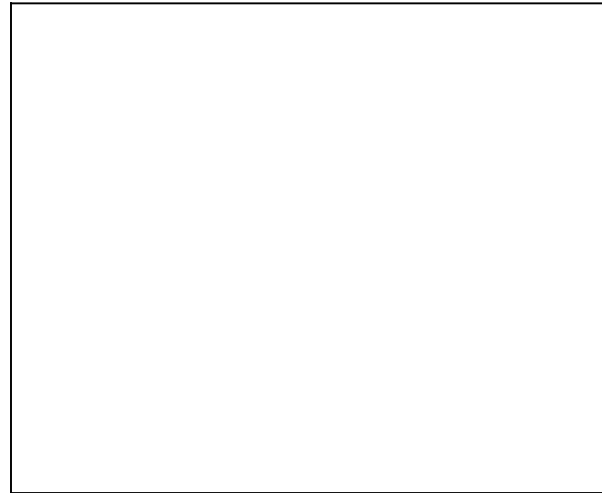


The Radiation Safety Manual guides users on the safe use of radioactive materials and radiation generating equipment in campus research or instructional activities.



Environmental Health & Safety
California State Polytechnic University, Pomona



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Annual Plan Review

| Revision Date | Reviewer | Summary of Changes |
|--------------------|-------------|---|
| September 29, 2017 | M. DeSalvio | Changes to use authorization procedures. |
| July 10, 2018 | M. DeSalvio | New plan template, policy changes, updated pregnant worker program, exposure limits, dosimetry program and updated references. |
| November 2, 2018 | M. DeSalvio | Amended RAM receipt and transfer procedures in alignment with license requirements. |
| February 25, 2019 | M. DeSalvio | Updated RSC meeting procedures. |
| May 14, 2019 | M. DeSalvio | Updated introduction and procedural changes in support of license amendment. Added training links and notation to radiation application (electronic submission process). Added dosimeter wear instructions. |
| October 1, 2019 | M. DeSalvio | Formatting- justified text and updated training links. |
| June 24, 2024 | L. Coey | Updated links and contact information. |

Article I. Introduction

California State Polytechnic University, or Cal Poly Pomona, hereinafter referred to as The University, operates under a broad scope radioactive materials license (License) issued by the California Department of Public Health – Radiologic Health Branch (RHB). Therefore, the regulations contained in Title 17, California Code of Regulations (CCR) in conjunction with Title 10, Code of Federal Regulations, govern the use of all radioactive materials (RAM) and radiation generating equipment (RGE). Furthermore, the Radiation Safety Program utilizes the ALARA (As Low As Reasonably Achievable) principle as an integral part of its day-to-day operations. Violation of ALARA may present cause for revocation of a use authorization or disciplinary procedures as deemed appropriate by the RSC. Pursuant to Title 17, violation of relevant regulations pertaining to radiation safety may result in criminal charges and/or administrative action from the University. This plan is a living document and is updated as deemed appropriate by the RSO and/or RSC. Changes to the plan that impact personnel exposure shall be approved by RHB as a license amendment. Changes which are administrative in nature and does not impact personnel exposure to radiation shall be committed by the RSO and approval by the RSC shall be noted on page 2 by the RSC chair.

Title 17 requires that a policy authorizing the Radiation Safety Committee (RSC) and a Radiation Safety Officer (RSO) exist for any license of broad scope. The RSC consists of at least seven members who represent RAM authorized users and administration as defined below. The University President or designee, based upon recommendations from the RSO, makes appointments to the RSC. The appointment of the RSO requires approval by the University President and confirmation by State RHB.

The RSC discharges its obligations at meetings requested by the Chairman or RSO during which time, matters requiring RSC action are reviewed and approved. The RSC reviews and approves all proposed uses of RAM and RGE. It also investigates all instances of abuse of RAM and RGE. As a result of such investigations, the RSC may suspend the violator from all activities that involve the use of RAM and RGE and may impound or remove the RAM or RGE from the authorized user for a predetermined period of time.

Radiation Safety Officer:

Lance Coey, BSO, RSO
Biosafety & Radiation Safety Officer, Environmental Health & Safety

(909) 869-5054; lwcoey@cpp.edu

Section 1.01 Radiation Safety Committee Responsibilities

- (a) The RSC shall be comprised of at least seven (7) members with a quorum established by simple majority when the RSO is present. Membership shall consist of the following representatives:
 - (i) *Committee Chair;*
 - (ii) *Radiation Safety Officer (RSO);*
 - (iii) *University Police or Campus Emergency Management;*
 - (iv) *Student Health Center;*
 - (v) *Environmental Health and Safety;*
 - (vi) *At least two authorized users (other than RSO and Chair); and*
 - (vii) *Other member(s) as reasonable and appropriate for the successful implementation of the radiation safety program.*

- (b) RSC appointments shall be confirmed by the University President or designee based on recommendation from the RSO and in alignment with CSU Executive Order 1039.
- (c) The Committee shall meet on a semi-annual basis either in-person or through electronic means. Both the Chair and RSO may call for emergency or special meetings as-necessary. The appropriateness of meeting frequencies shall be evaluated by the RSO and increased through general license amendment if necessary. Meeting minutes shall be maintained to document actions taken during the meeting.
- (d) The Committee shall have authority over final approval of the following:
 - (i) *Use authorizations*
 - (ii) *Policies and procedures regarding RAM and RGE usage*

- (e) The Committee shall have authority to handle all disciplinary actions regarding RAM and RGE use. This shall include but not limited to the following:
 - (i) *Suspension of use authorizations;*
 - (ii) *Seizure of RAM and RGE; and*
 - (iii) *Lock-out of equipment.*

- (f) Additional RSC responsibilities shall include:
 - (i) *Familiarity with applicable regulations,*
 - (ii) *Prescribing special conditions,*
 - (iii) *Evaluating and approving minor program changes,*
 - (iv) *Maintaining meeting minutes.*

Section 1.02 Radiation Safety Officer Responsibilities

The RSO has been delegated authority by the University President to ensure the following:

