having limited amounts of radioactive materials, is an option that requires approval by the RSO.

4.6 SPECIAL HANDLING

Nothing in the wastes section relieves AU's from responsibility for complying with regulations governing any other toxic or hazardous substances that may be part of their radioactive wastes.

AU's should give advance notice to EH&S of any special hazards or concerns that may be associated with wastes from their project.

AU's are required to sufficiently neutralize strongly acidic or basic wastes, to prevent violent reactions or release of strong vapors or fumes if mixed with other materials during preparation for disposal.

4.7 PREPARATION FOR WASTE PICK-UP

Request waste pick-up or collection when one or more containers are full, or a project or phase is complete. Waste disposal costs are based on actual waste volume collected.

The following rules apply to preparation of wastes for pick-up:

1. Update and complete waste log sheets.
2. Record total activity on the waste log sheet, of all wastes added to the container.
3. Record an appropriate expense billing number.
4. Sign and date the waste log as generator.
5. Close and seal boxes and/or tighten liquid caps.
6. Submit a pick-up request.

Waste containers should be fully prepared, with completed documentation, prior to requesting collection. Waste will not be collected if it is improperly packaged or required documentation is incomplete.

5.0 DOSIMETRY

Federal and State regulations require that radiological licensees provide dosimetry to personnel when annual occupational exposure could reasonably exceed 10% of regulatory dose limits. (Specific limits can be found in section 5.5.) Due to effective controls and limited uses, USU is not currently required to provide dosimetry. However, the Committee has directed that a dosimetry program exist for monitoring some radiological personnel.

Dosimetry is designed to record exposure to relatively energetic and penetrating ionizing radiation. Readings from dosimetry are reported as dose. Types of dosimetry currently in use at USU are whole body Thermo-Luminescent (TLD), extremity (ring), and area.

The RSO manages the dosimetry program. Appropriate regulations, rules, and protocols guide issuance and use of dosimetry. The RSO determines issuance during authorizations of projects or personnel, and reports this to the Committee. The RSO also monitors readings, resolves concerns, and provides annual reports as necessary.

The following table is a summary of key protocols used for issuing dosimetry. Dosimetry may be issued more extensively as reasonable concerns arise.

RADIATION TYPE & QUANTITY	DOSIMETRY
Dispensable High Energy Beta (e.g. ^{32}P) Monthly or one-time use > 1 mCi	Personnel Ring
Dispensable Gamma/X-Ray (non-RIA kit) Monthly or one-time use > 0.25 mCi	Whole Body & Personnel Ring
Open Beam Gamma/X-Ray Equipment	Whole Body & Personnel Ring
Nuclear Gauge Neutron	Whole Body

(Revised 9/12)

Authorized Users may request less extensive dosimetry issuance. The RSO may approve or disapprove such requests, or refer them to the Committee.

Authorized Users and lab personnel are responsible for appropriate care and use of dosimetry. Issued dosimetry is for use during authorized radiological work. Rings must be protected from contamination by gloves or other means approved by the RSO. Personnel dosimetry is not shared, and is not to be worn during medical radiological procedures or treatments, which include dental, X-ray, and CT scans. Lost or irreparably damaged dosimetry will be investigated to determine if assignment of a calculated dose is warranted. Costs for lost or intentionally damaged dosimetry are billable to a person, project, or department.

Placement of dosimetry affects the accuracy of dose readings. Area dosimetry is kept in specific locations determined by the RSO. Whole body dosimetry is worn on the front of the torso. Ring dosimetry is worn on the hand with the greatest potential for

exposure, and faced toward the palm (or source). Dosimetry storage must be away from sources of radiation, excess heat, and excess moisture.

5.1 INTERNAL MONITORING (BIOASSAYS)

Detrimental effects of ionizing radiation can be significantly multiplied if radioactive materials are introduced to internal soft-body tissues. Routes of inadvertent internalization include inhalation, absorption, and injection. When internalization of radioactive material is suspected or evident, bioassays are the best method of determining exposure and potential effect. Bioassays are generally limited to urinalysis, but can include direct readings by meters and/or tissue sampling.

Any known or suspected internal exposure to radioactive material at USU must be reported to the RSO immediately. Personnel involved are required to present themselves for bioassays as requested. The number, type, and frequency of bioassay samples will be determined by the RSO.

User's of unsealed sources of Iodine and Tritium may need bioassays to test for for internal exposure to these isotopes. To keep internal exposures ALARA, use of volatile or dispersible forms of radioisotopes in open laboratories will not normally be approved by the Committee.

Bioassay requirements vary with each isotope. Generally, if an individual's use of one isotope exceeds regulatory limits bioassays are required. The RSO monitors use statistics and notifies those meeting criteria for participation in a bioassay program. The following table lists common isotope use limits, at or above which bioassays are required.

Bioassay Levels			
Isotope	**ALI mCi**	**mCi/month**	**mCi/use**
^{3}H (Tritium)	80	10	10
^{14}Carbon	2	10	10
^{32}Phosphorus	0.4	4	4
^{35}Sulfur	2	20	20
^{45}Calcium	0.4	4	4
^{51}Chromium	20	200	200
^{125}Iodine volatile	0.3	1	1
^{125}Iodine bound	0.3	10	10

5.2 RADIOIODINE (^{125}I) USE

If an authorized project will be using 10 mCi or more of an unsealed or unbound form of radioiodine (^{125}I) during **any** continuous 3 month period they must handle the material in iodine fume hoods fitted with charcoal filters, or in glove-boxes approved by the Committee. Bioassays will be required based on individual use.

Bioassays are less necessary in laboratories working only with ^{125}I in radioimmunoassay (RIA) kits, due to low quantities and low volatility.

All individuals who work with ^{125}I must present themselves for bioassays when requested by the

RSO. Bioassays and/or direct thyroid measurements will normally be performed before, during, and after use of ^{125}I.

Radioiodine absorption through the skin is almost ensured if protective clothing (PPE) is not worn. Proper PPE for ^{125}I users, should completely cover the body and extremities. When using iodine fume hoods or glove-boxes, use of special gloves, shielding materials, handling tools, plastic aprons, labels, waste containers, detection instruments, and possibly other protective measures are required to maintain ALARA exposures.

5.3 TRITIUM (^{3}H) USE

Tritium (^{3}H) can be inadvertently taken into the body by inhalation, ingestion, absorption, or injection (puncture of the skin). Internal exposure to this isotope is usually determined by bioassay, such as urinalysis.

All individuals working with ^{3}H may be required to have urinalysis performed, and should provide samples as requested.

For purposes of maintaining ALARA exposures the following general quantity limits are used when considering applications for ^{3}H use.

Lab Conditions	**3 Month Quantity / Possession Limits**
Open Lab	1 mCi or less
Fume Hood	10 mCi or less
Open Lab & HTO*	10 mCi or less
Fume Hood & HTO*	100 mCi or less
(* Tritiated Water Vapor)	

If approval for use of quantities greater than those stated above is given, then additional directions will be given by the Committee.

Gaseous or volatile forms of ^{3}H require bioassays, as well as greater restrictions on quantity limits.

All users are reminded that ^{3}H migrates through many materials, such as plastic and rubber. Freezers which are not frost free are particularly susceptible to ^{3}H migration. Double and triple bagging, and other protective measures, should be used to minimize

the possibility of contamination of personnel and equipment.

5.4 DOSE / EXPOSURE RECORDS

Dose or exposure records are kept for each individual who is assigned dosimetry, and/or receives an occupational dose of ionizing radiation.

Individuals who were involved in radiological work elsewhere are required to provide, or assist in obtaining, historical dose/exposure information.

The RSO maintains dose/exposure records on all radiological personnel at USU. These records are confidential and protected under the Federal Privacy Act and other State and Federal Laws.
The RSO provides annual reports of dose/exposure to each individual being monitored. Individuals can also access to their own records by submitting a written request to the RSO. Exposure data may also be provided to an individual's current employer, after receipt of a written request by the RSO. Request forms are available from the RSO.

5.5 OCCUPATIONAL DOSE LIMITS

There are regulatory limits on allowable radiation dose or exposure over time. These limits vary depending on the person and exposure conditions.

As of January 1, 1994, the limit for adult whole body occupational exposures is set at 5 rem annual "effective dose."

Effective dose is the sum of the Deep Dose Equivalent (DDE), from external sources, and Committed Effective Dose Equivalent (CEDE), to internal organs, which is then expressed as the Total Effective Dose Equivalent (TEDE).

The effective dose concept makes it possible to combine both internal and external doses, allowing overall risk of health effects in an individual to be assessed. The "critical organ" concept is replaced by evaluating dose to all major organs. The RSO will multiply organ doses by weighting factors and then sum organ-weighted doses to obtain a whole body risk weighted effective dose.

Table 1
ANNUAL OCCUPATIONAL DOSE LIMITS

Affected Tissue	rem	milliSv
Deep Skin	5	50
Eye	15	150
Shallow Skin	50	500
Body Extremity	50	500
Internal Organ	50	500
Embryo / Fetus	0.5	5

[Note: Arms above the elbow or legs above the knee are part of the "whole body" and are not to be considered in extremity measurements.]

