

RADIATION SAFETY MANUAL

FOR

RADIOACTIVE MATERIAL USERS AT

CREIGHTON UNIVERSITY

Type A Broad Scope License

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INTRODUCTION

1.1 BROAD SCOPE LICENSE

Creighton University has a Type A Broad Scope Radioactive Materials License (Broad Scope License) issued under 180 NAC 3-013 by the Nebraska Department of Health and Human Services (DHHS) covering the transfer, receipt, possession and use of radioactive materials at Creighton University's Omaha campus.

Copies of the Broad Scope License are available for inspection at the Radiation Safety Office. The Broad Scope License describes the possession limits for each radioisotope, the authorized locations, and lists conditions of the license.

The Radiation Safety Committee (RSC) and DHHS must approve requests for amendments to the Broad Scope License.

1.2 THE RADIATION SAFETY MANUAL (MANUAL)

The Radiation Safety Manual (Manual) is based on the terms of the state Broad Scope License as well as current laws and regulations. The content of the Manual may be changed without DHHS approval if the changes are for purposes of clarification, correction, or updating, and so long as the changes are approved by the Radiation Safety Officer and RSC prior to implementation, satisfy regulatory requirements, do not diminish the effectiveness of the Radiation Protection program, and do not constitute a change to license conditions. More substantial changes to the Manual will require prior approval of the RSC and DHHS. Affected users will be instructed on any revisions to the Manual prior to implementation.

The RSC prepared this Manual with guidance from laboratory scientists and technical staff who use radioactive material. This Manual describes rules and procedures for the procurement, use, storage and disposal of radioactive materials used in teaching and research, and is designed to be used as a reference resource. Additional procedures containing detailed instructions for specific sources or categories of use are available from the Committee through the Radiation Safety Office.

1.3 SCOPE

The responsibility for establishing radiation protection policies and for authorizing the use of specific radiation sources at Creighton University is assigned to the Radiation Safety Committee. All users of radioactive material at Creighton University are subject to this Manual and the policies and actions of the RSC.

It is the responsibility of each individual who works with sources of ionizing radiation to know and follow the policies and procedures issued by the RSC and administered by the Radiation Safety Officer, including the requirements set forth in this Manual. All operations involving radioactive material must be in accordance with the requirements, procedures, and safety standards contained in this Manual and in the Nebraska Regulations for Control of Radiation, 180 NAC.

2.0 Program Management

2.1 GENERAL

Three primary groups participate in the Radiation Safety Program and have varying degrees of management and reporting responsibilities. They are the Radiation Safety Committee (RSC), Radiation Safety Officer (RSO), and Authorized Users (AU).

THE RADIATION SAFETY COMMITTEE AND THE RADIATION SAFETY OFFICER ARE AUTHORIZED BY THE UNIVERSITY PROVOST TO LIMIT OR REVOKE AN INDIVIDUAL'S AUTHORITY TO USE RADIOACTIVE MATERIAL OR SOURCES OF IONIZING RADIATION IF SUCH USE PRESENTS A HAZARD TO INDIVIDUALS, VIOLATES THE RADIATION SAFETY PROGRAM AS OUTLINED IN THIS MANUAL, OR VIOLATES HEALTH AND SAFETY CODES.

2.2 RADIATION SAFETY COMMITTEE (RSC)

The Radiation Safety Committee (RSC) is delegated the authority to oversee the safe use of ionizing radiation. The RSC reports to the University Provost.

2.2.1 Selection and Composition of the Radiation Safety Committee

The Provost of Creighton University appoints the members of the RSC. The RSC reports to the University Provost through the Director of Research Compliance or his/her designee.

The RSC shall be composed primarily of persons trained and experienced in the safe use of radioactive materials, radiation generating equipment, and members of the Administration of Creighton University. The Provost appoints the Chair(s), at least one of which will be a person trained and experienced in the safe use of radioactive materials. The RSC Chair(s) is responsible for insuring that the procedures, functions, and policies of the RSC are carried out.

Membership on the RSC shall include, but is not limited to:

- A. The Radiation Safety Officer;

- B. Representatives from the various Schools, Colleges and Offices of the University who have experience in handling radioactive materials in research, development, training and instruction;
- C. A representative from the School of Dentistry with expertise in dental radiography;
- D. A representative of the Creighton University administration with the authority to ensure that policies and actions taken by the Committee are enforced at the University;
- E. A representative of Environmental Health and Safety;
- F. The Laser Safety Officer; and
- G. A representative of the Office of General Counsel.

A link to the current list of the RSC members can be found at:
www.creighton.edu/radiationsafety

RSC members and Chair(s) serve at the pleasure of the University Provost. The Radiation Safety Officer shall notify DHHS of any changes to the structure of the Committee.

2.2.2 Radiation Safety Committee Authority and Responsibilities

The RSC is the governing body for all aspects of radiation protection at Creighton University. The RSC is responsible to the University Provost. The Radiation Safety Chair(s) is responsible for insuring that the procedures, functions, and policies of the Committee are carried out.

The RSC has authority to identify radiation safety issues, initiate, recommend and, if necessary, impose corrective action, and verify that any corrective action proposed has been implemented through the RSO. The RSC shall be familiar with all pertinent Nebraska Regulations for Control of Radiation (180 NAC), the Broad Scope License Application, Broad Scope License and all amendments and this Manual.

The RSC shall ensure that:

- A. Policies and procedures are established governing the safe use of ionizing radiation sources;
- B. Radiation sources are used in compliance with Nebraska Regulations for Control of Radiation (180 NAC), the Broad Scope License and this Manual;
- C. The use of radiation sources is consistent with the As Low As Reasonably Achievable (ALARA) philosophy and program;
- D. A Radiation Safety Program is established that satisfies the condition of the Broad Scope License;
- E. Radiation use and the Radiation Safety Program are regularly reviewed.

2.2.3 Functions of the Radiation Safety Committee

To fulfill its responsibilities, the RSC shall, consistent with this License:

- A. Monitor the institutional program to maintain occupational doses as low as reasonably achievable;
- B. Review, on the basis of safety and with regard to the training and experience standards of 180 NAC, and approve or disapprove any individual who is to be listed as the RSO;
- C. Review, pursuant to Nebraska regulations and Section 5 of this manual any application by a prospective Authorized User (in vitro research, animal research, or educational uses), and approve the application prior to allowing that individual to work as an Authorized User;
- D. Review the safety-related aspects of the use of all radioactive materials, and either approve or disapprove each proposed use. This includes the use of radioactive materials in human subjects and may be subject to further review by a Radioactive Drug Research Committee;

- E. Review at each meeting, with assistance of the RSO, all incidents involving excessive exposure to individuals, contamination of equipment, and releases of radioactive materials to the environment, with respect to cause and subsequent corrective actions taken;
- F. Review annually, with assistance from the RSO, occupational radiation exposures of all personnel working with radioactive material who are required to be badged;
- G. Establish and monitor programs to ensure the persons whose duties may require them to work in or near areas where radiation sources are used (e.g., security, housekeeping, physical plant) are appropriately instructed as required in 180 NAC 10;
- H. Review on the basis of safety and approve, with advice and consent of the RSO and the management representatives, or disapprove procedures and Radiation Safety Program changes prior to submittal to DHHS for licensing action;
- I. Ensure that the Broad Scope License is amended, if required, prior to any change of facilities, equipment, policies, procedures and personnel, or addition or increase of radioactive materials;
- J. Provide oversight of the Radiation Safety Program implemented by the RSO, including annual review, with assistance from the RSO, of the Radiation Safety Program.

2.2.4 Radiation Safety Committee Meetings

2.2.4.1 Meetings

The RSC shall meet as often as necessary to properly perform its duties, but not less often than once every 6 months. Prior to each meeting, an agenda is delivered to members notifying them of the date, time, and place of the meeting. A quorum shall consist of one-half of the members, to include the RSO and management

representative from the University. Members are expected to attend a majority of RSC meetings. No member shall vote on a matter in which he/she is involved.

2.2.4.2 *Minutes of Meetings*

The minutes of each meeting shall include the following information:

- The date of the meeting;
- Members present, absent and excused;
- Summary of deliberations and discussions;
- Recommended actions and results of votes taken; and

Each member shall be given a copy of the minutes and the Radiation Safety Office shall retain a copy of the approved minutes for the duration of the License.

2.2.5 Human Subjects Research

The Radiation Safety Officer shall be responsible for reviewing and approving the use of radioactive materials and/or radiation in research studies involving human subjects that fall outside standard of care. The RSO may request expert advice from Creighton RSC members or Creighton University faculty as needed. Creighton University does not have a Radioactive Drug Research Committee to evaluate studies involving non-approved and non-IND drugs. Further information can be found in the manual titled "Use of Radiation in Human Subjects Research", found at www.creighton.edu/radiationafety.