- Occupational and student radiation exposures are as low as reasonably achievable (ALARA);
- Personnel exposure, including University employees, contractors and students, greater than 10% of the occupational exposure limits are reviewed and personnel exposure greater than 20% of the occupational exposure limits are investigated; the investigation results are discussed at the following RSC meeting; Radiation protection procedures associated with the usage and operation of RAM and RGE are developed, distributed, implemented and are up-to-date.
- Possession, use and storage of licensed material are consistent with the License authorizations, CCR's, and the manufacturer's recommendations and instructions for the use of RAM or RGE devices.
- Individuals installing, relocating, maintaining, or repairing devices containing sealed sources are trained and authorized by an NRC or an Agreement State license.
- Training of personnel is conducted and is commensurate with the individual's duties regarding RAM and RGE.
- Any activity involving RAM and RGE that the RSO considers unsafe, is stopped.
- When necessary, personnel monitoring devices are used and exchanged at the proper intervals, and records of the results of such monitoring are properly maintained.
- When necessary, bioassay activities are conducted to ensure that internal occupational exposure limits are not exceeded.
- Licensed material is properly secured.
- When necessary, the RSO will verify that the total effective dose equivalent does not exceed the annual limit for members of the public. This determination may be documented by measurement or calculation.
- RHB is notified of incidents such as radiation exposures in excess of regulatory limits, loss or theft of licensed RAM, damage to or leaking sealed sources, damage to or malfunctioning RGE, fire and explosions or other events that compromise the safety and security of RAM and RGE beyond the capability of the University to control the event.
- Audits of the radiation protection program are performed and documented at least annually.
- Violations of the CCR's, License conditions or program weakness are identified, effective corrective actions are developed, implemented, and documented, as needed.
- RAM is transported in accordance with all applicable DOT requirements.
- RAM is disposed in accordance with the CCRs and Federal requirements.
- Appropriate radiation safety program records are maintained and available for regulatory and RSC review

- An up-to-date License is maintained and that License amendments, renewal requests are submitted in a timely manner
- All license fees are paid and up to date.
- Ensure that on-site evaluations of the Radiation Safety Program are made by physically visiting the authorized use areas on a monthly basis and more frequently as needed.
- Occupational and academic exposure records and contamination surveys are reviewed quarterly at the RSC meetings.
- ALARA practices are developed and followed.
- The qualifications of new users, and any associated Use Authorization, are reviewed by the RSC prior to the use of RAM and RGE.
- When considering a new use of RAM or RGE, the RSO will review to assure that any anticipated occupational exposure is ALARA.
- Commitments made in the License submittal and Radiation Safety Manual are implemented.
- In the event of the RSO ending employment, the University shall promptly notify RHB of the event. Additionally, the University shall submit the qualifications of a qualified individual to serve as the RSO replacement as soon as practical.

Note: In the sustained absence of the RSO, the Chair of the RSC or the University President may appoint a qualified individual to temporarily fulfill the duties of the RSO in order to ensure RAM and RGE security and continued program operation in accordance with 10 CFR § 35.24.

Article II. Radiation Use Approval and Restrictions

Section 2.01 Application Procedures

Any employee requesting unsupervised use of RAM or RGE, must submit the following completed forms to the RSO for consideration as an authorized user.

- (a) Statement of Training and Experience (RHB Form 2050 A)
- (b) University Application for a Radiation Use Authorization,
- (c) Employee Policy Acknowledgement Form (EHS Form F2017:004) to acknowledge receipt and review of the Radiation Safety Manual.

As part of this process, the employee will also be issued a copy of this Radiation Safety Manual. The forms mentioned above are required for any project, investigation or student laboratory involvement with RAM or RGE, including those using license-exempt or generally licensed quantities of RAM. The application must be complete or it will be returned prior to review and consideration by the RSC. Applications are only approved during RSC meetings in alignment with the provisions in Article 1.

Authorized Users can apply by downloading and completing the required forms for the Environmental Health and safety website and submitting the forms to the campus RSO.

Website: <https://www.cpp.edu/ehs/lab-safety/radiation-safety.shtml>

RSO Email: lwcoey@cpp.edu

Section 2.02 Qualifications

Employees who are proposed as Authorized Users, i.e. will use RAM or RGE or supervise the use thereof by University employees or students, shall have the following minimum qualifications:

- A college degree or the equivalent in the physical or biological sciences or engineering.
- At least 40 hours of training and 6-months of practical experience involving the characteristics of ionizing radiation, radiation dose quantities, radiation detection instrumentation, and the biological hazards of exposures to radiation. This training/experience must be relevant to the type of RAM and RGE requested for use at the University and reported using the RB 2050 A form identified above.

Furthermore, employees must establish that his/her facilities, equipment and procedures are adequate to assure safety to all University personnel, contractors and students and property. The RSC and RSO shall ensure that the procedures and equipment are consistent with the License authorizations, CCRs and other State and Federal requirements.

Section 2.03 Use Authorizations (approval and renewal)

Use Authorizations are granted in one-year intervals. Authorized Users must submit a revised application for Radiation Use and/or Radionuclide Authorization Form if there have been any changes in the following:

- (a) Activities of radionuclides being used or requested;
- (b) Chemical/physical forms of radionuclides;
- (c) Research procedures;
- (d) Location of research;
- (e) Type and quantity of equipment; and
- (f) Facility.

If there have been no changes in the above items, the Authorized User may submit a memo to this effect to the RSO. If the Authorized User has received any requests to correct safety violations or any other disciplinary action by the RSC or the RSO, the Authorized User must indicate, within the memo, what has been done to correct the problem and prevent a reoccurrence. A project can be renewed in this manner for a maximum of two years at which time the Authorized User must submit a new application prior to the third year regardless of no changes.

Before any renewal is considered by the RSO or the RSC, the RSO, or designee, will inspect the authorized use area for the following:

- (a) Records of ambient radiation levels and removable contamination measured during the period of use;
- (b) Adequate monitoring and safety equipment;
- (c) All radiation workers are properly trained in the following areas:
 - (i) *Personal Protective Equipment and clothing*
 - (ii) *Operating and emergency procedures*
 - (iii) *Methods of measuring and controlling surface contamination*
- (d) Adequate maintenance of records for receipt, transfer, use and disposal;
- (e) Adequacy of the use area for the RAM or RGE; and
- (f) Verification of any information provided by the Authorized User.

Section 2.04 Restrictions

Several program restrictions are in place to further enhance this program and ALARA.

(a) Pregnancy

In keeping with regulations set in 10 CFR 20 and the intent of the ALARA principle, it will be University policy to limit radiation exposure to pregnant workers and their fetus upon enrollment as a “declared pregnant woman”. For a declared pregnant woman to be monitored with fetal dosimetry, she must first declare her pregnancy in writing to the RSO. Declaration of pregnancy is voluntary and at the sole discretion and responsibility of the employee.

(i) Enrollment

An employee may enroll as a declared pregnancy woman by declaring in writing to the RSO. The employee’s enrollment shall be voluntary and shall not be assumed based on physical appearance or verbal declaration to others.