Regarding Table 1, Annual Occupational Dose Limits:

1. Annual dose limits for the whole body also depend upon which is more restrictive.
    a) The TEDE of 5 rem, or
    b) The sum of DDE and CDE to any individual organ or tissue (other than the lens of the eye) being equal to 50 rem.
2. Annual dose limits to the lens of the eye, skin, and extremities are:
    a) Eye Dose Equivalent = 15 rem
    b) Shallow Dose Equivalent = 50 rem to 1 square cm of skin or to any extremity.

Derived Air Concentration (DAC) or Annual Limit on Intake (ALI) values may be used to determine individual doses if necessary. For example, the inhalation of 1 ALI or an exposure of 2000 DAC hours would correlate to a CEDE of 5 rem.

5.6 DOSE LIMITS FOR MINORS

At USU, a minor is someone under 18 years of age. If the minor is an employee of USU, or is specially assigned to USU, they may be allowed occupational radiation exposure under USU's license. Exposure of minors must be preapproved by the Committee, and is limited to 10% of adult dose limits. Otherwise, non-student or special assignment minors are considered part of the general public, and are not allowed in "Restricted Areas" except under conditions approved by the RSO.

5.7 DOSE LIMITS FOR AN EMBRYO/FETUS

A "declared pregnant worker" is a women who has **voluntarily** informed the RSO **in writing** of her pregnancy and the estimated date of conception. It is the fundamental responsibility of the worker to decide when or whether she will formally declare her pregnancy. Declaration rights are derived from legal, not health protection, considerations.

Individuals working in or frequently entering a radiological restricted area must receive instructions concerning prenatal radiation exposure and associated biological risks.

Special concerns arise when an occupationally exposed woman is pregnant. Abdominal radiation exposure of a pregnant worker includes exposure to an embryo/fetus. Concerns about biological effects of ionizing radiation on an embryo/fetus have been expressed since 1906, with publication of the "Law of Bergonie and Tribondeau." Recent investigations have confirmed the validity of this law, which takes into account the increased sensitivity of an embryo/fetus. The first trimester (3 months) of pregnancy are the most important to a developing embryo/fetus. This is when its sensitivity to the effects of radiation is highest. Concerns about prenatal exposure are also based on studies which suggest an increased risk of childhood cancer following prenatal

exposure.

Occupational exposures at USU are to remain As Low As is Reasonably Achievable (ALARA). Therefore, we support recommendations from the DRC, the NRC, the National Council on Radiation Protection and Measurements (NCRP), the International Commission on Radiological Protection (ICRP), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and others who recommend reduced dose limits for the embryo/fetus of a pregnant worker. Further information pertaining to prenatal exposures may be found in the NRC Regulatory Guide 8.13, Rev 3, June, 1999. Copies of this guide may be obtained from the RSO.

USU's responsibility is to ensure that dose to an embryo/fetus, from occupational exposure to a declared pregnant worker, during the entire pregnancy is less than the legal limit stated in section 5.5 Table 1 above.

The worker's responsibility is to avoid substantial variation from a uniform monthly exposure rate (approximately 55 mrem per month).
The RSO can determine whether or not radiation levels in your working areas are high enough for an embryo/fetus to receive 500 mrem (0.5 rem) or more dose before birth. If so, your alternatives are:

1. Postponement or discontinuation of assignments in restricted areas.
2. Reduction of exposure time, increase in distance from sources, and/or increase in shielding from sources.
3. Reassignment to functions or areas having lower exposure rates.
4. Postpone childbearing until work with radiation is completed or sufficiently delayed.
5. Continue working, but with full awareness of a somewhat increased health risk for your unborn child.

5.8 DOSE LIMITS FOR MEMBERS OF THE PUBLIC

A member of the public is essentially anyone not authorized to participate in work with ionizing radiation under USU's license. This includes USU staff functioning in spaces that may be adjacent to authorized use areas.

AU's shall conduct their research and operations in such a manner that individual members of the public shall not be exposed to licensed ionizing radiation in a manner that would allow them to receive a dose in excess of 100 mrem (0.1 rem) in any year, or 2 mrem (0.002 rem) in any one hour.

Monitoring and recording of radiation levels for controlled and restricted areas are critical methods for demonstrating that members of the public are protected in accordance with laws pertaining to dose or exposure.

6.0 EMERGENCY RESPONSE

The term "emergency," relative to USU Radiation Safety, means any incident involving radioactive materials or devices that creates additional external or internal hazard to anyone. Campus emergencies involving radioactive materials can range from minor spills of small amounts of materials, where no serious problems exist, to major releases resulting from fires, explosions, or other causes. Hazards that result from such incidents can range from minor to very serious, and could include human injury or property loss. **During and after an emergency, individuals should:**

First protect themselves,
Second protect or attend to others, and
Last protect property.

Workplace releases (spills) of radioactive material cannot be totally prevented, but should be rare occurrences. They may occur in any USU laboratory or area where radioactive materials are used, stored, moved, or transported. Detailed rules for response to such releases are not given since each situation can be significantly different. Principal Investigators and their Participating Personnel are trained in basic response to minor spills in laboratories, however they are not always available.

The Radiation Safety Program must be involved when radioactive materials or devices are associated with major incidents or releases, as well as when humans are contaminated.

Personnel who have not received Radiation Safety Training should avoid unknown spills in radiological labs. They should report such spills to lab staff if available, or to Radiation Safety Staff. If personal contamination is suspected immediately contact Radiation Safety.

6.1 MINOR LIQUID SPILLS

For minor liquid spills **(less than 1 mCi)**:

1. Contain liquid spills immediately, by applying paper towels or other absorbents.
2. Apply personal protective equipment (e.g. shoe covers, gloves, lab coats or aprons, safety glasses, etc.).
3. If contamination is airborne, try to turn off building ventilation. This should be done by someone not involved in the spill, and who is unlikely to spread contamination.
4. Mark or outline the entire suspect area with tape, pen markings, and/or other methods. This should prevent contamination of others and removal of contaminated items.
5. **Limit area access to those persons necessary for resolving the spill.**
6. When cleaning, work from the outer edges of the spill toward the center.
7. Inexperienced personnel should control the spill, mark off the area, and wait for the Authorized User or an experienced worker, rather than risk spreading contamination. Radiation Safety Staff can also help.

8. If inhalation, ingestion, or skin contamination is suspected or known, the RSO must be contacted as soon as possible. The RSO or a designee will provide suitable bioassay procedures as needed.
9. Check shoes and clothing for visible signs of contamination and survey with appropriate equipment. Leave contaminated shoes in the spill area when exiting. Remove other contaminated clothing promptly, survey exposed skin, and collect contaminated items for analysis by the RSO.
10. Appropriate survey instruments must be used to verify decontamination. Portable meters can be used for most isotopes, but wipe samples must be used when ^{3}H is spilled. Decontamination efforts can be stopped when wipe samples are below100 dpm, or meter readings are below 3 times background.
11. When decontamination is finished all wastes should be properly disposed of.
12. Thoroughly wash hands and survey personally before exiting the lab. Do not leave until you are sure you are free of contamination.
13. Document the spill by recording the time, the date, names of those involved, a description of the incident, instrument background readings, instrument contamination readings, a description of decontamination efforts, etc..

Wear enough PPE to fully protect you and your clothing. Use remote manipulators when reasonable and possible, to pick-up contaminated absorbents. For higher energy isotopes survey your PPE often, and replace PPE as needed.

Start decontamination as soon as possible to achieve the best results. **Remember to clean toward the center of the spill, not away from it**. Destructive methods (e.g. sanding, peeling) ARE NOT ALLOWED for removing contamination. Effective decontamination can usually be done by one person.

Bag wastes in plastic and deposit in the dry/solid radioactive waste container.

6.2 MINOR DRY SPILLS

Dry spills may occur during grinding or other manipulation of dry or solid source materials. Additionally dry materials may mix with aerosols, natural dusts, etc., which could present other hazards. Generally, minor dry spills are easily picked up with masking tape.

Guidelines for Minor Liquid Spills (section 6.1 above) can be adapted for use with dry spills. Remember that even slight air movement can carry fine particles.

6.3 MAJOR LIQUID OR DRY SPILLS

For major liquid or dry spills **(more than 1 mCi)**:

1. Move to a safe location outside affected areas, along with co-workers, as soon as possible.
2. Call campus 911 and report the incident. Provide the following information:
   Your Name,
   Your Location,

Incident Location,
Injury Status,
Other Related Information (e.g. isotopes and quantities involved, individual and/or lab contamination).
a) 911 Operators will contact necessary response units.

3. Remove contaminated clothing and apply suitable replacement clothing as needed.
   a) Personal contamination may not be obvious, but can be indicated by stains, wetting, or soiling.
4. Record events, times, and other related information.
5. **Segregate affected individuals, and wait for Radiation Safety Staff or Emergency Personnel. DO NOT allow potentially contaminated individuals to leave the area.** Radiation Safety Staff need to review their condition before release.
6. Secure affected areas by closing doors and/or setting barriers. Guard all entrances to prevent access.