2.2.5.1 *Reviews and Approvals - Application*

The Authorized User must complete and submit either RSO Form 11, 12 or 13 to the Radiation Safety Office prior to the start of the research project. RSO Form 13 should be used if the research involves only exposure to radiation produced from radiation generating equipment and the research subjects are 19 years of age or older. In all other instances use RSO Form 11 or 12, as appropriate.

Approval of studies involving humans will be contingent on a review of the protocol and the informed consent language related to the human subject's exposure to radiation. The informed consent must give an accurate description of the exposure received from all procedures involving radiation, must be consistent with the protocol,

and must give the subject an explanation of the risk. If the RSO does not approve the application, the application shall be forwarded to the full RSC for review at its next meeting. The Authorized User must also obtain approval from the Creighton Institutional Review Board before any research involving human subjects can begin.

The Radiation Safety Office shall have access to copies of all approved IRB applications for at least three (3) years after the end of the research study through the IRB Office. It will be IRB's responsibility to inform the RSO when these studies terminate.

2.3 RADIATION SAFETY OFFICER (RSO)

The Radiation Safety Officer (RSO) is specifically appointed by the University to implement the Radiation Safety Program. The RSO will be named on the Broad Scope License.

2.3.1 Radiation Safety Officer Authority and Responsibilities

The RSO reports to the RSC and acts on decisions made by the RSC. The RSO shall, and is delegated the authority to:

- A. Monitor safe use of radioactive materials under the License;
- B. Enforce compliance with regulations, License conditions and institutional policies;
- C. Manage the day to day operations of the Radiation Safety Program;
- D. Identify radiation safety problems, initiate, recommend and, if necessary, implement appropriate corrective action.

2.3.2 Radiation Safety Officer Functions

Responsibilities of the RSO shall include, but not be limited to the following activities:

- A. Immediately stop a procedure or activity involving radioactive material or source if, in the opinion of the RSO, it is unsafe to continue such use;

- B. Investigate overexposures, accidents, spills, losses, thefts, unauthorized receipts, uses, transfers, disposals, and other deviations from approved radiation safety practice;

- C. Establish and implement written policy and procedures for:
 - 1. Authorizing the purchase of radioactive material;
 - 2. Receiving and opening packages of radioactive material;
 - 3. Storing radioactive material;
 - 4. Keeping an inventory record of radioactive material;
 - 5. Using radioactive material safely;
 - 6. Taking emergency action if control of radioactive material is lost;
 - 7. Performing periodic radiation surveys;
 - 8. Performing checks and calibrations of survey instruments and other safety equipment;
 - 9. Disposing of radioactive material;
 - 10. Training personnel who work in areas where radioactive material is used or stored; and
 - 11. Keeping a copy of all records and reports required by the Nebraska regulations, a copy of Title 180, a copy of each licensing request, License, amendments, and the written policy and procedures required by the regulations.

- D. Annually inform management on the radioactive material program;

- E. Establish personnel exposure investigational levels that when exceeded, will initiate investigations and considerations of action by the RSO;

- F. Assist the RSC in the performance of its duties.

2.4 THE AUTHORIZED USER AND RADIOACTIVE MATERIAL USER

All work involving radioactive material must be conducted by either an Authorized User, or by a Radioactive Material User under the authority of an Authorized User. The Authorized User ("A.U.") is responsible for the accuracy and adequacy of all documentation related to the use, transfer, or disposal of radioactive material under

his/her permit. Each Authorized User is ultimately responsible for the safety of those who use radioisotopes under his/her supervision, as well as any person who may be in an area under the Authorized User's institutional permit issued under the Broad Scope License.

2.4.1 Radioactive Material User Responsibilities

All Radioactive Material Users are responsible for their actions and for the safe use of the materials and devices in their possession. At a minimum, every Radioactive Material User shall:

- A. Keep exposures as low as reasonably achievable (ALARA);
- B. Wear the appropriate monitoring equipment (i.e., personal dosimeters) when in restricted areas;
- C. Survey hands, shoes and body for radioactivity and remove all removable contamination after working with radioactive materials before leaving a restricted area;
- D. Utilize all appropriate protective measures as outlined in Section 9.2.1 below.
- E. Report immediately any suspected loss or theft of radioactive materials.
- F. Immediately report any incident of inhalation, ingestion, or injury involving radioactive materials to the Authorized User and to the Radiation Safety Officer;
- G. Comply with RSO requests for body burden measurements by body counter or urine samples for radioassays (Section 4.2).

2.4.2 Authorized User Responsibilities

In addition to the above responsibilities, Authorized Users shall:

- A. Comply with the provisions of this Manual, the Broad Scope License, Authorized User Permit, DHHS regulations and other state or federal requirements regarding the use, transfer and disposal of radioactive material;
- B. Instruct any individuals he/she supervises or involves in research in the principles of radiation safety appropriate to that individual's use of the radioactive material and the type of radioactive material to be used;
- C. Contact the Radiation Safety Office whenever there are changes regarding individuals in their areas (e.g., changes in personnel, addition/deletion of personal dosimeters) and whenever there are changes in operational procedures, new isotopes or facility alterations are anticipated;
- D. Review any Radioactive Material User's use of radioactive material, provide re-instruction as needed, and review records kept to reflect this use;
- E. Be present, or designate another Authorized User or Millicurie User to be present with the supervised Radioactive Material User when radioactive materials are being used;
- F. Only permit those individuals specifically trained and designated by the Authorized User, and authorized by the RSO, to administer radionuclides or radiation to human research subjects.

3.0 ALARA and Radiation Exposure Limits

3.1 AS LOW AS REASONABLY ACHIEVABLE (ALARA) PHILOSOPHY

It is everyone's responsibility to reduce potential and expected radiation exposures to levels As Low as Reasonably Achievable (ALARA). The ALARA principle is applicable even when the potential dose is well below the individual dose limit because it is assumed that some risk may be associated with any dose of radiation, no matter how small.

The following methods can be used as part of the ALARA philosophy. Access to controlled areas must be restricted and secured. External exposure may be reduced by limitation of time, use of distance and use of shielding. Contamination by radioactive material may be avoided by attention to safety precautions, including use of appropriate personal protective clothing, and by good housekeeping in the labs.

3.1.1 Basic Principles of Radiation Protection

3.1.1.1 *External Radiation Protection*

Minimize Time of Exposure. The less time one remains in a radiation field, the smaller the dose received. Perform the experiment or the procedure as quickly and efficiently as possible without increasing the probability of a spill or other accident.

Maximize the Distance from the Source. The dose rate for most gamma and x-ray varies with the inverse square of the distance from a "point" source. Therefore, the farther you position yourself from the source of radiation, the smaller the dose you receive.

Shield the Radiation Source. Place appropriate shielding between oneself and a source of penetrating radiation to decrease the dose. For low energy beta emitters (H-3, C-14, P-33 and S-35) shielding is not typically necessary. For high energy beta emitters (P-32), 3/8" acrylic is the shielding material of choice. For gamma emitters (Cr-51 and I-125) lead shielding is used.

3.1.1.2 *Internal Exposure Protection*

Inhalation. A chemical fume hood is highly recommended when using potentially volatile compounds. Some equipment is capable of generating radioactive aerosols. Use centrifuges, vortex mixers, shakers, and chromatography plate scraping procedures, etc. in such a way that production of and exposure to radioactive aerosols is minimized.

Safe Handling Procedures. Practice safe handling procedures as outlined in Section 9.2 of this Manual.

3.2 LIMITS OF EXPOSURE

3.2.1 General Rule

No individual is to exceed the following annual limits of exposure from occupation use of radiation:

- A. The more limiting of the following:
 - 1. The total effective dose equivalent (TEDE) being 5 rem (0.05 Sv);
or
 - 2. The sum of the deep dose equivalent (DDE) and the committed effective dose equivalent (CEDE) to any individual organ other than the lens of the eye being 5 rem (0.05 Sv); or
- B. The annual dose to the lens of the eye (LDE) is limited to 15 rem (0.15 Sv); or
- C. The shallow dose equivalent (SDE) to the skin or to any extremity is limited to 50 rem (0.5 Sv) per year.