Upon declaration, the RSO will provide supplemental training, if necessary, and request a fetal dosimeter for the employee. The receipt of fetal dosimetry may take upwards of 15 days to receive. The declared pregnant woman will be provided further instruction on usage of the fetal dosimeter.

(ii) Exposure Limits

Occupational exposure limits for the declared pregnant woman are based on the sum of the deep dose equivalent to the pregnant female and the dose equivalent from radionuclides in the fetus and radionuclides in the pregnant woman. The dose limit is :

- 0.5 rem or 5 mSv after declaration for the duration of the pregnancy; and
- Exposure should be uniform over the course of pregnancy.

(iii) Withdrawal

A declared pregnant woman shall have the right to withdraw a pregnancy declaration at any time by submitting a written request to the RSO. Upon such withdrawal, the declared pregnant woman will cease to be considered a pregnant worker and the dosimetric restriction of 0.5 rem shall be removed. The fetal monitoring dosimeter shall be surrendered upon withdrawing from the pregnant worker program. Employees withdrawing from the program shall continue to wear standard dosimetry as required by the RSO or the manual.

(iv) License Exempt Quantities

License-exempt activities of RAM, as identified in 10 CFR 30.71 Schedule B, shall also be subject to the use authorization process.

(v) Iodine

Due to the body's affinity for iodine uptake to the thyroid, the risk of adverse effects from radioactive iodine warrants special consideration. As such, approval to use radioactive iodine is more restrictive than with other radionuclides that are typically included in the University's radioactive material inventory.

- i) Radiation exposures associated with release of radioactive iodine will be managed in accordance with the limits stated in 10 CFR 20.1202.
- ii) Conditions requiring thyroid scan and/or bioassay are available from the RSO as deemed appropriate.
- iii) Approval for use of I-125 and I-131 shall be restricted.
- iv) In the event of a suspected exposure to radioactive iodine, report the exposure to the RSO immediately at (909) 869-4987.

Article III. Basic Operation Procedures for Authorized Users

Section 3.01 Sources of Occupational Exposure

Overexposure to radiation can arise from the improper use of any of the following sources:

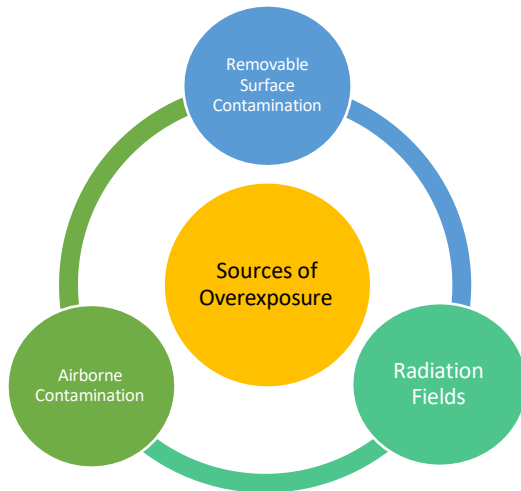


Figure 1: Diagram depicting the three most common sources of occupational exposure to radiation.

(a) Radiation Fields

The Authorized User must maintain radiation fields at the lowest practicable levels. Authorized Users shall observe the following posting requirements.

(i) Unrestricted Areas

Pursuant to 10 CFR 20, Subpart D, all licensees shall ensure that radiation exposure to a member of the public does not exceed 100 mrem/yr and that the dose in an unrestricted area does not exceed 2 mrem in any one hour.

(ii) Restricted Areas

Radiation exposure that exceeds 100 mrem/year or dose may exceed 2 mrem in any one hour shall be identified as a restricted area with appropriate signage and access controls. A sign labeled "Restricted Area" must be posted at access points. Restricted areas shall be secured to control access.

(iii) Radiation Areas

A radiation area is defined as any area where a radiation field of 5 mrem/hr at 30 centimeters or more from the source may be present. This area shall be identified with signage as a "Radiation Area". Radiation areas should be secured to control access when not in use.

(iv) High Radiation Areas

A high radiation area is defined as any area where a radiation field of greater than 100 mrem/hr at 30 centimeters or more from the source may be present. These areas shall be secured with entrance controls and signage indicating a “High Radiation Area” exists. Three options for entrance controls are provided in 10 CFR 20.1601. When such areas could exist, the Authorized User shall propose a particular entrance control relative to the three options and seek RSC approval.

(v) Very High Radiation Areas

A very high radiation area is defined as any area where a radiation field of 500 rads/hr at 1 meter from a source may be present. These areas shall be secured with entrance controls and signage indicating a “Very High Radiation Area” exists. These areas require the strictest access controls. When such areas may be needed, proposed access controls shall be reviewed and approved by the RSC at the design stage.

(vi) Airborne Radioactivity Areas

Any areas that may exceed Derived Air Concentrations (DACs) shall be identified with a sign stating “Airborne Radioactivity Areas”. Such areas shall be secured to control access.
Note: For more information on DACs please contact the RSO.

(vii) Caution, Radioactive Material Areas:

Any areas where radioactive materials are stored in quantities at least 10-times the values identified in Appendix C of 10 CFR 20 shall be properly identified with signage or label “Caution - Radioactive Materials.” Such areas shall be secured to control access in accordance with Subpart I of 10 CFR 20.

(viii) All Areas

Every location where RAM or RGE are used shall bear all required postings as mandated by the RSO and/or EH&S. Examples include but may not be limited to emergency procedures, emergency contact information and operating procedures.

(b) Removable Surface Contamination

Removable surface contamination, which often results from spills and/or leaks, can be a safety concern because it can lead to ingestion, inhalation, or skin absorption of radioactive materials. Therefore, wipe tests must be performed periodically and whenever a spill or leak is suspected.

A dry wipe sample using a surface-loading filter, such as National Diagnostic Nuc-Wipes, must be rubbed over an area of approximately 100 cm². Wipe samples suspected of containing low energy beta emitters, such as H-3 and C-14, must be analyzed using a liquid scintillation counter. Wipe samples suspected of containing higher energy beta emitters, such as P-32, can be analyzed using a GM pancake detector. These instruments are available in the Radiation Safety Office. Please contact the Environmental Health and Safety office for additional information or assistance.

The maximum permissible removable contamination levels from environmental surfaces are as follows:

(i) Alpha Emitters:

- 220 disintegrations/min (100 cm²)

(ii) Beta or Gamma Emitters:

- 2,200 disintegrations/min (100 cm²)

If these contamination levels are exceeded, the area must be decontaminated, the cleaning materials collected for disposal as radioactive waste and the source of contamination must be identified and isolated. The RSO must also be informed promptly so that the RSO may evaluate the situation and clear the facility for use.