6.4 AIRBORNE RELEASES

Airborne releases of radioactive materials can include fumes, mists, vapors, gases, aerosols, or dusts. Some radioactive materials may become airborne due to fire or explosion.

For radioactive materials that are or may be airborne:

1. Limit breathing or use simple breathing filtration (e.g. tissue paper, cloth, etc., ...) while evacuating the area.
2. **If safe and easy to do** eliminate the source of release.
3. **If safe and easy to do** turn off air handling equipment.
4. Call campus 911 and report the incident. Provide the following information:
   Your Name,
   Your Location,
   Incident Location,
   Injury Status,
   Other Related Information (e.g. isotopes and quantities involved, contamination is believed to be airborne).
   a) 911 Operators will contact necessary response units.
   b) Request that the 911 operator call someone to shut down the HVAC (ventilation) systems for the building.
5. Record events, times, and other related information.
6. **Segregate affected individuals, and wait for Radiation Safety Staff or Emergency Personnel. DO NOT allow potentially contaminated individuals to leave the area.** Radiation Safety Staff need to review their condition before release.
7. If the HVAC remains on it may be necessary to evacuate the building.
8. Secure affected areas by closing doors and/or setting barriers. Guard all entrances to prevent access.

6.5 INJURIES INVOLVING RADIOACTIVE MATERIALS

When individuals are injured in a radiation lab:

1. Move individuals with minor injuries to a clean and safe location outside affected areas. Individuals with major injuries will be managed by Emergency Personnel.
2. If radioactive material may be in a wound, begin rising the wound with clean warm water. Be sure to rinse the edges of the wound as well. If it is a puncture wound, try to induce bleeding as well.
3. If radioactive material may be in the eye, begin flushing with clean warm water.
4. Call campus 911 and report the incident. Provide the following information:
   - Your Name,
   - Your Location,
   - Incident Location,
   - Injury Status,
   - Other Related Information (e.g. isotopes and quantities involved, contamination is believed to be airborne).
   - a) 911 Operators will contact necessary response units.
5. Record events, times, and other related information.
6. Inform emergency personnel of potential and/or real contamination of individuals.
7. **Wait for Radiation Safety Staff or Emergency Personnel. DO NOT allow potentially affected or contaminated individuals to leave the area.**

6.6 INGESTION OR ABSORPTION OF RADIOACTIVE MATERIAL

Typically ingestion or absorption emergencies are associated with radiation workers in the laboratory.

When individuals have or may have ingested/absorbed radioactive materials:

1. Move affected individuals to a clean and safe area (possibly a restroom) immediately. Do not leave the affected individual(s).
2. Call campus 911 and report the incident. Provide the following information:
   - Your Name,
   - Your Location,
   - Incident Location,
   - Injury Status,
   - Other Related Information (e.g. isotopes and quantities involved).
   - a) 911 Operators will contact necessary response units.
3. If instructed to induce vomiting, save the materials for analysis.
4. Record events, times, and other related information.

6.7 FIRES AND RADIOACTIVE MATERIALS

It is expected that USU's fire emergency plans will be implemented in the event of a fire.

For fires that are affecting or may affect radioactive materials:

1. Inform individuals in the area.
2. Activate a fire alarm if possible.
3. Evacuate and follow USU's fire emergency plan.
4. Call campus 911 and report the incident. Provide the following information:
   Your Name,
   Your Location,
   Incident Location,
   Injury Status,
   Other Related Information (e.g. isotopes and quantities involved).
   a) 911 Operators will contact necessary response units.
5. Record events, times, and other related information.
6. Inform emergency personnel that individuals may be contaminated.
7. **Wait for Radiation Safety Staff or Emergency Personnel. DO NOT allow potentially affected or contaminated individuals to leave the area.**

6.8 EXPLOSIONS AND RADIOACTIVE MATERIALS

For explosions that have or may have affected radioactive materials:

1. Move to a safe location outside affected areas, along with co-workers, as soon as possible. This reduces possible exposure to airborne radioactive materials.
2. Call campus 911 and report the incident. Provide the following information:
   Your Name,
   Your Location,
   Incident Location,
   Injury Status,
   Other Related Information (e.g. radioactive materials may be present).
   a) 911 Operators will contact necessary response units.
3. Assemble individuals with known or suspected contamination.
4. Removing affected clothing will minimize possible exposure. Segregate contaminated clothing by owner, and bag and label accordingly. Apply suitable replacement clothing as needed
5. Showering, washing, or rinsing skin will minimize possible exposure by removing possible contaminants.
6. Record events, times, and other related information.
7. **Segregate affected individuals, and wait for Radiation Safety Staff or Emergency Personnel. DO NOT allow potentially contaminated individuals to leave the area.** Radiation Safety Staff need to review their condition before release.
8. Also, refer to guidelines for spilled materials.

6.9 BOMB THREATS AND RADIOACTIVE MATERIALS

For bomb threats that do or may involve radioactive materials:

1. Calmly and immediately facilitate evacuation.
2. Individuals should follow established bomb threat response procedures. Campus Police can provide information on established procedures.

3. Follow instructions from Emergency Personnel, or **from a safe location** call campus 911 and report the incident. Provide the following information:

Your Name,
Your Location,
Incident Location,
Injury Status,
Other Related Information (e.g. radioactive materials may be involved).

a) 911 Operators will contact necessary response units.

4. Record events, times, and other related information.
5. **Wait for Emergency Personnel**, and provide additional information as requested.
6. Do not enter affected areas until Emergency Personnel approve.

6.10 RADIATION EMERGENCY RESPONSE / AGENCY RESPONSIBILITIES

CAMPUS POLICE / 911 OPERATOR / LOGAN CITY FIRE

1. Incidents involving radioactive materials shall be received and recorded by 911 Operators.
2. 911 Operators shall notify local emergency agencies necessary for response to the incident.
3. 911 Operators shall also notify the Radiation Safety Officer of radioactive materials incidents by calling 435-770-0295 and providing incident details.
4. Responding agencies shall report to the Incident Commander, and shall proceed to bring the incident to a satisfactory conclusion.
5. In cases of fire, bomb threat, or explosion, Incident Command shall determine when to evacuate additional buildings and when evacuated buildings are safe to occupy. Such decisions will be relayed through 911 Operators. Advice for such decisions shall be provided by the Radiation Safety Officer and/or other external agencies (e.g. Utah Division of Radiation Control, FBI, Local Police, etc, ...).
6. When injured persons need attention at medical facilities and are or may be contaminated with radioactive materials, Incident Command shall direct 911 Operators to alert medical facilities to activate appropriate response protocols. Advice for such decisions shall be provided by the Radiation Safety Officer and/or other external agencies (e.g. Utah Division of Radiation Control, FBI, Local Police, etc, ...).

RADIATION SAFETY OFFICER AND STAFF

1. Respond to radiological incidents and report to the Incident Commander.
2. Act as scientific adviser to the Incident Commander until the incident is brought to an acceptable outcome or until relieved by a superior radiation expert.
3. Assess individuals relative to radioactive contamination, and advise Command on appropriate response measures (e.g. evacuation, sampling, bioassays, etc.).
4. Advise emergency responders and assume primary responsibility for the following:

a) Directing emergency response in accordance with established Emergency Radiation Safety Protocols.
b) Advising responders and support personnel on radiological hazards

and possible actions.
c) Overseeing radioactive cleanup and decontamination.
d) Reporting on radiological aspects of incidents to governing agencies and authorities.

RADIATION SAFETY OFFICER or DESIGNEE

1. Act in the capacities described in this plan under authority and established policies of the Utah Division of Radiation Control, the US Department of Homeland Security, the USU Radiation Safety Program, and the USU Radiation Safety Committee.
2. Serve as liaison between USU and State/Federal agencies in radiological emergencies, overseeing all internal and external responder activities prior to carrying out any emergency response operation. State/Federal radiological agencies are considered superior experts and may relieve the RSO of emergency duties.
3. Notify all pertinent State/Federal regulatory agencies as described by material licensing requirements based on the license issued by the Utah Division of Radiation Control.
4. Recommend and advise on courses of actions and recommend procedures and/or equipment to utilize.
5. Provide additional radiation safety support and assistance as needed during emergency operations.

7.0 IONIZING RADIATION PRODUCTION DEVICES

Some machines or devices capable of producing ionizing radiation must be authorized by the
Committee prior to use. Generally Licensed Items are excluded from Committee authorization or approval, though safety, accountability and security responsibilities remain. All machines and devices capable of producing ionizing radiation must be registered with the RSO. Registration does not constitute authorization. The following RSO forms (see Appendix) are used to request authorization for work with radiation production devices.

1. Application For Use of a Radiation Device (RSO-1B)
2. Request for Facility Approval (RSO-1.1C)
3. Statement of Training and Experience (RSO-2)
4. Request for Personnel Monitoring (RSO-3, IF NEEDED)
5. Permanent Storage Location for Nuclear Gauges (RSO-15, IF NEEDED)

Prior to initial operation an inspection of the equipment and facility shall be conducted by the RSO, or designated representative. The inspection shall include, but may not be limited to, machine function, facility design, operational procedures, exposure to the general public, and establishment of an isodose map for the operation area.