3.2.2 Declared Pregnant Worker

During pregnancy, the occupational dose to the declared pregnant worker shall not exceed 0.5 rem (0.005 Sv). Declaring a pregnancy, thereby implementing the lower dose limit, is voluntary. To declare the pregnancy, the woman must notify the Radiation Safety Office in writing of the fact that she is pregnant and the month of conception. If the embryo/fetus has already exceeded 0.45 rem (4.5 mSv) at the time of declaration, the dose for the remainder of the pregnancy shall not exceed .05 rem (0.5 mSv).

3.3 RESPONSIBILITIES

3.3.1 Authorized Users and Radioactive Material Users

Authorized Users and Radioactive Material Users are expected to make every reasonable effort to maintain radiation exposures and releases of radioactive materials as effluents to unrestricted areas, As Low as Reasonably Achievable (ALARA).

3.3.2 Radiation Safety Officer

In accordance with the institution's ALARA policy, the RSO shall review all occupational radiation exposures from dosimetry reports and will investigate levels of exposure which exceed Creighton University's ALARA policy thresholds. Causes of potential excessive exposure will be identified and corrected when possible. Any exposure deemed unusual by the RSO may be investigated at his/her discretion.

4.0 Personnel Monitoring

The Radiation Safety Office, upon notification, shall issue personal monitoring devices to individuals likely to receive ten percent (10%) of the annual regulatory limits of occupational radiation exposure. In addition, certain individuals working with I-125, I-131 (Iodine) or H-3 (Tritium) exceeding certain quantities, as outlined in Section 4.2 below, will be required to perform an appropriate bioassay.

4.1 ISSUANCE OF PERSONAL MONITORING DEVICES

The following procedures shall be followed in issuing personal monitoring devices:

- A. New personnel who will be working in areas where it is possible that they could receive 10% of the annual regulatory limits of occupational radiation exposure during normal as well as unusual situations in the lab shall submit Form RSO-1 to the Radiation Safety Office, detailing their previous exposure history;
- B. The Radiation Safety Office will review the completed Form RSO-1 and investigate the previous exposure history or otherwise document that there was no previous history of exposure to assure present compliance with regulations;
- C. Based upon its investigation, the Radiation Safety Office will issue one or more of the following types of personal monitoring devices, based upon the expected working conditions:
 - Deep and Shallow TLD or optically stimulated luminescence (OSL) badges sensitive to X, Gamma, and Beta radiation. These badges will be evaluated monthly, bi-monthly or quarterly;
 - Extremity TLD rings sensitive to X, Gamma, and Beta radiation, evaluated monthly or bi-monthly;

- Extremity wrist badges (OSL or TLD) sensitive to X, Gamma, and Beta radiation, evaluated monthly;
- Pocket or digital dosimeters sensitive to X, Gamma, and Beta radiation, evaluated as needed.

D. Radiation workers are expected to wear all assigned dosimeters whenever working with radioactive materials.

4.1.1 Distribution and Inventory of Personal Monitoring Devices

The Radiation Safety Office shall obtain personal radiation monitoring devices from a NVLAP certified vendor and distribute the new devices to the assigned Badge Coordinator for each area where radioactive materials are used.

The Badge Coordinators are responsible for distributing the devices to the appropriate personnel and retrieving the previous period's devices. The Badge Coordinator is responsible for returning in a timely manner all collected devices to the Radiation Safety Office. The Radiation Safety Office will forward the devices to the analysis company for processing.

Late, lost, or damaged dosimeters may incur a fee from the vendor. This fee will be passed on to the wearer's department.

When an individual leaves employment or otherwise discontinues use of a personal monitoring device, their personal monitoring device must be returned to the Radiation Safety Office. Upon request by the individual, the Radiation Safety Office will provide a report of that individual's total exposure, year-to-date, when the information from the last time period of dose measurement becomes available from the analysis company.

4.1.2 Receipt, Review and Distribution of Exposure Reports

Reports of dosimeter exposures are received by the Radiation Safety Office and reviewed by the RSO or assigned individual for any excessive or out of the ordinary exposures. Any exposures exceeding the ALARA policy threshold will be investigated by the RSO or his/her designee to assure compliance with acceptable dose

regulations, to mitigate the circumstances leading to the excessive or out of the ordinary exposure and to formulate methods to prevent their reoccurrence. Unusual exposures not meeting the ALARA threshold will also be investigated at the RSO's discretion to attempt to determine the cause and possible prevention of future occurrences.

The original copy of all exposure reports shall be kept on file in the Radiation Safety Office. The Radiation Safety Office shall make the exposure reports available to the affected individual upon request.

Any individual at Creighton University who is employed by another entity and monitored for radiation exposure by that entity is required to report any such exposures obtained from that entity to the Creighton Radiation Safety Office on a regular basis.

Any individual may request and receive their current radiation exposure history at any time by contacting the Radiation Safety Office in writing.

4.2 BIOASSAYS

4.2.1 Individuals Working with I-125 or H-3

Any individual who works with I-125, I-131 or H-3 in quantities that exceed those in Table 4.T1 must submit to an appropriate bioassay. The Authorized User is responsible for notifying the Radiation Safety Office in advance when anticipating that such quantities will be used.

The need for an iodine bioassay or tritium bioassay is based on the activity put into process at one time or the cumulative amount of radioactive material used in one month. Bioassays shall be performed through the Radiation Safety Office within 6 to 72 hours from the time the work with the radioactive material was performed. The tritium bioassay shall be performed using radio-urinalysis techniques capable of detecting nCi/ml quantities of H-3. Iodine bioassays are typically done as thyroid uptake measurements which may be done at another location with any fees paid by the A.U's department.

Bioassays are very rarely required at Creighton University. Authorized Users who apply for a permit with possession limits that could necessitate bioassays will be required to acknowledge the potential requirement in their application.

4.2.2 Evaluation, Investigation and Emergency Action

The Radiation Safety Office will evaluate all bioassays and institute action as indicated in Table 4.T2. All bioassay results will be recorded and tracked.

The Radiation Safety Office shall follow the investigation and emergency procedures outlined in NRC Regulatory Guide 8.20, "Applications of Bioassay for Radioiodine, Revision 2" and NRC Regulatory Guide 8.32, "Criteria for Establishing a Tritium Bioassay Program."

4.T1 Activity Levels Requiring Bioassays

Iodine

I-125 or I-131	Volatile or dispersible	Non-Volatile or RIA Kits
Open Room or Bench with possible escape of iodine from process vessels (discouraged)	0.1 mCi	1.0 mCi
Fume Hood of adequate design, reliability and face velocity with possible escape from process vessels	1.0 mCi	10 mCi
Glove Box, ordinarily closed but with possible release.	10 mCi	100 mCi

Tritium

H-3	HTO* or Tritiated Compounds	Tritium Gas in sealed vessels
Open Room or Bench with possible escape from process vessels	0.1 Ci	1 Ci
Processes with possible escape carried out in a fume hood of adequate face velocity, design and reliability	1.0 Ci	10 Ci
Glove box ordinarily closed by with possible release	10 Ci	100 Ci

*HTO is tritiated water

**Compounds include Nucleotide Precursors

4.T2 Action Levels for Bioassays

	I-125	I-131	H-3
Annual Limit of Uptake (ALI)	40 uCi	30 uCi	8×10^4 uCi
RSO Evaluation Level (.004 ALI)	.16 uCi	.12 uCi	3.2×10^2 uCi
RSO Investigation and follow-up (.1 ALI)	4 uCi	3 uCi	8×10^3 uCi
Emergency Action (.5 ALI)	20 uCi	15 uCi	4×10^4 uCi

5.0 Radioactive Material Users

5.1 CATEGORIES OF RADIOACTIVE MATERIAL USERS AND USES

There are three categories of Radioactive Material Users at Creighton University as follows:

- Microcurie User - Allowed to work with microcurie quantities of radioactive materials only when personally supervised¹ by a Millicurie User or Authorized User;
- Millicurie User - Authorized to work with microcurie or millicurie quantities of radioactive materials unsupervised, and may supervise a Microcurie User as coordinated with their supervisor; and
- Authorized User - Authorized to work with radioactive materials not involving human use; may supervise Microcurie Users and is qualified to obtain a permit for radioactive materials under Creighton's Broad Scope License (Section 6 below).

Anyone wishing to use radioactive materials at Creighton University must obtain certification of their radioactive user status from the Radiation Safety Office prior to obtaining or working with radioactive materials.

5.2 QUALIFICATIONS OF RADIOACTIVE MATERIAL USER

5.2.1 Age Requirements

All radiation workers must be at least 19 years of age. Department of Labor standards prohibit minors from being exposed to ionizing radiation as a part of their employment.

¹ "Personally supervised" means that the Authorized User or Millicurie User is physically present while the radioactive materials are being used.