(c) Airborne Contamination

Airborne contamination (depending on its level) can pose a health hazard because it can be inhaled or absorbed through the skin. Derived Airborne Concentrations (DACs) airborne radioactive materials are given in Table 2, Column 1 of Appendix B of 10 CFR 20. It is the Authorized User's responsibility to assure that, when needed, appropriate air samples are collected and analyzed to facilitate the estimation of internal doses associated with inhalation of radioactive material. The potential for airborne contamination and mitigation activities must be outlined in the use authorization application. Details concerning the type of monitoring system to use, etc., will be discussed with the RSO before radiation use authorization is granted.

Annual Limit on Intake (ALI)

In alignment with the exposure limits specified in this manual, a radiation worker shall not exceed one (1) ALI. One (1) ALI is equal to 5 rem per year or 2,000 DAC-hours.

Derived Air Concentrations (DAC)

The product of the concentration of radionuclide material in air (expressed as a fraction or multiple for each radionuclide) and the exposure time to that radionuclide, in hours is referred to the Derived Air Concentration. A licensee may take 2,000 DAC-hours to represent an ALI, equivalent to a committed effective dose equivalent (CEDE) of 5 rem (0.05 Sv.)

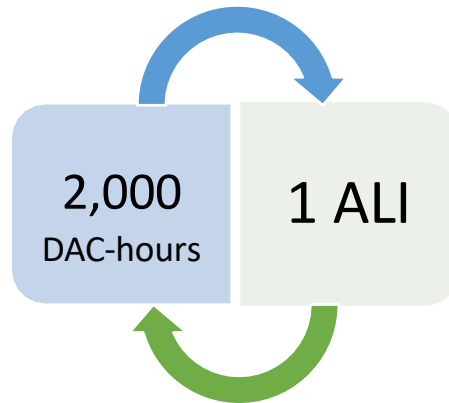


Figure 2: Diagram describing the relationship between Derived Air Concentration (DAC) Hours and Annual Limit on Intake (ALI)

(d) Exposure Control Measures

Radiation exposure can be effectively controlled or mitigated using the following principles.

(i) Time:

Reducing the exposure time to a radiation field will effectively reduce the dose to the radiation worker. Practicing lab activities that will involve the use of a RAM in the absence of those materials is considered to be a safe work practice because it allows the user to practice and demonstrate proficiency that will increase work efficiency and thus reduce exposure time.

(ii) Distance

Radiation exposure decreases as you increase your distance from the source. Maintaining the maximum distance possible through the use of tongs, reach rods etc. will help to maintain distance and in turn, reduce exposure. As an example, doubling your distance from a point source of gamma / x-ray emitting RAM reduces the exposure rate by a factor of four.

(iii) Shielding

Shielding provides added protection to attenuate radiation. Placing shielding between yourself and the source will reduce the radiation field and overall exposure to the user. Plastics, water, glass and many other solids are effective at shielding beta emissions, while

lead, steel and other high-density materials are required for gamma / x-ray emitting nuclides.

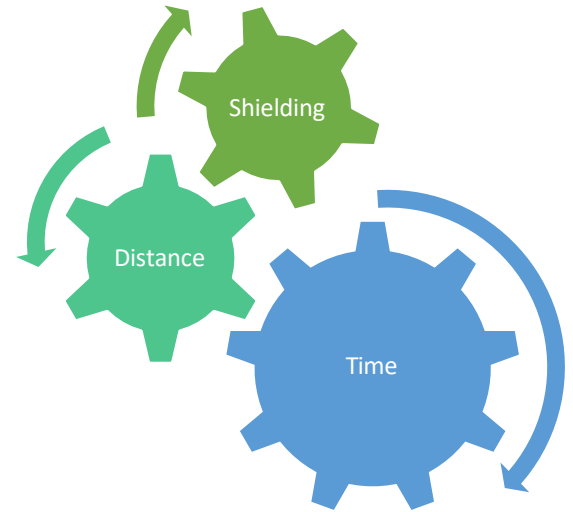


Figure 3: Time, Distance, and Shielding are time-honored principles to reduce radiation exposure.

1) Half-value Layer (HVL)

A half-value layer or HVL is the penetrating ability for a gamma / x-ray to penetrate shielding. Each HVL reduces the intensity to 0.5 or half of the original intensity. HVL is commonly expressed as Pb1/2, or the thickness of lead required to stop half the gamma / x-ray emissions.

2) Tenth-value layer (TVL)

A tenth-value layer or TVL is the thickness of material required to reduce the original intensity of a gamma or X-ray to 10% or 1/10 of the original intensity.

Example Calculation:

TVL's for common shielding materials suitable for Cs-137 are as follows:

Water: 50 cm

Concrete: 20 cm

Lead: 2.5 cm

BASED ON THE EXAMPLE ABOVE, LEAD IS MORE EFFECTIVE AT REDUCING THE INTENSITY OF CS-137 BECAUSE IT REQUIRES A THINNER LAYER TO REDUCE THE ORIGINAL INTENSITY BY THE SAME AMOUNT (90%). IT WOULD TAKE 20 CM OF CONCRETE TO ACHIEVE THE SAME RESULT.

Section 3.02 Exposure Limits

The following limits shall be observed

- (a) Annual Total Effective Dose Equivalent (TEDE)
In accordance with 10 CFR 20.1201, the TEDE in one year shall not exceed the following limits for a radiation worker.
 - (i) *5 rem (5,000 mrem); or in SI terminology,*
 - (ii) *50 mSv (0.05 Sv);*

- (b) In accordance with 10 CFR 20.1201, the annual exposure limit to any organ, known as the Committed Dose Equivalent (CDE), shall not exceed any of the following for a radiation worker:
 - (i) *50 rem, (50,000 mrem); or in SI terminology,*
 - (ii) *500 mSv (0.5 Sv)*

In addition, the following limits shall also apply:

- (c) In accordance with 10 CFR 20.1201, the annual Lens Dose Equivalent (LDE) to the eye shall not exceed any of the following:
 - (i) *15 rem, (15,000 mrem); or in SI terminology,*
 - (ii) *150 mSv (0.15 Sv)*

- (d) In accordance with 10 CFR 20.1201, the annual Shallow Dose Equivalent (SDE) to the skin of the whole body or any extremity shall not exceed any of the following:
 - (i) *50 rem, (50,000 mrem); or in SI terminology,*
 - (ii) *500 mSv (0.5 Sv)*

- (e) Exposure limits for all minors under the age of 18, in accordance with 10 CFR 20.1207, shall be 10% of the above limits with written consent from a parent or legal guardian.

