



HANDBOOK FOR RADIATION SAFETY

ENVIRONMENTAL HEALTH AND SAFETY OFFICE

(704) 687-1111

November 2012

TABLE OF CONTENTS

INTRODUCTION

SECTION 1: ADMINISTRATION

- 1.1 Radiation Protection Program
- 1.2 Radiation Safety Committee
- 1.3 Radiation Safety Officer
- 1.4 Authorized User in Charge

SECTION 2: RADIOACTIVE MATERIALS

- 2.1 Application for Use
- 2.2 Processing Purchase Requisitions
- 2.3 Inventory Records
- 2.4 Monitoring and Control
- 2.5 Personnel Safety
- 2.6 Waste Disposal
- 2.7 Transfer and/or Shipment
- 2.8 Procedures for Receiving & Opening Radioactive Materials
- 2.9 Pregnant Employee - Dose to Embryo/Fetus (Fetal Protection Policy)
- 2.10 Bioassay Program
- 2.11 Public Dose
- 2.12 Emergencies
- 2.13 Material Loss
- 2.14 Auditing

SECTION 3: RADIATION PRODUCING MACHINES

- 3.1 Application for Use
- 3.2 Monitoring and Control
- 3.3 Personnel Safety
- 3.4 Auditing

SECTION 4: TRAINING (Including listing of Nuclide Safety Data Sheets)

- 4.1 Radioactive Material (RAM) Radiation Workers
- 4.2 RAM Laboratory Workers
- 4.3 RAM Students/Classroom Use
- 4.4 Nuclide Safety Data Sheets
- 4.5 RAM -- Example Training Certification
- 4.6 X-Ray Machine Radiation Workers

SECTION 5: ENFORCEMENT

- 5.1 Radiological Health Surveys
- 5.2 Radiation Safety Committee Disciplinary Mechanisms

SECTION 6: APPENDIX -- UNCC RAS FORMS SPREADSHEET OVERVIEW (RAS forms can be found on the [UNCC EH&S website](#)).

INTRODUCTION

The University of North Carolina at Charlotte is licensed by the State of North Carolina to possess and use certain radioactive materials and ionizing radiation producing machines. The Radiation Protection Section of the NC Department of Health and Human Services – Radiation Protection Section <http://www.ncradiation.net/> regulates the acquisition, use and disposal of radioactive materials and radiation producing machines on the UNC Charlotte campus through periodic inspections to ensure compliance with the *North Carolina Regulations for Protection Against Radiation*.

This Handbook has been prepared as a guide for persons using radioactive materials and/or ionizing radiation machines in an effort to meet the conditions of the UNC Charlotte license. In no case should any statement in this *Handbook* be construed to be a variance from any federal or state regulation.

It is the responsibility of every authorized user of radioactive materials and/or ionizing radiation producing machines to be familiar with and adhere to the requirements set forth in this *Handbook* and the published handbook of the North Carolina Radiation Section, *North Carolina Regulations for Protection Against Radiation*. Both of these documents are available in the UNC Charlotte Environmental Health and Safety (EH&S) Office.

Section 1 - Administration

1.1 Radiation Protection Program

- A. To the extent possible, procedures and engineering controls shall be used to achieve occupational doses and doses to members of the public and releases of radioactive materials that are As Low As Reasonably Achievable (ALARA).
- B. At least annually, the UNC Charlotte Radiation Safety Program shall be reviewed for program content and proper implementation of procedures in accordance with the North Carolina Regulations for Protection Against Radiation.

1.2 Radiation Safety Committee

The Radiation Safety Committee shall consist of faculty and staff members actively engaged in teaching, research or other work involving the use of radioactive materials and/or ionizing radiation producing devices. The purpose of the Committee shall be to ensure that the radiation usage at UNC Charlotte is conducted in accordance with ALARA and at the lowest risk possible to the University community.

Meetings shall be held whenever necessary to offer direction for the safe use of these materials or devices or at least once a year.

The Radiation Safety Committee is responsible for the following:

- A. Review and approval of policies and procedures governing the use of radioactive materials and radiation-producing devices. A majority vote of a quorum will be required to approve an agenda item.
- B. Review and issue final approval of applications for possession and use of radioactive materials and radiation-producing devices within UNC Charlotte
- C. Review and approval of amendments to the radioactive materials licenses and registrations, as submitted to the North Carolina Radiation Protection Section
- D. Review the Radiation Safety Program Activities and Status reports as completed by the Radiation Safety Officer each Radiation Safety Committee Meeting
- E. Assist with preparation and compilation of an annual audit of Radiation Safety program operations and performance when requested by the Radiation Safety Officer
- F. Provision of professional advice to the Chancellor or a designee regarding the Radiation Safety Officers' qualifications and performance
- G. Provision of professional advice to the Radiation Safety Officer on matters regarding radiation safety

1.3 Radiation Safety Officer

The Radiation Safety Officer shall be that person appointed by the University and acceptable to the N.C. Radiation Protection Section as qualified to advise University members on safety matters pertaining to ionizing radiation.

Responsibilities of the Radiation Safety Officer shall be to:

- A. Establish and oversee operating, safety, emergency, and ALARA procedures and review them at least annually to ensure that the procedures are current and conform with 15A NCAC 11 rules;
- B. Oversee and approve all phases of the training program for operations and/or personnel so that appropriate and effective radiation protection practices are taught;
- C. Ensure that required radiation surveys and leak tests are performed and documented in accordance with these rules, including corrective measures when levels of radiation exceed established limits;
- D. Ensure that personnel monitoring is used properly by occupationally exposed personnel, that records are kept of the monitoring results, and that timely notifications are made as required by regulatory entities;
- E. Investigate and submit appropriate documentation to NC RPS for each known or suspected case of radiation exposure to an individual or radiation level detected in excess of limits established by these rules and each theft or loss of source(s) of radiation, to determine the cause(s), and to take steps to minimize a recurrence.
- F. Investigate and submit a report to the appropriate Agency for each known or suspected case of release of radioactive material(s) to the environment in excess of limits established by these rules;
- G. Have knowledge of management policies and administrative procedures of the license;
- H. Review and provide provisional approval as needed of Principal Investigator applications, amendments, protocols and possession limits;
- I. Assume control and have the authority to institute corrective actions, including shutdown of operations when necessary in emergency situations or unsafe conditions;
- J. Ensure that records are maintained as required by 15A NCAC 11 regulations;
- K. Ensure the proper storing, labeling, transport, and use of sources of radiation, storage, and/or transport containers;
- L. Ensure that inventories are performed in accordance with the activities for which the license application is submitted;
- M. Ensure that personnel are complying with these rules, the conditions of the license, and the operating, safety and emergency procedures of the license to provide oversight or assistance to the Hazardous waste disposal program for radioactive materials.

1.4 Authorized User In-Charge

The authorized users in charge shall be those persons licensed and authorized by the State of N.C. to use radioactive materials and/or ionizing radiation producing devices.