5.2.2 Microcurie (uCi) User Status

Microcurie User status may be granted to anyone who meets the following 4-8 hours of training criteria/requirements:

- View Radiation Safety Training Videos covering radiation safety principles, personnel dosimetry issues and review of Laboratory set-up and procedures²; and
- Orientation with the Authorized User or laboratory manager, covering the uses, waste procedures, emergency procedures, and record keeping requirements in that specific research lab; and
- Orientation with the Radiation Safety Office staff, covering Creighton University policies and procedures for radioactive material workers.

Once these criteria have been met, the Radiation Safety Office will issue a certificate of Microcurie User Status. The certificate of Microcurie User Status will be sent to the Authorized User who is responsible for maintaining it in his/her records. Microcurie Users are required to be in the presence of an Authorized User or Millicurie User at all times when working with radioactive materials.

5.2.3 Millicurie (mCi) User Status

Millicurie (mCi) User status may be granted to anyone who meets the requirements for Microcurie User as well as the following criteria/requirements:

- (1) College Degree or equivalent experience at the RSO's discretion; and
- (2) Successfully complete 40 hours of documented formal training (approved by the RSC) as evidenced by one of the following²:
 - (a) Documentation (Transcript, Course Description, Certificate, etc.) of training, including where trained, the duration of the training

² This requirement may be waived if the individual can provide proof of 40 hours of training in radiation safety acceptable to the Radiation Safety Officer.

in clock hours, and the course name, evidencing training in the following four (4) areas:

- Principals and Practices of Radiation Protection;
- Radioactivity Measurement Standardization and Monitoring Techniques and Instruments
- Mathematics and Calculations Basic to the Use and Measurements of Radioactivity; and
- Biological effects of radiation.

OR

(b) Review the Creighton University Study Guide, NRC Regulatory Guides 8.13 and 8.29;

AND

(c) Take and pass the Millicurie User Exam, covering those materials with a minimum score of 70%.

Once these criteria have been met, the Radiation Safety Office will issue a certificate of Millicurie User Status. The certificate of Millicurie User Status will be sent to the Authorized User who is responsible for maintaining it in his/her records. A second certificate documenting the 40 hours of training will be sent to the individual. Millicurie users may work unsupervised, but any use of radioisotopes by a Millicurie User must be under the valid permit of an Authorized User.

5.2.4 Authorized User Status

Those seeking certification as an Authorized User must meet the requirement for Millicurie Use and must provide documentation evidencing 160 hours of experience working with radioactive materials.

Authorized User status may be granted to faculty, students at the graduate level or above, or professional staff who have met the requirements for Authorized User status and are responsible for the radioisotope efforts.

6.0 Authorized User Permits

6.1 GENERAL

All work involving radioactive material must be conducted under the auspices of a permit approved by the RSC and issued by the Radiation Safety Office. Only Authorized Users (as defined in Section 5.2.4) who are employed by Creighton University shall be issued permits under Creighton's Broad Scope license to obtain, possess and use radioactive materials.

6.1.1 Radioactive Materials Allowed

Authorized User candidates may apply for a permit to obtain, possess and use radioactive materials with atomic numbers 1 through 83, half-lives less than or equal to 120 days, and compounds containing them in sealed and unsealed forms. Carbon-14 and Hydrogen-3, which have significantly longer half lives, are also allowed. Authorized Users wishing to work with other radioactive materials must first consult with the Radiation Safety Office to determine the feasibility of allowing such use.

6.1.1.1 *Mixed Hazardous Material*

Mixed Hazardous Material is that which contains a radionuclide and an EPA classified hazardous material or biohazardous material. Mixed Hazardous Materials should be avoided if at all possible and must first be pre-approved by the RSC. Any use of a mixed hazardous material must also be pre-approved by the Radiation Safety Office and the Director of Environmental Health and Safety.

6.1.2 Meeting with Radiation Safety Office Staff and Other Required Approvals

Authorized Users wishing to use radionuclides for research purposes must first meet with a representative of the Radiation Safety Office to discuss the application procedure, training/education requirements, proposed uses, and required documentation for use of Radioactive Materials.

6.1.2.1 *Animal Use.* If work is to involve use of radionuclides with animals, the Authorized User must obtain approval from the Creighton Institutional Animal Use and Care Committee (IACUC).

6.2 AUTHORIZED USER PERMIT

6.2.1 Application for Permit

The Authorized User must complete and submit Form RSO 5 to the Radiation Safety Office. The RSO 5 will require information regarding the Authorized User, types and quantities of nuclides desired, proposed uses of nuclides, facilities where nuclides will be used/stored, methods of meeting procedural and facilities requirements, as well as the training and experience of all individuals who will be supervising work with the radionuclides.

6.2.1.1 *Maximum Possession Limits*

Maximum possession limits on an Authorized User's permit include all radioactive material of a licensed type, whether it is in storage, in use, or stored as waste for decay/disposal. Maximum possession quantities approved by the RSC will be determined based upon the Authorized User's training experience and needs, the needs of other Authorized Users, the limits under the Broad Scope License as well as safety and bioassay considerations.

6.2.2 Permit Approval Process

The Radiation Safety Office will review each RSO 5 application. Research use of radionuclides in animals will require approval from other Committees within the University before any research can begin.

6.2.2.1 *Provisional Approval*

If the application indicates that the proposed uses will be in compliance with State and University requirements, Authorized User training is adequate, facilities and equipment are appropriate, and that there are no significantly unusual or different procedures from those presently being used at the University, the Radiation Safety Office and the Chair of the Radiation Safety Committee may provisionally approve the

use of radioactive materials until the next regularly scheduled meeting of the Radiation Safety Committee.

All provisionally approved applications will be submitted to the RSC at its next meeting, at which time the RSC shall review and either approve, modify or disapprove the application.

6.2.2.2 RSC Review and Approval

All applications shall be submitted to the RSC at its next meeting for review. Any application proposing significantly unusual or different procedures from those currently being used by other Authorized Users cannot be provisionally approved under section 6.2.2.1 and will be submitted to the RSC at its next meeting for review. The RSC shall review and either approve, modify or disapprove the application. The Radiation Safety Office shall notify the Authorized User in writing if his/her application is approved or modified, noting the modifications, if any, made in the application.

6.2.2.3 RSC Disapproval of the Application

The Radiation Safety Office shall notify the Authorized User in writing if his/her application is denied by the RSC, noting the reason(s) for the denial of the application. The Authorized User may re-submit a new Application at any time after RSC disapproval of an Application.

6.2.3 Permit Term

Permits for use of radionuclides are typically granted for a period of no longer than two (2) years. The RSC may grant a shorter license term based on the proposed use set forth in the application. The Radiation Safety Office shall send out the renewal form to the Authorized User before expiration of the permit. The Authorized User is responsible for submitting the renewal form to the Radiation Safety Office as set forth in 6.2.5 below. The permit shall automatically terminate if the Authorized User fails to timely submit his/her renewal form, in which case, all radionuclides under that permit shall be turned over to the Radiation Safety Office.

6.2.4 Significant Changes in the Permit

The Radiation Safety Officer may provisionally approve any significant changes to procedures, uses or radionuclides prior to their inception, which will be reviewed by

the RSC. Significant changes include such changes as adding new rooms or labs, using different radionuclides, or including new Radioactive Material Users. The Authorized User must notify the RSO in writing of the proposed significant changes. Change requests will be submitted to the RSC for review at the next meeting. The RSC may approve, modify or deny the request. Any RSC action regarding requests for significant changes shall be in writing.

6.2.5 Permit Renewal

The Radiation Safety Office shall send the permit renewal form to the Authorized User prior to the expiration date of the current permit. Authorized Users must submit the completed renewal form to the Radiation Safety Office prior to expiration of their current permit. Authorized Users who have not actively utilized radioactive material(s) for 24 months or more, may have his/her possession limits for each such unused radionuclide automatically decreased to no more than 1 millicurie unless the Authorized User can justify, in writing, to the RSC why his/her possession limits should not be decreased. The RSC shall have the final authority in determining possession limits for any permit renewal.

6.2.6 Termination of Permit and Transfer of Radioactive Materials

The Authorized User may terminate his/her permit at any time by notifying the RSO in writing of the intent to terminate the permit, including how he/she will transfer the radioactive material currently in his/her possession. The Authorized User must transfer all radioactive material in his/her possession to either the RSO or another Authorized User upon termination of his/her permit. Authorized Users may reapply to activate their license at any time within 7 years of their last training should the need for isotopes arise. The Authorized User must have an exit survey conducted after all radioactive material has been removed from the room(s). The Authorized User must submit the exit survey results to the Radiation Safety Office before the room is cleared and permit terminated.