7.1 PORTABLE GAUGING DEVICES

Portable gauging devices (gauges) require authorization from the Committee prior to purchase. They also require annual renewal of a Nuclear Gauge Permit in order to operate the device.

Sealed radioactive sources used in portable gauging devices are regulated by the DRC, EPA, and DOT. The following requirements are based on those regulations.

1. Each operator must have successfully completed training equivalent to that of the manufacturer. The RSO provides manufacturer equivalent operator training.
2. Records of gauge use must include use dates, work locations, and operators.
3. A permanent storage location must be approved for each gauge. Complete and submit form RSO-15 to the RSO for each new gauge, or when a change in location is desired. During storage the gauge must be effectively secured against unauthorized removal.
4. Permanent storage locations must have one or more "CAUTION, RADIOACTIVE MATERIAL" signs posted for public viewing.
5. The gauge may be used at temporary sites, under the control and jurisdiction of USU, and within the State of Utah.
6. With sufficient advance notice, gauges may be used temporarily in other licensing jurisdictions. Other licensing jurisdictions include Federal lands, other States, and Native American lands. Other licensing jurisdictions must be notified, in writing by the RSO, at least 5 days in advance of any planned use. Gauge operators must allow sufficient time to submit notification and receive approval before work can begin.
7. Personal dosimetry must be worn during transport and use of gauges. Dosimetry is issued to each operator by the RSO, and is not shared by or

transferred to others. Dosimetry must be requested well in advance of expected gauge use. When not in use dosimetry must be stored away from the gauge in a low background radiation area.

8. During transport and use of gauges operators must carry a copy of each of the following:

a) Authorization and Permit for Use
b) Radiation Safety Plan
c) Operators/Users Manual
d) Shipping Paper (Manifest)
[During vehicle transport of a gauge, the shipping paper must be in the vehicle on the seat next to the driver, or in a document holder on the drivers door.]

9. During vehicle transport gauges must be fully secured and located away from personnel.

a) When transported in a closed vehicle (car or van) the case will be locked and the vehicle locked when an operator is not with the vehicle, or when the vehicle is in transit.
b) When transported in an open truck bed the case will be locked and securely fastened and locked to the bed of the truck, when an operator is not with the vehicle, or when the vehicle is in transit.

10. Gauges must be transported in their assigned DOT shipping container, with all required labels and markings.
11. Gauges must be effectively blocked against movement during transport.
12. Occupancy of vehicles transporting gauges is restricted to currently authorized operators.
13. Gauge repair and adjustment will only be performed by certified service personnel.
14. Gauges are not to be shipped by common carrier, unless specifically authorized by the RSO.
15. Gauges are not to be transferred to other users, until specifically authorized by the RSO.
16. Costs for disposal of a nuclear gauge are the responsibility of the Authorized User, and should be understood and addressed before purchase. Gauge disposal costs are a significant expense.
17. Gauges are required to be leak (wipe) tested at least every 6 months. Authorized Users must make gauges available for testing as requested by the RSO.

7.2 X-RAY PRODUCTION DEVICES

A device that produces X-rays does so by directing a current of electrons (measured in millivolts) at a target within an X-ray tube. X-ray radiation exists whenever the machine or device is on. To limit and/or prevent unnecessary exposure to operators or others, warning lights, safety interlocks, beam stops, shielding, collimators, etc., are usually provided and required by the manufacturer.

Operator safety training is required before using X-ray equipment, and is provided by

the RSO. Operators should be familiar with the operators manual and able to demonstrate competence in the safe and prudent use of the equipment.

All X-ray producing equipment must be registered with the Committee.

Those who desire to purchase, receive, transfer to others, or operate X-ray equipment must first
be approved and authorized by the Committee. Forms for authorization are available from the RSO and in the Appendix.

Purchasing must provide a copy of any purchase order for devices which produce X-rays to the RSO prior to commitment of the order.

7.3 X-RAY OPERATING REQUIREMENTS

Written operating procedures shall be available to all X-ray equipment users and participating personnel.

No person will be allowed to operate the equipment in any manner other than specified in the procedures, unless written approval has been obtained from the Committee.

The components of X-ray equipment shall be operated and maintained in such a manner that dose to the general public will not exceed 2 mR per hour or 100 mR per year.

Radiation surveys shall be conducted to delineate isodose lines and detect any leakage from equipment. Isodose maps will be posted conspicuously near the equipment for operator review.

Surveys will be conducted by Radiation Safety staff following installation and maintenance or repair, and at least annually thereafter.

If issued, operators and participating personnel must wear dosimetry when using X-Ray equipment. If dosimetry readings show a significant increase (e.g. by 1/10 of the extremity limit) an investigative survey will be conducted. (Revised 9/12)

An X-Ray Machine Safety Protocols poster shall be conspicuously displayed near the equipment. An example of a protocol is in the next section.

No person shall bypass any X-ray safety mechanism unless express written approval of the Committee has been obtained. Such approval shall be valid only for a brief period of time. During an approved bypass obvious signage stating "**Safety Device Not Working**" shall be on the equipment.

7.4 SAMPLE X-RAY MACHINE SAFETY PROTOCOL

1. X-ray production equipment may only be operated by personnel authorized by the Radiation Safety Committee. All authorized personnel shall receive instruction in and demonstrate understanding of equipment operation before starting unsupervised work.
2. If assigned, wear personnel dose monitors (TLD) while working with licensed X-Ray production equipment. (Revised 9/12)
3. DO NOT override safety interlocks.
4. DO NOT rely on safety interlocks to turn the machine off. Use the main power switch.
5. Make sure the machine is OFF before changing samples. Check current and voltage meters and/or use a survey meter to detect X-ray production.
6. No operation involving removal of covers, shielding materials, or tube housing, or modifications to shutters, collimators or beam stops shall be performed without first verifying that power to the tube is off and will remain off until all safety mechanisms have been restored. Use the main power switch. Do not rely on safety interlocks.
7. The Radiation Safety Officer (RSO) provides all surveys for radiation scatter and/or shine Request a survey after any modification which may have affected radiation output or shielding effectiveness.
8. X-ray equipment must be secured against unauthorized use. This can be accomplished through key control of the equipment and/or room.
9. Use data must be maintained, available for review, and include the following:
    a) Date of Use
    b) Operator
    c) Beam Voltage and Current
    d) Total Exposure Time
10. If accidental exposure is suspected or occurs, notify the RSO immediately.
11. Gloves, aprons, or other shielding must be provided and used as conditions warrant.
12. Personnel are forbidden to hold film in the path of the primary beam. Stands to hold such film must be utilized.
13. Changes in the location or disposition of X-ray equipment must be approved by the RSO. Notify the RSO prior to acquisition, disposal or transfer of X-ray equipment.
14. Contact the RSO for information regarding regulations, or to use a survey meter. Copies of the Utah Division of Radiation Control regulations and USU rules are available at EH&S.

7.5 GAS CHROMATOGRAPHY, X-RAY FLUORESCENCE, STATIC ELIMINATORS, ETC.

Gas chromatographs with radioactive elements, X-ray fluorescence equipment, and radioactive static eliminators are generally licensed devices and must be registered with the RSO. To register generally licensed devices provide the following information to the RSO.

1. Isotope(s) or Source of Radiation,

2. Equipment Manufacturer and Model (if applicable)
3. Activity or Output of Radiological Material/Component,
4. Manufacturer and Model Number of Radiological Material/Component, and
5. Purpose/Use for the Device.

Security is important for all radiological materials and devices. Controlling access to labs/rooms holding radiological items is key to maintaining their security. Labs/rooms should be locked when staff are absent.

Periodic leak testing is required to verify the integrity of each device. Devices/Equipment must be made available for testing at the request of the RSO.

Repair and/or disposal of damaged or spent devices must be coordinated through the RSO.

1888
UTAH STATE UNIVERSITY

OFFICE OF THE PRESIDENT
Logan, Utah 84322-1400
Telephone 801/750-1162
FAX 801/750-1173

6 December 1993

Professor LeGrande C. Ellis, Chairman
Radiation Safety Committee
Utah State University
Campus UMC 5305

Dear Professor Ellis:

I commend and strongly support Utah State University's Radiation Safety Committee. The Obligations and responsibilities of this committee are far-reaching and directly affect our academic community, service organizations, and scientific research groups as they use radioactive materials.

The recommendations, rules, and regulations set forth in this revised Handbook of Radiation Control and Safety incorporate all the new State and Federal regulations pertaining to the use of radiation at universities. I take this opportunity to emphasize that the policies and procedures described within the handbook pertain to all radiation activities conducted at or for USU. These activities must be authorized and maintained within the limits of the *Broad Scope License for Byproduct Material* granted by the State of Utah Division of Radiation Control, and I reaffirm that administrative support and direction will continue from this office.

My appreciation and thanks go out to all those who have helped in any way to make this the healthful and safe program it has been over the past few decades, and I look forward with expectation to future success.