Each authorized user shall:

- A. Establish and maintain a culture for radiation safety awareness in the workplace. This shall include control of radiation exposure to the lowest reasonable level (ALARA)
- B. Ensure the following services for laboratory areas and radiation workers under their supervision are provided:
 1. Appropriate personnel dosimetry (RAS Form #2);
 2. Bioassay services;
 3. Personal protective equipment;
 4. Availability of appropriate and calibrated survey instrumentation;
 5. Facility maintenance.
- C. Follow procedures for procurement of radioactive materials and radiation producing devices
- D. Provide correct and current posting of laboratory areas, radioactive material containers and radiation-producing equipment
- E. Ensure maintenance of accurate and current inventory records for all radioactive materials under his or her responsibility (RAS Form #6)
- F. Follow established procedures for packaging, inventory listing, disposal and notification of Environmental Health and Safety for collection of radioactive wastes (RAS Form #7)
- G. Immediately report any potentially hazardous spills, suspected radiation overexposures, loss or theft of radioactive materials, or other incidents having possible radiation safety implications to the Environmental Health and Safety Office
- H. Perform radiation and contamination monitoring as required by applicable regulations, procedures in this manual, and commitments to the Radiation Safety Committee. Maintain accurate records of such monitoring results (RAS Form #4)
- I. Ensure that all radiation workers and laboratory workers are properly trained on specific RAM/radiation producing machine usage protocols, nuclide safety data sheets, emergency procedures and security requirements within their area of accountability and provide yearly awareness training to radiation workers and laboratory workers.
- J. Notify the Environmental Health and Safety Office of any need for changes in the authorized use of licensed materials or registered equipment, including changes in use as well as a possession limit increase. Such changes may require the review and approval of the full Radiation Safety Committee following the Radiation Safety Officer
- K. Obtain written approval for procurement of radioactive materials from the Environmental Health and Safety Office (RAS Form #3)
- L. Follow established procedures for transfer of licensed radioactive materials to other authorized UNC Charlotte users (RAS Form #8)

- M. Arrange for appropriate actions with the Environmental Health and Safety Office in the event of anticipated extended absence from UNC Charlotte. An Authorized User may declare their laboratory “inactive” using RAS FORM 12 when they anticipate extended periods with no use of radioactive materials. A declaration of inactivity relieves the Authorized User from monthly swipe test requirements.. During periods of inactivity radioactive materials storage areas must be swipe tested for contamination every six months
- N. Arrange for disposal or transfer of all radioactive materials promptly upon termination of the authorized use or application (RAS Form #'s 7 and 8)
- O. Ensure proper security levels for a RAM sources, including sealed sources per the requirements of the Radiation Safety Program – Material Security and Loss/Theft Procedure

Section 2 – Radioactive Materials

2.1 Application for Use

All persons desiring to use radioactive materials must fill out the UNC Charlotte Application for Use (RAS Form 1) and return to the EH&S Office for submittal to the N.C. Department of Health and Human Services, Radiation Protection Section. Persons eligible to be authorized users in charge include adequately trained faculty or staff employees of UNC Charlotte. Students or research assistants are not usually included as authorized users on the UNC Charlotte License, but may work under the direction of an authorized user.

2.2 Processing Purchase Requisitions

The EH&S Office shall review all purchase requisitions for radioactive materials to ensure the following criteria are met:

- A. An authorized user of radioactive materials, as dictated by inclusion on the University's broad scope RAM license, places the requisition.
- B. The authorized user has been approved for the nuclide being ordered.
- C. The quantity ordered by the authorized user is within their authorized radioisotope possession limit and the UNC Charlotte possession limit.
- D. The requisition is accompanied by a Certification of Current Inventory (RAS Form 3).
- E. A current Radioactive Materials Inventory Record (RAS Form 6) is placed on file

2.3 Inventory Records

As a condition of the University Radioactive Materials License, the N.C. Radiation Protection Section requires authorized users to maintain accurate records of the receipt, use, transfer and disposal of radioactive materials in their possession. These records must be readily available for periodic review by EH&S. Authorized users must submit Current Radioactive Materials Inventory Records (RAS Form 6) to the EH&S Office at quarterly intervals.

2.4 Monitoring and Control

- A. Survey Instruments.

Suitable radiation equipment shall be available to all laboratories where radioactive materials are used or stored. Side window survey meters do not detect alpha or low level beta radiation (i.e., H-3, C-14, S-35, Ca-45), and shall not be used for this purpose; end window survey meters or smear surveys are the only practical methods of monitoring these radiations. Calibration of survey meters shall be at least once a year and is coordinated by the Environmental Health & Safety Office.

- B. Survey of Working Areas

- 1. At the completion of each experiment, or at regular intervals (at least monthly), the Authorized User shall be responsible for recording a survey of the area of the experiments involving use of open amounts (non-sealed sources) of radioisotopes. This formal survey frequency may be changed by EH&S in accordance with potential exposures. Laboratory

personnel must conduct more frequent surveys to ensure day to day radiation control.

2. Smear surveys should be made of the counting equipment, the working area, the floor under the working area, the floor at the door opening, and other surfaces where contamination is likely.
3. The surface area shall be smeared in approximately 100 square centimeter segments with cotton swabs or filter paper. Cotton swabs: being careful not to touch the tip of the cotton swab, break or cut off the tip so that it will fit into the scintillation vial. Filter paper: handle the paper by the edges and side not used to take the sample. Fold the filter paper in half and place it in the scintillation vial.
4. After placing the cotton swab or filter paper in the vial, put the top on the vial and screw it on tightly. Mark the top to identify the sample.
5. After taking all of the samples, fill each vial with approximately 10 ml of the scintillation counting fluid, and count the samples using full scale settings in a liquid scintillation counter. Record the results as counts per minute (cpm) and as activity (microcuries) on UNC Charlotte RAS Form 4, and submit the results to the EH&S Office at quarterly intervals.
6. If counts indicate significant contamination (more than three times background), the area shall be decontaminated and recounted. This procedure shall be continued until there is no significant removable contamination. Contact the Radiation Safety Officer if problems exist.
7. After counting, each user shall be responsible for disposal of the vials and scintillation cocktail following the guidelines contained in Section 2.6A of this manual.

C. Surveys of Sealed Sources

Each sealed source containing radioactive material, other than H-3, with a half-life greater than 30 days and in any form other than gas shall be tested for leakage at intervals not to exceed six months (licensed sealed sources containing 100 microcuries or less of beta or gamma, and 10 microcuries or less of alpha are exempt). These leak tests are to be conducted by the EH&S Office every 6 months. Records of leak tests shall be maintained in the EH&S Office.

1. At the nearest accessible surface to the source or areas of potential contamination, take smear surveys covering approximately 100 square centimeters with cotton swabs or filter paper.
2. Cotton swabs: being careful not to touch the tip of the cotton swab, break or cut off the tip so that it will fit into the scintillation vial. Filter paper: Handle the paper by the edges and side not used to take the sample. Fold the filter paper in half and place it in the scintillation vial.
3. After placing the cotton swab or filter paper in the vial, put the top on the vial and screw it on tightly. Mark the top with pencil to identify the sample.
4. After taking all of the samples, place approximately 10 ml of the scintillation cocktail fluid in each vial, and count the sample in a liquid scintillation counter. Record the results in CPM and in microcuries on RAS Form 5. (For vials containing 10 ml of fluid which are

being counted at full scale in a liquid scintillator which has a 55% counting efficiency for H-3 and a 95% counting efficiency for C-14, 0.005 microcuries is roughly equivalent to 5,700 cpm for H-3, and 10,400 cpm for C- 14.)