7.0 Radioactive Material Safety Training

7.1 INITIAL TRAINING

7.1.1 New Employee Training

Creighton University Human Resources has included a slide in the New Hire Orientation that summarizes the presence of radiation on campus and the need for additional training if the new individual finds their job duties include any functions inside radiation restricted areas. This is not training but provides information for contacting the Radiation Safety Office with questions or if further training is required.

In addition, Authorized Users shall orient all of their staff, including those who do not handle radioactive materials, on the specific procedures followed in their laboratory, including a review of the posted radiation safety posters. "Frequent Training" is a brief powerpoint presentation available online for any individuals who may frequent a radiation area but do not have any responsibilities in working with radioactive materials.

7.1.2 Radioactive Material Users Orientation

All Microcurie Users, Millicurie Users and Authorized Users are required to meet with the Radiation Safety Officer for initial training as outlined in Section 5. Documentation of orientation shall be maintained by the Radiation Safety Office.

7.2 ANNUAL TRAINING

Annual radiation safety training is required each calendar year as more fully described below.

7.2.1 Ancillary Personnel (Housekeeping, Security, Central Receiving and Mail Center)

Ancillary personnel are employees or contractors of Creighton University who do not handle or use radioactive materials but whose job duties may require them to enter

restricted areas and have the potential to be exposed to radiation due to the nature of their support function.

Ancillary personnel are required to participate in mandatory annual radiation safety training. The Radiation Safety Office shall coordinate annual training for ancillary personnel at Creighton through the various department heads. Attendance is tracked.

7.2.2 Non-Radiation Workers

Non-Radiation Workers are those individuals who work in or frequent a restricted laboratory or area but do not handle radioactive materials. Non-Radiation Workers are required to complete annually the online “Frequenter” radiation safety training during each calendar year. Participation in the online course is tracked through Research Compliance and available to the Radiation Safety Office. Identification of the individuals who require this training is the responsibility of the Authorized User.

7.2.3 Radioactive Material Users

All Radioactive Material Users are required to participate in annual radiation safety training provided throughout the year. Initial training will satisfy this requirement during the first calendar year. The training shall be in compliance with §10-003 of the Nebraska Regulations for the Control of Radiation. Attendance is documented and available to the Radiation Safety Office.

8.0 Security of Radioactive Materials

ALL RADIOACTIVE MATERIALS IN ALL CREIGHTON UNIVERSITY LOCATIONS MUST BE SECURED OR UNDER CONSTANT SURVEILLANCE AT ALL TIMES.

8.1 LABORATORY SECURITY

Any radioactive material in use in a laboratory must be attended at ALL TIMES by a Radioactive Material User. When not in use, radioactive material must be secured by having a Radioactive Material User in the lab with line-of-sight ability to monitor the material or securely stored in a locked area as approved by the RSC when Users are present but unable to monitor the materials. All radioactive material rooms must have the doors closed and secured when the room is unattended.

8.2 SECURITY AUDITS

The Radiation Safety Office may conduct random security audits of laboratories and other areas where radioactive material is used or stored. If any area is found to be unsecured, the RSO shall notify the authorized user via email of the finding and the Authorized User shall respond, in writing, to the notice of violation. Any security violations shall be addressed under the Corrective Action Policy of the Inspection and Enforcement manual.

9.0 Facilities & Equipment; Safe Handling Procedures

9.1 FACILITIES AND EQUIPMENT REQUIREMENTS

9.1.1 Facilities for Use/Storage of Radioactive Materials and Security

Facilities for use/storage of radioactive materials should incorporate an area that is secure, will avoid the spread of isotopes and will allow for easy decontamination. The radiation area should be clearly segregated from non-radiation areas. The radioactive area or isotope storage area must be lockable (all entrances/exits) and secured at all times when there is no Radioactive Material User in the area. The Authorized User is ultimately responsible for ensuring security of the area and his/her radioisotopes.

9.1.2 Work Surfaces, Drains and Floors

All work surfaces, including bench tops, laboratory hoods and biosafety cabinets should be constructed of non-porous material and designed to contain spills and for easy clean-up in the event of an unexpected release. Adequate work space should be available and free from clutter to avoid accidental spills and spread of contamination. Floors should also utilize hard surfaces that can be easily decontaminated. Special radioactive sewer drains are not normally required.

9.1.3 Fume Hoods and Air Flow

Fume hoods may be required for volatile materials or higher activity quantities. Procedures that generate airborne contamination such as aerosols, dust, or gaseous products should be conducted in an approved laboratory hood, biosafety cabinet, or static hood.

Negative air flow out of the laboratory may be required for volatile materials or radioactive gases. Discharge must be out of the building, not recirculated.

9.1.4 Shielding of Sources

Radiation shielding is generally required when the activity being used has an exposure rate of greater than 0.25 mR/hr at 1 meter. Lead containers, L-Blocks, plastic beta shields, and shielded waste containers may be necessary and should be appropriate in thickness to reduce exposures to less than 0.1 mR/hr at 1 meter. The Authorized User will be responsible for providing the appropriate shielding.

9.1.5 Survey Instruments

Radiation detecting equipment shall be appropriate in energy sensitivity and minimum detectable activity. Generally, one survey meter which can detect 0.1 mR/hr (or its equivalent) is sufficient for external monitoring. A scintillation detector is required for area wipe tests and must have a minimum detectable activity of 0.005 μ Ci. Section 10 of this manual will provide more information on formal and informal surveys with detection equipment.

9.1.6 Equipment Removal and Repair

Equipment once used in a radioactive materials procedure shall not be used for other work until it has been surveyed by a Radioactive Material User and demonstrated to be free of contamination. Equipment that has been used with radioactive material(s) shall not be removed from a restricted area until it has been surveyed by a Radioactive Material User and free of contamination as approved by the RSO.

Equipment to be repaired shall be monitored for contamination and shall not be released for service until it has been demonstrated to be free of contamination. If it becomes necessary to make emergency repairs on contaminated equipment, the work will be supervised by the Radiation Safety Office to insure that all necessary safeguards are taken. The Authorized User must notify the Radiation Safety Office of any emergency repairs.

9.1.7 Proper Marking of Work Areas and Equipment

9.1.7.1 *Laboratories and Restricted Areas*

A "CAUTION RADIOACTIVE MATERIALS" ("CRM") sign shall be conspicuously posted at all entrances to laboratories/rooms that house radioactive isotopes. A

"CAUTION RADIOACTIVE AREA" and "CAUTION RADIOACTIVE MATERIALS" sign shall be conspicuously posted at all entrances to areas where an exposure of 5 mR/hr or greater is present. For new users, the Radiation Safety Office will place the "CAUTION RADIATION AREA" or "CAUTION RADIOACTIVE MATERIALS" signs in appropriate places before the first shipment of radioactive material is received. Safety posters (Notice to Employees, Emergency Procedures and Safe Handling Procedures for all Radionuclides) as well as "Instructions for Personnel Entering Laboratories Containing Radioactive Materials" are available from the Radiation Safety Office and shall be posted in all restricted areas. The Authorized User must notify the Radiation Safety Office if new, additional or replacement stickers are needed. Additionally, a sticker indicating "No food or drink allowed" must be present on all lab entrances.

9.1.7.2 *Radioactive Containers*

Authorized Users shall clearly identify all isotope containers with "CRM" labels and identify the isotope. Containers that resemble food or beverage containers should not be used for this purpose.

9.1.7.3 *Disposal Sinks*

Disposal sinks shall be demarcated with radioactive material label tape and/or a sign posted designating the sink is suitable for the disposal of radioactive isotopes. The sink trap shall also be tagged with a "CRM" sign or tag. These signs/tags are available in the Radiation Safety Office. Whenever possible, only one sink per lab should be designated as approved for radioactive material disposal.

9.1.7.4 *Equipment*

All equipment contaminated with radioactive material shall be marked with CRM signs, decals, tape, or by other conspicuous means. Labeling is not required for laboratory containers such as beakers, flasks, or test tubes used in laboratory procedures if those containers are in the restricted areas or in the possession of trained personnel at all times and if those items are decontaminated immediately following the procedure. Test tube racks may be labelled rather than labeling each individual tube if all tubes in the rack contain radioactivity and the same isotope.