Very sincerely,

George H. Emert

George H. Emert
President

GHE/cjc

AUTHORIZATION APPLICATION INSTRUCTIONS

As a first time prospective Authorized User of radioactive materials at Utah State University you need to establish a permanent file in your name, therefore you must submit the following forms as proof, to the Radiation Safety Committee, that you are a qualified and informed radiation worker and researcher.

RSO-B	STATEMENT OF REQUEST AND AGREEMENT
RSO-1A	APPLICATION FOR USE OF RADIOACTIVE MATERIALS
or RSO-1B	APPLICATION FOR USE OF A RADIATION DEVICE
RSO-1.1B	RADIONUCLIDES AND ANIMAL USE (if needed)
RSO-1.1C	REQUEST FOR FACILITY APPROVAL
RSO-1.1D	FACILITY SKETCH
RSO-2	STATEMENT OF TRAINING AND EXPERIENCE
RSO-3	REQUEST FOR PERSONNEL MONITORING (if needed)
RSO-4	OCCUPATIONAL RADIATION EXPOSURE HISTORY (if needed)
RSO-5	AUTHORIZATION FOR RELEASING RADIATION EXPOSURE INFORMATION (if needed)

Submit the required forms properly executed and signed by you and your Department Head and forward to the Radiation Safety Officer at UMC-8315. If during the process difficulty is encountered please call 797-3514 or 797-2892 for assistance.

When significant changes are required to properly conduct your project you must amend or renew your authorization. It is the project that is approved and you are authorized to use isotopes within the bounds of the project protocol. A change in participating personnel is considered a significant change. You should submit RSO-14 AMENDMENT/RENEWAL NOTICE to assure that you are in compliance with the University's license. This form shall be submitted at least annually on or about the anniversary of the effective day and month of your authorization.

If you are a PREVIOUSLY AUTHORIZED USER wishing to begin a new project, or substantially change the old protocol, you already have a permanent file established in your name. You need only complete RSO-1 and the necessary sub-parts that are changing.

Project authorizations will be assigned unique numbers for identification and will allow the user to purchase and utilize the isotopes or equipment as authorized by the USU Handbook of Radiation Control and Safety, the State of Utah Division of Radiation Control, the U.S. Nuclear Regulatory Commission and other regulatory bodies as applies.

To: Radiation Safety Committee
UMC 8315

Subject: STATEMENT OF REQUEST AND AGREEMENT

I hereby request authorization to work with the radioactive materials and/or radiation producing devices as specified within the attached forms and supporting documents. By virtue of my signature below I signify that I have read and am willing to abide by the Utah State University regulations and the license as provided by the State of Utah Division of Radiation Control governing the use of isotopes and any other source of ionizing radiation. I the undersigned agree to comply strictly with all such rules and regulations and hereby waive any right of recourse against Utah State University for any damages whatsoever from any failure to fully conform with said regulations.

_____
Applicant's Signature

_____
Date (Month, Day, Year)

APPLICATION FOR USE OF RADIOACTIVE MATERIAL

Submit completed application to: Radiation Safety Officer
Environmental Health & Safety
Utah State University
Logan, UT 84322-8315

1) APPLICANT INFORMATION

First and Last Name	
Degree	
Department	
Office Telephone Number	
Lab Telephone Number	
Fax Number	
E-mail Address	

2) USE LOCATION(S) - Please specify locations intended for use and/or storage of radioactive materials. Examples include cold rooms, counting rooms, and waste storage areas. Also list buildings and room numbers. Work area diagrams must be included with the application.

Location	Building	Room #

3) RADIOISOTOPES & LIMITS - Please specify radioisotopes and chemical forms desired, as well as the maximum activity (in mCi's) needed for a single experiment, for a single order, and to possess at any time.

	Radioisotope	Chemical Form	Use Limit	Order Limit	Possession Limit
A			mCi	mCi	mCi
B			mCi	mCi	mCi
C			mCi	mCi	mCi
D			mCi	mCi	mCi
E			mCi	mCi	mCi
F			mCi	mCi	mCi

4) HAZARDOUS CHEMICAL EVALUATION - Please specify hazards associated with radio-chemical(s) listed above. **(circle Y for Yes or N for No)**

Radioisotopes Listed in 3	A	B	C	D	E	F
Known Carcinogen	Y N	Y N	Y N	Y N	Y N	Y N
Known Mutagen	Y N	Y N	Y N	Y N	Y N	Y N
Known Toxin	Y N	Y N	Y N	Y N	Y N	Y N
Incorporated directly into genetic material.	Y N	Y N	Y N	Y N	Y N	Y N
Highly localized in germ or somatic cells.	Y N	Y N	Y N	Y N	Y N	Y N
Used in synthesis or labeling procedures (iodination of proteins).	Y N	Y N	Y N	Y N	Y N	Y N

Additional Information or Comments:

5) NEW APPLICANTS ONLY:
PREVIOUS TRAINING AND/OR WORK EXPERIENCE WITH RADIOACTIVE MATERIALS - Please specify training completed previously (formal or on-the-job). If previously approved as an Authorized User of Radioactive Materials at other institutions, please include names and dates of authorization. Certificates of training from other institutions may also be attached.

AUTHORIZED USER

Institution		
Address, City, State		
Date(s) of Authorization		

RADIATION SAFETY TRAINING

Principles of Radiation Safety	None	Formal Course	On-the-Job
Radiation Detection and Measurement	None	Formal Course	On-the-Job
Biological Effects of Radiation	None	Formal Course	On-the-Job
Location(s)			
Duration			
Date of Completion			

Additional Information or Comments:

Please specify types of radioactive materials or radiation producing devices with which you have experience.

ISOTOPE/DEVICE	MAX ACTIVITY	EMPLOYER	USE	DURATION

6) EXPERIMENTS - Please attach brief descriptions of purposes for the radioisotopes requested. (DO NOT SUBMIT ABSTRACTS OR JOURNAL ARTICLES.)

Include the following types of information for each experiment or isotope:

a) Experimental Design
b) Identification of Labeled Compounds
c) Approximate Activity per Experiment
d) Estimated Number of Experiments per Month
e) Specify Type of Laboratory Animal (if applicable)

For each Animal Use Committee protocol that includes radioactive materials, written approval must be submitted. Example:

a) Various bacteria will be grown in the presence of tritiated adenine and a variety of nicotinic analogs. Adenine will be incorporated by the bacteria into NAD and into NAD analogs. The products will be purified and examined by chromatography.
b) Hydrogen-3 labeled Adenine
c) Maximum of 1.0 mCi per experiment
d) Maximum of 5 experiments per month
e) No animals

7) ^{35}SULFUR USE (if applicable) - Please describe special precautions to be taken to minimize internal deposition of volatile material if the use of Sulfur-35 is requested.

Description:

8) BIOASSAYS (if applicable) - Individuals exposed to activity levels in excess of those in Table 1 are required to submit samples for bioassay. Please indicate whether or not bioassays may be required.

☐ NOT APPLICABLE ☐ MAY BE REQUIRED

Table 1 - Bioassay Levels

Isotope	ALI (mCi)	mCi/Month	mCi/Use
^{3}H	80	10	10
^{14}C	2	10	10
^{32}P	0.4	4	4
^{35}S	2	20	20
^{45}Ca	0.4	4	4
^{51}Cr	20	200	200
^{125}I volatile	0.3	1	1
^{125}I bound	0.3	10	10

9) PERSONNEL DOSIMETRY - Dosimetry is issued to individuals using some activities of high energy beta emitters and gamma emitters. Dosimetry is not issued to persons using ^{3}H, ^{14}C, ^{35}S, and ^{45}Ca. You will be contacted by Radiation Safety if dosimetry is required.

10) SPECIAL SAFETY EQUIPMENT - All users of radioactive materials must wear appropriate protective equipment, beginning with lab coats, safety eyeware, and gloves (minimum personal protective equipment). Please specify and/or describe special safety equipment intended to be used.

☐ Fume Hood
☐ Beta Shielding
☐ Gamma Shielding
☐ Remote Handling
☐ Respiratory Protection

Description(s):

11) EMERGENCY PROCEDURES - Briefly describe protocols/procedures you plan to use when responding to spills or contamination events.

Description(s):

12) SECURITY OF MATERIALS - State and Federal regulations require Authorized Users (AU's) to maintain control and/or constant surveillance of licensed material, or secure it from unauthorized removal or access. Please describe intended storage locations and plans for maintaining control/security.

Description(s):

13) RADIATION DETECTION EQUIPMENT - Please list radiation detection equipment to be used with experiments and to have available for lab personnel.

Portable Survey Instrument(s)

Detector Type	Manufacturer	Model	Serial Number

Counting Equipment (Specify: Liquid Scintillation Counter, Gamma, or Beta Counter)

Equipment Type	Manufacturer	Model	Serial Number

14) RADIOACTIVE WASTE DISPOSAL - All radioactive waste must be disposed through the Radiation Safety Program. Estimate amounts of radioactive waste to be produced monthly. Also, specify chemical profiles for the various wastes to be produced.