- (f) Exposure for declared pregnant workers shall not exceed 10% of the TEDE identified in subsection (a) above and remain in alignment with the procedures identified in Section 2.04 (a) of this program and meet the requirements of 10 CFR 20.1208.

Section 3.03 Procurement Procedures

RAM and RGE may only be obtained through a purchase order. Procurement Cards (P-Cards) may not be used for this purpose. The University is authorized by its license for specific radionuclides, chemical forms and activities. The RSO must review the requested purchase to ensure license conditions and possession limits are followed. The RSO may require older RAM to be disposed of as a condition of approval in order to maintain compliance with License authorizations.

- (a) Upon preparing a purchase order for University Procurement or Foundation Accounting, the following statement and signature line must be typed on the requisition.

Example:

RADIATION SAFETY OFFICER APPROVAL
(CA RADIATION MATERIAL LICENSE NO. _____)

| | |
|----------------------|-------------|
| <i>RSO SIGNATURE</i> | <i>DATE</i> |
|----------------------|-------------|

(i) University Procurement

Requisitions sent to University Procurement shall have signature line above added to the purchase order.

(ii) Foundation Financial Services

Requisitions sent to Foundation Financial Services shall have the signature line above added to the purchase order. The purchase order may be returned to the requestor who shall receive approval from the RSO prior to sending the purchase order to the vendor.

- (b) All shipments of RAM must be delivered to the Environmental Health and Safety Office during normal business hours,
- (i) Monday through Friday, 8 a.m. to 5 p.m. or,*
 - (ii) Monday through Thursday 7 a.m. to 6 p.m. (Summer 4/10 schedule when observed.)*
- (c) Upon receipt of the materials, the RSO shall thoroughly inspect the items for leaks or excessive radiation levels and inventoried before being released to the authorized user.
- Failure to have materials sent to the Radiation Safety Office may result in administrative action which may jeopardize future eligibility as an authorized user.

Section 3.04 Receipt, Use and Disposal Procedures

All incoming packages of RAM must be sent to the attention of the RSO in the EHS Office. The requirement in 10 CFR 20 Appendix B specifies that the package of radioactive material needs to be surveyed for surface exposure rate and surface contamination within 3-hours of receipt if received during business hours or within 3-hours the next business day if the package was received after normal business hours.

(a) Receipt Procedures:

The RSO, or designee, shall perform the following to ensure radioactive materials are safe to release to the authorized user.

- (i) *Check exposure rate levels conform with material documentation provided by manufacturer and are consistent with Department of Transportation requirements;*
- (ii) *Perform wipe tests to check for presence of surface contamination;*
- (iii) *Record the receipt of RAM;*
- (iv) *Ensure RAM activity is added to the University radionuclide inventory;*
- (v) *Ensure packaging materials are indistinguishable from background before discarding via regular trash. Materials with radiation levels above background will be transported by EH&S to the waste facility for proper disposal.*
- (vi) *Materials shall be transferred to the Authorized User in accordance with Section 3.09. Authorized User will pick-up the transferred materials at the EH&S Office.*

Maximum exposure rates and removable surface contamination are found in 10 CFR 172.403 *Class 7 (radioactive) material* and 49 CFR 173.443 *Contamination control*.

(b) Maximum Radiation Levels:

- o Surface exposure rate - 200 mrem/hr; and
- o Transportation Index (TI)* - 10 at 1 meter.

**Note: TI is expressed as a unitless number but is measured in mrem / hr.*

(c) Maximum Removable Surface Contamination:

- o Alpha Emitters: 2,400 disintegrations/min / 100 cm²; or
- o Beta or Gamma Emitters: 24,000 disintegrations/min / 100 cm².

Note: Wipe samples are taken over 300 cm² in accordance with U.S DOT requirements.

Authorized users shall maintain records of all receipts, uses and disposals of radioactive materials in microcuries utilizing the Radioactive Material Status Record, available from the RSO.

Section 3.05 Animal Use

RAM used in animal studies requires authorization from the RSC and the Institutional Animal Care & Use Committee (IACUC). The University Radiation Safety Office has established the following guidelines for animal research with radioactive materials:

- 1) PI's who desire to become an Authorized User should first submit a protocol to the IACUC and indicate in the relevant sections that RAM will be used.
- 2) PI's must meet with the RSO regarding anticipated IACUC submission to discuss applicable License and RSC requirements.
- 3) RSC review and, if appropriate, approval will occur after IACUC approval has been granted.

- 4) RAM shall only be administered to animals owned by the University.
- 5) Any animals used in RAM studies are to be kept in the Authorized User's laboratory.
- 6) The Authorized User will be responsible for compliance with all appropriate animal care regulations.
- 7) Animals that have been administered RAM, carcasses, bedding and other potentially contaminated materials that have been will be turned over to the RSO, or designee, upon completion of research protocol unless the authorized user can demonstrate that the animals do not contain RAM.
- 8) All animal cages shall be labeled with the appropriate radiation warning labels including authorized user name, radionuclide, activity, date of assay, and physical/chemical form.
- 9) All animal carcasses that have been administered RAM shall be managed as radioactive waste. All feces and urine from these animals will be managed as radioactive waste unless the Authorized User can demonstrate that the radiation level is not statistically significant relative to background radiation.
- 10) The Authorized User is responsible to tag or otherwise keep track of treated animals.
- 11) All animals are to be placed on an absorbent-lined tray when injected with any RAM.
- 12) Adequate ventilation and/or air filters will be used where airborne concentrations may exceed acceptable levels identified in Section 3.01.
- 13) The authorized user is responsible for the training of subordinate personnel regarding handling of treated animals. This training will cover at least the following items:
 - a. Use of gloves, laboratory coats or scrub suits and any other appropriate barrier personal protective equipment.
 - b. Use of ventilation equipment and/or air filters if airborne concentrations exceed acceptable limits.
 - c. Use of animal handling equipment.

Section 3.06 Waste Disposal Procedures

All radioactive waste shall be brought to the Campus Hazardous Materials Facility by EHS personnel for disposal in accordance with License, Federal and state requirements. The authorized user shall organize the waste in the following manner prior to requesting collection for disposal:

- (a) Radionuclides shall be stored in separate containers, unless co-mingling is specifically authorized by the RSO, and
- (b) Each container shall be marked and labeled and such identification shall include radionuclide(s), activity, date, physical form, chemical form and authorized user's name.
- (c) Dry waste must be separated from liquid waste.
- (d) Liquid scintillation vials and cocktail must be separated from other liquid wastes.
- (e) Surface contamination levels and radiation levels must be within acceptable limits to protect the health of personnel handling the waste (see Section III. A.1 and 2).
- (f) All containers must be sufficiently strong and compatible in order to retain their contents even if the container is dropped or damaged.
- (g) All radioactive waste must be collected for transport to the hazardous materials facility as soon as practical after it is generated. Excess amounts of waste shall not be stored in the authorized use area.