9.2 SAFE HANDLING PROCEDURES FOR ALL RADIONUCLIDES

9.2.1 Protective Measures

Utilize appropriate protective measures to avoid unnecessary exposure. These may include the following recommended practices:

- Wear lab coats and appropriate gloves when working with radionuclides. You should wear two pair of gloves when handling unbound Iodine compounds and change the outer pair periodically. Two pair of plastic gloves will significantly reduce beta particle exposure. Remove gloves before leaving a restricted area;
- Handle all potentially volatile compounds in a certified fume hood or a glove box with suitable filters or traps, if necessary;
- Confine contamination by using absorbent coverings, spill trays, mechanical transfer pipettes, etc. NEVER PIPETTE BY MOUTH;
- Keep all air-reactive and volatile radionuclides in a sealed container except during an experiment in a certified fume hood;
- Maintain good personal hygiene, avoiding all work with radioactive materials if there is an open or unprotected cut or abrasions;
- Dispose of contaminated sharps in an appropriate sharps container designated for radioactive waste.

9.2.2 Monitoring and Decontamination

Perform regular monitoring appropriate to the nuclides used to assure control over contamination. Decontaminate any area and equipment as soon as practicable. Anything that cannot be decontaminated down below acceptable levels as shown in Table 10.2T must be labeled as radioactive material.

9.2.3 Other Measures

- 9.2.3.1 Smoking, eating, drinking, chewing gum, and applying cosmetics (including lip balm) are prohibited in areas where radionuclides are used or stored.
- 9.2.3.2 Do not store food or beverages in the same location (refrigerator, freezer, etc.) as radioactive material.
- 9.2.3.3 It is suggested that you perform a trial run for every new experiment to assure safety, lessen exposure time and eliminate contamination and waste. Anticipate chemical reactions and mechanical problems and solve the problem before proceeding with the experiment.
- 9.2.3.4 Do not remove sealed sources from equipment or dispose of devices containing sealed sources without the assistance of the Radiation Safety Office.
- 9.2.3.5 It is strongly recommended to have a spill control kit available in every lab using radionuclides. The kit should contain extra gloves, absorbent coverings and wipes, plastic bags, forceps, shoe covers and decontamination solution.

9.2.4 Appendices

For more detailed information on safe handling procedures for specific isotopes, refer to the Appendices at the end of this Manual.

10.0 Surveys and Survey Instruments

10.1 REMOVABLE CONTAMINATION SURVEYS

Authorized Users who are using unsealed radioactive materials are responsible for having removable contamination surveys performed, by using wipes, at least once a month, or as otherwise required herein. Survey frequencies shall be determined by utilizing Table 10.1T. Surveys are not required when radioactive materials are not being used. All Authorized Users, regardless of whether or not a survey is required, must submit a completed and signed RSO-3 form each month to the Radiation Safety Office. Authorized Users are responsible for ensuring that all survey information reported to the Radiation Safety Office on RSO-3 is accurate and complete. Locations to be surveyed should be representative of where contamination is expected, such as the areas around sinks, hoods, waste containers, countertops, and storage areas. The Radiation Safety Office is available to assist with the identification of areas to be surveyed. These locations are identified in the Authorized User's current permit application or subsequent amendment request.

10.1.1 Performing a Removable Contamination Survey

To perform a survey for removable contamination, use a piece of filter paper, cotton swab, or similar material to wipe an area of 100 cm² with moderate pressure. Prepare the sample for counting as suggested by the counting instrument's manual. Count the sample using an instrument appropriate to the nuclide(s) being used in the laboratory. The instrument must be sensitive to 1 significant digit of the limits in Table 10.2T.

Locations surveyed will be maintained below the action levels indicated in Table 10.2T. Perform decontamination on locations having survey results that exceed the action limits in Table 10.2T.

10.1.2 Reporting Results of Removable Contamination Survey

Results of all removable contamination shall be reported to the Radiation Safety Office on form RSO-3, which shall be reviewed and personally signed by the Authorized User. When the Authorized User is unavailable for an extended period of time, a Millicurie User or other Authorized User may be designated by the Authorized User

to sign the RSO-3 form. However, the Authorized User must personally initial the form upon his/her return to the lab. Results shall be documented in terms of uCi or dpm. Results may be reported in cpm only if sufficient information is provided to show a threshold level where contamination is greater than 200 dpm/100cm². The Authorized User shall maintain records of all survey results.

10.2 AMBIENT RADIATION LEVEL SURVEYS

Ambient radiation level surveys are performed using a hand held survey meter. All areas where radiation workers are exposed to radiation doses that may exceed 2.5 mR/hour are to be surveyed. Additionally, any area where members of the public may exceed exposures of 100 mR/year must be surveyed. An ambient dose rate at or above 0.1 mR/hour must be in a restricted area, and an ambient dose rate exceeding 5 mR/hour must be reported to the Radiation Safety Office immediately.

10.2.1 Performing an Ambient Radiation Level Survey

The person conducting the area survey shall stand one meter away from any storage location of radioactive material and shall take the reading using a hand held survey meter. The person shall also take background readings. All readings shall be documented and submitted to the Radiation Safety Office.

10.2.2 Ambient Radiation Level Surveys in Research and Teaching Laboratories

Authorized Users are responsible for performing ambient radiation level surveys in their laboratories to estimate exposure levels where radioactive materials are used and/or stored. These surveys must be documented at least monthly. Areas to be surveyed are those labs where more than 1 millicurie of any combination of radionuclides other than H-3 and C-14 are kept to ensure that areas where exposure levels possibly exceeding 0.1 mR/hour are checked. Any reading exceeding twice the background level (mR/hour or cpm) must be reported to the Radiation Safety Office for further testing and evaluation. The reading and location will be evaluated by Radiation Safety with a meter capable of reading in units of mR/hr to determine the level of radiation exposure and finding means of lowering the exposure levels for personnel in the laboratory.

10.3 INFORMAL SURVEYS FOR CONTAMINATION

All Radiation Workers using unsealed radioactive materials should perform informal surveys of radiation exposure levels consisting of occasional survey meter observations when working with radioactive materials. Work areas as well as gloves and clothing should be surveyed periodically to identify contamination. If an item or area with a sustained count that is more than twice background is found, the item or area should be considered contaminated and decontamination efforts should be initiated. These surveys are done by using an appropriate hand-held survey meter in close proximity (within 1 cm) to the area being surveyed. Slowly move the probe over the area of concern.

10.4 SEALED SOURCE SURVEYS

Either the manufacturer of the equipment, the Radiation Safety Office staff or contracted services, shall perform leak testing of sealed sources in accordance with regulations and the License provisions. Records will be maintained in the Radiation Safety Office.

10.5 RADIATION SAFETY OFFICE SURVEYS

10.5.1 Routine and Special Surveys

The Radiation Safety Office may perform routine and special surveys for radiation exposure levels in and around all laboratories where radiation may be present. Surveys are performed using an appropriate survey instrument, with findings documented for any area where readings are above background.

10.5.2 Audit Surveys

The Radiation Safety Office shall perform supplementary contamination surveys during audits of Authorized Users' laboratories when radioactive materials have been used within the previous 12 month period.

10.6 EXIT SURVEYS

The Authorized User is responsible for performing required exit surveys to remove any restricted areas from his/her permit. These surveys are to be done after all radioactive material, including waste, has been removed from the area. The Authorized User shall submit a written notice to the Radiation Safety Office, along with a copy of the data, documenting the survey results. Survey results must be below the action levels indicated in Table 10.2T. No areas will be released from the Authorized Users permit for unrestricted use and no signs shall be removed until an exit contamination survey has been completed and signed by the Authorized User and approved by the Radiation Safety Office.

10.7 INSTRUMENT CALIBRATION

10.7.1 Survey Meters

Survey meters are to be calibrated and checked for proper operation by a qualified individual before use and after any maintenance. Survey meters will be calibrated by the Radiation Safety Office or contracted service annually. Survey meters will be operationally function checked before each use with a check source sufficient to indicate no change in operational performance since being calibrated.

10.7.2 Area Monitors

Area monitors used to evaluate radiation fields in restricted areas shall be checked annually by the Radiation Safety Office or contracted vendors.

10.7.3 Other Instruments

Well detectors, liquid scintillation counters and any other detection equipment used for evaluating removable contamination surveys will use an appropriate reference standard during each use. Radiation Safety Office staff or contracted service will perform an annual inter-comparison of all working LSC's on campus to ensure that readings are consistent.