Type	Solid	Liquid	LSC Vials	Animal Carcasses	Gas
Amount / Units					
Chemical Profile					
Radioactivity / Units					

15) HAZARDOUS WASTE (if applicable) - Specific approval must be obtained if radioactive waste will also contain hazardous materials (e.g. pathogens, carcinogens, toxics such as toluene or xylene, flammables, corrosives, oxidizers, or reactives). Describe hazardous content (if any) of waste to be generated, and reasons why non-hazardous materials cannot be substituted. Also, estimate monthly amounts of hazardous waste.

Description(s):

16) PARTICIPATING PERSONNEL - List current personnel who will work with radioactive material under your supervision. Indicate if any are younger than 18 years old. All personnel must complete USU's radiation safety training before using material, or must provide proof of comparable training.

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

17) SIGNATURE

By signing below:

I affirm that I am familiar with and agree to abide by rules and instructions established in USU's Radiation Safety Handbook.

I agree to abide by conditions stipulated in this application, my authorization, and related protocols.

I understand that I am responsible for safety and regulatory compliance related to this application/authorization.

I understand that I am responsible for promptly notifying the Radiation Safety Officer when I desire to make changes to this application/authorization.

_____ _____
APPLICANT DATE

_____ _____
DEPARTMENT HEAD DATE

APPLICATION FOR USE OF A RADIATION DEVICE

Submit completed application to: Radiation Safety Officer
Environmental Health & Safety
Utah State University
Logan, UT 84322-8315

1) APPLICANT INFORMATION

First and Last Name	
Degree	
Department	
Office Telephone Number	
Lab Telephone Number	
Fax Number	
E-mail Address	

2) LOCATIONS OF USE - Please indicate the locations where you will use and store your radiation producing device(s).

Location	Building	Room #

3) RADIATION PRODUCING EQUIPMENT REQUESTED

Electron Capture (Gas Chromatograph)

	Source A	Source B	Source C	Source D
Manufacturer				
Model				
Serial #				
Nuclide				
Activity				

Nuclear Gauge

	Gauge A	Gauge B	Gauge C	Gauge D
Type	Moisture Density Combination	Moisture Density Combination	Moisture Density Combination	Moisture Density Combination
Manufacturer				
Model				
Serial #				
Nuclide				
Activity				

Other - Please Describe:

X-Ray Machine

	Instrument 1	Instrument 2	Instrument 3
Type	Cabinet X-Ray X-Ray Diffraction Fluorescence Industrial Diagnostic Mobile Radiographic General Purpose Combination Other (specify) _____	Cabinet X-Ray X-Ray Diffraction Fluorescence Industrial Diagnostic Mobile Radiographic General Purpose Combination Other (specify) _____	Cabinet X-Ray X-Ray Diffraction Fluorescence Industrial Diagnostic Mobile Radiographic General Purpose Combination Other (specify) _____
Manufacturer			
Model			
Serial #			

Please describe radiation safety features of the instrument(s).

4) FOR NEW APPLICANTS ONLY: PREVIOUS TRAINING AND WORK EXPERIENCE WITH RADIATION PRODUCING DEVICES - Please describe any previous training (formal or on-the-job) you have completed. If you have been approved previously as an Authorized User of radiation producing devices at another institution, please include the name of the institution and the date of your approval. You may attach to this application any certificates of training you have received from other institutions.

AUTHORIZED USER

Institution		
Address, City, State		
Date(s) of Authorization		

RADIATION SAFETY TRAINING

Principles of Radiation Safety	None	Formal Course	On-the-Job
Radiation Detection and Measurement	None	Formal Course	On-the-Job
Biological Effects of Radiation	None	Formal Course	On-the-Job
Location(s)			
Duration			
Date of Completion			

Please list types of radioactive materials or radiation producing devices with which you have previous experience. If you have no previous experience, please circle NONE below.

ISOTOPE /DEVICE	MAX ACTIVITY	EMPLOYER	USE	DURATION

NONE

5) DESCRIPTION OF EXPERIMENTS - Please describe briefly (DO NOT SUBMIT ABSTRACTS OR JOURNAL ARTICLES) the purpose(s) of the device(s) you requested.

Experiments:

Describe typical setting and procedures. Include approximate number of uses per month. Indicate if device will be transported or used at temporary job sites.

Typical setting and procedures:

For projects that involve animals, submit written permission from the Animal Use Committee.

6) EXTERNAL DOSIMETRY - Dosimetry may be issued to individuals working with high energy beta emitters, gamma and neutron emitters. Dosimetry is not issued to persons using ^{3}H, ^{14}C, ^{35}S, and ^{45}Ca. You will be contacted by Radiation Safety if dosimetry is required.

7) EMERGENCY PROCEDURES - Please describe YOUR procedures to be followed in the event of an emergency involving the device(s).

Description:

8) SECURITY OF RADIATION PRODUCING DEVICES - State and Federal regulations require you to secure from unauthorized removal or access all radiation producing devices. The authorized user must maintain control and/or constant surveillance of the device. Please Describe your storage locations and methods or measures that you will take to ensure that radioactive materials are secured at all times.

Description:

9) RADIATION DETECTION EQUIPMENT - Please list radiation detection equipment to be used in your experiments and to have available for lab personnel.

Portable Survey Instrument(s)

Detector Type	Manufacturer	Model	Serial Number	Units	Efficiency

10) PARTICIPATING PERSONNEL - List current personnel who will work with radiation producing devices under your supervision. Indicate if any are younger than 18 years old. All personnel must complete USU's radiation safety training before using devices, or must provide proof of comparable training.

a) _____ e) _____

b) _____ f) _____

c) _____ g) _____

d) _____ h) _____

11) SIGNATURE

By signing below:

I affirm that I am familiar with and agree to abide by rules and instructions established in USU's Radiation Safety Handbook.

I agree to abide by conditions stipulated in this application, my authorization, and related protocols.

I understand that I am responsible for safety and regulatory compliance related to this application/authorization.

I understand that I am responsible for promptly notifying the Radiation Safety Officer when I desire to make changes to this application/authorization.

_____ _____

APPLICANT DATE

_____ _____

DEPARTMENT HEAD DATE

RADIONUCLIDES AND ANIMAL USE

Animal Type(s): _____

Average Animal Weight: _____

Total number of animals to be used in the project: _____

Millicuries (mCi) per Animal: _____

Route of Radionuclide Administration: _____

_____

_____

_____

Do you anticipate that the radioactivity will be contained in the animals

Exhaled Air	Yes	No	(circle one for each item)
Urine	Yes	No	
Feces	Yes	No	
Carcass	Yes	No	

Note: If any are answered Yes, please describe procedures and methods you will use to control and/or prevent the spread of contamination to equipment, materials, or other animals.

_____

_____

_____

_____

_____

_____

_____

_____

REQUEST FOR FACILITY USE

AUTH. USER: _____ ROOM: _____

DEPARTMENT: _____ BUILDING: _____

Walls & Ceiling (material, coating, ..):

Floor (material, coating, ..):

Bench-Top (material, coating, ..):

Hood a) Sash Working Height Flow Rate: _____ cfm

b) Filtration if any:

Number of personnel normally working in the area OTHER THAN the user and participating personnel: _____

Education level of each person identified above (if any):

Detection, Monitoring, Counting Equipment (readily available):

Special Handling Equipment (shielding, glove box, ...):

If not the user, who is in charge of the laboratory? _____

_____ _____

Authorized User Telephone

Approval: _____ _____

Radiation Safety Officer Date

Comments: _____

_____

_____

FACILITY SKETCH

STATEMENT OF TRAINING AND EXPERIENCE

Radiation Safety Officer
Environmental Health and Safety
Utah Sate University
Logan, Utah 84322-8315

NAME	
DATE OF BIRTH	
SOCIAL SECURITY NUMBER	
AUTHORIZED USER	
DEPARTMENT	
UMC	
E-MAIL	

PREVIOUS TRAINING AND/OR WORK EXPERIENCE WITH RADIOACTIVE MATERIAL

Please specify training completed previously (formal or on-the-job). If previously approved as an Authorized User of Radioactive Materials at other institutions, please include names and dates of authorization. Certificates of training from other institutions may also be attached.

AUTHORIZED USER

Institution		
Address, City, State		
Date(s) of Authorization		

RADIATION SAFETY TRAINING

Principles of Radiation Safety	None	Formal Course	On-the-Job
Radiation Detection and Measurement	None	Formal Course	On-the-Job
Biological Effects of Radiation	None	Formal Course	On-the-Job

Location(s)	
Duration	
Date of Completion	

Please specify types of radioactive material or radiation producing devices with which you have experience.

ISOTOPE/DEVICE	MAX ACTIVITY	EMPLOYER	USE	DURATION

PERSONNEL RADIATION DOSIMETRY

(Print Clearly)

User's Full Name: _____

Gender: M F DoB: _____ A #: _____

Personal Mailing Address: _____

_____

Authorized User (PI): _____

Laboratory/Work Location: _____

Department: _____ UMC: _____

Isotope(s) to be Used: _____

Device(s) to be Used: _____

IMPORTANT

- If you've been monitored for dose at another institution/organization please complete and submit forms RSO-4 and RSO-5. Utah State University is required to maintain accurate and complete radiation exposure histories. ☐ NO PREVIOUS MONITORING

- TLD service is currently free to researchers and lab personnel, nevertheless economy of resources is important to the University. **Costs for lost or damaged dosimetry are the responsibility of TLD users.**
- TLD users are responsible to notify the RSO when terminating work with radioactive materials or radiation producing devices.
- TLD's are exchanged regularly according to service contract schedules.
- Each TLD may only be used by the individual it's assigned to. Reported exposures will be investigated, and may be removed if reasonable explanations are available.
- You may request a written summary of your dose history.