5. If the leak test reveals removable contamination of 0.005 microcuries or more, the source shall be considered to be leaking and must be immediately withdrawn from service. The Radiation Safety Officer shall be consulted for appropriate action including filing a report with the Division of Radiation Protection.
6. After counting, each user will be responsible for disposal of the vials and scintillation cocktail following the guidelines contained in Section 2.6A of this manual.

D. Posting of Regulations

Each authorized user shall post the standard form "*Notice to Employees*" on the main door of any room in which radioisotopes or ionizing radiation are used.

2.5 Personnel Safety

A. Limits of Exposure

1. No exposed employee shall be permitted to receive a radiation dose in one calendar year in excess of those listed below.

an annual limit, which is the more limiting of:

- (A) the total effective dose equivalent being equal to five rem; or
- (B) the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rem; and

the annual limits to the lens of the eye, to the skin, and to the extremities which are:

- (A) an eye dose equivalent of 15 rem, and
- (B) a shallow-dose equivalent of 50 rem to the skin or to each of the extremities.

2. In no case shall an individual under the age of 18 years be permitted to receive an occupational radiation dose in excess of 10 percent of the limits set forth above.
3. The occupational exposure of a declared pregnant woman shall not exceed 0.5 rem during the pregnancy. (See Section 2.9)
4. The total effective dose equivalent to individual members of the public shall not exceed 0.1 rem in a year. The dose in any unrestricted area from external sources shall not exceed 0.002 rem in any one hour.

B. Film Badge Protection

1. Situations that require the use of film badges are as follows:
 - a. All persons who are likely to receive a radiation dose in excess of 10% of the radiation exposure limits specified in Section 2.5 A.1. (above).
 - b. All persons who enter a designated *High Radiation Area*.
 - c. Persons who work **only** with pure alpha emitters or **only** with pure beta emitters

having a maximum energy of less than 0.2 MeV (i.e., H-3, C-14, S-35, Ca-45) are discouraged from wearing film badges. These badges cannot detect these radiations and therefore may give a false sense of security.

2. It shall be the responsibility of each authorized user to determine which persons (students, technicians, graduate assistants) working under him/her will require the use of badges. Contact EH&S for guidance in situations where this is uncertain.
 3. Each new user shall submit an Application for Film Badge Service (RAS Form 2). All training certification documents must accompany the RAS Form 2 for the badge application to be processed.
 4. Authorized users shall notify EH&S promptly when it is necessary to cease film badge coverage for persons no longer exposed.
 5. The EH&S Office shall contract for dosimetry service in accordance with university and state purchasing regulations. Dosimetry badges and/or rings shall be exchanged at least quarterly and dose levels determined by the dosimetry service provider.
 6. When not in use, film badges shall be stored in areas where they will be protected from radiation. Film Badges shall not be worn during non-occupational exposure such as medical X-ray, dental X-rays, etc. Film badges should never be taken home.
 7. Film badge exposure records shall be maintained within the EH&S Office. Annual reports of exposure will be provided to each film badge/ring user as issued by the badge service. Any exposure above detection limits shall be detailed in the EH&S cover letter that will accompany the film badge service annual report. Any quarterly whole body doses greater than 6% of the annual dose (300 mREM) shall be reported immediately to the appropriate authorized user and film badge wearer upon report receipt by the Radiation Safety Officer. Included in this notification will be an inquiry into if there are devices or techniques available to minimize dose amounts.
- C. The occupational intake of radioactive materials shall be monitored and the committed effective dose equivalent assessed for individuals likely to receive an intake in excess of 10% of the applicable annual limit (ALI).
- D. General Safety Rules. The following rules are to be followed by all persons working with radioisotope sources of radiation.
1. Eating, drinking and smoking are not permitted in any laboratory or room where radioactive materials are used or stored. Additionally, storage of food or drink for is not allowed in the laboratory.
 2. If radioactive materials are in use, all open wounds, no matter how slight, shall be monitored to determine if the wound is contaminated. Because radioactive materials are more readily absorbed in wounds, and decontamination is difficult, special precautions may be appropriate until the wound heals.
 3. All equipment, furniture or supplies which might come in contact with loose radioactive material shall be considered potentially contaminated and shall be smeared for contamination before being removed from the laboratory.
 4. All persons shall monitor themselves with a survey meter for contamination before leaving a laboratory where loose radioactive material (beta emitters over 0.2 MeV, or

gamma emitters) is used or stored or suspected to be present.

5. All Persons designated to wear film badges shall wear them at all times when working with or near sources of radiation (beta emitters over 0.2 MeV or gamma emitters).
6. Radioisotope solutions shall not be pipetted by mouth.
7. Protective clothing appropriate to the conditions shall be worn at all times when working with loose radioactive materials. In all uses, appropriate gloves shall be the minimum protection required. No opened toed shoes are permitted in the laboratory while working with radiation.
8. Remote equipment (long-handled tongs, remote pipettes, etc.) shall be used routinely when handling highly radioactive materials.

2.6 Waste Disposal

Radioactive waste shall be retained in the laboratory in which it is generated or in room 1 of the EH&S Solvent Storage Building until it can be discarded. All radioactive waste shall be clearly marked and labeled and records of the waste disposal maintained (see UNC Charlotte RAS Form 7). Each authorized user shall be responsible for properly segregating radioactive waste by isotope and the preparing any radioactive waste he/she generates for storage or disposal. Long and short term half life radioisotopes must not be mixed in the same waste containers.

- A. Scintillation vials containing H-3, C-14, or I-125 may be treated as non-radioactive waste if they contain less than 0.05 microcuries/gram of medium. Authorized users shall be prepared to demonstrate, using the counting efficiency settings in use, that they can accurately measure activity of a sample. (For vials containing 10 ml of fluid which are being counted at full scale in a liquid scintillator, which has a 55% counting efficiency for H-3 and a 95% counting efficiency for C-14, 0.05 microcuries is roughly equivalent to 57,000 cpm for H-3, and 104,000 cpm for C-14.) Vials containing less than the radioactivity stated above may be disposed of as nonradioactive hazardous waste per hazardous waste regulations unless the scintillation liquid is non-hazardous (such as the Fisher Scientific Scintiverse BD). Then it may be disposed of in the sink as non-radioactive, non-hazardous wastes. After removal of all labels indicating the presence of radioactivity, the empty vials can be placed in normal trash cans.

Vials containing more than the amounts stated above shall be held until picked up for disposal.

- B. Other Liquids

Liquids other than scintillation vials shall be stored in capped and labeled appropriate containers. No radioactive waste may be discharged into the sanitary sewer .

- C. Solid Wastes

Solid wastes shall be stored in covered plastic lined containers.

- D. Decay-in-Storage

Radioactive wastes of isotopes with a half-life of less than 120 days may be held for decay provided:

1. Waste is properly contained, labeled, and is held for decay a minimum of 10 half-lives.
2. Before disposal waste is surveyed to determine no activity above background.
3. Disposed as ordinary waste with all radiation labels removed if there are no hazardous components. If there are hazardous chemicals present in the waste, remove the radiation labels and contact EH &S for a pickup.

E. Animals

If a proposed project includes introducing radioactive material into animals, the applicant shall state details in the application which will include at least the following:

1. The kind and number of animals to be used (monthly or total).
2. The nuclide to be given including quantity and method of administration to the animal.
3. The places where the animals and cages will be kept and handled.
4. Procedures for handling, monitoring, and disposal of animals.
5. Cages must be labeled radioactive until rinsed and run through a washer and tested for residual activity.