**TABLE 10.1T REMOVEABLE CONTAMINATION SURVEY FREQUENCY FOR
RESEARCH LABORATORIES**

Amount placed into process in a 1 month period
(not applicable to sealed sources)

Radionuclide Group	Surface Contamination Surveys		
	Daily/After Use	Weekly	Monthly
I.			
Cr-51 In-113m	> 1 Ci.	> 100 mCi	< 100 mCi
Tc-99m H-3		< 1 Ci	
II.			
C-14 C1-36 Ca-45	> 100 mCi	> 10 mCi	< 10 mCi
Cd-109 Co-57 Co-60		< 100 mCi	
Cs-137 Fe-59 Hg-203			
In-111 Ir-192 K-42			
Mn-54 Na-22 Ca-63			
P-32 S-35 Ca-47			
Ru-86			
III.			
I-125	> 10 mCi	> 0.1 mCi	< 0.1 mCi
I- 131		< 10 mCi	
IV.			
Sr-90	> 1 mCi	> 0.1 mCi	< 0.1 mCi
Alpha Emitters		< 1 mCi	

NOTE: For materials not listed above, contact the Radiation Safety Office to assure into which group the material falls.

TABLE 10.2TCONTAMINATION ACTION LEVELS

Type of Surface	Alpha Emitters dpm/100 cm²	Beta & Gamma Emitters dpm/100 cm²
Unrestricted Area	20	200
Restricted Areas	200	2000
Personal Clothing	20	200
Lab Clothing	200	2000
Skin	200	200

11.0 Decontamination and Emergency

11.1 GENERAL EMERGENCY PROCEDURES AND CONTACTS

Each Radioactive Material User should be familiar with the basic emergency responses listed below and methods for applying them in his/her own work area.

11.1.1 Emergency Contact Information

The first consideration in any emergency is to assist injured persons and prevent any further injury. Contact Public Safety at 402-280-2911 immediately in any injury related emergency situation. In the event of any incident, accident or emergency that possibly involves radioactive material, contact the Radiation Safety Officer as soon as reasonably possible:

Radiation Safety Officer:	Jayne E. Samp
Office Phone:	(402) 280-5570
Cell Phone:	(402) 250-6741

The Radiation Safety Office will provide emergency posters for every restricted area. The office telephone number is on that poster. Additionally, the door posting from EH&S lists the office telephone number for Radiation Safety. The after-hours emergency telephone number is on the voicemail.

11.2 MINOR SPILLS

The following action should be taken in the event of a minor spill:

Notify: Notify persons in the area that a spill has occurred.

Prevent the Spread: Cover the spill with absorbent paper.

Clean Up: Use protective clothing, disposable gloves and remote handling tools to clean up the spill. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose of in the radioactive waste container. Also insert

into the plastic bag all other contaminated materials, including the disposable gloves.

Survey: Depending on the radioactive material, check with an appropriate survey meter, for contamination. Conduct a wipe test when the clean up is completed. If contamination remains above limits in Table 10.2T, repeat the clean-up procedures. Contact the Radiation Safety Office if the contamination persists.

Report: Report the incident to the RSO.

11.3 MAJOR SPILLS

A major spill is generally defined as a spill that is outside of contained areas such as hoods or radioactive work areas. Any spill which incorporates hazardous or biohazardous materials as well as radioactive material, no matter the activity of the isotope, must be considered a major spill and treated accordingly. In the event of a major spill, take the following action:

Clear the Area: Notify all persons in the area not involved in the spill to vacate the room.

Prevent the Spread: Cover the spill with absorbent pads, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.

Shield the Source: If possible, the spill should be shielded, but only if it can be done without further contamination and without significantly increasing your radiation exposure.

Close the Room: If the spill does not involve hazardous or biohazardous materials, and is of a nature that the radiation workers feel they are able to handle on their own without undue risk to themselves and they have adequate resources available to clean up the spill, they may do so. However, if there is any question of having appropriate materials on hand or personal safety of the

lab workers, or if hazardous or biohazardous materials are involved, leave the room and lock all doors to the room to prevent entry.

Call for Help: Notify the RSO immediately. Contact EH&S if hazardous or biohazardous material is involved. All individuals involved in the spill must remain in the area until help arrives.

Personnel Decontamination: Contaminated clothing should be removed and stored for further evaluation by the Radiation Safety Office.

11.3.1 Personnel Decontamination

If the major spill is on the skin flush thoroughly then wash with mild soap and lukewarm water. Contaminated clothing should be removed and placed in a plastic bag or other suitable container to prevent further contamination of the area. It is to be marked as radioactive and safely stored in that area for further evaluation by the Radiation Safety Officer. Do not leave the area until the RSO has determined that you have been successfully decontaminated.

12.0 Procurement and Tracking of Radioactive Material

12.1 ORDERING AND RECEIPT THROUGH CREIGHTON UNIVERSITY

12.1.1 Ordering Radioactive Material

Orders for radioactive material may be made electronically through the Creighton CUBuyPlus online tool. All requests must include the Authorized User's name or permit number, department, vendor, product name, catalog number, isotope and activity. No radioactive material may be ordered through the University credit card program unless written authorization is first obtained from the Radiation Safety Office and the Purchasing Department.

12.1.2 Review and Approval by Radiation Safety Office

The Business Service Center will put the requisition into final form. Approval is done online by the Radiation Safety Officer or approved delegate. Upon Radiation Safety approval, a purchase order number will be generated and the order will be electronically sent to the vendor. The Radiation Safety Office will expect next-business-day delivery unless otherwise requested in the purchase order. If not received the following work day, the Radiation Safety staff will contact the vendor to determine the anticipated delivery date.

12.1.3 Receipt of Radioactive Materials

All packages containing radioactive material will be shipped directly to the Radiation Safety Office. The Radiation Safety Office will accept packages Monday through Friday, excluding University holidays, from 8:00 a.m. through 4:00 p.m. The Radiation Safety Office will receive, survey as appropriate, and distribute all packages containing radioactive material within three (3) business hours of receipt and will initiate the Radioactive Material Tracking (Form RSO-2) procedure at this time.

12.2 RADIOACTIVE MATERIALS TRACKING PROCEDURE

12.2.1 Radiation Safety Office Responsibilities

12.2.1.1 Receipt of Radioactive Materials

Upon receipt of all packages containing radioactive material in quantities greater than exempt quantities, the Radiation Safety Office will initiate "Cradle to Grave" tracking of the radioactive material using Form RSO-2.

12.2.1.2 Survey

Each Department of Transportation labeled package of radioactive material received will be surveyed to assure that there has been no contamination or leakage.

12.2.1.3 Tracking Form

The Radiation Safety Office will fill tracking Form RSO-2 containing the following information:

- Date of Receipt;
- Date of Assay;
- Activity on Date of Assay;
- Activity on Date of Receipt;
- Lot Number of Radiochemical;
- Form of Radionuclide;
- Results of Radiation Survey, if required;
- Type and serial number of Instrument Used to Survey the Package, if required;
- Manufacturer of the Radioactive Material;
- Shipper of the Radioactive Material Package;
- Authorized User of the Radioactive Material;
- If a sealed source, the Serial Number will be recorded.

The original tracking form will be delivered with the package and a copy will be filed in the Radiation Safety Office.

12.2.1.4 *Radionuclide Inventory Spreadsheet*

The Radiation Safety Office will enter the information from the tracking form onto a Radionuclide Inventory Spreadsheet (excluding sealed sources) for each Authorized User.

12.2.1.5 *Delivery*

The Radiation Safety Office will turn over possession of the radionuclide along with the tracking sheet to the Authorized User or designated Radioactive Material User with the signature of the person receiving it recorded on Form RSO-2.

12.2.2 Authorized User Responsibilities and Radioactive Material Users

12.2.2.1 *Handling Procedures*

The Authorized User and Radioactive Material Users will exercise the usual Radiation Safety Handling procedures described in Section 9.2 when opening and handling any package containing the radioactive material.

12.2.2.2 *Record Keeping*

The Authorized User shall record on the tracking sheet each disposal or transfer of the radionuclide, recording the following information:

- Date of disposal;
- Activity in microcuries disposed;
- Location of disposal (sewer, decay, transfer to RSO);
- Remaining radionuclide activity.

When the radionuclide is completely disposed or decayed, the Authorized User will return the tracking sheet to the Radiation Safety Office where the Radionuclide Inventory will be updated, and the tracking sheet filed.

12.2.2.3 *Reporting Loss or Theft*

Suspected loss or theft of any radioactive material must be reported **immediately** to the Radiation Safety Office. This includes not only source material, but radioactive material being held for disposal/decay as well.