Deliver completed forms to:

Radiation Safety Program
Environmental Health & Safety
8315 Old Main Hill
Logan, UT 84322

Type(s): ☐ WB/X-Ray(14) ☐ WB/Neutron(16) ☐ Ring (S M L)

Approved By: _____ Date: _____

Date Started: _____ Badge Number: _____

Date Stopped: _____

OCCUPATIONAL RADIATION EXPOSURE HISTORY

IDENTIFICATION

1. NAME (last, first, middle) *print* _____

3. Social Security Number _____

2. Date of Birth (month, day, year) _____

4. Occupation _____

OCCUPATIONAL EXPOSURE HISTORY

5. Previous employment involving radiation. Name & Address	6. Dates of Employment From - To	7. Periods of Exposure	8. Dose	
			Whole Body (rem)	Recorded or Calculated

9. _____
Remarks

10. _____
Total Dose

I CERTIFY THAT THE EXPOSURE HISTORY IN COLUMNS 5, 6, 7 AND 8 ARE CORRECT AND TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

_____ _____
Employee's Signature Date

Licensee: Utah State University

CONTAMINATION SURVEY RESULTS

		Mfg.	Calibration Date	Beta Efficiencies (%) C-14	Si-32	Tc-99	Gamma Efficiencies (%) Co-60	Na-22	I-125
User: _____	INST.#1 m/n s/n								
Isotopes: _____	INST.#2 m/n s/n								
Locations: _____	INST.#3 m/n s/n								

SURVEY MUST BE PERFORMED AFTER EACH USE.

NOTE: Results > 3 times BKG require survey following decontamination.

COLUMN NUMBERS REFER TO LOCATIONS ILLUSTRATED ON FACILITY SKETCH.

DATE	INST.#	BKG	1	2	3	4	5	6	7	8	9	10	Surveyor INITIALS

LOG # ________

INVENTORY CONTROL OF RADIOACTIVE MATERIALS

(TO BE MAINTAINED BY AUTHORIZED USER OR DESIGNEE)

AUTHORIZED USER ____________________

FORM OF ISOTOPE ____________________

ISOTOPE IDENTITY ____________________

SPECIFIC ACTIVITY ____________________

ACTIVITY RECEIVED ____________________ uCi

P.O. NUMBER ____________________

DATE RECEIVED ____________________

WEIGHT / VOLUME ____________________

SUPPLIER ____________________

VENDOR LOT # ____________________

THE CATEGORIES LISTED REFER TO THE ORIGINAL STOCK OF THE ISOTOPE.

	Activity Taken	Activity Remaining	Date	Taken By (Initials)
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		

	Activity Taken	Activity Remaining	Date	Taken By (Initials)
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
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	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		
	uCi	uCi		

DECAY DATE (10 HALF LIVES) ____________________

IMPORTANT NOTE:
Bioassay required if more than ____ mCi is used at one time, or within 30 days.

UTAH STATE UNIVERSITY
RADIOACTIVE MATERIAL OR EQUIPMENT REQUEST

[See PDF form available from EHS web pages.]

UTAH STATE UNIVERSITY
PERMANENT STORAGE LOCATION FOR NUCLEAR GAUGES

_____
(Licensee)

_____
(Permanent Storage Address)

_____
(City, State, Zip) (Date)

I certify that the sketch of the proposed storage location is an accurate representation our storage intentions. I also certify that the gauge will be stored on temporary job sites in accordance with the same procedures and recommendations as closely as is practical.

_____
(Principal Investigator)

GENERAL

License regulations require secure (locked) storage of nuclear devices when not in use, with final key access only by authorized users. Each storage area will differ for each user, however the final key access integrity will be maintained.

RECOMMENDATIONS

- Lighted area with electrical outlet for charging gauges while in storage.
- Gauges stored at least 10 feet from nearest desk or other location requiring full-time employee attention. Coming and going around the gauge is all right
- Check the other side of the nearest wall by the gauge. Somebody may work there full-time..
- In a space shared with others, the gauge will be separately locked to the floor, wall, or pipe, thus preventing removal or movement.

TYPICAL STORAGE EXAMPLES

- Gauge shipping case, or “like” case, secured to the floor or wall in a shared closet or cabinet. Radiation signs on case, case locked and immobile.
- Gauge stored inside cabinet or closet with lock and sign on outside of cabinet or closet, limited key access. Gauge case is not necessarily locked (e.g. charging).
- Gauge case and/or cabinet or closet not locked, however the room is locked with limited key access. Sign on room door.

PROPOSED STORAGE LOCATION SKETCH

The Sketch below proposes the manner in which we will store nuclear gauge(s). Doors, windows, desks, and/or work areas are designated. We have designated the hours per day required for employees for each work area within 10 feet of the gauge.

CERTIFICATION

Locked, Labeled, and Posted (Notice to Employees)

Guage storage area 10 feet plus from any peoples work area

Log #: _____

Isotope Shipping Package Analysis

Authorized User: _____

Laboratory: _____

Date Received: _____

P.O. #: _____

Method of Survey: _____

Isotope: _____

Results: _____

_____
Name

_____
Date

Please return ASAP to Radiation Safety, UMC 8315.

FOLD

Sender _____
_____
_____

NO
POSTAGE
NECESSARY

Environmental Health & Safety
Attn: Radiation Safety
UMC 8315

Radiation
Safety

FOLD

DEFINITIONS

ABSORBED DOSE - *The energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy) (equal to one joule per kilogram).*

ACTIVITY - *The rate of disintegration or decay of radioactive material. The units of activity are the curie (Ci) and the Becquerel (Bq) (equal to one disintegration per second)*

ALARA - *Acronym for As Low As Reasonably Achievable, which means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical.*

ALI - *Acronym for "annual limit on intake", which is a derived limit for the amount of radioactive material taken into the body of an adult radiation worker by inhalation or ingestion in a year. 1ALI is the value of intake that would result in a committed effective dose equivalent of 5 rems to the individual in any one year.*

BACKGROUND - *Radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material) and global fallout as it exists in the environment from the testing of nuclear devices. Background radiation does not include radiation from source, byproduct, or special nuclear materials regulated by the*

BETA PARTICLE - *Charged particle emitted from the nucleus of an atom and having a mass and charge equal in magnitude to those of an electron.*

BETA RAY - *A stream of high speed electrons or positrons of nuclear origin more penetrating but less ionizing than alpha particles.*

BIOASSAY - *The determination of kinds, quantities or concentrations and, in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo) or by analysis of materials excreted or removed from the human body (in vitro).*

BIOLOGICAL HALF-LIFE - *The time required for the bo0dy to eliminate one-half or any dose of radioactive material in the human body. The time is approximately the same for stable and radioactive isotopes of the same element.*

BREMSSTRAHLUNG - *Secondary photon radiation produced by deceleration of charged particles passing through matter. It is especially prominent with the use of 32p.*

BY-PRODUCTS - *Any material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process or producing or utilizing special nuclear material.*

CALIBRATION - *Determination of variation from standard or accuracy of a measuring instrument to ascertain the necessary correction factors for surveying, detecting and measuring radioactivity and contamination.*

COLLECTIVE DOSE - *The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.*

COLLIMATION - *Confining a beam of particles or x-rays to a defined cross sectional area*

CDE - *Committed Dose Equivalent is the equivalent dose to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50 year period following the intake.*

CEDE - *The sum of the products of weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues.*

COLD - *Term referring to no radiation being present.*

CONTAMINATION - *Disposing of radioactive material in a place where it is not expected or wanted and particularly in a place where its presence could be harmful. The harm may be in vitiating the validity of an experiment or a procedure, or actually being a source of danger to people.*

CONTAINER - *A holder of radioactive material. Could mean a rack or other such device holing much smaller units too small to label.*

CONTROLLED AREA - *A defined area in which the occupational exposure of personnel to radiation is under the supervision of an individual in charge of radiation protection. Such an area requires access control, restricted occupancy and working condition that are specified for radiation purposes.*

CURIE - *The basic unit used to describe the intensity of radioactivity. A curie is equal to 37 billion dps (disintegrations per second), which is approx. the rate of decay of 1 gram of radium.*

DAC - *Derived Air Concentration is the concentration in air, which if breathed by a standard "reference man" for a working year of 2000 hours (inhaling 1.2 cubic meters of air per hour) would result in 1 ALI intake.*

DDE - *Deep Dose Equivalent is the whole body dose equivalent at a tissue depth of 1 cm.*

DE - *Dose Equivalent is the product of the absorbed dose in tissue, quality factor (Q),*

and all other necessary modifying factors at the location or interest. Measured in rem and/or sievert (Sv) (the SI unit equal to 100 rem).