F. Non-Disposable Materials

Material that cannot be disposed of in one of the above methods shall be stored until UNC Charlotte arranges for their disposal by a commercial firm.

2.7 Transfer and/or Shipment of Radioactive Materials

The transfer of radioactive materials from one laboratory, building or user to another must be accompanied by a Radioactive Material Transfer form (RAS Form 8)

Off-campus shipment of radioactive materials may take place only after contacting the EH&S Office. The shipper of such materials must furnish verification that the person or agency receiving the materials has a current license to receive the shipment and has agreed to receive it. The shipper is responsible for packaging such materials in accordance with all applicable state and federal regulations and for performing a radiation survey of the package prior to shipment and for noting the disposition of the material on an appropriate inventory sheet (RAS Form 6).

2.8 Procedures for Receiving and Opening Radioactive Materials

All Radioactive material shipments will be received and opened in accordance with this procedure.

- A. Radioactive material packages will be received at the following locations:
 - a. Biology Stockroom -- 1st Floor Woodward Hall OR
 - b. Chemistry Stockroom -- 2nd floor Burson Hall.
- B. The EH&S Office will be notified immediately by the Biology or Chemistry Office upon receipt or immediately the next working day if received after hours.

- C. The EH&S Office will monitor the external surfaces of the package for contamination and radiation levels within 3 hours of receipt, if the package:
 - a. is labeled as containing radioactive material, or
 - b. has evidence of potential contamination such as when crushed, wet, or damaged.
- D. The EH&S Office will immediately notify the final delivery carrier and the N.C. Radiation Protection Section when:
 - a. removable surface contamination exceeds the limits of 10 CFR 71.87 (i) or
 - b. external radiation levels exceed the limits of 10 CFR 71.47.
- E. Packages exhibiting no contamination will be picked up by the Authorized User.
- F. The User will open the packages expeditiously and monitor the container and packing materials for contamination.
- G. Any contamination will be reported immediately to the EH&S Office.
- H. A copy of the packing list shall be dated and forwarded to the EH&S Office for receipt record. In addition, radioactive material received shall be listed on Radioactive Material Inventory Record (RAS Form 6).

2.9 Pregnancy - Dose to Embryo/Fetus (Fetal Protection Policy)

This procedure is established to ensure that the dose to an embryo/fetus during the entire pregnancy, due to exposure of a declared pregnant woman, does not exceed 0.5 rem. To the extent possible, exposures shall be controlled to avoid substantial variation above a uniform monthly exposure rate to satisfy the above limit.

- A. It is the responsibility of the Principal Investigator, Authorized User, and the Supervisor to inform the woman of the Fetal Protection Policy.
- B. It is the fundamental responsibility of the pregnant woman to decide when or whether she will formally declare her pregnancy to the University. The University has no responsibility for providing specific fetal radiation dose precautions until a voluntary formal declaration is made in writing.
- C. The declared pregnant woman will be assigned a monthly radiation monitoring badge and placed on a monthly bioassay program when radioactive material is used.
- D. The RSO will investigate any exposures exceeding 90 millirems in a quarter.
- E. When the radiation dose of a declared pregnant woman exceeds 200 millirems per quarter, the woman may request a review of job duties or instructional requirements in accordance with personnel or academic policies.
- F. In addition to the 0.5 REM exposure limit, the As Low As Reasonably Achievable (ALARA) radiation protection policy will be applied.
- G. All radiation employees and students have the individual responsibility of adhering to the UNC Charlotte Handbook for Radiation Safety.

Fetal Protection Policy

The North Carolina Regulations for Protection Against Radiation (15A NCAC 11, Section .1610) requires that the dose to an embryo/fetus during the entire pregnancy of a declared pregnant woman not exceed 0.5 rem per year due to occupational exposures.

This limit is one-tenth the annual limit for occupational exposure. To benefit from this limit, it is required that female employees and students formally notify the University of pregnancy in writing.

Please complete the section below and return to the EH&S Office if you choose to make this voluntary notification.

Otherwise please indicate that you have reviewed this information by completing the last section and return to the EH&S Office.

I understand that it is the fundamental responsibility of the pregnant woman to decide when or whether she will formally declare her pregnancy to the University. I hereby choose to make this formal notification.

Signature: _____ Date: _____

Name (please print): _____

Expected delivery date: _____

I have reviewed a copy of the NRC Regulatory Guide 8.13 and the UNC Charlotte Fetal Protection Policy.

Signature: _____ Date: _____

Name (please print): _____

2.10 Bioassay Program

Radioactive material usage will be approved only when the associated safety program, equipment, facilities and staff experience assures that safe use will be routinely maintained. The potential for radiation exposure due to inadvertent failures of procedures and equipment may increase, however, when certain combinations of radionuclides, chemical or physical forms and activities are involved.

This program provides for necessary personnel monitoring to measure operational or accidental uptakes by radiation workers.

- A. A determination of bioassay personnel monitoring needs and frequency is made by the Radiation Safety Officer during the review of applications. The status of existing usage programs is periodically reviewed through radiation worker registrations, surveys, inventory records, and verification of radiation staff and radionuclide use limits.
- B. Routine bioassay monitoring will be conducted when any individual is working with radionuclide form/activity combinations exceeding established limits. "Working with" includes withdrawing a stock supply which itself exceeds a limit, even when the activity actually used is below the bioassay limit.
- C. Bioassay Radionuclide/Form/Activity Limits

Iodine (I-125, I-131)

A thyroid bioassay by external counting is required within 24 to 72 hours after working with the following limits or greater:

- 1. Processes in open room or bench with possible escape of iodine from vessels:
 - 1 mCi if volatile form
 - 10 mCi if bound to nonvolatile agent
- 2. Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability:
 - 10 mCi if volatile form
 - (Usually not required for nonvolatile agent unless quantities exceed 100 mCi)

Other Radionuclides (H-3, C-14, P-32, S-35, Ca-45, Cr-51, etc.)

Urinalysis is required within 24 to 72 hours following potential ingestion, inhalation, or skin contamination of personnel. Additional urinalysis or external organ counting may be conducted, depending on the biological attributes of a specific radionuclide or when large quantities are used.

- D. Any employee request for a bioassay will be honored. Pregnant radiation workers using radioactive materials will be placed on a monthly bioassay schedule.
- E. Standard methods of bioassay analysis evaluations are normally sufficient to measure body organ uptakes of radionuclides to a small fraction of a maximum Permissible Body Burden. An outside laboratory specializing in bioassay service will be used for any analysis requiring extraordinary equipment or procedures.
- F. Bioassay results will be recorded and maintained as part of the radiation worker's overall personnel monitoring history.

2.11 Public Dose

The use of radioactive materials shall be controlled to limit unauthorized access and to limit doses in unrestricted areas to less than 0.002 rem/hr and to levels as low as reasonably achievable (ALARA).

In accordance with 15A NCAC 11.1611, the Occupational Radiation Exposure Reports will be reviewed to determine potential radiation exposure to members of the public. The reports indicate that the maximum measurable levels of radiation exposure for radioactive material program users by quarter in year XXXX were X exposure/s to:

- *millirems in Quarter 1 (January – March)*
- *millirems in Quarter 2 (April – June)*
- *millirems in Quarter 3 (July – September)*
- *millirems in Quarter 4 (October – December)*

- **NR = No recorded measurement of radiation exposure on monthly reports**

Because of these maximum measured amounts shown by people that work with radioactive material sources, the inverse square law dictating radiation exposure potential and the non-public access of RAM usage areas, it is estimated that the radiation exposure to the general public is unlikely to exceed 0.1 rem (100 millirems) in one year.