13.0 Radioactive Waste Disposal

13.1 SEGREGATION AND LABELING OF RADIOACTIVE MATERIALS

All radioactive waste containers must be clearly labeled with a “Caution Radioactive Material” sticker on two sides, and with the isotope each contains. Radioactive waste being held for decay or shipment must be in a container clearly labeled not only with the CRM sticker and isotope, but also with the activity contained, the date the container was closed, and the name of the Authorized User. Hang tags are available from Radiation Safety to use for the labeling. Solid, inorganic, and organic liquid must be segregated. Each short-lived nuclide must be disposed of in a separate container, with the exception of P-32 and P-33, which can be stored together. H-3 and C-14 solid materials may be disposed of in the same container. Sharps and glass must be kept in appropriate containers and not mixed in with bags of regular dry waste. Sharp and glass containers must be marked with the CRM sticker on two sides and the isotope identified.

13.2 METHODS OF DISPOSAL

Radioactive materials may only be disposed of using one of the following methods:

- Decay
- Disposal in a sanitary sewer system
- Transfer to another Authorized User
- Transfer to the Radiation Safety Office for decay in storage, or for shipment

All disposals must be documented on the tracking form (RSO-2) regardless of the disposal method chosen.

13.3 DECAY

13.3.1 Long-Lived Isotopes

Long-lived (half-life > 120 days) isotopes and contaminated items cannot be held for decay without an approved waiver from DHHS, and will be shipped for disposal.

13.3.2 Short-lived Isotopes

Short-lived (half-life < 120 days) isotopes and contaminated items may be held for decay in a holding container. Before disposal in the holding container all "Radioactive Material" labels must be defaced or obliterated. The outside of the holding container must be clearly marked "Radioactive Material" and must identify the isotope contained. Materials to be disposed of through decay should be transferred to Radiation Safety unless approval for storage is granted by the RSC. Transfer to the RSO must be documented on the tracking sheet (Form RSO-2). All waste will be held for a minimum of 10 half-lives of the longest lived radionuclide in the material. The material will then be surveyed with an appropriate survey instrument to determine if there is any radiation exposure above background. Exposure values must be recorded in mR/hr.

If no radiation above background is detected, the material may be disposed of as non-radioactive waste. Before disposal, all remaining "Radioactive Material" labels must be removed or obliterated. The tag must be detached and the information on the back of the tag is to be filled-in with the survey data in mR/hr and instrument identification. If the disposal is handled by the Authorized User, this tag must be included in the Authorized User's records. If the waste has been transferred to the Radiation Safety Office, disposal records will be kept there.

If radiation over background is detected after 10 half-lives, consult the Radiation Safety Office to determine why there is still radiation and what will be required to dispose of the radioactive material.

13.4 SANITARY SEWER DISPOSAL

13.4.1 Requirements

Radioactive material may be disposed of in the sanitary sewer system provided it meets EPA requirements of not being harmful to the wildlife or environment, is readily soluble in water and the activity disposed does not exceed the institutional limits of concentration described in Nebraska Control of Radiation, §4-041. Anytime a radioisotope is disposed of in the sanitary sewer it must be accompanied by copious amounts of water.

13.4.2 Limits for Disposal

Monthly limits have been calculated for Creighton University based on monthly sewer volumes to assure compliance with these limits. The Creighton University limits for common isotopes are shown in Table 13.T1

Any Authorized User who wishes to dispose of radioactive materials not shown in Table 13.T1 via the sanitary sewer must contact the Radiation Safety Office to determine the limits and any additional restrictions which may apply.

13.4.2.1 Disposal of More than one Isotope

If more than one isotope is released into the sanitary sewer, the fraction of each limit must be determined, and the sum of these must not exceed unity.

13.4.3 Sewer Log

A log of the radioactive materials disposed of in the sanitary sewer must be kept showing the date, isotope, activity and the person responsible for each disposal. Sewer disposals must also be documented on the tracking sheet.

13.T1 Limits for Disposal of Radioisotopes via Sanitary Sewer

Nuclide	Disposal Limit per Authorized User
H-3	5000 uCi/month
C-14	1000 uCi/month
P-32 and/or P-33 (combined)	250 uCi/month
S-35	250 uCi/month
Ca-45	250 uCi/month
I-125	500 uCi/month

13.5 TRANSFER TO THE RADIATION SAFETY OFFICE

Radioactive material may be transferred to the Radiation Safety Office. Materials transferred to the Radiation Safety Office shall be labeled and separated as required

under Section 13.1. Any hazardous material must be labeled with the hazardous material's chemical name and the concentration in the waste.

Long-lived dry waste should be transferred to the RSO for ultimate disposal through a contracted waste broker. Authorized Users are responsible for all costs incurred by Creighton University in shipping/handling/disposal of long-lived radioactive waste.

13.6 RECORDS OF DISPOSAL - DRY WASTE

If the lab handles disposals rather than transferring to the RSO, the Authorized User shall be responsible for the completion of the radioactive material waste tag.

The front of the tag, completed when the container was closed, must identify the isotope, the activity originally placed in the container, and the date the container was closed. The initials of the Radioactive Material User filling out the tag along with the identity of the Authorized User responsible for the waste also must be identified.

The back of the tag, completed at the time of disposal, must identify the date of disposal, who disposed of the radioactive material, the meter used to survey (including the serial number), the exposure level at the surface of the bag and the exposure level at background. If the user does not have a meter calibrated to read in mR/hr, one may be borrowed from the Radiation Safety Office. The exposure readings must be recorded in mR/hr, not in CPM.

14.0 Audits

14.1 AUDIT OF AUTHORIZED USERS

Audits will be performed in accordance with the Inspection and Enforcement policy for every Authorized User to include every area where radioactive materials are authorized for use/storage.

14.1.1 Purpose

The purpose of the audit is to:

- Assure the safety of all personnel, students, visitors, and the environment;
- Assure compliance with all State and University regulations;
- Assist the Authorized User in finding safer and more economical methods of performing their work; and
- Answer any questions anyone in the area may have concerning radiation and safety.

14.1.2 Scope

The audit will include the following activities:

- Review uses of radiation in the authorized area;
- Review records of radiation source receipt, use and disposal;
- Review monitoring records;
- Evaluation of proper facility use and signage;
- Spot checks of radiation levels and radioactive contamination; and
- Any other matters deemed relevant by the RSO or RSC.

14.1.3 Audit Process

The Radiation Safety Office shall follow the audit procedures outlined in the Radiation Safety Office's Inspection and Enforcement Policy and Procedure, which shall be given to each Authorized User.

14.1.4 Authorized User Audit Reports

Copies of all audit results will be given to the Authorized User being audited, the Radiation Safety Committee and any other individual(s) in accordance with the Inspection and Enforcement policy. The audit results will be filed in the Authorized User's permanent record maintained by the Radiation Safety Office.

14.2 REVIEW OF RADIATION SAFETY OFFICE

The Radiation Safety Office will be reviewed annually by an individual(s) knowledgeable in radioactive materials, including State regulatory requirements, to monitor its performance and make suggestions for improvement.

14.2.1 Radiation Safety Office Audit Reports

Results of the Radiation Safety Office review will be presented to the Radiation Safety Committee. The report shall be filed in the Radiation Safety Office and made available upon request to all users of radioactive material, Radiation Safety Committee members and University Officials.

15.0 Shipping and Transfer of Radionuclides

15.1 SHIPMENT OF RADIOACTIVE MATERIAL

15.1.1 Documentation of Shipment and Packaging

Radioactive material to be shipped off campus will be internally documented using the radioactive material tracking form RSO-2. The material must be packaged and labeled according to Department of Transportation regulations listed in 49 CFR. Prior approval must be obtained from the RSO. Anyone packaging the radioactive material for shipment must have appropriate Department of Transportation training, as determined by the RSO.

15.1.2 Labeling and Survey of Package

Inner containers and shielding shall be labeled "Radioactive Material" and both will be wipe tested for removable contamination. The complete package will be surveyed for radiation dose and labeled accordingly per Department of Transportation regulations. The Radiation Safety Office will also verify that the addressee on the package is licensed to receive the radioactive material. The shipping airbill and hazardous material declaration will be completed in accordance with the DOT regulations.

15.2 TRANSFER TO ANOTHER AUTHORIZED USER

Radioactive material may be transferred from one Authorized User to another through the Radiation Safety Office. The Authorized User must notify the Radiation Safety Office before transferring any radioactive material to another Authorized User. The Radiation Safety Office will verify that the recipient of the radioactive material is authorized to possess that nuclide in the amount specified. The information on the tracking sheet for the radioactive material to be transferred must be copied and the actual activity on the day the material is transferred shall be calculated and marked as disposed on the original tracking sheet. A new tracking sheet for the transferred material will be issued by the Radiation Office to the Authorized User to which the radioactive material has been transferred.