Section 3.07 Security of Radioactive Materials

Every authorized use area containing RAM and RGE must be secured when unattended. General requirements for RAM security are contained in 10 CFR 20 at §20.1801 and §20.1802. All other personnel who have access to the use area, by virtue of possessing a key or card key access, must be informed by the authorized user of the location of all RAM and RGE and any associated risks or hazards. Students and staff are not allowed to use or have access to RAM and RGE except under the direct supervision of an authorized user. It follows that contaminated objects, e.g. pipettes, vials, reusable glassware, must NEVER be given to personnel for cleaning, disposal, unless such transfer is associated with an approved use authorization. Additionally, RAM and RGE shall not be transferred to unauthorized personnel at any time.

Section 3.08 Labeling Requirements

In accordance with 10 CFR 20.1904, all containers of RAM must be clearly labeled with the universal radioactive material symbol and must display the following information:

- Radionuclide,
- Activity;
- Date;
- Surface radiation level (if > 2 mrem/hr)
- Physical and chemical form
- Authorized user's name; and
- Any special handling precautions or hazards.

Section 3.09 Transfers (within campus)

RAM shall not be transferred between authorized users without RSO approval to verify the RAM has been added to the use authorization of the transferee; and subsequently removed from the transferor. Modifications to use authorizations shall be in accordance with Article 2 of this document.

All RAM approved for on-campus transfers must satisfy the following conditions before being transported from one location on campus to another.

- (a) RAM must be enclosed in an unbreakable container with a liquid-tight lid that will prevent spillage if the container is overturned, dropped or otherwise disrupted. Plastic (not glass) LSC vials with screw-on caps constitute an "unbreakable container" as specified in this paragraph; however, LSC vials should be placed in a secondary container or vial rack to facilitate transportation.
- (b) Transport containers shall be transported on a sturdy, four-wheeled cart, with sides capable of containing any liquid spilled.
- (c) RAM and RGE shall be transported as follows on private University roads:
 - (i) *RGE shall be prepared for transport utilizing appropriate shipping crates or containers;*
 - (ii) *RAM shall be prepared for transport by utilizing DOT approved shipping containers;*
 - (iii) *Transport vehicles shall be in good working order with a fire extinguisher and a spill kit;*
 - (iv) *RAM package and RGE shall be secured to prevent shifting during transport;*
 - (v) *The transport vehicle, and RAM or RGE, shall be secured when unattended;*
 - (vi) *Local law enforcement and RHB shall be notified immediately in the event of loss or theft.*

Article IV. Dosimetry

Personnel monitoring devices, i.e. dosimeters, may be required for specific RAM and RGE activities. Regulatory requirements regarding the use of dosimeters are contained in 10 CFR 20.1502. A permanent record of all occupational exposure is maintained by the RSO in accordance with 10 CFR 20.2106.

The whole-body dosimeter should be worn on the torso between the waist and neck, preferably near the center of the chest. An extremity dosimeter, i.e. ring dosimeter, should be worn on the hand expected to receive the greatest exposure. The recommendation is to wear an extremity dosimeter on the non-dominant hand. If a shielding garment is also utilized, the dosimeter shall be worn at the collar with the dosimeter located on the outside of the shielding garment and thyroid shield.

Section 4.01 Dosimeter Enrollment

Workers, including students, will be enrolled in the dosimetry program and issued dosimetry if they will likely receive a dose greater than 10% of the Total Effective Dose Equivalent (whole body) described in Section III. A.

(a) Dosimeter Requests

To request a dosimeter, the wearer should contact the Environmental Health and Safety Office. The RSO may require additional details related to the wearer's planned or anticipated activities and to which authorized activity they are associated. The wearer may or may not be a current or prospective authorized user. An example may be a student within an instructional course requesting a dosimeter for the duration of the class.

For class activities, instructors (Authorized Users) are provided with a group of dosimeters to be distributed to students. Dosimeters are sequentially numbered and color coded by class. Students must complete a dosimeter request form and return to the instructor. A copy of the form must be submitted to the RSO before the wearer begins using the dosimeter. The associated information captured on the dosimeter form ensures the RSO can associate any accumulated exposure to the specific student during a specific time-frame.

Section 4.02 Wearer Responsibilities

Failing to wear the dosimeter correctly or misusing the dosimeter can cause exposure results to be inaccurate. Wearers must follow the requirements listed below to ensure accurate dosimeter readings. Requirements are noted with a "must" statement. Guidelines are noted with a "should" statement.

- 1) Wearers must have a dosimeter issued to them.
- 2) A request form must be completed with information necessary to track exposure data.
- 3) Wearers must only wear their assigned dosimeter and should confirm ID number to ensure the correct dosimeter is being utilized.
- 4) Wearers should never take the dosimeter from campus. Dosimeters should never leave the work or instruction area.
- 5) Dosimeters marked 'Control' should never be worn to monitor personnel exposure.
- 6) Dosimeters must be worn correctly. Whole-body dosimeters should be worn at the center of the chest, or at the collar if shielding garments are utilized. Extremity dosimetry should be worn on the non-dominant hand.
- 7) Dosimeters must be returned to their designated areas upon the end of the day.

(a) How to Properly Wear a Dosimeter

Dosimeters are an accurate method of assessing employee exposure to radiation fields however, exposure can only be accurately measured if the dosimeter is worn properly.

(i) *Whole body dosimeters:*

A whole body dosimeter, typically in the form of a TLD or electronic dosimeter should be worn on the upper torso and outside of any clothing with the collection window facing towards the source of exposure. These dosimeters are often accompanied with a clip that allows them to be attached to the collar or lapel.

(ii) *Ring Dosimeters:*

Ring dosimeters are another type of dosimeter and often accompany a standard whole-body dosimeter. A ring dosimeter should be worn on the dominant hand with the label facing the source of exposure (i.e. the palm of your hand).

Ring dosimeters provide an extremity dose where whole body dosimeters provide shallow and deep dose equivalents for whole body exposures.

Section 4.03 Lost Dosimeters

Lost or missing dosimeters may require dose reconstruction to capture exposure received during the badge period. Dose reconstruction shall be initiated at the discretion of the RSO or RSC as applicable. Lost dosimeters that are not located within 30-days will result in a badge replacement fee of \$50.