DECAY - *The decrease in the amount of radioactive material with the passing of time , due to the spontaneous emission from atomic nuclei of either beta or alpha particles. Quite often such decay is accompanied by gamma radiation.*

DECONTAMINATION - *Is the removal of contamination radioactive material from a person, object or area and is commonly referred to as "decon".*

DETECTOR - *Material or device that is sensitive to radiation and can produce a suitable response for measurement or analysis.*

DISPOSED WASTE - *Any radioactive waste collected by the Radiation Safety Staff from an Authorized User for final disposal.*

DOSE - *A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.*

DPW - *A Declared Pregnant Woman is a one who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.*

EDE - *Effective Dose Equivalent is the sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.*

EFFECTIVE HALF-LIFE - *Time required for an isotope fixed in the body tissues to be reduced by 50% as a result of the combined action of decay and biological process.*

EFFICIENCY - *A measure of the probability that a count will be recorded when radiation is incident on a detector. Infers that a particular detector measures a particular isotope at a given reliability.*

EH&S - *Environmental Health and Safety encompasses radiation safety , hazardous waste management, industrial hygiene, chemical and biological safety, and occupational and environmental concerns.*

EMBRYO/FETUS - *The developing of a human organism from conception until the time of birth. More accurately; embryo: 2 weeks (when implantation occurs) to 8 weeks; fetus: end of 8 weeks to full term.*

EXPOSURE - *Being subject to ionizing radiation, usually x-ray. The units of exposure are the roentgen (R). One R equals 2.58 X 10-4 coulombs per kilogram.*

EXTREMITY - *Means hand, elbow, arm below the elbow, foot, knee or leg below the knee.*

FREE RADICAL - *An atom, molecule, or group of atom carrying an unpaired electron. It has no net electric charge, because it has the same number of protons as electrons. However, it is reactive because it wants to complete its shell of electrons. Free radicals combine readily with other molecules. They lose energy when they complete this bonding.*

GAMMA RAY - *Short wavelength electromagnetic radiation originating from the nucleus of an atom with a range of wave lengths from about 10-8 to 10-11 cm.*

GEOMETRY - *The fraction of the total solid angle about the source of radiation that is subtended by the face of the sensitive volume of a detector.*

HALF-LIFE - *Generically refers to the physical decay or transformation of radioactive material, and the time required to decay to one-half of the original strength.*

HALF-VALUE LAYER - *The thickness of any material required to reduce the intensity of radiation to one half of its original value.*

HEALTH PHYSICS - *A professional branch of nuclear science which deals with the protection and health of people and the environment, from harmful effects of ionizing radiation. Used synonymously with radiological safety, radiological health, and radiation protection.*

HOT - *Refers to the presence of radiation or contamination.*

INCIDENTAL WASTE - *Low level waste produced by a user which is not significant or quantified. Examples would include gloves, lab bench paper, pipette tips, etc. Incidental waste activity need not be entered on waste control forms.*

INTERLOCK - *A device for precluding access to an area of radiation hazard either by preventing entry or by automatically removing the hazard.*

IONIZATION - *The process or the result of any process by which neutral atoms or molecules acquire either a positive or negative charge.*

LAB WASTE - *Any material, incidental or transitional, which has been placed in a 'Radioactive Waste' receptacle.*

LEAK TESTING - *The procedures necessary to determine if the integrity of a sealed source has been disrupted in any manner resulting in a leak of radioactivity.*

LEAKAGE (X-RAY) - *All radiation coming from within the x-ray tube housing except the*

useful beam of x-rays. Also, the radiation which escapes through the protective shielding of an x-ray tube.

LIMIT - *(Dose Limit) means the permissible upper bounds of radiation doses.*

METASTABLE - *An excited state of a nucleus which returns to its ground state by the emission of a gamma ray over a measurable half life.*

MINOR - *An individual less than 18 years of age.*

MONITORING - *Radiation monitoring is the measurement of radiation levels, concentrations, surface areas or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposure and doses.*

NON-STOCHASTIC - *Health effects, the severity of which varies with the dose and for which a threshold is believed to exist. Lenticular opacification (cataract formation) is an example of this effect.*

NRC - *Nuclear Regulatory Commission*

OCCUPATIONAL DOSE - *The dose received by an individual in a restricted area in the course of employment in which the individual's assigned duties involve exposure to radiation and to radioactive material from licensed sources. Does not include doses received from background radiation, as a medical or dental patient, as a voluntary participant in medical research program, or as a member of the general public.*

PRIMARY RADIATION - *All radiation coming directly from the target of an x-ray tube or the device.*

PUBLIC DOSE - *The dose received by a member of the public from exposure to radiation released to the public in the process of the university handling licensed material. It does not include occupational dose nor doses received from background radiation, as a medical or dental patient or form voluntary participant in human medical research programs.*

QUALITY FACTOR - *The modifying factor (Q) that is used to derive dose equivalent from absorbed dose.*

RADIATION - *Alpha particles, beta particles, gamma rays, x-rays, neutrons, and other particles capable of producing secondary ions.*

RADIATION AREA - *An area accessible to individuals, in which, radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem in one hour at 30 centimeters from the radiation source or from an surface that the radiation penetrates.*

RADIOLYSIS - *The chemical dissociation of molecules are a result of radiation. Particularly important in the breakdown of water into ions and fee radical in mammalian organisms. Both oxidizing and reducing byproducts are created.*

RESTRICTED AREA - *An area, access to which is limited for the purposes of protecting individuals against undue risks from exposure to radiation or radioactive materials. Does not include areas that are used as residential quarters.*

SEALED SOURCE - *Any radioactive material that is permanently bonded or fixed in a capsule or matrix which is designated to prevent the release and dispersal of the radioactive materials.*

SDE - *Shallow Dose Equivalent is the external exposure of the skin or of an extremity, taken as the dose equivalent at a tissue depth of 0.007 centimeter (mg/cm2) averaged over an area or one square centimeter.*

STOCHASTIC - *Health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without a threshold. Heredity effects and incidence of cancer are examples.*

STOCK SOLUTION ALIQUOTS - *Pure unaltered isotopic materials. Recovered or purified material, are included in this category.*

TEDE - *Total Effective Dose Equivalent is the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).*

TRANSITIONAL MATERIALS - *Materials containing the bulk of stock materials, which are used by the Authorized User for data collection in research*

UNRESTRICTED AREA - *An area to which access is neither limited nor controlled for radiation purposes by the university.*

WHOLE BODY - *For purposes of external exposure, the head, trunk (including male gonads), arms above the elbow or legs above the knee.*

X-RAY - *Penetrating electromagnetic radiations having wavelengths shorter than visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum. X-rays originate from the extra-nuclear area (outer shell) of an atom. Formerly call Roentgen rays after the discoverer, Wilhelm Roentgen.*

X-RAY FACILITY - *The area of radiation hazard under the administrative control of the person or organizing possessing an x-ray source and duly authorized to do so.*

REFERENCES

1. Utah Division of Radiation Control Rules

R313-12	General Provisions
R313-15	Standards for Protection Against Radiation
R313-16	General Requirements Applicable to the Installation, Registration, Inspection, and Use of Radiation Machines
R313-18	Notices, Instructions and Reports to Workers by Licensees or Registrants -inspections
R313-19	Requirements of General Applicability to Licensing of Radioactive Material
R313-35	Requirements for X-Ray Equipment Used for Non-Medical Applications
R313-36	Special Requirements for Industrial Radiographic Operations
R313-38	Licenses and Radiation Safety Requirements for Well Logging

2. Federal Registry - Code of Federal Regulations (CFR)

10 CFR 20	STANDARDS FOR PROTECTION AGAINST RADIATION
10 CFR 35	MEDICAL USE OF BYPRODUCT MATERIAL
10 CFR	other parts that apply are 2, 19, 30, 31, 32, 34, 39, 50, 61, 70

3. NRC Information Notice

in90009	Extended Interim Storage of Low-level Radioactive Waste by Fuel Cycle and Materials Licensees (2/5/1990)

4. NRC Regulatory Guide

8.25	Air Sampling in the Workplace

5. Department of Transportation

49 CFR 100-199	Hazardous materials shipping regulations.

6. National Council on Radiation Protection and Measurements (NCRP)

Report No. 112	Calibration of Survey Instruments Used in Radiation Protection for the Assessment of Ionizing Radiation Fields and Radioactive Surface Contamination

7. International Commission on Radiological Protection (ICRP)

Publication 60	1990 Recommendations of the International Commission on Radiological Protection
Publication 68	Dose Coefficients for Intakes of Radionuclides by Workers

8. American National Standards Institute (ANSI)

N323-1978	American National Standard Radiation Protection Instrumentation Test and Calibration

9. Scinta, Inc., Silver Springs, MD
1992 Health Physics and Radiological Health Handbook

10. US HEW, Rockville, MD
1970 Radiological Health Handbook

11. American Chemical Society (ACS), Washington, D.C.
1990 Safety in Academic Chemistry Laboratories

12. U.S. Congress, Washington, D.C.
1985 Low-Level Radioactive Waste Policy Act, Amended