Additionally, radioactive material packages are fully screened upon arrival at the University using a calibrated Geiger Counter and/or liquid scintillation (as appropriate for radioisotope) to determine if there is potential for contamination from radioactive packages. Leak test results from all applicable sealed RAM sources will be analyzed to determine if any there is any sealed source with leakage amounts above allowable regulatory levels.

The use of radioactive materials is restricted to designated areas that are secured when not occupied. Therefore, unauthorized entry into radiation areas is not likely. Furthermore, radioactive materials are stored in lockable containers and/or refrigerators/freezers for additional security.

To ensure the public is not being exposed to radiation in excess of 0.1 rem/year, radiation exposure reporting, package screening, authorized user swipe sampling and authorized user audits of RAM operations will be used to monitor compliance with the standard.

2.12 Emergencies

RADIATION SAFETY PROGRAM EMERGENCY PROCEDURES

1. Report any leak, spill, or release of radioactive material to the responsible Authorized User immediately. If the Authorized User is unavailable, call the Emergency Contact. The Environmental Health and Safety Office may also be contacted via University Police number below.
2. Only the Authorized User, trained radiation workers in the lab or the Radiation Safety Officer can complete leak/spill cleanups. All persons working on a leak/spill cleanup must be fully aware of the hazards posed by the particular radioactive isotope involved – always consult the Nuclide Safety Data Sheet for the isotope involved in the spill for hazard/risk control requirements.
3. Prevent spread of contamination from accident site. Use absorbent paper to stop or confine the spread of contaminants if it can be done safely. Decontaminate the area, starting from the perimeter and cleaning toward the center of the spill (use mild cleaning agents such as White Vinegar, Formula 409, Fantastik or Windex). Avoid any physical contact with contaminants.
4. Clear all unnecessary persons from radiation area.
5. Use nearest telephone for communications and avoid walking spilled material throughout the building.
6. Assemble all personnel in nearby safe area until radiation surveys and personnel decontamination are completed by authorized lab personnel and the Environmental Health and Safety Office.
7. Close doors and windows and if isotope is highly aerosol (Iodine 125/131), turn off air handling equipment that could lead to the spread of contamination throughout the building. Keep fume hoods operating within the laboratory.
8. Control access to the radiation area and place warning signs indicating radiation and/or contamination hazards.
9. Decontamination of rooms and building shall be done under supervision of the Environmental Health and Safety Office. See the “Responding to Radioactive Material Spills in Laboratories” flowchart for more information.
10. The Environmental Health and Safety Office will assess the emergency event and contact the NC DHHS – Office of Radiation Protection as required by the reporting thresholds, if exceeded, as detailed in 15 NCAC 11 rule .1646.

EMERGENCY CONTACTS:

Radiation Safety Officer:

Office: 687-1111

Campus Police: Campus phone dial 911 – Non-campus phone dial 704- 687-2200

2.13 Material Security and Loss / Theft Procedure

1. The usage of Radioactive Material must be controlled at all times to prevent unauthorized use or theft.
 - All locations containing Radioactive Materials must be securely locked when not in use. This includes the locking of laboratory doors, storage containers, etc.
 - Constant surveillance and control must be maintained while Radioactive Material is in use. The Authorized User or designee must be in the laboratory or surrounding area, at all times, where he or she is in position to monitor for unauthorized access.
 - This requirement applies to Radioactive Material in waste and experiments in progress, as well as stock solutions. There is no exempt quantity of radioactive material which eliminates this level of security.
 - Radioactive Material must be stored / used within designated areas of laboratories in accordance with the Authorized User's license.
 - All machines that use Radioactive Material sources, such as Gas Chromatographs (if equipped with an Electron Capture Detector - ECD), Liquid Scintillation Counters and Troxler Soil Moisture-Density gauges must be kept secure at all times and if their use/storage locations are changed on campus the Radiation Safety Officer (RSO) must be notified immediately upon transfer. Additionally, if these machines are to be surplus, sold, transferred or otherwise removed from campus, the Radiation Safety Officer must be notified immediately so the proper tracking and recordkeeping can be completed on the RAM sources that are contained in the units. Sources may not be removed from the units without notification of the Radiation Safety Officer.
2. The initial suspicion of loss or theft of Radioactive Material requires the immediate notification to the Police and Public Safety Department at 687-2200 and the EH&S Office (EH&S) at 687-1111. The information needed is:
 - Radioisotope
 - Chemical and physical form
 - Isotope ID# (assigned by the EH&S Office)
 - Quantity (activity)
 - Location from which the Radioactive Material is missing
 - Principal Investigator's name
 - Person reporting the loss/theft
 - Date and time the Radioactive Material was discovered to be missing
3. The EH&S Office and RSO will determine the extent of hazard presented by the possible loss/theft of radioactive material. Dependent upon the loss/theft risk level to the public health, the EH&S Office will coordinate appropriate action with Police and Public Safety, Vice Chancellor for Business Affairs, Associate Vice Chancellor for Risk Management, Safety and Security and the Radiation Safety Committee.
4. The EH&S Office will report the loss or theft of Radioactive Materials to NC Radiation Protection Section in accordance with 15 NCAC 11 rule .1645.
5. Any loss or suspected theft must be thoroughly investigated and documented. The incident report and supporting documentation will be placed in the radiation safety file for recordkeeping purposes.

EMERGENCY CONTACTS:

Radiation Safety Officer:

Office: 704-687- 1111

Campus Police:

Campus phone dial 911 – Non-campus phone dial (704-687-2200)

2.14 Auditing – Radioactive Materials

Authorized User laboratories using RAM will be audited on a quarterly basis by the Radiation Safety Officer. The Radiation Safety Officer will examine the areas detailed below when completing the RAS Form #11 – authorized user audit record for RAM users. After the completion of the audit, the Authorized User and Radiation Safety Officer will sign off on the audit form. The Radiation Safety Officer will send the completed audit form via email, with the appropriate deficiency action items, if noted, to the Authorized User. The Authorized User is required to send a written email reply to the Radiation Safety Officer or designee with follow up actions within 10 working days.

A. Work Practices

1. All work involving physical or chemical manipulation of open radioactive material sources must be performed directly on work surfaces suitable for containing any contamination and allow for easy decontamination.
2. Researchers manipulating open sources of radioactive materials must conduct operational work area surveys. The criteria for performing surveys can be found in the Handbook for Radiation Safety. These surveys are performed using portable survey meters and/or wipe testing, as appropriate. Records of such surveys must be kept on RAS Form #4.
3. Survey meters must have a current calibration and must be able to detect the isotopes used. Contact EH&S for calibration services.
4. Location of wipe tests must correspond to the radiation work areas of the laboratory and wipe test locations must be sufficient to detect contamination.
5. Decontamination must be performed in a timely manner when authorized users find contamination on equipment or in work areas. Skin contamination must be immediately decontaminated to the extent possible and reported to EH&S. To protect other lab personnel, contaminated areas and objects must be labeled.
6. A radioisotope user must be familiar with the properties of any radioisotope used, including half-life, emissions, shielding requirements, special hazards and how to detect the radioisotope. Information about specific radioisotopes is available in the Handbook for Radiation Safety, the Nuclide Safety Data Sheet for the isotope being used and from EH&S.
7. The radioactive material usage laboratory must be fully labeled with appropriate warning signage detailing RAM usage. Additionally, emergency and security procedures need to be posted in the laboratory. Copies of nuclide safety data sheets, the Handbook for Radiation Safety and appropriate procedures for RAM usage need to present as reference materials in the laboratory.