- (a) Employee dosimeters: The employee's department office will be responsible to pay the replacement dosimeter fee.
- (b) Student dosimeters: The student will be responsible to pay the replacement dosimeter fee within 30-days or an academic hold will be applied.

Section 4.04 Exposure Reports

The RSO reviews exposure data from dosimeters after each read-period to assess overall exposure associated with the use of RAM and RGE. Generally, dosimeters have a minimum detection threshold of 10 mrem. Exposure within a wear period that is less than 10 mrem is considered to be background, thus no exposure is reported. Exposure records are available upon request by contacting the RSO or visiting the dosimeter self-check database using the following link.

Self-Dose Check: <https://myradcare.radetco.com/dosecheck.aspx>

Section 4.05 Dosimetry Exemptions

Under certain situations, users may be exempted from wearing a dosimeter. An example would be operators of an X-ray diffraction device that exposes users to very low levels of radiation (e.g. 0.01 μ Sv per hour) due to adequate internal shielding. The RSO may authorize an exemption for those operators and in lieu may provide an area dosimeter to monitor exposure levels for the entire working environment. Exemptions shall be determined by the RSO on a case-by-case basis and should neither be assumed nor expected.

Section 4.06 Exposure Notifications and Follow-up

The RSO will notify a wearer if an exposure is received greater than 10% of regulatory limits with any calendar quarter, or instruction period.

Section 4.07 Bioassay

Personnel bioassay is generally not required for laboratory research scale use of RAM. The RSO shall evaluate the necessity of personnel bioassay when a use authorization is submitted. Should the conditions identified in NRC Regulatory Guide 8.20 *Applications of Bioassay for Radioiodine* or Regulatory Guide 8.32 *Criteria for Establishing a Tritium Bioassay Program* be met, the RSO shall implement the necessary bioassay testing and analysis.

Article V. Safe Handling and Emergency Procedures

Section 5.01 Lab Safety Rules

- 1) Eating and drinking are prohibited in all University laboratories and the authorized use areas specifically. Smoking is prohibited on campus in addition to laboratories.
- 2) Use remote handling devices, e.g. tongs or forceps when handling radionuclides.
- 3) To reduce exposure, users should demonstrate proficiency with experimentation techniques by performing a dry run to master skills necessary for handling radioactive materials. This reduces risk of spills and also reduces the amount of time the user is exposed to the material(s).
- 4) Hands and clothing should be monitored when radionuclide use has ceased.
- 5) Always wear a dosimeter when working with RAM and RGE unless the lab or activity is exempt under Section IV.
- 6) Evaluate the potential radiation exposure before embarking on an experiment. Use an appropriate survey instrument to screen the work area for surface contamination before setting up for your experiment. If contamination is identified, follow spill clean-up procedures using the proper PPE and re-assess with the survey instrumentation.
- 7) When working with unsealed sources, the following precautions must be taken in addition to those described above.
 - a) Wear lab coat and disposable gloves. Nitrile gloves are generally recommended for laboratory operations.
 - b) Never pipette by mouth.
 - c) Cover the work surfaces with absorbent paper with an impermeable base, i.e. bench coat or chux.
 - d) Store and transport containers of radioactive materials on trays that will hold the materials if the container breaks.
 - e) Special ventilation requirement will be outlined in any use authorization. Generally, the radionuclides and chemical forms used in academic laboratory operations do not require special ventilation.

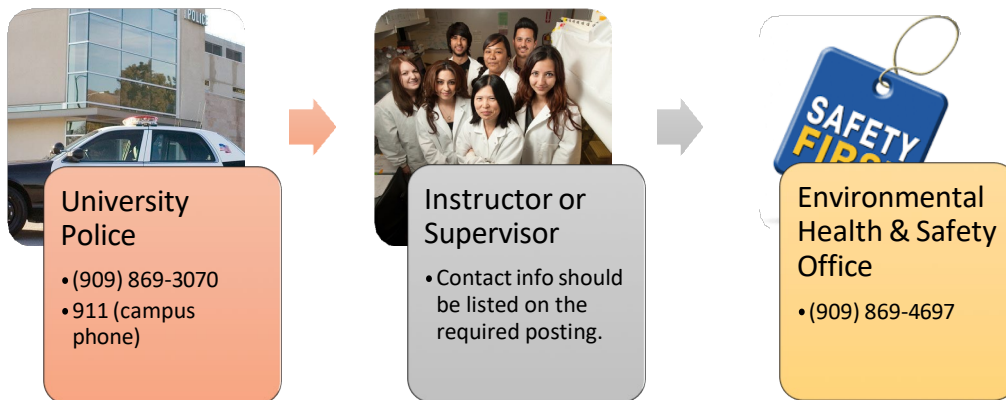
- f) Perform an end-of-use contamination of the work area. Surface contamination distinguishable from background must be cleaned prior to exiting the area.

Section 5.02 Emergency Procedures

Every location where RAM and RGE are used shall post a copy of the Radiation Emergency Poster with Supervisor(s) or Authorized User(s) office and home or mobile phone number.

In the event of a medical emergency or spill, immediately notify the following:

- (a) University Police (909) 869-3070 or 911 from a campus phone
- (b) Lab Instructor or PI
- (c) Radiation Safety Officer (909) 869-4697



Section 5.03 Spill Procedures

In the event of contamination of an area or work location by radioactive materials or suspected radiation exposure, the following procedures will be immediately initiated:

- (a) Employ every effort to reduce or restrict spread or dispersion of radioactive materials.
 - (i) *If liquid, apply absorbent material.*
 - (ii) *If gas or airborne powder, stop the release, if this can be safely accomplished.*
- (b) Restrict access to the contaminated area.
- (c) If material is a gas or airborne powder,
 - (i) *Evacuate the area.*
 - (ii) *Seal and post the location.*
 - (iii) *Shut down ventilation at that location.*

- (d) Identify the specific radionuclide(s).
- (e) Assemble in a nearby location with other contaminated individuals.
- (f) If radioactive material reaches any skin surfaces, wash with soap and warm water (see following section for detailed decontamination procedures).
- (g) Do not leave scene until instructed.
- (h) If exposure is suspected from a radiation generator, medical attention may be necessary. Notify your instructor, supervisor or emergency personnel.

Section 5.04 Personnel Decontamination

In the event of any personnel contamination, ensure the RSO is contacted immediately after attending to the contaminated individual.

Never delay first aid or emergency medical care to a radiologically contaminated individual, or individual suspected to be radiologically contaminated.

Minor skin surface contamination can typically be cleaned using warm soap and water and washing the affected area in any laboratory sink. If the contamination cannot be removed after three attempts, contact should be made with an appropriate receiving hospital for transport. Depending the particular circumstances, the hospital may engage the services of the Radiation Emergency and Assistance Center in Oak Ridge, TN.

EXTERNAL CONTAMINATION WITH RADIOACTIVE MATERIALS

- (a) INTACT SKIN: Notify Radiation Emergency Medical Service by dialing 911. If incorporation is suspected: get nose swab, sputum sample. Avoid spread of contamination. Remove clothing from contaminated person. Decontaminate affected area of skin.
- (b) Decontaminate with mild soap, water, and soft brush (2-3min). Repeat at least 3-4 times. Monitor in-between washes. If necessary use mild abrasive (paste of cornmeal and tide, 50/50, in water), repeat 3-4 times. Dry skin, monitor again. Avoid highly abrasive actions which could create penetrations in the skin.
- (c) CONTAMINATED HAIR: Wearing gloves, shampoo hair with your head deflected backwards. Rinse with 3% citric acid, wash again, rinse, and dry with hair dryer. Monitor and repeat as necessary.
- (d) CONTAMINATED EYES: Spread eyelids, rinse with water from nose to lateral angle of eye.

- (e) WHOLE BODY CONTAMINATION: Remove all clothing, shower immediately with water, brush with mild soap and repeat at least 3-4 times, towel - monitor. Use mild abrasive paste if necessary. If unsuccessful – await physician's orders. Following decontamination take care of skin with skin lotion.
- (f) CONTAMINATED WOUNDS: Any wound acquired in the presence of open radionuclides has to be considered to contaminated until proven otherwise.
- (g) FIRST AID: Rinse wound under running water. Delimit contaminated area with waterproof material. Decontaminate skin around the wound. Remove tape, apply sterile dressing. In case of contamination with highly radiotoxic substances - apply venous tourniquet close to the wound. Notify physician.
- (h) MEDICAL TREATMENT: In combined injury primary care is desirable. With associated burns less aggressive treatment is best. If wounds are contaminated with short-lived radioisotopes of less toxicity, rinsing the wound with physiological sodium chloride or 3% hydrogen peroxide can be used. Monitor, sterile dressing, tetanus shot.
- (i) If the contaminant is highly toxic: maintain venous tourniquet, wash wound, wound should be excised through surgical means by a physician.
- (j) Contact Radiation Emergency Medical Service by dialing 911 from a campus phone or (909) 869-3070 from a cell phone.

INCORPORATION OF RADIOACTIVE SUBSTANCES

- (k) Intake may occur by ingestion, inhalation, or absorption through intact or injured skin.
- (l) INGESTION (swallowing): When smoking eating, drinking, pipetting
- (m) INHALATION: Radioactive dusts, aerosols, gases
- (n) PENETRATION OF SKIN: Gaseous substances; acne, wounds
- (o) COUNTER MEASURES: Determine time of accident, type of uptake, kind of radionuclide, chemical nature and level of activity of contaminant. Notify the RSO immediately at (909) 869-3070 or by dialing 911 from a campus phone. Only in the event of ingestion should the mouth be rinsed and vomiting induced.
- (p) Decision to treat with chelating agents should be made by medical staff. Chelation should be started within one hour of the exposure in order to be effective.

Article VI. Training Requirements

Section 6.01 Authorized Users

The Environmental Health and Safety Office will periodically schedule a course in radiation properties, policies, and procedures. This course will be designed to meet requirements stated in Title 17, California Code of Regulations Section 30255 and Special Requirements for Broad Scope Research and Development Radioactive Material Licenses Type B and C as written by the Radiologic Health Branch of the California Department of Health Services. The RSO will ensure periodic training is available and sufficient to meet regulatory and License requirements. Periodic training shall include information on changes in Regulations, License Conditions, University Policy, Operating Procedures, and Emergency Procedures. Training may be offered in person or online.

- [Radiation Safety Training](#)
- [Non-Ionizing Radiation Safety](#)

Section 6.02 Students and Graduate Students

It is the authorized user's responsibility to inform the RSO when a new student has been hired/recruited to work on an approved project where the student will be using RAM or RGE. The RSO, or designee, shall interview the student and provide appropriate training to ensure their safety and that of other personnel. The decision as to which course is appropriate shall be at the discretion of the RSO. Online trainings include:

- [Radiation Safety Training](#)
- [Non-Ionizing Radiation Safety](#)
- [Laboratory Safety Fundamentals](#)

Article VII. Audits

Laboratory inspection/safety audits are conducted at least once a quarter for every authorized use area where RAM or RGE are utilized. If the RSO believes that a laboratory requires additional or supplementary monitoring, audits may be conducted after each use of radioactive material. The audit should consist of the following areas:

- 1) Wipe tests of the laboratory use areas, and equipment;
- 2) Visual inspection of work and storage areas;

- 3) Monitoring of exposure rates or contamination levels;
- 4) Verification that safety procedures and work rules, as listed in the Radiation Safety Manual, are being followed; and
- 5) Other activities deemed reasonable and appropriate by the RSO or RSC.

Article VIII. RAM Use Area Clearance for Unrestricted Usage

The RSC retains the authority to authorize new usage of RAM in dispersible form. Additionally, the RSC shall be responsible for releasing an approved use area for unrestricted usage if the use area was within or on University property and buildings.

The general process for releasing a use area from radiological control is as follows:

- 1) The authorize user shall contact the RSO and indicate that RAM activities have ceased.
- 2) All licensed and authorized RAM has been removed from the use area.
- 3) The RSO reviews the historical radionuclide usage and contamination survey information.
- 4) The RSO, or designee, prepares a written report summarizing the historical usage of radioactive materials and outlining the survey plan required for surveying the use area for potential radioactive materials contamination.
- 5) The RSO, or designee, executes a final survey consistent with the survey plan but allowing for necessary adjustments as field conditions warrant.
- 6) The survey results shall be documented in a written final status report and the final status report shall be submitted to the RSC for review, comment, and approval if appropriate.
- 7) The historical review, survey plan and final status survey report shall be retained for review by RHB personnel at the next compliance inspection.

The criteria utilized to the clearance determination shall be as follows:

- 1) ANSI / HPS N13.12-2013 (or latest update) Surface and Volume Standards for Clearance;
or
- 2) Nuclide specific Derived Concentration Guideline Levels (DCGL) scaled to 1 mrem / year for the maximally exposed individual.
- 3) The more restrictive contamination level identified in either ANSI or the DCGL will be utilized as the clearance criteria.