B. Personnel Dosimetry

1. The use of radiation monitoring badges (RAS Form #2) is required for work with certain radioisotopes used in specified amounts. The criteria for monitoring are described in the Handbook for Radiation Safety Manual, Nuclide Safety Data sheet for the radioisotope used and Radiation Use Authorization provided by the Radiation Safety Officer.
2. Badges must be exchanged in a timely manner. Lost badges must be reported to EH&S as soon as possible. Personal dosimeters must be stored away from radiation and heat sources. Laboratories may be charged for lost or non-returned badges.
3. Users issued dosimeters must have access to their dosimetry records, which are available from their Authorized User or the Radiation Safety Officer within EH&S.

C. Exposure Control

1. Appropriate protective clothing, including gloves, a full-length laboratory coat, shoes and socks must be worn at all times for work with any open radioactive source. The use of face shields or eye protection should be considered to reduce the risk of face and eye contamination.
2. Wearing sandals or open-toed shoes, while working with radioactive material, is prohibited.
3. In cases where the use of radioactive material presents unique or unusual hazards, special radiation safety equipment, shielding, precautions or procedures may be required.
4. Smoking, eating, drinking and pipetting by mouth in radioisotope laboratories is prohibited. Food for human consumption shall not be placed or stored in any equipment such as refrigerators, freezers or ovens in which radioisotopes are stored or used or in any other RAM lab area. Storage of food and utensils on open surfaces in the laboratory is discouraged.

D. Inventory Control

1. Access to "Restricted Areas" must be controlled, and visitors should be supervised by a member of the laboratory staff who is familiar with the activities of the laboratory. All radioactive stock materials and sealed sources must be stored in a secured container or secured storage area when not in use.
2. Purchase/possession limits must not exceed the Authorized User's authorization limits. EH&S maintains records of possession limits assigned to Authorized Users along with their Radiation Use Authorization. The authorization limits must be provided on RAS Form #3.
3. EH&S provides a Radioactive Material Receipt and Use Record (RAS Form #6) for each stock vial received, including a specifically assigned identification number provided by the Radiation Safety Officer. The identification number must be placed onto the radioisotope pig/container. An entry in the Record must be made for every withdrawal from the stock vial and each addition to waste through the use of RAS Form #7.
4. All RAM waste must be fully documented on radioactive waste disposal record (RAS Form #7). All waste streams must be fully segregated by radioisotope due to the differences in half lives and waste disposal requirements. Hazardous wastes must not be mixed in with RAM wastes.

EH&S must be contacted before a transfer between Authorized Users occurs through the use of a completed RAS Form #8. Recipients of transferred RAM must be authorized or licensed to use the isotope. Inventory reports (RAS Form #6) that authorized users submit to EH&S on a quarterly basis must be updated to show any transfers during the inventory period.

Section 3 – Radiation Producing Machines and Devices

3.1 Application for Use

All persons desiring to purchase or use ionizing radiation producing machines or devices must submit the UNC Charlotte RAS Form #9 to the EH&S Office. Use of these machines or devices must be in conformity with all applicable requirements of the *North Carolina Regulations for Protection Against Radiation* which are designated to control the external radiation exposure hazards which arise from the use of such equipment.

Ionizing radiation producing devices are those which emit ionizing radiation due to difference of voltage potential. Devices which produce X-rays as a by-product such as electron microscopes are covered by the regulations. Contact the EH&S Office if any questions exist as to whether a piece of equipment is to be considered as a source of X-rays when it is operated.

3.2 Monitoring and Control

- A. Each user shall inform individuals working in or frequenting any portion of a restricted area of the occurrence of radiation or sources of radiation in the area through the posting of a standard form "Notice To Employees" – current revision 12/2011.
- B. All machines or devices shall be labeled in a manner which cautions individuals that radiation is produced when the machine is operated.
- C. Radiation producing machine surveys must be completed monthly and documented on RAS Form #13, in addition, daily checks should be completed to show that there is no stray radiation emanating from the machine.
- D. RAS Form #10 utilization logs must be kept currently available for inspection by the RSO and the NC Radiation Protection Section.
- E. Shielding
 - 1. With equipment operating above 125 kvp, the required protective barriers provided for all wall, floor and ceiling areas that can be struck by the useful beam shall be an integral part of the building.
 - 2. With equipment operating above 150 kvp, the control station shall be within a protective booth or outside the treatment room.
 - 3. X-Ray therapy equipment operated at potentials of 60 kv and below shall have on the control panel some easily discernible device which will give positive information as to whether or not the tube is energizing.
 - 4. Machines having an output of more than 1,000 roentgens per minute at any accessible place shall not be left unattended without the power being shut off at the primary disconnecting means.

3.3 Personnel Safety

A. Limits of Exposure

1. No exposed person area shall be permitted to receive a radiation dose in one calendar year in excess of those listed in Section 2.5 A.1 of this Handbook.
2. In no case shall an individual under the age 18 years be permitted to receive an occupational radiation dose in excess of 10 percent of the limit set above.
3. The occupational exposure of a declared pregnant woman shall not exceed 0.5 rem during the pregnancy. **See Section 2.9 for the fetal protection policy.**

B. Film Badge Protection

All persons working on or near X-ray machines while in use are required to wear film badges. Submit UNC Charlotte RAS Form 2 to the Radiation Safety Office to obtain this service.

C. General Safety Rules

1. Safety glasses, personal eye glasses or other appropriate eye protection devices shall be worn at all times when working with low energy output X-ray apparatus.
2. Follow ALL safety requirements outlined in the specific laboratory X-ray operating manual pertaining to the X-ray machine that will be used. If you have any questions or reservations about how to properly operate the machine and minimize risk, contact the Principal Investigator or Authorized User of the X-ray before using the machine.
3. A current knowledge of the various radiation levels at all places around the X-ray apparatus shall be maintained.
4. Port closures should be double checked before moving the beam stop, collimator on the main body of an instrument, or before changing a specimen.
5. Persons should be especially careful about keeping their fingers out of the main beam, especially when making adjustments on goniometer heads. It is often best to keep one's hands on the X-ray tube side of the goniometer to prevent some part of the hand from drifting, unnoticed, into the beam.
6. When changing the equipment configuration or equipment alignment relative to an energized X-ray tube, the radiation field shall be continuously monitored with a survey meter and the survey recorded on the RAS #13 survey form.

3.4 Auditing – Radiation Producing Machines

Authorized User laboratories will be audited on a biannual basis by the Radiation Safety Officer. The Radiation Safety Officer will examine the areas detailed in RAS Form 14 – X-ray Authorized User Audit Record. After the completion of the audit, the Authorized User and Radiation Safety Officer will sign off on the audit form. The Radiation Safety Officer will send the completed audit form via email, with the appropriate deficiency action items, if noted, to the Authorized User. The Authorized User is required to send a written email reply to the Radiation Safety Officer with follow up actions within 10 working days.

Areas covered in the audit:

1. Are training records available and current for all individuals listed as operators?
2. RAS #9 Form completion for the Authorized User/s
3. Is the equipment properly labeled with a standard tri-foil and words to the effect of "Caution, High Intensity X-ray Beam" on the source housing and "Caution, this Equipment Produces Radiation when Energized" on any switch that energizes the tube or "Caution, Radioactive Material" on the source housing if appropriate?
4. Is there an easily visible warning light with the words "X-ray On" located at each entrance to the controlled area that is lit only during operation?
5. Are monthly radiological surveys performed and documented on RAS #13 in a manner to ensure no individual is receiving a dose in excess of local control levels? Are daily survey checks completed?
6. Are surveys available for initial installation, following any change in local components, following any maintenance that requires removal or change to local components, and during any maintenance activities?
7. Is the area or room properly posted IAW standard radiological practice?
8. Are operating procedures written and available that covers startup, shutdown, steady-state operation, and emergencies?
9. Are RAS #10 instrument operating logs available and current?
10. On open beam configurations, is there a device which either prevents access to the primary beam or shuts off the device upon entry into beam path?
11. On open beam configurations, is there an easily discernable warning device that gives indication of tube or shutter status at the point of tube or shutter control?

Section 4 -- Training – Radioactive Material (RAM) and X-Ray (Machine) Applications

4.1 RAM Radiation Workers

The Authorized User of any person who is applying to work with radioactive materials must notify the Environmental Health & Safety office. The applicant will be provided with a “RAM packet” that details the steps of training that are required in order to be approved by the University to use radioactive materials. The material that must be covered during RAM training prior to authorization for use includes:

1. [Online Radiation Safety Training](#). Upon receiving notification of the applicant’s intent to use radioactive materials, the RSO will enroll the radiation worker into the online radiation training queue. The applicant will receive notification via e-mail detailing the steps to take to complete enrollment. Your initial registration address and your password are identical to your NINERnet credentials (xxxx@uncc.edu). If you have forgotten your 49er connect password, click on the “forgot your password” link and the system will send you a new password to your university email address. Then use your full e-mail address and the password to login to the training. The training is followed by a quiz, of which a successful score of 80% is required to complete the application process.
2. Authorized User training. Authorized User training is to consist of the following:
 - a. Discussion and overview of the specific RAM usage protocols and procedures as they pertain to the Authorized User’s laboratory. The Authorized User is responsible for ensuring that his/her radiation workers have received adequate instruction in radiation safety principles applicable to specific practices of their laboratory;
 - b. Review of the Radiation Safety Program - Emergency Procedures document including the appropriate response to emergencies or unsafe conditions within the authorized user’s laboratory;
 - c. Review of the Radiation Safety Program – Material Security and Loss/Theft Procedure document including a discussion of security procedures used in the authorized users laboratory and the appropriate response to loss or theft of Radioactive Material within the laboratory;
 - d. A review of the [nuclide safety data sheet\(s\)](#) applicable to the Authorized User’s laboratory;
 - e. A review of the “Radiation Safety Handbook” and where it can be found within the laboratory;
 - f. If applicable, a review of the “Fetal Protection Policy”.

All of the training detailed above must be documented on the sign in sheets as provided in the RAM application packet.

Once all training has been completed and sign in sheets are received by the EH&S office, the film badge application for the Radiation Worker will be processed, if applicable. Radiation Workers are not permitted to proceed with RAM work until all training has been completed. Refresher training for Radiation Workers is to be completed on an annual basis by the Authorized User and documented

through a training certificate memo, see Section 4.5. Refresher training can also be accomplished through the online training program detailed above.

4.2 RAM Laboratory Workers

Individuals that work in a laboratory which uses radioactive materials, but will not personally handle or work with radioactive materials, must read the Handbook for Radiation Safety and the appropriate Nuclide Safety Data Sheets for the radionuclides being used.

Additionally, each Authorized User shall ensure that all persons working in a radionuclide laboratory through the course of their assigned work duties (excluding ancillary personnel) are informed of:

1. The storage, transfer or use of radioactive materials within the laboratory and the shielding available and radiation exposure levels to be expected in various sections of the laboratory
2. Review of the Radiation Safety Program - Emergency Procedures document including the appropriate response to emergencies or unsafe conditions within the authorized user's laboratory.
3. Review of the Radiation Safety Program – Material Security and Loss/Theft Procedure document including a discussion of security procedures used in the authorized users laboratory and the appropriate response to loss or theft of Radioactive Material within the laboratory.

The training provided shall be documented on a training certificate memo, see example in Section 4.5. Copies of training certificate memos should be returned to the Environmental Health and Safety Office.

4.3 RAM usage by students -- classroom use

The use of radionuclides in student labs must be carried out under the direct supervision of an Authorized User and/or their trained Radiation Worker. Information on the training requirements for students when radioactive materials are used in the classroom is provided in Section 4.1. All training of students must be fully documented by the Authorized User.

4.4 RAM Nuclide Safety Data Sheets (also found on EH&S [website](#))

RADIOISOTOPES -- NUCLIDE SAFETY DATA SHEETS
Hydrogen - 3
Carbon - 14
Cesium - 137
Phosphorus - 32
Phosphorus - 33
Sulfur - 35
Chromium - 51
Iodine -125
Iodine -131
Nickel - 63

4.6 X-Ray (Machine) Radiation Workers

The Authorized User of any person who is applying to work with X-Ray devices must notify the Environmental Health & Safety office. The applicant will be provided with an "X-ray packet" that details the steps of training that are required in order to be approved by the University to use radiation producing devices. The material that must be covered during this training prior to authorization for use includes:

1. [Online Radiation Producing Devices Radiation Safety Training](#). Upon receiving notification of the applicant's intent to use radioactive materials, the RSO will enroll the radiation worker into the online radiation training queue. The applicant will receive notification via e-mail detailing the steps to take to complete enrollment. Your initial registration address and your password are identical to your NINERnet credentials (xxxx@uncc.edu). If you have forgotten your 49er connect password, click on the "forgot your password" link and the system will send you a new password to your university email address. Then use your full e-mail address and the password to login to the training. The training is followed by a quiz, of which a successful score of 80% is required to complete the application process.
2. Authorized User training. Authorized User training is to consist of the following:
 - a. Instruction on the safe operation of X-Ray equipment within the laboratory;
 - b. Instruction about the emergency shut-down procedures for x-ray machines including the appropriate response to emergencies or unsafe conditions within the laboratory;
 - c. Instruction on radiation safety; use of whole body and ring badge dosimeter; use of radiation shields and shutters; use of radiation survey meters; record keeping;
 - d. Thorough review of Manufacturers Operation Manuals for X-Ray Machines including the appropriate radiation safety procedures for the radiation producing machines used in the authorized users laboratory;
 - e. A review of the "Radiation Safety Handbook".
 - f. If applicable, a review of the "Fetal Protection Policy".

All of the training detailed above must be documented on the sign in sheets as provided in the X-Ray application packet.

Once all training has been completed and sign in sheets are received by the EH&S office, the film badge application for the Radiation Worker will be processed. Radiation Workers are not permitted to proceed with X-Ray work until all training has been completed. Refresher training for Radiation Workers is to be completed on an annual basis by the Authorized User and documented through a training certificate memo, see Section 4.5. Refresher training can also be accomplished through the online training program detailed above.

Section 5 -- Enforcement

5.1 RAM and Radiation Producing Equipment User Audits

It is necessary to perform radiological health audits whenever radiation sources are used. Surveys must be designed for the specific sources involved. Radioactive material (RAM) and radiation producing electronic equipment must be considered.

Routine monitoring of laboratories containing radioactive material is necessary for the protection of radiation workers, compliance with regulations, and prevention of the contamination of experiments.

Each laboratory using radiation sources is assigned a survey frequency by Radiation Safety Officer based on a variety of factors, including the type and amount of radiation used and the experimental techniques employed. At the discretion of the Environmental Health & Safety office, assigned survey frequency of any laboratory may be changed to reflect the needed level of surveillance. Laboratories that work with radiation sources intermittently may be removed from the routine survey schedule providing a survey is performed and documented after the last work with the radioisotope. Upon resuming isotope work, the lab will be placed back onto the survey schedule.

Corrective Actions for Violations

Comprehensive inspections are performed by the Environmental Health & Safety office. Items ranging from ambient radiation levels to observance of prudent laboratory safety practices are evaluated. Any radiation safety violations observed during a routine survey are documented on the survey form, and a formal set of steps are initiated to correct the problem. The procedure that is used to correct radiation safety violations involves a series of notifications:

- Step One: If, during any routine inspection of a radiation laboratory, a problem involving radiation safety is found, the technician staff will be notified of the problem. The observed deficiency will be recorded on the survey report form which is provided to the Approved User for the laboratory and copied to the Department Chair. Upon receipt of this survey report, the Approved User will be charged to take the necessary steps to correct the problem. A written response detailing how the problem was addressed is required by the laboratory within ten working days from the date of the survey.
- Step Two: If within a six month period, a second survey reveals that the same problem(s) still exist, notification of this situation will be sent to both the Approved User and the Department Chair. No further orders of radioactive material will be placed for the Approved User until a written response concerning the item is received by the Radiation Safety Section. This response shall include the specific steps taken to ensure that the problem does not reoccur. For users of X-Ray producing machines, steps may be taken to lock out the machine until a written response concerning the item is received by the Radiation Safety Section.
- Step Three: If within a new six month period, a third survey indicates a persistence of the problem, both the Approved User and the Department Chair will be given a final written account of the situation. No more orders for radioactive material will be placed for the Approved User by the Environmental Health & Safety Office, and procedures will be initiated to remove existing inventories of radioactive materials. For users of X-Ray machines, steps may be taken to revoke the authorized use of the machine from the University registration.

Any operation causing an **excessive** radiation hazard immediately dangerous to personnel will be suspended immediately by the Environmental Health & Safety office without regard to disciplinary procedures. Such hazards include intentionally exposing personnel to unshielded radiation or defeating interlocks.

5.2 Radiation Safety Committee Disciplinary Mechanism:

Investigation of safety violations may be initiated by the Radiation Safety Committee (RSC) or the Radiation Safety Officer of any facilities where radiation sources are used, including radioactive materials and radiation producing machines. A prompt report of the investigation, completed by the Radiation Safety Officer, shall be submitted to the RSC for review and appropriate action upon completion.

After consideration of the violation report, the RSC may:

- A. Make a recommendation for mandatory remedial action, including, but not limited to suspension of ordering privileges, heightened inspection schedules, recertification of training. Failure to comply with committee remedial action may result in withdrawal of Radiation Safety Officer and RSC approvals for radioactive material use as it is set forth in the UNC Charlotte broad scope RAM license the authorized user;

or

- B. Revoke the authorization forthwith, if the violation significantly endangers the health or safety of persons or property. In the event the committee withdraws its approval, the activity shall no longer be carried out at UNC Charlotte until a new authorization application has been submitted, reviewed and approved.

The principal investigator/authorized user has the right to be present at the RSC meeting to present his or her position on continued radiation source usage.

UNC Charlotte - Radiation Safety Recordkeeping Requirements - Summary Sheet - 11/2012

FORM	PURPOSE OF FORM	TYPE OF RADIATION SOURCE	ACCOUNTABILITY	FREQUENCY OF ACTION
RAS 1	Application for use of Radioactive Materials	Radioactive Material	Authorized User/ Applicant	University licensing required when radioactive materials are requested to be used for Research by an Unauthorized radioactive material user.
RAS 2	Application for film badge or TLD ring service	Radioactive Material & Radiation Machine Sources	Authorized User	Required when new worker is to be brought into the radiation safety program to use a RAM or Xray source controlled by an Authorized User
RAS 3	Certification for the purchase of radioactive materials	Radioactive Material	Authorized User completes form - RSO approves form	This form must accompany all requisitions for new radioactive materials under a current ACTIVE Authorized User
RAS 4	Radiation survey report for NON-Sealed sources	Radioactive Material	Authorized User	Required to be completed <u>monthly</u> for active sources and <u>once every six months</u> for inactive authorized users - "stored" isotopes
RAS 5	Radioactive sealed source leak test report	Radioactive Material	Authorized User / RSO	Required to be completed <u>once every six months</u> for all regulated quantity isotope sealed sources in active use
RAS 6	Radioactive material inventory record	Radioactive Material	Authorized User	One form is completed per specific source ID number. Send a copy of the updated form to EH&S Office on a quarterly basis.
RAS 7	Radioactive waste disposal record	Radioactive Material	Authorized User	Required to be completed when radioisotope is used and considered to be a waste by an authorized user AND is properly collected and stored for pickup and disposal by the EH&S Office
RAS 8	Notification of transfer or radioactive materials	Radioactive Material	Authorized User	Required to be completed whenever isotope is moved from one location at University to another location on campus or offsite. DOT clearance is required when RAM is to be shipped offsite. Consult with the EH&S Office before shipping RAM.
RAS 9	Application for the use of radiation producing machines or sources	Radiation Machine Sources	Authorized User/Applicant	Required when new ionizing radiation producing device is to be purchased/brought on Campus by an Authorized or Un-Authorized User.
RAS 10	Radiation producing machine utilization log	Radiation Machine Sources	Authorized User	Required to be completed whenever the radiation producing device is operational. Must be submitted to the Environmental Health and Safety Office on a <u>quarterly</u> basis.
RAS 11	RAM Authorized user audit record	Radioactive Material	EH&S Office / RSO	Required to be completed every <u>6 months</u> by the Radiation Safety Officer (RSO) on each Authorized "active" RAM user.
RAS 12	Notification of inactive user status request for reactivation of authorized user status	Radioactive Material & Radiation Machine Sources	Authorized User	Required when an Authorized User wishes to go to "inactive" status and vice versa...required when active RAM usage status is desired from previous inactive use status.
RAS 13	Radiation producing machine radiation survey log	Radiation Machine Sources	Authorized User	Formal check required to be completed and documented monthly...but Xray users complete daily "start up" checks whenever the radiation producing device is operational. Must be submitted to the EH&S Office on a <u>biannual</u> basis.
RAS 14	Xray Authorized user audit record	Radiation Machine Sources	EH&S Office / RSO	Required to be completed <u>once a year</u> by the Radiation Safety Officer (RSO) on each Authorized "active" Xray user.
Red Font = Common Used Forms for Authorized Users and Designated Employees / Students -- Environmental Health and Safety Office (EH&S)				